ERASMUS UNIVERSITEIT ROTTERDAM

Financial Integration in ASEAN-5 Countries

A Cointegration and Granger Causality Approach

Bachelor Thesis

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Abstract

This paper examines the short-term and long-term regional financial integration for five major ASEAN countries using cointegration and granger causality test. The result from cointegration test shows that ASEAN-5 is fairly integrated albeit still far from complete. Results from granger causality, on the other hand, indicates limited evidence in favor of short-term financial integration. The deviations in both finding suggest that the problem lies on the high transaction cost between member countries. Nevertheless, we conclude that the attempts to integrate the financial market have been fairly successful. We suggest, to further integrate, the causes of high transaction cost need to be minimized along with the improvement or creation of transition governances for ASEAN.

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1. Introduction

In the last few decades, the world economy has undertaken a transition from a closed to a more open and unrestrictive economic system. The changes are indicated by a significant increase in flow of goods across countries, more deregulated financial and good markets, and an increasing number of trade blocs.

In the Southeast Asian region, Singapore led the trend in the mid 1970's by abolishing exchange control and relaxing interest rate regulations. Afterwards, Malaysia followed by imposing financial deregulation. In the early 1980's, Indonesia and Philippines interest rate controls were fully deregulated. Reaching the late 1980's, most of the Southeast Asian countries had achieved sizeable financial deregulations.

The idea of liberation and deregulation had also affected its regional umbrella organization, the Association of Southeast Asian Nations (ASEAN). Officially established on the 8th of August 1967, it was initially a political movement aiming to facilitate better communications among countries in the region. It did not have any significant economic implication until ASEAN Free Trade Area (AFTA) initiative was created in 1993. The policy later ratified, resulting in gradual abolishment of tariffs and taxes. Currently, all the ten ASEAN countries do not implement internal tariffs.

After the successful integration of goods markets, ASEAN is currently examining the possibility of integrating capital market for national bonds and stock markets. Discussions regarding this subject have already started, projecting its implementation in 2015. It is apparent that the focus of ASEAN is no longer merely political, but is also moving towards an economic aspect.

With these developments in the region, it is suitable to investigate the degree of economic integration in the region. The results can be used as an indicator for measuring how successful the attempts of integration in the market are. Moreover, as the region is examining the feasibility of a currency union, this kind of study is gains greater relevance.

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In light of this, the aim of this thesis is to identify the short and long run financial integration within the five core ASEAN countries or ASEAN-5 (Indonesia, Malaysia, Singapore, Thailand and Philippines) using a Real Interest Rate Parity hypothesis. The focus is only on these five countries as these are the biggest and most influential financial markets in the region In addition, these are the five original countries that established ASEAN, and therefore the most likely candidates to undertake integrative measures first.

1.1. Financial Integration

Topics on financial integration have been intensively discussed by many researchers due to the interesting and important economic implications it embeds. Kose et al. (2003) reported that rising financial openness, as measured by gross capital flows as a ratio to GDP, is associated with rising consumption volatility. However, the relation is not linear. Once the gross capital flows reach a particular level, the relation becomes negative. This finding implies that financial integration may give benefits in term of consumption-smoothing possibilities and improved risk-sharing, but only when countries reach certain thresholds of gross capital flows.

Edison et al. (2002) found positive associations between financial openness and economic success (high GDP level and strong institutions). However, the paper found no evidence to support the notion of financial integration accelerating economic growth, even for controlling particular economic, financial, institutional and policy characteristics.

Furthermore, integrated regional stock markets are more efficient than segmented national capital markets. With more cross border flows of funds, the liquidity of stock markets will improve. This in turn reduces the cost of capital for capital seeking firms and minimized transaction costs for the investors. A more efficient capital market eventually will increase the attractiveness of regional capital market. This will provide the member countries access for larger pools of external finance, resulting in widening investment opportunities which lead to an increase in economic growth.

Apart from the increasing consumption volatility as explained by Kose et al. (2003), financial integration is also often associated with a number of shortcomings, particularly on the ability of central banks to hold its monetary independence (Swanson, 1987). With open borders and a

free flow of funds, real interest rates will move according to market power, lessening the power of the central bank at setting target nominal interest rates. This factor might be the reason why some governments are reluctant to integrate its financial market.

1.2. Literature Review

The early works in financial integration focused on the absolute equality parity of real interest rates (see, for example Mischkin 1984; Mark, 1985; Cumby and Mishkin 1984). However, these initial researches did not take into account the time series property of the data. As a result, the outcomes might have been subject to inferential biases due to the existence of non-stationary data and render the conclusions doubtful.

Goodwin and Grennes (1994) argued that since there is a transaction cost band within countries, real interest rates can fluctuate independently, albeit only in the short run. Thus, the cointegration test is more appropriate for evaluating real interest rate parity. In addition, the multivariate cointegration has been used extensively for evaluating financial integration. Examples of these include articles from Chung and Liu (1994), and Corhay, Tourany, Rad and Urbain (1993). In a different line of research, Cavaglia (1992) found that real interest rate is a stationary variable. This finding is relevant since many economic and financial variables are suspected to be non-stationary.

Although the empirical research is vast, a consensus is hardly found. Empirical researches for financial integration in developed countries found mixed and conflicting results. Choudhary (1994) found no evidence of long-term relation among the United States, Japan, Canada, Italy, France and Germany for the period of 1953 to 1989. In contrast, Corhay et al. (1993) found evidence of financial integration between the United States and five major European countries (Germany, Italy, France, Netherlands and United Kingdom). Davies (2006) found unconvincing evidence of market integration between seven major equity markets (United States, United Kingdom, Japan, Germany, Switzerland, Australia and Canada) using single market treatment. However, when two regimes Markov switching is applied, long-run relationship is found.

For the Southeast Asian countries, results are also conflicting. Masih and Masih (1999) argued that the volatilities of stock markets in the ASEAN countries are mostly caused by

regional movements rather than pressure from the global market. This finding was however disapproved by Janor and Ali (2007). Using a multivariate cointegration test, they found that the ASEAN financial market is not only regionally integrated but also globally integrated, which implies that global financial markets do have a significant effect on the regional financial market.

Click and Plummer (2005) examined the ASEAN-5 stock market integration using a cointegration test. The results indicated that the market is gradually integrating, particularly after the 1997's crisis, albeit still far from completion. Ibrahim (2009), using the cointegration test by Gregory and Hansen, examined the financial market integration in the ASEAN+3 (China, Korea and Japan) using stock and credit markets as indicators. In contrast with the findings of Click and Plummer, it was found that the crisis in 1997 had no positive effect on financial integration in the region. Additionally, the integration gradually started to build up, albeit still weak, and measures that were planned by the ASEAN+3 to strengthen the integration have yet been successful.

Summarizing, there is a limited consensus on how strong the integration is in Southeast Asia, but the majority of researchers agree that the region is becoming more and more integrated.

2. Data Analysis

The monthly Consumer Price Index (CPI) and nominal interest rate data were obtained from the IMF-International Financial Statistic (IFS) database. The data sample covers the months from January 1987 until December 2009 for both variables. It is important to note that within this sample range, there are two major crises: the 1997 Southeast Asia crisis, and the 2008 financial crisis.

The CPI is calculated from the weighted average of consumer goods and services purchased by households with the weighting factor set to the IMF-IFS database default setting. The set of data for nominal interest rates consist of monthly non-control annually compounded interest rates, e.g. money market rates for Thailand and the Philippines, three month interbank rates for Singapore, interbank overnight money rates for Malaysia, and call money rates for Indonesia.

In order to calculate continuously compounded (year-on-year) ex-post inflation rate, the data for CPI is converted using the following equation:

$$\pi_t = 100 * \ln\left(\frac{CPI_{t+12}}{CPI_t}\right) \quad (1)$$

As nominal interest rates obtained from the IMF database are annually compounded, it needs to be converted into continuously compounding before being processed. The following equation is used to convert annually compounded interest rate into continuously compounded interest rates:

$$i_t^c = 100 * ln\left(1 + \frac{i_t^a}{100}\right) \quad (2)$$

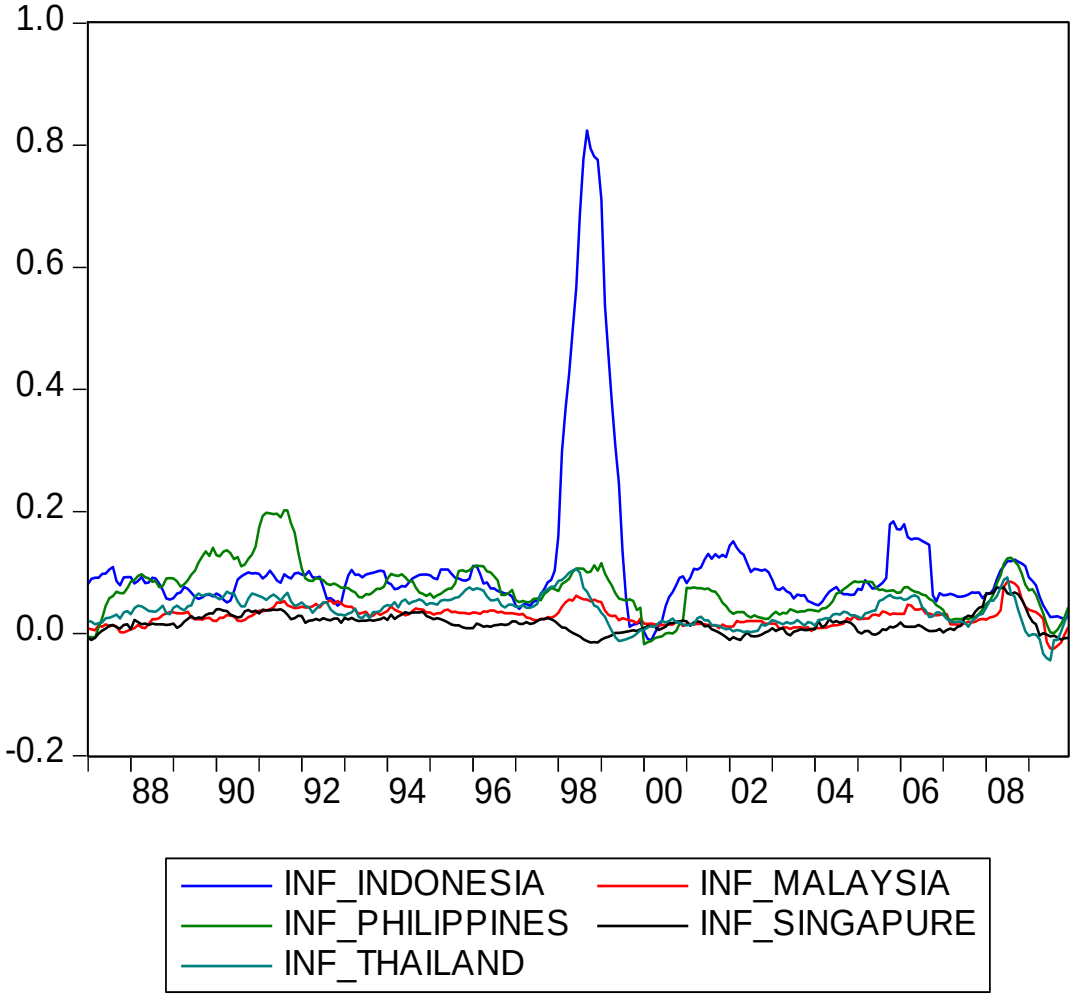
The data for ex-post real interest rates can be deduced from the fisher equation, by deflating the nominal interest rate by ex-post inflation:

