Interdependence of Income between China and ASEAN-5 Countries

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Abstract

This paper examines the interdependence of income between China and ASEAN-5 countries by resorting to the time series econometrics analysis from 1960 to 2000 of the real Gross Domestic Product (GDP). Empirical results are found to support the strong interdependence of income between China and ASEAN-5 countries. With the increasing interest of economic integration around the globe especially the proposed China-ASEAN Free Trade Area (CAFTA), the interdependence and synchronization movements of income between member countries is an important characteristic for suitability toward the regional common currency goal.

JEL classification: R1, O18.
Key words: interdependence, cointegration, China, ASEAN-5

1. Introduction

Southeast Asia has a long history of international trade, for centuries the peninsula has been a major thoroughfare for traders passing between China and the Indian subcontinent. This is one of the reasons why the Southeast Asian countries have traditionally been more outward looking which led to the colonization by the West, except for Thailand. The colonization process had internationalized the region into an imperial division of labor and trade. The formation of Association of Southeast Asian Nations (ASEAN) is an antagonistic move where it remains as a diverse collection of nations yet there are also notable

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similarities within the subsets of members[1]. Among the high performing economies in the region are the ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore and Thailand). The ASEAN-5 economies are endowed with a wide range of natural resources both renewable and non-renewable except for Singapore, which is situated in the middle of the four countries. Together, these ASEAN countries annually export a major bulk of the world's palm oil, rubber and coconut products in addition to the significant amount of other mineral and agricultural commodities that include natural gas and petroleum.

From its birth until now, regional cooperation has been the main agenda[2]. Cooperation with other East Asian countries especially China, Japan, and the Republic of Korea (or known as ASEAN+3) has accelerated, with the holding of an annual dialogue showing the efforts initiated to build a stronger economic bond between East Asian countries. ASEAN acknowledges the benefits they have gained from sustaining close relations with these three countries and foresees more advantages from the proposed cooperation of ASEAN+3 ties. According to Dutta (2002), integrating countries with diverse economic background will promote trade and sustainable economic growth.

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[1] The Bangkok Declaration signed on 8 August 1967 by the five core members of Indonesia, Malaysia, the Philippines, Singapore and Thailand marking the birth of Association of Southeast Asian Nations (ASEAN). The newly independent Brunei joined in on 8 January 1984 and later by Vietnam (25 July 1995), while Myanmar and Laos acceded to ASEAN in 23 July 1997. Combodia joined ASEAN in 30 April 1999. To date there are 10 countries under the flagship of ASEAN.

[2] Central to establishing a clearer economic rationale was a proposal tabled at the group's fourth summit held in Singapore in January 1992 to create an ASEAN Free Trade Area (AFTA). The strategic objective of AFTA is to increase the ASEAN region's competitive advantage as a single production unit. The elimination of tariff and non-tariff barriers among the member countries is expected to promote greater economic efficiency, productivity, and competitiveness.

Since the implementation of the Open Door Policy and economic reforms, China's economy is seen to be growing rapidly and it has drawn the interest of the world[3]. China is now a target market for investment and trade, as there is a big potential market in China due to its large population. In addition, China's entry into World Trade Organization (WTO), has led to the reduction of a wide variety of tariff and non-tariff barriers where it provides an advantage in creating better opportunities, especially for this region. It means that there is less trade protection and this encourages foreign investment into China. As pointed out by Liu (2004), there is growing interdependence between ASEAN and China. Under the established ASEAN+3 framework for cooperation, the Framework Agreement on Comprehensive Economic Cooperation between ASEAN-China signed at Phnom Penh summit and the Free Trade Area (FTA) negotiations are expected to provide new opportunities for ASEAN-China relationships (Zhang, 2005). The interest of the cooperation is arisen due to the success of the European Union (EU) and the North American Free Trade Area (NAFTA) where efforts of cooperation and integration have been progressing at a rapid pace. In the inaugural World Bank conference held in Bonn, Germany in December 1999 on the Global Development Network (GDN) the concept of economic regionalization based on a map-of-the-world is highlighted where the developing economies were grouped into seven regions of East Asia, South Asia, Central and South America, Africa, Middle East, Southern Europe, and Russia (see, Dutta, 2000, 68). It seems that there is no

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[3] According to the Earth Policy Institute (2005) statistics, the rapid growth of the Chinese economy is overtaking the United States in terms of the consumption of one resource after another.

alternative to regionalism in this millennium and the sense of togetherness is appealing among the countries in the world today.

Alarmed by the growing competition from EU, NAFTA and other mushrooming free trade areas in the world, a nascent sense of an East Asian community is emerging as these countries realize that they must cooperate to tackle common challenges in this increasingly borderless and interdependent world. In this regard, this paper empirically examines the interdependence of income between China and ASEAN-5 countries from 1960 to 2000 by using the real GDP. Besides answering this important policy question, we are also interested in ascertaining the causal direction between China and the ASEAN-5 income. The causal direction between China and the ASEAN-5 income will provide useful mechanism into how these economies could explore the possibility towards regional integration. In answering these objectives, we resort to the standard time series econometrics analysis. These include the unit root, cointegration and the Granger causality tests in order to test the causal interplay and interdependence of income between ASEAN-5 and China.

