Modeling Time-Varying Stock Market Integration in ASEAN: A Kalman Filter Approach

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ABSTRACT

This study focuses on the level of market integration between ASEAN-5 stock markets with the world market. Kalman Filter methodology is used on the International CAPM and we postulates the pricing errors estimated within the framework of International CAPM as a measure of market integration. The result shows that Singapore is highly integrated while the Philippines is fairly integrated with the world throughout the sample period. Meanwhile, Indonesia, Thailand and Malaysia demonstrate fluctuations in the level of integration. This study reveals that the current global crisis has less impact on the level of integration than that in 97/98 Asian financial crisis.

JEL Classification: G1, G10

Keywords: ASEAN, stock market, integration, ICAPM, Kalman filter

INTRODUCTION

In integrated markets, assets with identical risk should display identical return, regardless of country or currency. Meanwhile, the risk–return relationship of similar assets in segmented markets is primarily determined by domestic factors. In practice of global investors, emerging markets are somewhat segmented from the international market; thus, including an emerging G10performance of a portfolio due to the international diversification benefits. Harvey (1995) found evidence to reject the hypothesis that emerging markets are priced if they are integrated to the world market. However, the conclusion from this study is likely to change, as the

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emerging markets are increasingly liberalized, and they are expected to be more integrated with the world market (World Bank 1997).

The ASEAN-5 countries, namely, Malaysia, Thailand, Indonesia, the Philippines (emerging countries) and Singapore (developed country) are among the most attractive countries for global investors following dramatic structural change and industrialization. Since the late 1980s, Malaysia, Thailand, Singapore, and Indonesia experienced rapid economic growth with GDP growing well above 7 percent per year. The economic development of the Philippines is a bit slow compared with that of the other ASEAN-5 countries; the Philippines only opened up the economy in the early 1990s. The impressive economic growth in the region has been largely fueled by foreign direct investment, especially after the Plaza Accord's currency realignments on 1985. Japan and Northeast Asian newly industrialized economies (NIEs) are the origin of most of these inflows. These countries were eager to relocate their labor-intensive industries to Southeast Asia countries with lower land and labor costs. The high-performing Asian economies for Japan, first-generation NIEs (South Korea, Taiwan, Hong Kong, and Singapore) and second-generation Southeast Asian NIEs (Malaysia, Thailand, and Indonesia) were termed as the "East Asian Miracle" by the World Bank (1993).

However, the miracle of ASEAN-5 turned into disaster when the currency crisis originated from Thailand on July 1997. In 1998, most East Asian countries were in recession; specifically in Southeast Asia, Thailand, Indonesia, and Malaysia were the hardest-hit economies. The crisis was short-lived, however, and most of the economies had recovered by the second half of 1999. Despite the recovery, the investment rate of these hardest-hit countries had fallen persistently, and the GDP growth noticeably dropped after the crisis. (Park *et al.* 2009). On the other hand, the emergence of China and India has drawn a new chapter in the Asian Miracle. Nevertheless, ASEAN managed to turn the competition from China; thus, India became their growth opportunity. After a half decade, ASEAN has rebounded to become a global hub of production, manufacturing, and trade with close ties to China and India. The member countries' economy proved to be remarkably resilient during the 2008 global financial turmoil. The member countries have achieved a stronger fiscal position and embraced a healthier financial system with rational debt structure to withstand external shocks. Overall, the ASEAN region has gained more economic significance after its reformation from the 1997 Asian financial crisis as well as the growing population size of its member countries. Not only that, ASEAN also has gained an increasing strategic role in international political economy due to the expansion of political and economic interest of China, Japan, and United States in the Asia–Pacific region.

Today, ASEAN is realizing the goal of regional economic integration with the ASEAN economic community (AEC) by 2015. The AEC aims to promote ASEAN as a single market, a highly competitive economic region, a region of equitable economic development, and a region fully integrated into the global economy (ASEAN, 2015). With the progress, it is expected that the financial markets in the region will become more converged with the global financial market to facilitate international trade. The deregulation of their financial markets since the early 1990s and the recent structural reform under AEC are believed to increase the capital market integration of ASEAN with the world market.