$$r_t = i_t - \pi_t \quad (3)$$

Graph 1 shows the inflation rates for the five examined countries. The impact of the first crisis in 1997 are visible in the inflation rate of Indonesia; it increased sharply and reached almost the level of 60%, whereas the inflation rates of the other four countries seem to be more stable

during that period. However, during the 2008 crisis, the opposite was true. Indonesia was more resistant as compared to the other four countries. This may indicate that Indonesia is somewhat detached from the other four countries[1]. However more data analysis is needed before such conclusions can be made.

Graph 1: Inflation Rates

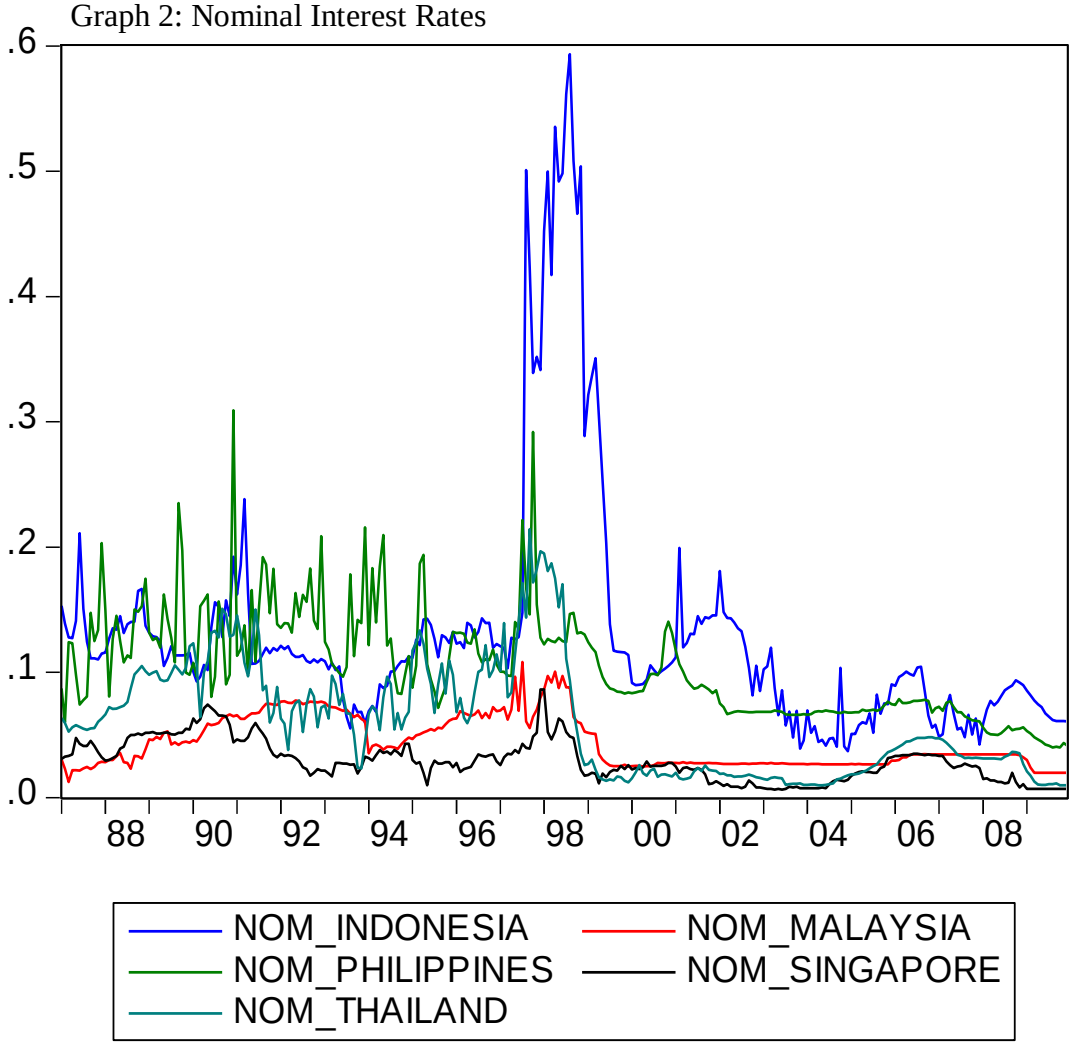


Unlike the inflation rates, the nominal interest rates show more irregular pattern as can be seen in graph 2. The irregularity is more apparent prior to the 1997 crisis where the nominal interest rates of each country fluctuated rapidly. After the crisis, however, fluctuations decreased and the interest rates have a tendency to converge. The reason of reduced volatility can be addressed to the creation of Chiang Mai Initiatives (CMI). CMI involves pooling

[1] The unusual movement of Indonesian inflation rates is more observable when each inflation rates are presented separately as shown in graph 1 in the appendix.

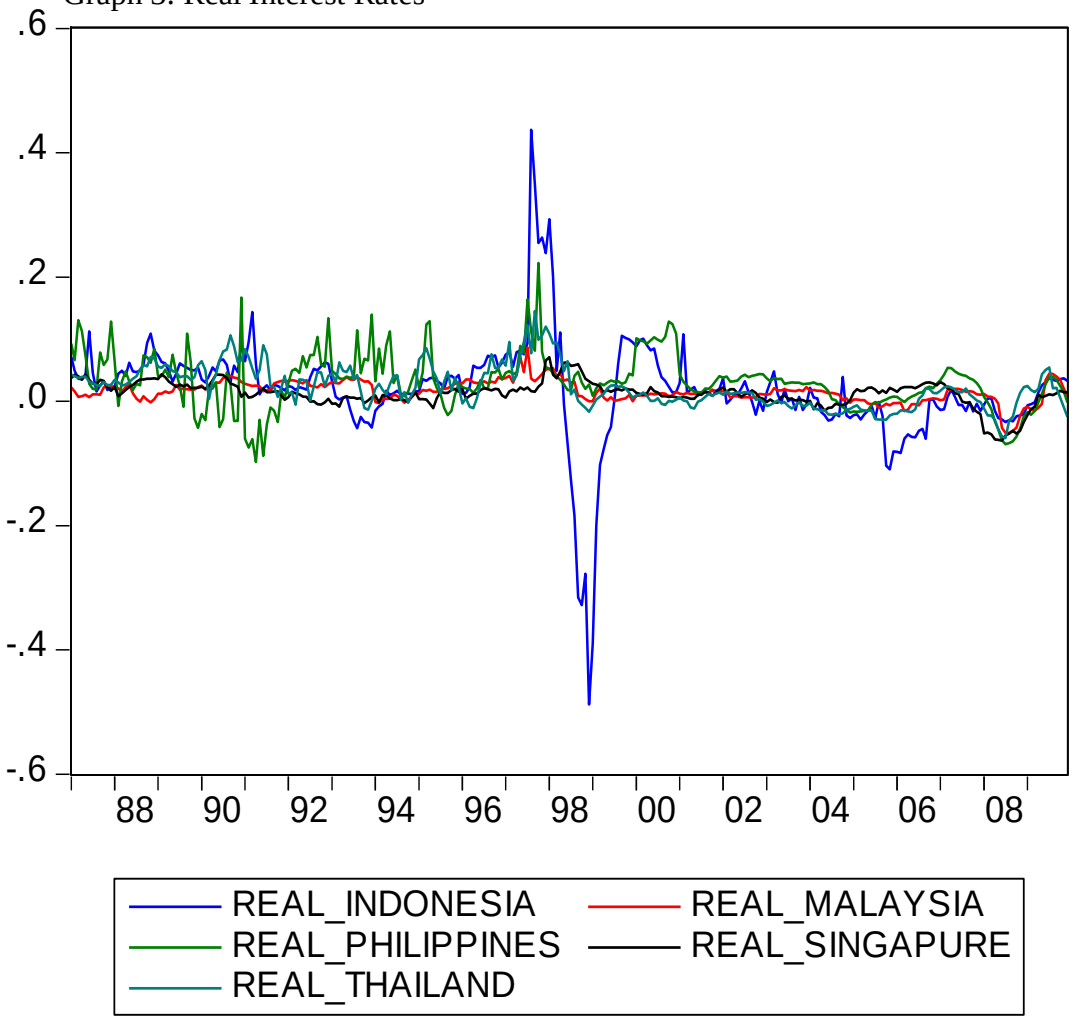
reserves aimed at increasing the effective size of international reserves through bilateral swap agreements across central banks and hence could reduced interest rates volatilities.