The main objective of this paper is to examine the time-varying world integration of ASEAN-5 stock markets based on the international capital asset pricing model (ICAPM). This study contributes to the literature in three important aspects. First, the use of Kalman Filter methodology to characterize the time-varying integration of the ASEAN-5 stock markets has

not been previously investigated. Hooy and Goh (2010) investigated a similar issue covering ASEAN-5, but their methodology is based on two-step multivariate GARCH with Roll's (1977) time-varying beta formula. The two-step methodology might not provide precise estimates on time-varying integration as compared with the Kalman Filter method. Second, this study focuses on five ASEAN countries, which have received less attention in previous literature. However, the ASEAN region has received increasing attention in the stage of international political economy. Thus, it is timely to provide more empirical evidence on their financial market integration in order to evaluate their economic progress. Third, in our findings, we offer comparison with how the estimates of time-varying integration match with the actual liberalization dates of the ASEAN-5financial markets. Previous literature often ignores this aspect, but it remains a key concern for portfolio managers, foreign investors, and regulators, as it would allow them to more effectively time their investment or regulation strategies.

The remaining sections of this paper are organized as follows. Section 2 provides a review of the relevant market integration literature. Section 3 outlines our empirical method,the ICAPM definition of market integration, and the Kalman Filter methodology in estimating the time-varying betas. We also discuss our sample and data. Section 4presents the estimated results and discussionofthe findings. Concluding comments are given in the final section.

LITERATURE REVIEW

The issue on stock market integration has been extensively studied and has evolved over the past few decades. The tendency in globalization of financial markets has increased the attention of researchers to empirically examine the interdependence and integration of regional and world-wide stock markets. In the East Asian context, the majority of empirical studies that focus on the integration process within the region suggest that the level of stock market integration in East Asia is relatively lower compared with that of Europe. The East Asia stock markets tend to integrate with the global financial markets rather than regional markets (Kwan *et al.*,1995; Park and Bae, 2002; Eichengreen and Park, 2005; Kim *et al.*, 2005). Despite these common findings, Click and Plummer (2005), using the VAR cointegration technique, found that the ASEAN-5 stock markets are not completely segmented from each other. In addition, by employing VAR technique and generalized impulse response analysis, Yang *et al.* (2003) revealed that the long-run cointegrated relationships and short-run causal linkages among 10emerging Asian markets were strengthened during the 1997/1998 Asian financial crisis; thereafter, these markets become more integrated than before the crisis. Other literatures that focus on the integration of stock markets within the East Asian region include Corhay *et al.* (1995), Hung and Cheung (1995), Palac-Mc Miken (1997), Roca *et al.* (1998), Ng (2002), and Sharma and Wongbangpo (2002).

From another perspective, some studies focus on the integration of East Asian markets with the global markets instead of intraregional integration. Masih and Masih (1999) utilize VAR and vector error correction model to examine the long-run and short-term dynamic linkages between the international and Asian emerging stock markets. The result reveals that the United States and the United Kingdom drive the fluctuations in emerging Asian markets. In addition, Cheung and Mak (1992) also found that most Asian–Pacific markets under investigation are led by the United States rather than by the regional leading market, Japan. However, by using the concept of cointegration, Wong *et al.* (2004) showed no long-run equilibrium relationship among Malaysia, Thailand, and Korea and the developed markets of

the United States, United Kingdom, and Japan for the period of 1981–2002 but the co-movements exist in some sub-period. Shazali and Razali (2006) analyzed the correlation of equity returns of Malaysia with other countries and reported that Malaysia is correlated more with regional markets and emerging markets, as compared with developed markets, but there is instability in the correlation over time. Indeed, similar unstable correlation structure on sectorial indices of the Malaysian stock market also was reported in Shamsher *et al.* (2006) and later in Lye and Hooy (2012) using multi fractal analysis.

By employing a regime-switching model, Bekaert and Harvey (1995) was the first to examine the time-varying integration of world stock markets, covering 12emerging markets including Korea, Malaysia, Taiwan, and Thailand. Generally, the results show that Korea, Malaysia, and Taiwan are integrated with the world market throughout the entire sample, while Thailand shows dramatic increase in the integration level beginning from 1986. By using similar approach, Cumby and Khanthavit (1998) used a regime-switching model for Korea, Taiwan, and Thailand. However, the time-variation nature of Bekaert and Harvey (1995) is not allowed in the study. Carrieri *et al.*(2007) used generalized autoregressive conditional heteroskedasticity GARCH-in-mean methodology to examine the evolution in market integration of eight emerging markets (including Korea, Taiwan, and Thailand) over the period of 1977–2000. In general, the results suggest that the three East Asian countries are mildly segmented, but there exist upward trends in the level of integration in response to liberalization of these markets in a different period.