Graph 2: Nominal Interest Rates



Akin to the nominal interest rates, the ex-post real inflation rates (presented in table 3) are more stable after the 1997 crisis. The real interest rate pattern (irregular before the crisis, stabilize after the crisis) to some extent give an initial indication of the region being more integrated after the crisis. An additional cointegration test is conducted later to verify this finding along with the analysis of the possible reasons.

Graph 3: Real Interest Rates



3. Theories and Methodologies

3.1. Real Interest Rate Parity Hypothesis

Real Interest Rate Parity (RIP) has been used extensively as a tool for measuring financial integration. Early works on RIP hypothesis focused on the evaluation of whether two interest rates are equal (for example works by Mishkin, 1984; Mark, 1985; Cumby and Mishkin, 1986) while the latest literature have put more emphasizes on the real rate linkages or Real Rates Differential (RID). The hypothesis states that in a deregulated international market where financial, services and goods can freely flow across countries, real return on a comparable investment should be equalized across countries. In other word, the acceptance of the RIP hypothesis is an indicator of financial integration in which there is free flow and financial assets substitutability.

The hypothesis is based on the assumption of Uncovered Interest Parity (UIP) and Relative Purchasing Power Parity (RPPP) conditions. UIP explains expected currency depreciation as a result of differences in (nominal) interest rates between countries. High interest rates attract more investors, causing the money supply to increase and consequently force the currency to depreciate. The opposite holds true for low interest rates. RPPP explains the expected currency depreciation as a result of differences in inflation. The depreciation is necessary to equalize the purchasing power between countries. Both of these assumptions are based on no-arbitrage opportunities. Mathematically, it can be written as following:

UIP condition : $\Delta s^{e}_{t,t+k} = i_t - i^{*}_t$ (4)

RPPP condition : $\Delta s^{e}_{t,t+k} = \pi_t - \pi^{*}_t$ (5)

From (4) and (5), ex-ante RIP hypothesis can be formulated

RIP condition : $i_t - \pi_t = i^{*}_t - \pi^{*}_t$ (6)

or : $r_t = r^{*}_t$ (7)

Where $\Delta s^{e}_{t,t+k}$ is the expected currency depreciation (appreciation) at time t, i_t is the domestic nominal interest rate of time t, i^{*}_t is the foreign nominal interest rate of time t, π_t is the domestic inflation rate at time t and r^{*}_t is the foreign inflation rate at time t

The RIP hypothesis is founded on the theories of UIP and RPPP, which imply mobility of goods, services, and financial assets across borders. As RIP considers the rate of return in real terms, it takes into account the movement of non-financial assets (e.g. factor of production) as well. Hence, analysing the theory provides a complete picture of both financial sectors and, to some extent, the real economy of a country. This could offer valuable insights for researchers and policy makers.

3.2. Methods and Econometric Techniques

This thesis adopts similar Econometric techniques and methods from a paper by Al Awad and Goodwin (1998), with several adjustments after considering the availability of certain data sets.

The first part is constructing the real interest rates. Then, each variable is examined to check the time-series property. The subsequent econometrics measurement depends on the time-series property of each variable. Finally, in order to evaluate the RIP hypothesis, cointegration test, and (in-sample and out-of sample) Granger causality are used.

3.2.1. Constructing Real Interest Rate

In order to evaluate the RIP hypothesis, the (unobservable) real interest rate needs to be constructed. There are several techniques researchers use, most often by deflating nominal interest rates with changes in the Consumer Price Index (CPI). However, this method has two main drawbacks. First, since the method assumes rational expectations on the calculation of ex-ante real interest rates, any test of equality will be joint tested for rational expectations on top of the real interest rate parity test. Secondly, the existence of non-traded goods possesses a problem since CPI does not take into account such goods.

Another method is to use post-ante real interest rates on top of several relevant economic variables as a proxy to project ex-ante real interest rates (e.g. Cumby and Mishkin, 1986), or use time series property of ex-post real rates to derive the ex-ante real interest rates. Both methods suffer from the same problem, namely non-stationary regressor.

For the original paper by Al Awad and Goodwin (1998), the ex-ante real interest rate is derived by deflating the nominal interest rate against the ex-ante inflation rate. The ex-ante

inflation rate is obtained from a method suggested by Frankel (1982),suggesting the extraction of ex-ante inflation rates from bond rates. This method has several advantages over the before-mentioned methods. Firstly, this method is consistent with economic theory. Secondly, it uses information that is available to investors from each starting period. Thirdly, it is suitable for financial markets.

However, this sophisticated method is not feasible in this sample case, as bond markets are not yet developed in the Southeast Asian region. Hence, in this paper the first method, using ex-post inflation rate (from current CPI) as a proxy for expected inflation and deriving the real interest rates, will be used. The choice of using this method is solely dictated by the availability of data. As mentioned before, this method has two conspicuous problems, and therefore the results need to be analysed cautiously.

3.2.2. Unit Root Test

To examine the time series property of the variables, the Augmented Dicky Fueler (ADF) test is conducted. This considers a simple auto-regression model as follows:

$$y_t = \rho y_{t-1} + x_t'\delta + \epsilon_t \quad (8)$$

Where y is the dependent variable, ϵ is the residual (assumed to be white noise), ρ is the parameter to be examined, and $x_t'\delta$ is the optional exogenous regressor. The exogenous regressor may consist of a constant ($y = \alpha + \rho y_{t-1}$) or a constant and trend ($y = \alpha + \beta t + \rho y_{t-1}$). The variable has a (trend) stationary property if ρ <1. If the variable has $\rho \geq 1$ the variable is called non-stationary, with the variance of y increasing over time.

The standard Dicky-Fueler model can be estimated by subtracting equation (8) by y_{t-1}:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \epsilon_t \quad (9)$$

With $\alpha = \rho - 1$. Hence the null hypothesis of the unit root can be written as:

H_0 : Non-stationary/unit root : $\alpha = 0$

H_1 : Stationary : $\alpha < 0$

However, the model described here is only valid for an AR (1) series. Higher order auto-regression will violate the assumptions of white noise disturbance for the residual. Hence, a

standard Dicky-Fueler is rarely used in a model where the variable is believed to have higher order of correlation.

To test unit root for higher order auto-regression, a parametric correction needs to be constructed by adding l-lagged difference terms of the dependent variable to the right-hand side of the test regression. This model is called an Augmented Dickey-Fueler (ADF) test. The equation can be written as following:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots + \beta_l \Delta y_{t-l} + v_t \quad (10)$$

The null and the alternate hypothesis are identical to the standard Dickey-Fueler test. The test statistic of the unit root does not follow the conventional student t-distribution and the critical value is independent of the number of lagged choice. MacKinnon (1991, 1996) tabulated custom critical values for various test and sample sizes which are used in this paper.

There are several methods to determine the lag length parameters, these include: The Akaike information criterion, Bayesian information criterion, or Hannan-Quinn information criterion. Each of these methods chooses l (the lag length) to minimize specific criterion. This paper employs the Hannan-Quinn information criterion.

3.2.2. Cointegration

In brief, a set of variables are defined as cointegrated if linear combinations among them are stationary, even if the individual variables are non-stationary. Cointegrated variables exhibit distinctive features by having co-movement behaviours and a tendency to trend towards a long run equilibrium state. Even if the variables may drift apart in the short run, it will go back to its trend value in the long run.

To test for cointegration, this paper uses techniques as suggested by Johanssen (1988, 1991), and Johanssen and Julius (1990) on the maximum likelihood technique. The technique uses two test statistics, namely trace test and maximum Eigen value, to examine the numbers of co-integrating vectors among a set of variables.

Consider an n-dimensional vector autoregressive (VAR) model:

$$X_t = c + \sum_{i=1}^{l} \pi_i X_{t-i} + \epsilon_t \quad (11)$$

Where X_t is an $n\,x\,1$ vector of I(1) variables, π is an $n\,x\,n$ matrix parameter, and c is a constant. n also indicates the number of included variables. The vector ϵ_t is a white noise which may be contemporaneously correlated. The VAR model can be written in the following error correction form:

$$\Delta X_t = c + \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{l-1} \Delta X_{t-l+1} + \Pi X_{t-l} + \epsilon_t \quad (12)$$

Where ΔX_t is the vector change in period t, with:

$$\Gamma_m = -I + \sum_{i=1}^{m} \pi_i \text{ , m =1, 2, ..., k-1} \quad (13)$$

$$\Pi = -I + \sum_{i=1}^{k} \pi_i \quad (14)$$

I is the identity matrix, Γ is the short run dynamic and Π is the long run coefficient matrix. The Johansen test focuses on the examination of variable Π by looking at the rank of its matrix via its eigenvalues (λ). The values of the rank specify the number of its cointegrating vector.

There are two test statistics for examining cointegration under the Johansen approach, trace test, and maximum eigenvalue test. These tests can be formulated as following:

1. Trace test:

$$\lambda_{trace}\,(r) = -T \sum_{i=r+1}^{n} \ln\,(1 - \hat{\lambda}_i) \quad (15)$$

With the null and alternative hypotheses:

$H_o: r \leq k$

$H_1: r \geq k + 1$

2. Maximum Eigenvalue test:

$$\lambda_{max}\,(r, r+1) = -T \ln\,(1 - \hat{\lambda}_{r+1}) \quad (16)$$

With the null and alternative hypotheses:

$H_o: r \leq k$

$H_1: r = k + 1$

And $k = 0,1,2,3 \ldots n$

Both of the testings are conducted in a sequence, starting from $k = 0$. For example, a maximum eigenvalues test will be conducted as follows:

$H_o: r = 0$ Versus $H_1: r = 1$

$H_o: r \leq 1$ Versus $H_1: r = 2$

$H_o: r \leq 2$	Versus	$H_1: r = 3$
:	:	:
$H_o: r \leq n-1$	Versus	$H_1: r = n$

If the first null hypothesis is rejected, the second null hypothesis will be tested, and so on until the null hypothesis is no longer rejected. If the rank is zero (the first null hypothesis is not rejected), it would be concluded that there are no co-integrating vectors. If the number of co-integrating vectors equal to the number of examined variables (full rank), the variable in question is a stationary variable. Thus, cointegrations exist if the rank of the cointegration vector is between $0 < r < n$. The higher the number of the co-integrating vector, the more stable the equilibrium is.

The long run coefficient matrix (Π) can be factorized as $\alpha\beta'$, where both α and β are $n\ x\ r$ matrices. The matrix β gives the cointegrating vector while α is the "adjustment parameters". The Johansen method allows the test for these coefficients. This particular test is useful to analyse the absolute parity equalization. Directly from equation (6), the test for absolute Real Interest Rate Parity equalization requires group of variables $i_{it}, i_{jt}, \pi_{it}, \pi_{jt}$ to be cointegrated with coefficient vector (β) equal to (1,-1, 1,-1).

Before conducting the Johansen procedure to test the eigenvalue, the lag length of the VAR from equation (11) needs to be determined. An empirical research conducted by Emerson (2007) shows that the result of the cointegration test is very sensitive to the number of lag orders for the underlying VAR. Higher order of lag will ensure the errors are approximately white noise, but it has to be small enough to allow an estimation. For this paper, the Akaike's Final Prediction Error (FPE) is used.

Deterministic specification is determined using the Pantula (1989) method in which a restricted model is prioritized. Consider the following example: Let $M_{i,j}$ denote the cointegration test specification where i is the rank (i =0,1,2,3) while j is the deterministic component. First, we start from rank 0 with the most restricted model in which the intercept is included (assume in this case, $j = 1$) $M_{0,1}$ and compare the Trace statistic to its critical value. If that is rejected, keeping the rank assumption, the second test is changed by including a deterministic trend in the level ($j = 2$) $M_{0,2}$. If rejected, the last model is considered by

adding a trend in the cointegration space ($j = 3$) $M_{0,3}$. If it is still rejected, the rank assumption will be increased by 1 and start the procedure again from the most restricted model ($M_{1,1}$) until the null hypothesis is not rejected

3.2.3. Granger Causality

In financial integration literature, the Granger causality test is often used to evaluate short term relationships among two or more variables. These include research by Swanson (1987), Karfakis and Moschos (1990) and Katsimbris and Miller (1993, 1995). In this paper, both in-sample and out-of sample Granger causality are conducted.

Variable y is said to be granger caused by variable x if the past value of x can improve the prediction of variable y. Or equivalently, if the coefficients of the lagged variable x are statistically significant when variable y is regressed against its own lagged value and the past value of variable x.

This paper carries out pair-wise in-sample granger causality of the form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \cdots + \beta_l x_{-l} + \epsilon_t \quad (17)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \cdots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \cdots + \beta_l y_{-l} + \epsilon_t$$

The choice of the lag (l) has to be based on reasonable belief and/or backed by solid economic arguments about the longest time the past variable can help predict the other. In general it is better to employ longer than shorter lag length. The test is conducted for all possible pairs of variables (x and y). It is a Wald test with the joint hypothesis of:

$H_0: \beta_1 = \beta_2 = \beta_3 = \cdots = \beta_l = 0$

H_1 : At least one of the β_i is not 0

Rejection of the null hypothesis implies that past value of variable x does not improve the prediction of variable y and thus variable x does not granger caused variable y.

In this thesis, a refined version of the Granger causality, namely out-of sample Granger causality, is also utilized. Out-of sample Granger causality is preferable as the technique overcomes several limitations that in-sample Granger causality embeds. Firstly, the technique implies the "causality" spirit that Granger suggested. Causality requires evidence of improved forecasting in which this technique elaborates on. Secondly, in-sample Granger causality might have omitted variable biases. For example, whilst evaluating the relationship between x

and y, neglecting the other (relevant) variable z, the causal relationship (if found) might not be the result of relationship x and y but might be because the effect of variable z. Lastly, the in-sample Granger causality cannot detect cointegration relationships among variables in use.

The out-of sample Granger causality method used in this thesis is similar to the version developed by Ashley (1981) with some adjustments. Let $r_{1,t}$, $r_{2,t}, r_{3,t}$ ...and $r_{5,t}$ be the real interest rate of ASEAN-5. The sample data is split into two sub-samples: the "primary" sub-sample and the "test" sub-sample. The "primary" sub-sample covers the period 1980-2005 while the" test" sub-sample covers the period 2006-2010. To test whether variable $r_{2,t}$ have effect on variable $r_{1,t}$, following the complete model (Equation 19) and restricted model (Equation 18), the auto regression are estimated:

$$r_{1,t}^{r} = \alpha + \sum_{j=1}^{l} \beta_{1,j}\, r_{1,t-j} + \sum_{j=1}^{l} \beta_{3,j}\, r_{3,t-j} + \cdots + \sum_{j=1}^{l} \beta_{5,j}\, r_{5,t-j} + \epsilon_t \quad (18)$$

and

$$r_{1,t}^{f} = \alpha + \sum_{j=1}^{l} \beta_{1,j}\, r_{1,t-j} + \sum_{j=1}^{l} \beta_{2,j}\, r_{2,t-j} + \sum_{j=1}^{l} \beta_{3,j}\, r_{3,t-j} + \cdots + \sum_{j=1}^{l} \beta_{5,j}\, r_{5,t-j} + \epsilon_t \quad (19)$$

Where ϵ_t is assumed to be white noise and p is determined by Schawrtz-Bayesian Criterion (SBC). Initially, the model is used to forecast one period ahead of the "primary" sub-sample. The result from the forecast is compared with the ex-post value and the forecast errors are recorded as $u_t^{(r)}$ for equation (18) and $u_t^{(f)}$ for equation (19). The procedure is repeated again until the entire "test" sub-sample is forecasted (rolling horizon forecast).

The last step of out-of-sample Granger causality is comparing the forecasting prediction of the complete model and restricted model using the forecast errors ($u_t^{(r)}$ and $u_t^{(f)}$). There are several methods to evaluate the comparison, for example by comparing its mean squared forecast errors, employ a regression based test and utilized a canonical correlations test. Gelper and Croux (2007), using Size-Power plots, a simulation based and computational intensive method, discovered that a regression based test is the most powerful test among the three methods mentioned previously. For that reason, this paper uses a regression based test suggested by Harvey et al (1998). Considering the following model:

$$\hat{r}_t = (1 - \partial) r_t^{r} + \partial r_t^{f} \quad (20)$$

With ∂ is the parameter to be estimated, $\hat{r}_t$ is the actual value, r_t^r is the forecasting value from restricted model and r_t^f is the forecasting value from complete model. If the value of coefficient ∂ equal zero, it implies that the additional information on the full model do not improve the prediction. In other words, there is no granger causality. Equation (20) can be derived further using the definition $u_t^{(r)}$ and $u_t^{(f)}$ into:

$\hat{r}_t = r_t^r - \partial r_t^r + \partial r_t^f$

$\hat{r}_t - r_t^r = \partial(r_t^f - r_t^r)$

Since $u_t^{(r)} = \hat{r}_t - r_t^r$ and $u_t^{(f)} = \hat{r}_t - r_t^f$, hence:

$$u_t^{(r)} = \partial(u_t^{(r)} - u_t^{(f)}) \quad (21)$$

With the null and alternative hypothesis:

$H_o: \partial = 0$

$H_1: \partial > 0$

An OLS regression is used to estimate equation (21), corrected for heteroscedasticity. The null hypothesis of coefficient ∂ equal zero implies that the complete equation (eq. 19) does not improve the forecasting prediction of $r_{1,t}$ and thus it means that $r_{2,t}$ does not Granger cause $r_{1,t}$. If coefficient found is negative, no test will be conducted.

4. Results and Analysis

4.1. Unit Root Test

The test for unit root is conducted using the Augmented Dickey Fuller unit root test with a modified Hannan-Quinn for the automatic lag selection. The test is carried out using two deterministic models: the first one takes into account only the individual intercept, while the second one takes into account both the individual intercept and the trend.

The results of the ADF unit root test are presented in table 1. For inflation rates and nominal interest rates, the null hypothesis of unit root cannot be rejected at a 5% significance level for all countries. Further tests in the first difference demonstrate that the null hypothesis is rejected. This implies that the inflation rates and nominal interest rates are non-stationary variable and integrated of order one. Both of the deterministic models confirm similar result.

Four out of five countries have the real interest rates variable reject the null hypothesis of unit root at a 5% significance level. The only exception is Singapore, which rejects the null hypothesis at 5% when only a constant is applied, and rejected at a 10% significance level when both the trend and constant are applied in the model. The first difference tests are not needed since the variable is already stationary.

The cointegrations test is conducted using the non-stationary variable, and hence inflation rates and nominal interest rates are used. The real interest rates variable is used to analyse the granger causality test.