Previous studies have failed to consider that integration among stock markets is an on-going process, as such, they have omitted the important element of time variation equity risk premium. Furthermore, it is worth noting that many empirical studies define market integration in terms of correlations or lead–lag relationships among markets; however, market integration should be grounded on the law of one price, as market linkages are not sufficient to explain how integrated two markets are. One relevant study on time-varying integration is by Hooy and Goh (2010) who study a unique capital asset pricing model that incorporates world and trading-bloc factors. They intend to show how the recent trend of trade regionalism has led to segmentation of world stock markets. The paper covers stock markets of nearly all trading blocs, including ASEAN-5. Using a multivariate GARCH framework to obtain the time-varying betas based on Roll's (1977) formula, the authors reported risk exposure behaviour that is not revealed using static risk estimates. The multivariate GARCH framework, however, does not estimate the time-varying betas directly. The goal of this paper is to enhance our understanding on the stock market integration of ASEAN-5 markets with the world market by using Kalman Filter methodology on the international capital asset pricing model (ICAPM). In essence, the Kalman Filter methodology allows time-varying parameters; therefore, the pricing error estimated within the framework of ICAPM as a measure of market integration is allowed to change over time. This is more superior than the two-step methodology employed in Hooy and Goh (2010).

The remaining structure of this paper is as follows. Section 2 explains the methodology employed for the analysis. Section 3 describes the data used. Section 4 contains the correlation and descriptive statistics for the stock markets under study. Section 5 discusses the result. Section 6 concludes the paper.

METHODOLOGY AND DATA

Traditionally, the CAPM provides the method for estimating the risk-return equilibrium. The CAPM allows a linear relationship between the expected excess return and the non-diversifiable risk of holding a financial asset. By extending the domestic CAPM to an international setting, the ICAPM can be considered as below:

$$R_{i,t} - R_{F,t} = \alpha_i + \beta_i(R_{W,t} - R_{F,t}) + \varepsilon_{i,t} \qquad t = 1,2,\ldots,n \qquad (1)$$

where $R_{i,t}$, $R_{F,t}$ and $R_{W,t}$ refer to the returns for the market portfolio, world portfolio and international risk free rate respectively, t represents time period with n sample size, i refers to the stock markets under study and $\varepsilon_{i,t}$ is the residual. Following Korajczyk (1996) and Levine and Zervos (1998), the deviation or the pricing error, α from the theoretically equilibrium price can be used as a measure of degree of market integration. If a particular stock market is perfectly integrated with the world, then the pricing error should be equal to zero. Although Korajczyk (1996) uses a multifactor equilibrium arbitrage pricing theory (APT) instead of ICAPM to measure the degree of market integration, the estimated mispricing from APT and ICAPM can be interpreted similarly and should not be an argument in both of the asset pricing models.

Korajczyk (1996) and Levine and Zervos (1998) make an adjustment to the pricing error to establish the stock market integration index defined as follows:

$$MII_i = -\left|\hat{\alpha}_i\right|. \qquad (2)$$

The index is positively correlated with the degree of market integration and the zero value of *MII* indicates perfect integration with the world market. Most of the previous studies on market integration employed constant coefficient models despite real-life situation demonstrate that the market conditions vary over time. In this sense, the more appropriate time-varying *MII* should be allowed. By employing Kalman filter methodology, the time-series behavior of the parameter, here α, is attempted to be characterized. The time-varying ICAPM and the adjusted market integration index are now written as below:

$$R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{i,t}(R_{W,t} - R_{F,t}) + \varepsilon_{i,t} \qquad (3)$$

$$MII_i = -\left|\hat{\alpha}_{i,t}\right|. \qquad (4)$$

Employing Kalman Filter methodology developed by Kalman (1960) and Kalman and Bucy (1961), the time-varying ICAPM of Equation (3) can be in the state space form as follows:

$$Y_t = \delta' Z_t + \varepsilon_t \qquad (5)$$

$$Z_t = AZ_{t-1} + w_t \qquad (6)$$

Where Y_t is ($R_{i,t} - R_{F,t}$) of Equation (3), $\delta'_t = [1 \quad R_{W,t}]$ is the vector of regressor and Z_t is the parameter vector that contains the intercept and beta coefficient of Equation (3), that is, $Z_t = [\alpha_{i,t} \quad \beta_{i,t}]^T$. Z_t act as the unobservable state variables and is assumed to vary over time

as an autoregressive process of order one, as given in Equation (6). In general, Equation (5) is known as observation equation while Equation (6) is a called state equation. In addition, the error process, ε_t and w_t are assumed to be independently distributed as:

$$\varepsilon_t \sim IID(0, \sigma^2) \text{ and } w_t \sim IID(0, Q) \tag{7}$$

The prediction equations are then given by defining $Z_{t|t-1}$ as the best estimate of Z_t, based on information up to time (t-1) and $P_{t|t-1}$ as the corresponding mean square error (MSE) estimate of $Z_{t|t-1}$:

$$Z_{t|t-1} = AZ_{t-1} \tag{8}$$

$$P_{t|t-1} = AP_{t-1}A' + Q \tag{9}$$

In this study, A is an identity matrix and thus Z_t varies over time according to a random walk process. Once the current observation, Y_t becomes available, the estimates are updated by using the equations below:

$$Z_t = Z_{t|t-1} + P_{t|t-1}\delta' f_t^{-1} e_t \tag{10}$$

$$P_t = P_{t|t-1} - P_{t|t-1}\delta' f_t^{-1}\delta P_{t|t-1} \tag{11}$$

Where e_t is the one-step-ahead prediction error and f_t is the corresponding MSE of Y_t which are given by:

$$e_t = Y_t - \delta' Z_{t|t-1} \tag{12}$$

$$f_t = \delta P_{t|t-1}\delta' + \sigma^2 \tag{13}$$

Under the assumption that ε_t and w_t are normally distributed, the sample log likelihood as below can be used to estimate the unknown parameters of the system equations:

$$\log L = -\frac{T}{2}\log 2\pi \sum_{t=1}^{n}\log|f_t| - \frac{1}{2}\sum_{t=1}^{n} e_t' f_t^{-1} e_t \tag{14}$$

The likelihood is evaluated by using the Kalman filter estimates and must be maximized with respect to the unknown parameters.

The stock returns in this study are computed from the country stock indices sourced from Morgan Stanley Capital International (MSCI). The world portfolio and international risk-free rate are represented by the MSCI All-Country World Index and weekly yields on the US 3month Treasury bill rate respectively. Weekly data over the period of February 1988 to September 2009 are used, summing up to a total of 1131 observations. All data are obtained from *Datastream*. Since some literature such as Aggarwal and Rivoli (1989) and Brooks and Persand (2001) among others have validated the presence of the Monday and Friday effects in Asian stock markets, the weekly return in this study is based on return on Wednesday to avoid such anomalies. In addition, to study the market integration of ASEAN countries from the

perspective of international investors, this paper uses the US dollar index instead of local currency index.

EMPIRICAL RESULT AND DISCUSSION

For a general picture of the interdependence among ASEAN-5 stock markets and these markets within the world market, Table 1 shows the Pearson correlation coefficient of weekly closing price for the stock markets. Note that all of the ASEAN-5stock markets are found to be significantly and positively correlated with each other, thus indicating the existence of stock market linkages and the tendency to co-move in the same direction for the ASEAN-5 stock markets. However, Thailand, Philippines, and Indonesia show negative correlation with the world market, and Malaysia hasa low correlation with the world market. This may be due tothe specific events that happened in these countries in certain periods and caused them tonot co-move with the world market when considering the whole sample period.

Table 1 Pearson correlation for ASEAN stock markets

Country	Malaysia	Thailand	Singapore	Philippines	Indonesia
Thailand	0.721[1]				
Singapore	0.765[1]	0.310[1]			
Philippines	0.788[1]	0.843[1]	0.428[1]		
Indonesia	0.678[1]	0.704[1]	0.387[1]	0.591[1]	
World	0.203[1]	-0.357[1]	0.726[1]	-0.128[1]	-0.190[1]

Note: [1] denotes significance at 5% level

Table 2 illustrates statistical properties of stock index returns for the ASEAN-5 and world market. It can be observed that the mean returns for all ASEAN-5 stock markets are positive;particularly, Malaysia, Singapore, and Indonesia haveoutperformed the world market, and the Indonesia stock market has the highest return compared withthe others. Generally, the ASEAN-5 countries achieved remarkable economic success in the late 1980s and first half of 1990s until the crisis years of 1997 and 1998. A measure of stock market volatility is indicated by standard deviation of the returns. It can be seen that all ASEAN-5 markets are quite risky, as the standard deviation ismuch larger than the corresponding mean returns. In line with the risk–return paradigm, the Indonesian stock market with the highest return is accompaniedby the highest standard deviation. Furthermore, the standard deviation for Indonesian stock market is approximately threetimes higher than that of the world market, indicating the instability of the Indonesian stock market.