Table 1: Unit Root Test

Variables	Augmented Dickey-Fuller Test			
	Level p-value		First Difference p-value	
	Constant, No Trend	Constant, Trend	Constant, No Trend	Constant, Trend
Ex-Post Inflation				
Indonesia	0.1120	0.3254	0.0003*	0.0021*
Malaysia	0.0791	0.1741	0.0000*	0.0002*
Philippines	0.2750	0.2913	0.0000*	0.0000*
Singapore	0.0869	0.2140	0.0000*	0.0002*
Thailand	0.2287	0.2741	0.0000*	0.0000*
Nominal Interest Rate				
Indonesia	0.2127	0.4388	0.0008*	0.0054*
Malaysia	0.5255	0.4484	0.0087*	0.0326*
Philippines	0.7450	0.0562	0.0000*	0.0000*
Singapore	0.3008	0.1219	0.0000*	0.0000*
Thailand	0.2287	0.1356	0.0006*	0.0042*
Real Interest Rate				
Indonesia	0.0013*	0.0057*	No Test	No Test
Malaysia	0.0089*	0.0126*	No Test	No Test
Philippines	0.0005*	0.0024*	No Test	No Test
Singapore	0.0558	0.1558	0.0000*	0.0000*
Thailand	0.0130*	0.0040*	No Test	No Test

An asterisk (*) indicates statistical significance at the $\alpha = 0.05$
No Test = indicates that the variable is already stationary in the level, and therefore does not need to be tested on the first difference

4.2. Cointegration Test

4.2.1. Absolute Real Interest Parity Test

Table 2 shows the test for absolute Real Interest Parity equalization. The hypothesis requires a group of variables $i_{it}, i_{jt}, \pi_{it}, \pi_{jt}$ t to be cointegrated with cointegration vectors equal to (1,-1,1,-1). The test is done through a likelihood ratio test. Results show that the absolute parity equalization exists only in two of the ten cases. This implies that the real interest rate is hardly equalized and thus absolute RIP hypothesis does not hold in this region. Similar findings are also found in Pacific Rim (Chinn and Frankel, 1995) and Europe (Al Awad and Goodwin, 1998) all of whom found support for cointegration among real interest rates but not for absolute RIP hypothesis.

Table 3: Absolute RIP Hypothesis Testing

Variables	β vector (1,-1,1,-1)			
	Restricted Log-Likehood	LR-statistics	DoF	P-Value
Indonesia-Malaysia	3505.373	18.35779	9	0.031242*
Indonesia-Singapore	3535.757	21.83251	9	0.009425*
Indonesia-Philippines	2805.083	63.65352	3	0.000000*
Indonesia-Thailand	3126.404	24.48892	9	0.003592*
Malaysia-Singapore	4299.755	14.96565	3	0.001846*
Malaysia-Philippines	3657.140	4.19354	1	0.040578*
Malaysia-Thailand	3954.746	6.53572	1	0.010573*
Singapore-Philippines	3699.118	14.70200	9	0.099453
Singapore-Thailand	3959.339	23.42160	3	0.000033*
Philippines-Thailand	3317.940	0.04201	1	0.837606

An asterisk (*) indicates statistical significance at the α = 0.05

4.2.2. Cointegration Test among Real Interest Rates

The results of the full sample cointegration test are presented in table 3[2]. Notation r indicates the cointegration rank. "λ-max" is maximum Eigen value test, while "Trace" is the trace test. Lag is based on the Akaike Final Prediction Error (FPE).

Before conducting the analysis, it is important to recognize that having at least one cointegration does not necessarily imply a real interest rates parity; one cointegrating vector is

[2] The complete result of full sample cointegration can be seen in table 1 in the appendix

necessary but not a sufficient condition. The reason is because one cointegrating vector might be caused by a cointegrating relationship between a pair of nominal interest rates or a pair of inflation rates. Only when the relationship involves three cointegration vectors does it imply a real interest parity. Two cointegration vectors may imply a real interest rate parity, albeit a weak indicator.

Table 3: Full Sample Cointegration Test Result

Variables	Rank	
	λ-max	Trace
Indonesia-Malaysia	2	2
Indonesia-Singapore	2	2
Indonesia-Philippines	1	1
Indonesia-Thailand	2	2
Malaysia-Singapore	0	1
Malaysia-Philippines	3	3
Malaysia-Thailand	3	3
Singapore-Philippines	2	2
Singapore-Thailand	1	2
Philippines-Thailand	1	3

Specification testing conducted using the Pantula (1989) method to determine the deterministic component indicates that for every case only an intercept is included in the cointegration relationship. For the maximum Eigenvalue test, three cointegrating vectors are found in two cases, two cointegrating vectors are found in four cases, and one in three cases. Results from the trace test shows that cointegrating vectors are higher; two cases of one cointegrating vector, five cases of two cointegrating vectors, and three cases of three cointegrating vectors. Summarizing, the results fairly favour a stable equilibrium in the region.

In comparison, a similar study by Al Awad and Goodwin (1998), regarding the ten major European countries, showed that 22 out of 45 cases have cointegration vectors of three. The rest have the rank of two. This indicates that in Europe, the financial integration has been very stable. This can be also seen in the relatively high level of cross border bank credit. In Europe, cross border bank credit accounts for 33.9 percent of regional GDP while in Southeast Asia only 3.5 percent (Eichengreen and Park, 2003) Furthermore, the highly developed

government and corporate bonds market, along with the good consolidation of its equity market, contribute to a stronger financial integration in the Europe.

Clearly the results are not surprising. European countries have started their integration process a long time ago, while Southeast Asian countries just recently attempted to take the integration seriously. However, by contrasting the political or economic characteristics of both regions, valuable insights may be gathered on the various factors that may hinder integration in Southeast Asian countries.

There are several things that exist in the European Union (EU) but currently are not present or severely lacking in ASEAN. In the political sphere, most noticeable is the existence of politically powerful nations or alliances to promote integration. It is well known that the process of integration is more a political rather than an economic issue. Economic improvements may be the incentives for integration, but without political willingness from its government or political pressure from other countries, integration will hardly exist. However, Southeast Asian countries currently do not have such countries that could push and lead the integration process as Germany and France in Europe. This problem is exacerbated in Southeast Asia, where most of the governments are very conservative and have a strong inward looking perspective.

Secondly, the EU has well functioning and established transition governances (i.e. European commission, the European Parliament, the European Court of Justice and the European Central Bank). In contrast, such transition governances are not found in ASEAN, which cause the inefficiency and poor coordination among member countries. As an example, when the ASEAN imposes a policy, it does not immediately affect the member countries. Member countries need to create separate bilateral agreements for every other country in the region.

Lastly, the intra-regional trade among Southeast Asian countries is significantly lower than its European counterpart. The intra-regional exports as a share of GDP in Southeast Asia account for only a third of Europe which might explain the lack of cross border credit within the region. A study by Bayoumi and Eichengreen (1997) show that the European Economic Community (EEC) and single market program have successfully promoted intra-regional trade. Furthermore, they added that the European Free Trade Area (EFTA) and EEC have different roles. EFTA is mainly about trade creation while the EEC, on top of trade creation,

also creates trade diversions which boost intra-regional trade further. This suggests that the creation of AFTA, which mirror EFTA, alone is not sufficient. ASEAN should also adopt EEC policies concerning intra-regional trade in order to fasten the integration in the region. Furthermore, motivated by the findings of Click and Plummer (2005) that financial integration in Southeast Asia is stronger after 1997, comparing the pre-crisis and post-crisis cointegration results. In addition, by doing the comparison it becomes possible to evaluate, to some extent, whether the integration attempt has been successful or not.

To carry out the test, the sample data is split into two sub-samples: the pre-crisis sample that covers the period from January 1987 to June 1997 and post-crisis sample that covers the period from July 1998 to December 2009. Data during the crisis are not included since at those periods the government policies were mostly only temporary, aiming to stabilize the currency and raising the confidence toward each country.

Table 4 shows the result of the post-crisis and pre-crisis cointegration test[3]. The results show that in almost every case, cointegration ranks, tested by the Trace test and maximum Eigenvalue test, are higher in the post-period sample. This confirms the findings by Click and Plummer (2005) that financial integration in ASEAN is stronger after the crisis.

Table 4: Cointegration Rank Comparison Table

Variables	Pre-Crisis		Post-Crisis	
	λ-max	Trace	λ-max	Trace
Indonesia-Malaysia	1	1	2	2
Indonesia-Singapore	0	0	3	3
Indonesia-Philippines	1	1	1	2
Indonesia-Thailand	1	1	3	3
Malaysia-Singapore	1	0	2	2
Malaysia-Philippines	1	1	3	3
Malaysia-Thailand	1	1	1	1
Singapore-Philippines	1	1	2	2
Singapore-Thailand	0	0	3	3
Philippines-Thailand	1	2	2	2

[3] The complete result of pre-crisis and post-crisis cointegration tests can be seen in table 2 and 3 in the appendix

There are some possible reasons why financial integration for the ASEAN-5 improved after the crisis occurred. Since this paper uses RIP hypothesis as an indicator of financial integration, the movement of interest rates before and after the crisis is the starting point of our analysis.

The relationship between interest rate, exchange rate regime, and monetary policy can be described mathematically using an Uncovered Interest Parity relation:

$$\Delta s^{e}_{t,t+k} = i_t - i^{*}_t \quad (22)$$

Where $\Delta s^{e}_{t,t+k}$ is the expected currency depreciation (appreciation) at time t, i_t is the domestic nominal interest rate of time t and i^{*}_t is the foreign nominal interest rate of time t. When a domestic currency is pegged to a foreign currency, the country's domestic interest rates must follow the movement of foreign nominal interest rates in order to keep the value of domestic currency equal against foreign currency (minimizing the $\Delta s^{e}_{t,t+k}$). Therefore the change of exchange rate regime might be the main contributor to the stronger financial integration.

Before doing such an analysis, the distinction between de jure and de facto interest rates need to be discussed. De jure exchange rates are what the government claims. De jure exchange rate regime classifications of ASEAN-5 countries are presented on table 5. While de facto is how the exchange rate really behaves in the market. De facto classification is determined by analyzing, among other things, the movements and the volatility of the exchange rate, and therefore is more credible since it reflects the facts in the market.

Pre-crisis, most of the ASEAN-5 currencies (de facto) were significantly pegged to the U.S. dollar (Baig, 2001).This implies that their financial market is more closely integrated to the United States market rather than the regional market. After the crisis occurred, the exchange rate regime tended to be more flexible (with the exception of Malaysia). This is also confirmed by the de facto finding from Cavoli and Rajan (2005). As a result, the interdependence toward United States markets is lessening, creating ample room in the regional market to be integrated.