Table 2 Descriptive statistics on returns of the ASEAN stock markets

Country	Mean	Std. Dev.	Skewness	Kurtosis
Malaysia	0.103	4.086	-0.72	14.85
Thailand	0.0598	5.039	-0.05	2.56
Singapore	0.1283	3.2048	-0.25	3.48

Philippines	0.0792	4.324	-0.07	3.21
Indonesia	0.157	6.569	0.98	25.32
World	0.0924	2.1697	-0.86	5.58

On top of that, all stock returns (except Indonesia) show negative signs in the measure of skewness, meaning that the distributions of these series are skewed to the left and this indicates a higher probability of obtaining profit in each trading week. Table 2illustrates that the kurtosis coefficients for all mean returns are larger than three, meaning the distributions are leptokurtic relative to the normal distribution. Note that Indonesia shows a much higher degree of leptokurtic as compared withother indices, showing that it has more extreme values with long fat-tail distributions.

The results for estimated market integration indices are shown in Figures 1 and 2.For clarification purpose, the indices are plottedin two graphs with the results for Malaysia in both graphs as comparison. The first two years of estimated $MII_{i,t}$ are not shown in the two figures due to the nature of the Kalman Filter approach, which producesan instable parameter estimation at the initial stage. The exclusion ofobservations in the first two years can avoid any unfair bias due to these start-up problems (Brooks *et al*., 1998; Hearn, 2009). Figures 1 and 2 provide valuable insights and demonstrate the evolution of market integration for the ASEAN-5 countries. Generally, the trends of market integration indices for the ASEAN-5 look similar over time, but the magnitude is notably different across countries. This reflects the common characteristics of the stock markets in the region but also reveals that the timing of adoption of the wide-ranging policies and measures of individual governments have a different impact on the level of integration.

The liberalization of the financial markets of ASEAN-5has increased the interest of international portfolio diversification among foreign investorsand, consequentlyattractshuge capital inflows into these countries in the early 1990s. In Figures 1 and2, the market integration indices for Malaysia, Thailand, and Indonesia show increasing trends from 1990–1992; particularly, the Indonesian market show a dramatic increase. On the other hand, Singapore is highly integrated with the world in this period. The result is not a surprise, as Singapore is often seen as the only developed country in the ASEAN region; this is expected to be more integrated with the world. With the exception of Philippines, the changes of the trends in the early 1990s may be explained by the liberalization date defined by various sources (see Table 3). Prior to the liberalization date, the ASEAN-5 stock markets are believed to be segmented from the world market. The financial liberalization in these countries (except Singapore) in the late 1980s and the beginning of 1990s has increased the integration of these countries with the world. The integration level of Singapore is higher compared with that ofits neighbor countries as Singapore hasopened up the financial market since 1978.

Table 3 Liberalization Date of ASEAN-5

Country	Indonesia	Malaysia	Philippines	Singapore	Thai
Liberalisation Date	September 1989[1]	December 1988[1]	June 1991[2]	June 1978[3]	September 1987[2]

Note: [1] see Bekaert and Harvey (1998), [2] see Bekaert and Harvey (2000) and [3] see Phylaktis and Ravazzolo (2002)

The 1997 currency crisis that originated inThailand has had serious and painful consequences for the Southeast Asia region, particularly for the most severely affected countries—Thailand, Indonesia, and Malaysia.The currency crisis led to a financial crisis, producing collapse of currencies, stock markets, and asset prices in the region. As indicated by Sangsubhan (2008), the opening up of the Thailand capital account, high confidence of investors on Thai Baht, fixed exchange rate, and a high interest rate policy have contributed to the huge short-term capital inflowsin Thailand since the early 1990s. However, the overheating economy due to capital inflows has not been revealed during 1993-1996. In late 1995, the dollar started appreciating, and the Thai Baht became overvalued.Together, with the slowdown in exports, asset bubbles, maturity mismatch, increase in short-term debt, and vulnerable financial sectors have exposed the Thai Baht to be attacked by speculators in 1996 and mid-1997 (Jittrapanun and Prasartset, 2009).

Similarly, Malaysia and Indonesia had opened up their capital account in the early 1990s to attract more foreign investments into the economy. McKinnon and Pill (1996) highlight that the capital inflows in the form of portfolio investment created rapid credit expansion but not the genuine improvements in structural economic performance. This has strengthened the boom–bust business cycle and caused the financial sector to have greater vulnerability to adverse shock. Furthermore, Malaysia and Indonesia have been considered as possessing similar characteristics in terms of economic fundamentals and orientations as Thailand; thus, when the crisis happened in Thailand, many investors lost confidence in these two countries. Figure 1 illustrates that Thailand, Indonesia, and Malaysia were obviously segmented from the world during the 1997/1998 Asian financial crisis. Particularly, the level of integration for Thailand started to decline sharply inMay 1996, with Malaysia and Indonesia only showing dramatic decreasing trends one year later, starting from May 1997.
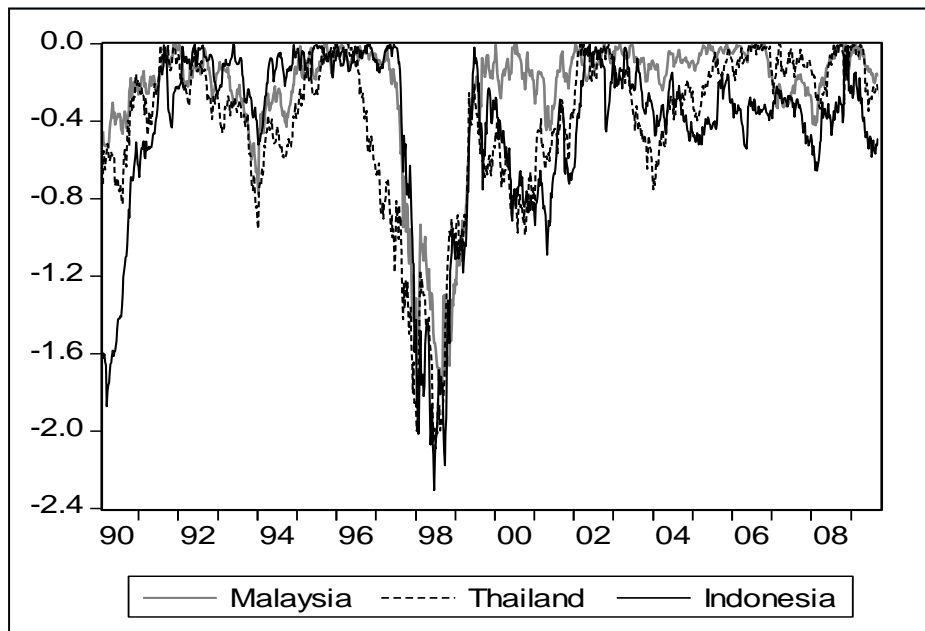
Figure 1 Time-varying Market Integration Index for Malaysia, Thailand and Indonesia
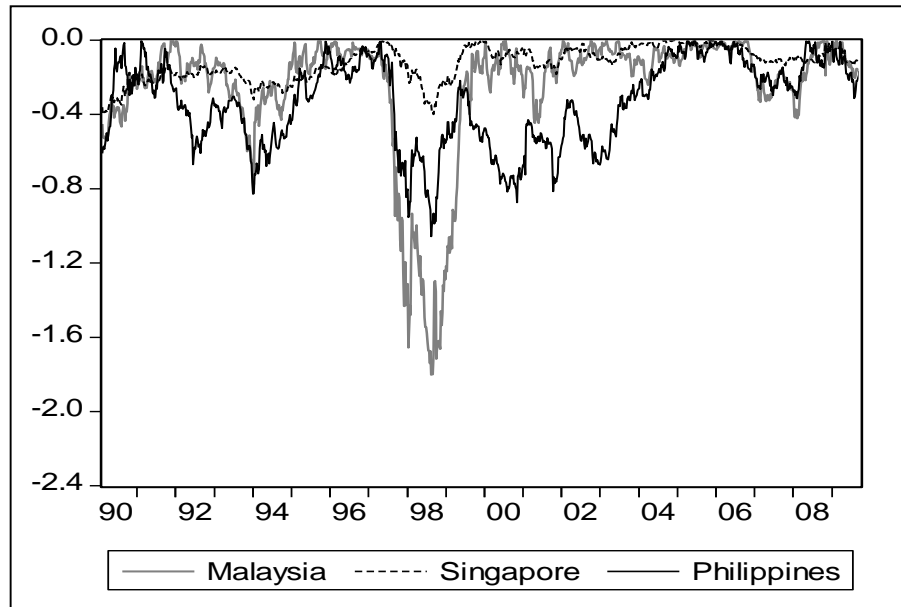
Figure 2 Time-varying Market Integration Index for Malaysia, Singapore and the Philippines

Nonetheless, Philippines and Singapore were not spared from this crisis, although with less deterioration of economy than in Thailand, Indonesia, and Malaysia. Figure 2 illustrates that the market integration indices for the Philippines and Singapore demonstrate fairly downward trends since May 1997.Noland (2000) argues that the Philippines endured the crisis relatively more successfully than its neighboring countries because its financial system was in better shape after the Philippines had already gone through its financial crises and because it had a uniquely low vulnerability to contagion. The less vulnerable is due to the policy that appeared to be particularly risk adverse with regard to short-term fixed interest rate bank debt, less exposure to Japanese bank lending, and less exposure to international hot money flows than the other emerging markets in the region. Although there were signs of segmentation for Singapore during the crisis period, the level of segmentation was much less pronounced compared with that ofothers. This suggests that the modest segmentation of Singapore stock markets from the world was more a result of regional contagion effect rather than the weak fundamentals.