Table 5: De Jure Exchange Rate Regime of ASEAN-5

Country	Period	Classification	
		Narrow	Broad
Indonesia	Nov 78 - Jul 97	Managed floating	Intermediate
	Aug 97 - now	Free floating	Floating
Malaysia	Sep 75 – Mar 93	Limited flexibility wrt USD	Intermediate
	Apr 93 – Aug 98	Managed floating	
	Sep 98 – now	Pegged to USD	Fixed
Philippines	Jul 82 – Sep 84	Managed floating	Intermediate
	Oct 84 – Jan 02	Independently floating	Floating
Singapore	Jun 73 – Jun 87	Limited flexibility wrt basket	Intermediate
	Jul 87 – now	Managed floating	
Thailand	Nov 84 – Jun 97	Limited flexibility wrt basket	Intermediate
	Jul 97 – now	Independently floating	Floating

Source: Frankel et al. (2002), and IMF Annual Report on Exchange Arrangements and Exchange Restrictions.

Although in theory it seems feasible, empirical results from Sahminan (2005) reject this claim. It was found that there are no clear implications on the choice of exchange rate regime on the transmission of international financial markets into the domestic interest rates of the five major ASEAN countries. Analyzing the domestic factor as the possible explanation of stronger integration was suggested.

This led us to examine the intra-trade within the region. Although the intra-trade in Southeast Asian countries is still far behind Europe, some evidence indicates that the export between countries in the region is steadily increasing. In the late 1970's, export within the region accounted for 20 percent of total export, while in the 2002 it increase to 40 percent (Zebregs, 2004). The claim that increasing volume of trade intensifies the economic linkage and interdependence between economies in the region was supported by Ng and Yeats (2003). This might further suggest that the reliance on the rest of the world was lessening in the region.

The increasing role of ASEAN also contributed to the integration. The increased intra-trade within the region can be attributed, to some extent, to the creation of AFTA. Since 1993, ASEAN countries have gradually reduced the tariffs and internal tax causing increasing regional trade. However, the involvement of ASEAN towards the formation of an economic integration is not limited to the creation of AFTA.

After the crisis, there was an initiative to strengthen the cooperation among central banks to deal with the increasing financial volatility. It was called the Chiang Mai Initiative (CMI). CMI involves pooling reserves aimed at increasing the effective size of international reserves through bilateral swap agreements across central banks. This might be the reason why the interest rate volatility after the crisis significantly reduced. The creation of such a scheme is one step further to creating a monetary institution in the region, and contributing to the stronger financial integration in the region.

4.3. Granger Causality Test

Granger causality does not mean "causality" in the strictest sense. It simply implies that the change of the past value of one variable has an impact on the value of another variable. This kind of relationship thus allows an evaluation of which market may be dominant.

Table 6 shows the result of Out-of-Sample Granger causality and In-sample granger causality using 3-month, 6-month, 12-month, and 24-months lags[4]. Out-of-Sample Granger causality uses Schawrtz-Bayesian Criterion (SBC) criterion to determine the lag length. Whereas the tests of in-sample granger causality are conducted using several lagged choices since currently we do not have suitable econometrics methods to determine the best one. The results between these four methods indicate that the causal relationship is relatively unchanged when we applied a different lag.

Considering the four cases, we pick only the stable cases in which the granger causality is still apparent when different lag is applied (that is, if the null hypothesis of non-causality is rejected in more than one lag). When such method is applied, there are six causal relationships in which Thailand is the most dominant market in the region by granger caused Indonesia, Malaysia and the Philippines. This result is unexpected since Singapore is better known as the centre of the Southeast Asian financial market.

In contrast to the in-sample granger causality result, the causal relationship in out-of sample granger causality is hardly apparent. One possible explanation is the existence of spurious

[4] The complete result of In-Sample and Out-of-Sample Granger causality can be seen in table 4 and 5 in the appendix

effect on in-sample granger causality test. The measurement of in-sample granger causality uses only two variables (bivariate test) while out-of-sample granger causality takes into account the five countries simultaneously (multivariate).

Table 6: In-Sample and Out-of-Sample Granger Causality Comparison Table

Causal Relation	In-sample				Out-of-Sample
	3 months	6 Months	12 Months	24 Months	
One Way Causality	4	3	6	4	3
Two Way Causality	4	4	4	2	0
No causality	12	13	10	14	12
No Test	-	-	-	-	5
Total	20	20	20	20	20

It can be concluded that the results of the granger causality give limited evidence in favour of short term financial integration. This result might be in contrast with the first findings from the cointegration test. But, further analysis shows that the source of deviation might lies in the "measurement" differences; granger causality measures the short term dynamic while cointegration measures the long term integration by allowing short term deviations which is caused by the transaction cost band.

Since cointegration results showed fairly strong indications of integration while granger causality did not, it suggests that the problem lies on the high transaction cost. High transaction costs might be caused by the existence of corruption, low corporate governance, and difference in legal and tax systems among other things.

1. *Corruption*

Corruption could have a negative influence on financial integration. Table 7 shows the corruption perception index, an index that is widely used to measure the scale of corruption in one particular country. In ASEAN-5 countries, the CPI varies from very clean (Singapore) to very corrupt (Indonesia). A clean government is favourable by investors, as clean governments can work competently, create a fair environment, and have more political stability which are ultimately good for the business and economy. This claim is supported by Wei (2000), who found that the level of corruption reduces foreign direct investment. In

addition, corruption also creates unnecessary costs in the form of collusion or illegal inducement, and thus contributes to increased transaction costs.

Table 7: Transparency International Corruption Perception Index

Country	2001	World Rank	1997	World Rank
Indonesia	1.9	88	2.7	46
Malaysia	5	36	5	32
Philippines	2.9	65	3.1	40
Singapore	9.2	4	8.7	9
Thailand	3.2	61	3.1	39

Source: Transparency International. Website: http://www.transparency.org/

2. Differences in the legal systems

The legal system operating in the ASEAN-5 countries are diverse. Three of the ASEAN 5 (Singapore, Malaysia, and Thailand) have English legal systems, while the other two (Indonesia and Philippines) adopted the French legal system. La Porta et al (1998) argue that differences in the origin of the legal system may lead to judicial efficiency differences. Furthermore, D'amury and Marenzi (2005) show that efficiency of judicial systems has a positive relationship to credit availability and can lower the collateral requirements and interest rates. On the other hand, inefficient judicial systems might be seen as unfavourable and therefore investors might demand a higher risk premium.

3. Large Variations in Corporate Governance

La Porta et al (1998) reported corporate governance indices as shown in table 8. The indices are created from four aspects of corporate governance: enforceable minority shareholder rights, anti-director rights, creditor rights, and accounting standards. The scale ranging from 0 (very poor) to 4 (excellence).

The large variations in the index for the ASEAN-5 countries reflect the lack of adequate disclosure standards (Ibrahim, 2009). According to reports by the European corporate governance network, international investors demand higher risk premiums when disclosure standards are low, and even will not invest at all if the disclosure standards are very low.

Table 8: Corporate Governance Indices in ASEAN-5

Country	Enforceable Minority Shareholder Rights	Anti Director Right	Creditor Right	Accounting Standards, 1990
Indonesia	1	2	4	n.a.
Malaysia	2	4	4	76
Philippines	3	3	0	65
Singapore	4	4	4	78
Thailand	2	2	3	64

Source: La Porta, R., Lopez-de Silanes, F., Shleifer, A. and Vishny, R. (1998)

Furthermore, a conducive corporate governance mechanism will ensure more stable and transparent financial markets which in turn create a favourable climate for investment (Adam et al., 2002). Thus, corporate governance nowadays is currently seen as a prerequisite for promoting integration.

5. Summary and Conclusion

This paper examines the short-term and long-term regional financial integration for five major ASEAN countries (Indonesia, Malaysia, Thailand, Singapore and Philippines) using cointegration and granger causality test. The result from cointegration test shows that ASEAN-5 is fairly integrated albeit still far from complete. Further test, by comparing the result from pre-crisis and post-crisis indicates that integration in ASEAN has been significantly improved. Several factors contributing to this finding such as: increasing intra-region trade and the increasing role of the ASEAN.

Using granger causality, causal relationships are found in only half the cases. This indicates limited evidence in favour of short-term financial integration. The deviations in both finding suggest that the problem lies on the high transaction cost between countries in ASEAN. Corruption, differences in legal system and variations in corporate governance between countries might be the reasons for the high transaction cost.

In light of this, to intensify the financial integration, the source of the high transaction cost need to be minimized. Combating corruption and create better corporate governance will ensure favourable climate for investments and at the same time reducing the transaction cost. To further integrates the market, ASEAN could learn from the European Union by improving or creating better and well functioning transition governances.

Nevertheless, we can conclude that the attempt to integrate the financial market in ASEAN has been fairly successful. If the integration process continues at this pace, in the next few years the creation of common currency is not impossible.

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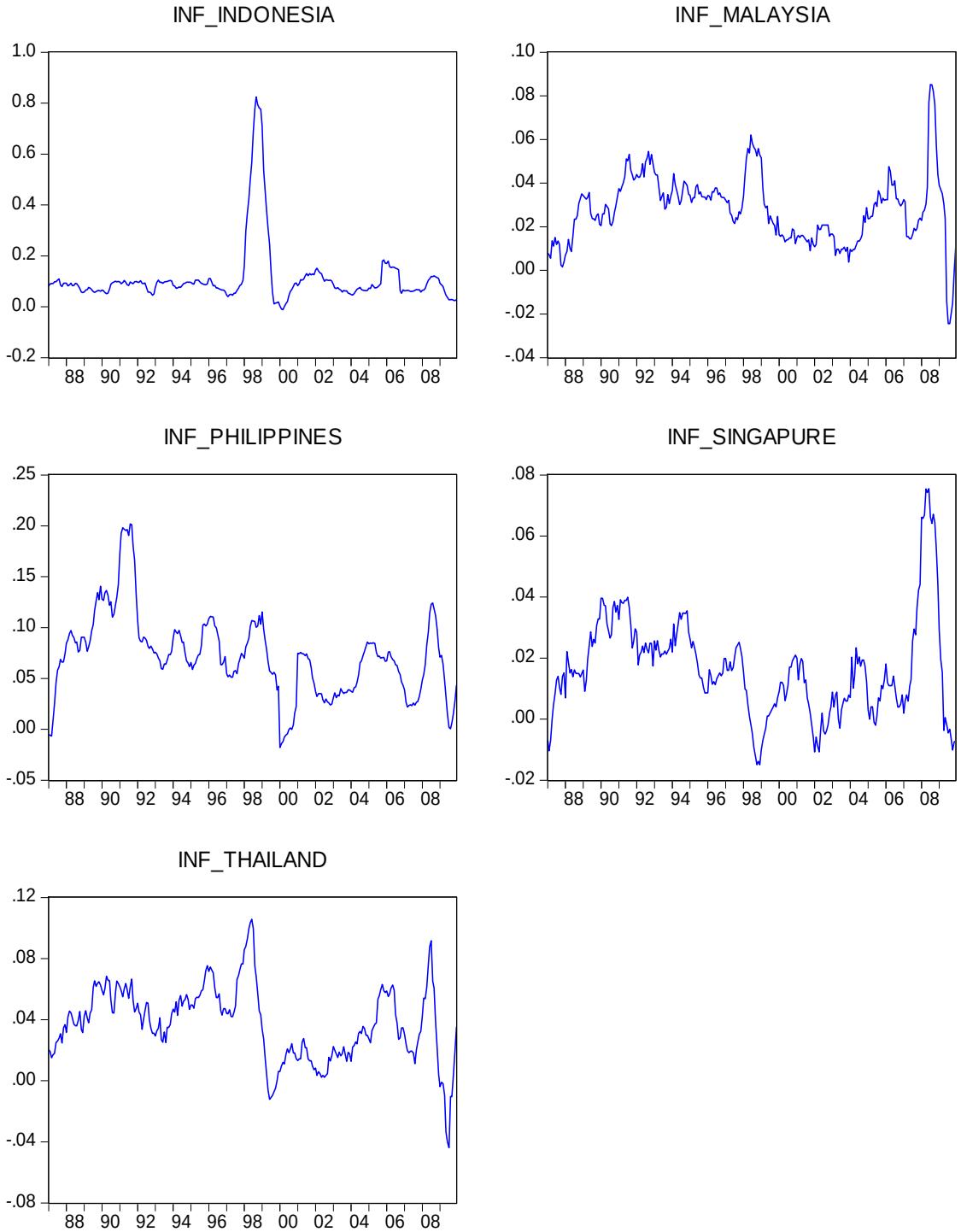
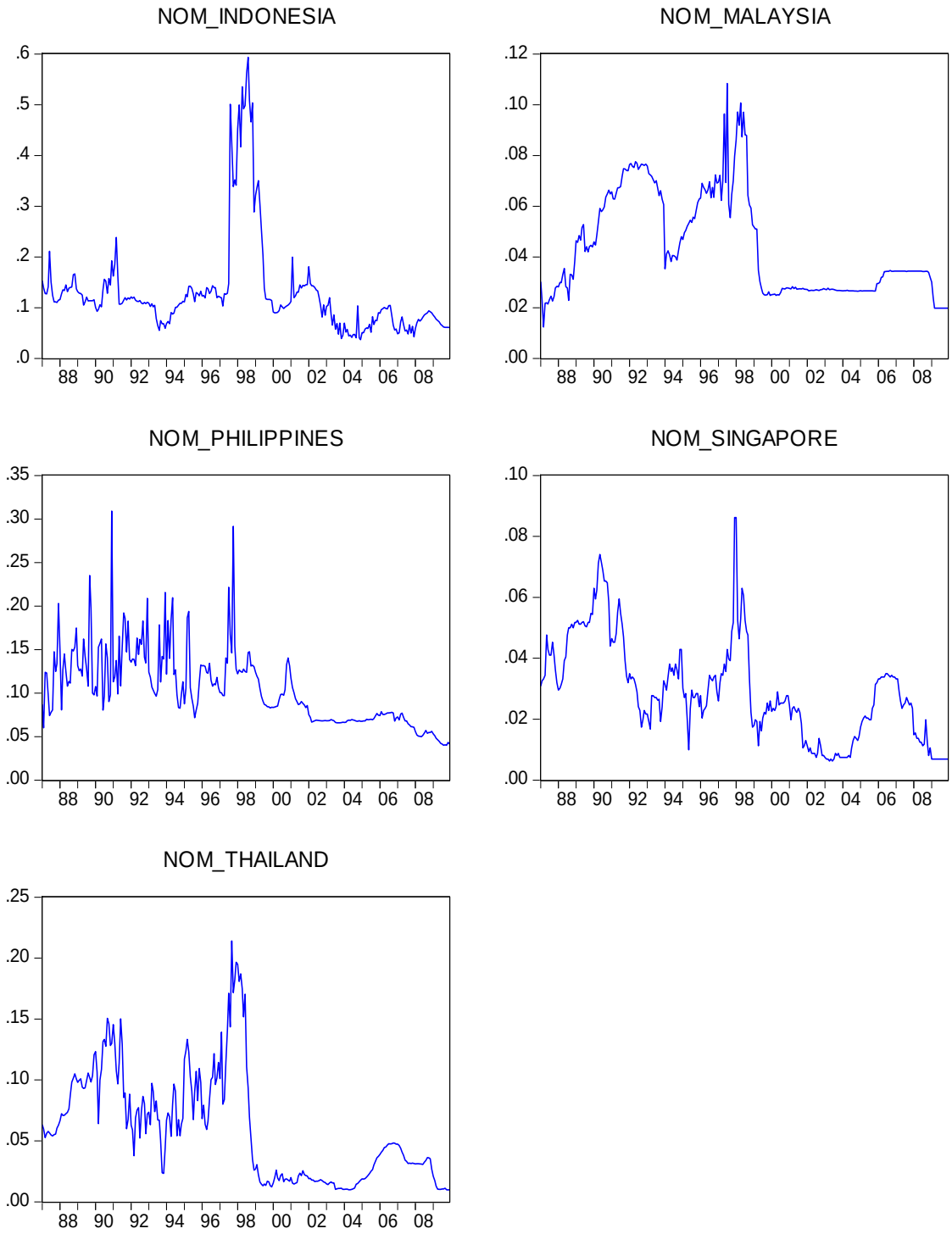
Appendix

Graph 1: Inflation Rates



Graph 2: Nominal Interest Rates



Graph 3: Real Interest Rates

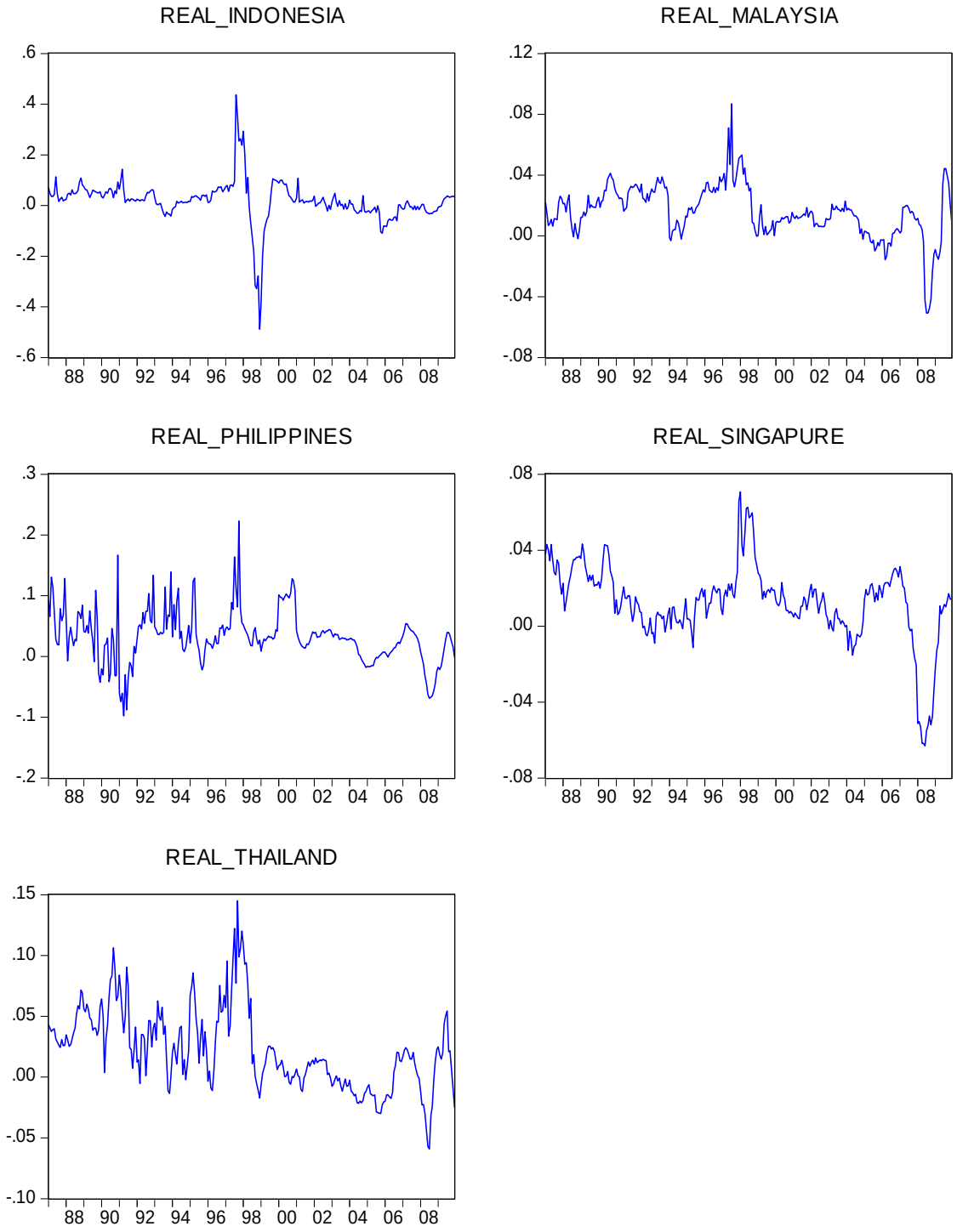


Table 1: Cointegration Test - Full Sample (January 1987 - December 2009)