In addition to allowing the currency to float or depreciate, each country adopted different measures to overcome the financial crisis. Thailand and Indonesia turned to the IMF for financial support by committing themselves to liberalizing the economy and undertaking structural reforms of the financial sector;Malaysia implemented selective controls (including fixed exchange rate at RM3.80 to USD1) to curb the attack of currency speculators and to inoculate the Malaysia economy from the financial instability. On the other hand, Philippines have builtup a specific provisionto commercial banks and credit institutions and controls on direct investment,while Singapore implemented drastic cutting measures. The crisis-affected countries showed a speedy recovery, as all of them have achieved positive GDP growth rates in the first or second quarter in 1999. As noted in Figures 1 and 2, the ASEAN-5 countries illustrate increasing trends starting frommid-1998, and the MII for Malaysia and Singapore have returned to the pre-crisis level.

The current global crisis, which originated from the subprime crisis in the United States, has had less impact on the level of integration of ASEAN-5 as compared withthe 1997/1998 Asian financial crisis. As shown in Figures 1 and 2, the level of integration between the ASEAN-5 markets with the world market is maintained at about the same level for the period prior to and during the global crisis.This may be explained by the different sources of these two crises; the 1997/1998 crisis is initiated from Thailand, while the current crisis is from the developed countries. During the 1997/1998 Asian financial crisis, the crisis did spill to the developed countries, but its impact on the world economy is much lesser compared with the current global crisis. This is why the ASEAN-5 countries were segmented from the world during that period. In contrast, the current crisis initiated by the United States has resulted in slowing the global economy .Because the ASEAN-5 countries are small and open markets, which rely heavily on the developed countries in terms of trade and investment, the ASEAN-5 countries are affected by the global contagion effect; therefore, the ASEAN-5 markets are integrated with the world market in this critical period.

Based on the previous discussion, it is obvious that the degree of stock market integration is time-varying instead of remaining constant over the sample period for all ASEAN-5 countries. According to the results tabulated in Table 4, OLS estimation concludes that all ASEAN-5 countries are integrated with the world throughout the sample period, as the α term of Equation (1) isnot significantly different from zero, even at 10 percent level for all countries. Also, Figure 3 illustrates that, although most of the estimated *MII* from Kalman Filter methodology falls within the 95 percent OLS confidence intervals, some of the estimated *MII* for critical periods (such as crisis) are outside the confidence intervals, indicating that these countries are not always integrated with the world as perceived by the OLS results.

Table 4 Results from Ordinary Least Square Estimation

	Parameter	Malaysia	Thailand	Singapore	Philippines	Indonesia
α	Coefficient	0.0156 (0.1145)	-0.0316 (0.1372)	0.0379 (0.0772)	-0.0080 (0.1217)	0.0683 (0.1893)
	t-Statistic	0.1364	-0.2306	0.4905	-0.0660	0.3609
β	Coefficient	0.6348[1] (0.0528)	0.9382[1] (0.0633)	0.8677[1] (0.0356)	0.6498[1] (0.0561)	0.7589[1] (0.0873)
	t-Statistic	12.0222	14.8280	24.3712	11.5838	8.6961

Note: [1] denotes significance at 5% level, standard errors are given in parentheses