Variables	r = 0		r = 1		r = 2		r = 3		Summary		Lag	Mode
	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace		
Indonesia-Malaysia	52.29410	100.40570	34.79240	48.11162	9.50193	13.31922	3.81730	3.81730	2	2	8	1
Indonesia-Singapore	59.25642	103.75790	30.01105	44.50148	8.27348	14.49043	6.21695	6.21695	2	2	5	1
Indonesia-Philippines	84.88981	119.58510	21.15492	34.69526	8.12122	13.54034	5.41913	5.41913	1	1	5	1
Indonesia-Thailand	61.78724	119.91160	39.60777	58.12438	12.94775	18.51661	5.56885	5.56885	2	2	6	1
Malaysia-Singapore	28.05805	58.73385	17.59483	30.67579	9.02497	13.08096	4.05599	4.05599	0	1	6	1
Malaysia-Philippines	37.05605	82.63990	24.88806	45.58385	17.29070	20.69579	3.40509	3.40509	3	3	3	1
Malaysia-Thailand	44.86574	105.89070	33.36558	61.02500	22.77879	27.65943	4.88064	4.88064	3	3	3	1
Singapore-Philippines	31.01032	69.25902	23.59691	38.24870	11.65989	14.65179	2.99191	2.99191	2	2	3	1
Singapore-Thailand	32.53350	70.64794	20.02381	38.11445	13.75684	18.09064	4.33379	4.33379	1	2	4	1
Philippines-Thailand	35.74267	81.03519	21.61789	45.29252	19.33508	23.67463	4.33955	4.33955	1	3	3	1

Table 2: Cointegration Test - Pre-Crisis Sample (January 1987 -June 1997)

Variables	r = 0		r = 1		r = 2		r = 3		Summary		Lag	Mode
	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace		
Indonesia-Malaysia	31.06153	56.53061	14.92915	25.46909	8.53820	10.53994	2.00174	2.00174	1	1	2	1
Indonesia-Singapore	21.04609	45.45785	11.03609	24.41175	10.49754	13.37567	2.87812	2.87812	0	0	2	*
Indonesia-Philippines	37.63316	71.32340	19.71696	33.69025	9.06491	13.97329	4.90838	4.90838	1	1	2	1
Indonesia-Thailand	33.28278	63.49454	13.12409	30.21176	10.72192	17.08767	6.36575	6.36575	1	1	1	1
Malaysia-Singapore	28.74500	51.58812	13.35077	22.84312	5.56956	9.49235	3.92279	3.92279	1	0	2	1
Malaysia-Philippines	35.46074	70.49463	15.26963	35.03389	13.47791	19.76426	6.28635	6.28635	1	1	2	1
Malaysia-Thailand	33.51908	62.49098	12.84324	28.97191	9.30137	16.12867	6.82730	6.82730	1	1	2	1
Singapore-Philippines	34.71028	66.99975	19.51868	32.28946	9.39420	12.77079	3.37659	3.37659	1	1	2	1
Singapore-Thailand	22.89581	51.66106	17.62063	28.76525	6.87747	11.14463	4.26716	4.26716	0	0	1	1
Philippines-Thailand	33.79677	71.31571	21.34936	37.51893	11.04021	16.16957	5.12937	5.12937	1	2	2	1

Table 3: Cointegration Test - Post-Crisis Sample (July 1998 - December 2009)

Variables	r = 0		r = 1		r = 2		r = 3		Summary		Lag	Mode
	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace	λ-max	Trace		
Indonesia-Malaysia	91.14088	141.75450	35.07171	50.61357	12.61418	15.54186	2.92768	2.92768	2	2	9	1
Indonesia-Singapore	51.23005	102.57240	25.91780	51.34239	16.86116	25.42459	8.56342	8.56342	3	3	8	1
Indonesia-Philippines	41.23282	76.49412	19.50147	35.26131	12.16916	15.75984	3.59068	3.59068	1	2	16	1
Indonesia-Thailand	67.65051	134.04050	45.25163	66.39001	17.48495	21.13838	3.65343	3.65343	3	3	19	1
Malaysia-Singapore	99.03642	135.00840	23.72665	35.97199	8.90621	12.24534	3.33913	3.33913	2	2	15	1
Malaysia-Philippines	52.42513	107.13090	27.34442	54.70572	21.57855	27.36130	5.78275	5.78275	3	3	19	1
Malaysia-Thailand	64.10598	91.50138	17.56655	27.39540	7.95838	9.82885	1.87048	1.87048	1	1	19	1
Singapore-Philippines	93.14472	131.64250	24.62249	38.49775	8.77043	13.87526	5.10482	5.10482	2	2	6	1
Singapore-Thailand	129.97050	226.53940	65.36184	96.56887	28.85185	31.20703	2.35518	2.35518	3	3	25	2
Philippines-Thailand	68.71219	113.16470	26.64952	44.45255	14.37729	17.80303	3.42574	3.42574	2	2	19	1

For all three cointegration result' test, column "Model" indicates the deterministic component used.
1: refers to the intercept only
2: refers to a deterministic trend in the level
3: refers to a deterministic trend in the cointegration space.

Table 4: In-Sample Granger Causality

Variable	Observation	3-Months		6-Months		12-Months		24-Months	
		F-Statistic	P-Value	F-Statistic	P-Value	F-Statistic	P-Value	F-Statistic	P-Value
Malaysia - Indonesia	272	6.9333*	0.0002	5.9108*	0.0000	6.4399*	0.0000	5.0487*	0.0000
Indonesia - Malaysia		2.0148	0.1122	1.2349	0.2888	0.6682	0.7811	1.2612	0.1945
Philippines - Indonesia	272	1.7083	0.1656	2.5629*	0.0199	1.6281	0.0845	1.3006	0.1665
Indonesia - Philippines		3.5639*	0.0147	1.7962	0.1002	1.0381	0.4145	0.8704	0.6422
Singapore - Indonesia	272	2.4000	0.0682	0.6536	0.6872	1.0834	0.3748	1.3163	0.1562
Indonesia - Singapore		3.4988*	0.0161	4.0400*	0.0007	2.3220*	0.0080	1.8370*	0.0129
Thailand - Indonesia	272	6.8259*	0.0002	3.5271*	0.0023	2.8868*	0.0010	2.9647*	0.0000
Indonesia - Thailand		3.8534*	0.0100	2.4843*	0.0236	2.3253*	0.0079	1.2949	0.1703
Philippines - Malaysia	272	0.1623	0.9217	0.3359	0.9176	0.2894	0.9906	0.4348	0.9909
Malaysia - Philippines		0.6215	0.6016	1.7389	0.1123	1.0537	0.4006	1.3566	0.1321
Singapore - Malaysia	272	2.1392	0.0956	1.5695	0.1564	1.5551	0.1057	1.1216	0.3225
Malaysia - Singapore		0.2121	0.8880	1.7740	0.1048	2.1001*	0.0176	1.4005	0.1095
Thailand - Malaysia	272	6.4113*	0.0003	5.0271*	0.0001	2.8920*	0.0009	2.4385*	0.0004
Malaysia - Thailand		4.7728*	0.0029	3.4785*	0.0025	2.2049*	0.0122	1.6542*	0.0333
Singapore - Philippines	272	1.3961	0.2444	1.9765	0.0694	1.8006*	0.0487	1.1235	0.3205
Philippines - Singapore		0.1291	0.9428	0.4511	0.8438	0.3539	0.9775	0.6292	0.9104
Thailand - Philippines	272	1.0191	0.3847	2.1069	0.0529	2.7564*	0.0016	1.8055*	0.0153
Philippines - Thailand		1.6980	0.1678	0.8383	0.5413	0.5795	0.8578	1.4838	0.0754
Thailand - Singapore	272	2.6944*	0.0465	1.4582	0.1930	0.9928	0.4564	1.0405	0.4166
Singapore - Thailand		2.2067	0.0877	1.2565	0.2781	1.9376*	0.0309	1.1839	0.2599

An asterisk (*) indicates statistical significance at the $\alpha = 0.05$

Table 5: Out-of-Sample Granger Causality

Excluded Variables	Endogenous Variables				
	Indonesia	Thailand	Phillipines	Singapore	Malaysia
Indonesia		0.660619	NO	0.528651	0.585483
		(0.5121)	TEST	(0.5995)	(0.561)
Thailand	1.276274		0.912285	NO	0.999946
	(0.2081)		(0.3663)	TEST	(0.3225)
Phillipines	1.854311	2.048247		NO	1.845538
	(0.07)	(0.0461)*		TEST	(0.0713)
Singapore	1.851103	2.148575	1.718953		3.513486
	(0.0704)	(0.0369)*	(0.0922)		(0.001)*
Malaysia	1.599357	1.977932	NO	NO	
	(0.1109)	(0.0538)	TEST	TEST	

An asterisk (*) indicates statistical significance at the α = 0.05

Numbers in parentheses are the probability values
a NO TEST indicates that the coefficient ∂ in Eq. (21) is significantly negative and, therefore, that the null hypothesis is not tested