Despite the attractive theoretical features, the estimation of the parameters of ICAPM by using the OLS methodology is often seen as less desirable from an economic and financial perspective, as the level ofthe stock market integration is an on-going process and the economic events that take placein a country will change the level of integration from time to time. Without taking into account the time-variation characteristics of market integration, the results from the OLS technique may have a misleading interpretation leading to serious consequences.
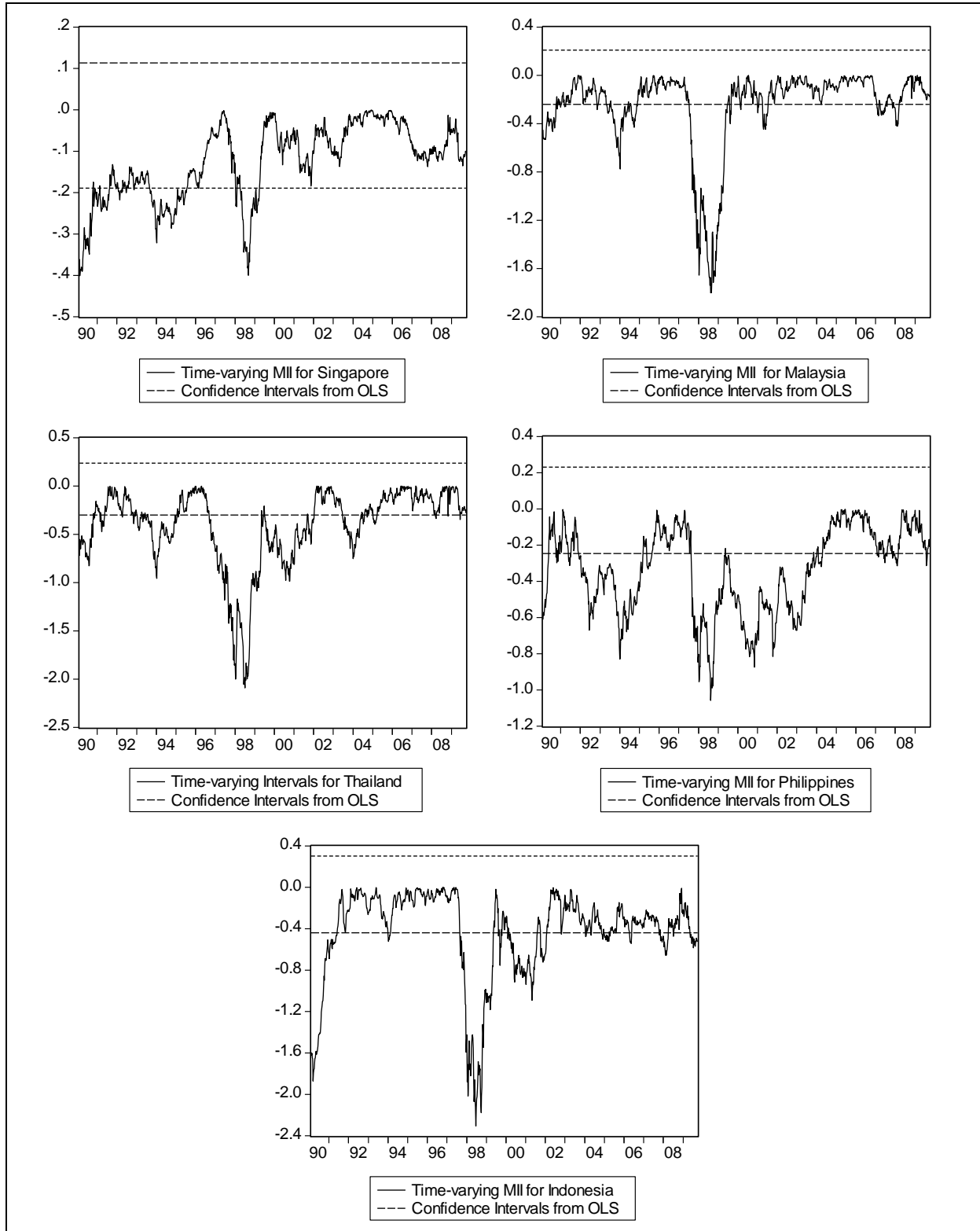
Figure 3 Time-varying Market Integration Index for ASEAN-5 Countries and the Corresponding OLS Confidence intervals

CONCLUSION

It is important to investigate the nature and extent of stock market integration of ASEAN-5 countries with the world market. The integration bringsa significant impact on the economic growth of the region and is crucial for international investors in terms of diversification benefits. The result of this study shows that Singapore is highly integrated with the world market throughout the sample period, thus indicating that investors could hardly obtain diversification benefits from the only developed country in this region. On the other hand, Indonesia, Thailand, and Malaysia display high fluctuation in the integration level throughout the sample period. This implies that,although investors may obtain diversification benefits by including these markets in their portfolios, these emerging markets do not provide consistent profits. The Philippines are fairly integrated and experience much less fluctuation when compared with other emerging countries.

Furthermore, this study reveals that the current global crisis has a different impact on the level of integration than that during the 1997/1998 Asian financial crisis. All ASEAN-5 countries are obviously segmented during the Asian crisis while integrated with the world in the current global crisis. This may be explained by the different sources of these two crises. In terms of methodology, the Kalman Filter approach in this study allows for time-varying coefficients, which makes more sense compared withthe common practice of OLS estimation. The ability to capture the dynamic of degree of market integration is crucial, especially for those emerging stock markets.

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