With the brief background, motivation and objective in place, this paper proceeds as follows: Section 2 provides a brief discussion on the related literature of the genre where we borrow the concept of income convergence as a guide. This is followed by a description of the data and methodology employed in Section 3. The subsequent section presents the empirical results as well as the analysis of the findings. Finally, concluding remarks and further implications for empirical research are given in Section 5 of the paper.

2. Relevant literature

We borrow the convergence hypothesis concept in the growing literature as a representation of the interdependence interaction of income among countries within a region or a continent[4]. The convergence hypothesis are built upon the theoretical underpinnings derived from Solow (1956) work on the neoclassical growth model, in which it postulated that differences in initial income do not have long term effects on growth, where initially poor economies are able to catch up with the richer economies. As for the empirical investigation, the income convergence literatures are mainly centered on two different approaches namely the cross-sectional and the time series analysis. Among the researchers that investigate the convergence hypothesis using the cross-sectional data are Baumol (1986), Barro (1991), Barro and Sala-i-Martin (1991, 1992), Mankiw *et al.*, (1992), Engelbrecht and Kelsen (1999), Bentzen and Smith (2003) and Dobrinsky (2003) where most of these inquiries have focused exclusively on developed countries. The conclusion that emerged from these studies is at best mixed.

However, Bernard and Durlauf (1996), criticize the empirical regularities of the cross-sectional studies on convergence hypothesis. Specifically, they demonstrate that evidence of a negative correlation between income differences and initial income levels within the cross-sectional framework cannot be taken as evidence of income convergence. Instead, it rather conveys the idea of catching up but not to converge. The bulk of empirical investigations that adopt the time series

[4] Lee (2002) provides an excellent empirical literature review on the income convergence hypothesis.

econometrics analysis are increasing in the literature (see, for example, Evans and Karras, 1996; Loewy and Papell, 1996; Li and Papell, 1999; Tsionas, 2000; DeJuan and Tomljanovich, 2004; Booth and Ciner, 2005 and Le Pen 2005), where the focus is on the developed nations. Only recently, empirical investigations of the income convergence on the developing nations have become increasingly available in the literature. Authors like Lee and McAleer (2000), Park (2000a, 2000b, 2003), Zhang *et al.* (2001); Lee *et al*. (2004), Kim (2005), Lee *et al.* (2005) and Liew and Lim (2005) emphasize on the possibility of convergence among the income in the Asian countries. Despite that the first theoretical foundation that was published fifty years ago, the empirical investigation of the convergence hypothesis is still increasing due to the regionalization of countries within regions or continents.

This study makes interesting contributions to the empirical literature in the following ways. ASEAN-5 represents the co-founding countries of the Association of Southeast Asian Nations (ASEAN) and these countries have a long history of multilateralism among themselves. The selection of this group of countries is interesting as they posses similar contention due to the episodes of currency crisis over 1975-1997 period as identified in Glick and Hutchison (2005). Importantly, the 1997 crisis serves as a wake-up call for Asian countries not only as a geographical concept but also as a regional community arrangement. These countries are the main trading partners of China, compared to rest of the ASEAN countries (see Liu, 2004 for details). The continuous high and robust growth of China's economy has significant impact on the world economy, particularly on the ASEAN-5 countries, as they are geographically linked. This shift of paradigm from the conventional bilateral relationship between countries to radical innovation of multilateral advancement among countries would promote economic interdependency and sustainable development in a global context. The evidence presented in this study would add to the literature on the host subject.

3. Econometric methodology and data description

3.1 Correlation coefficients

Before progressing to the formal empirical testing for interdependence in terms of real GDP growth rate of China and ASEAN-5 countries, a simple correlation analysis is conducted. Coefficient of correlation is defined as follows:

$$\rho = \frac{\text{cov}(X,Y)}{\sigma_x \sigma_y} \tag{1}$$

where ρ (rho) denotes the coefficient of correlation. The correlation between two random variables X and Y is simply the ratio of the covariance between the two variables divided by their respective standard deviations. The correlation coefficient is then defined as a measurable of linear association between two variables in which it measured how strong the two variables are linearly related (Gujarati, 1999).

Correlation coefficient can be in the positive or the negative figure. The correlation coefficient typically lies between –1 and +1. If the correlation coefficient is +1, then the two variables have perfect positive correlation while if the correlation coefficient is –1, then the two variables are perfectly negative correlated.

3.2 Univariate unit root and stationary testing procedures

In this paper, we deploy the Said and Dickey (1984, ADF), Elliott *et al.* (1996, DFGLS) and the Kwiatkowski *et al.* (1992, KPSS) testing principles. The ADF and DFGLS testing principles share the same null hypothesis of a unit root. Their difference however centers on the way the latter specifies the alternative hypothesis and treats the presence of the deterministic components in a variable's data generating process (DGP). Specifically, the DFGLS procedure relies on locally demeaning and/or detrending a series prior to the implementation of the usual auxiliary ADF regression. The use of the DFGLS tests statistics is likely to minimize the danger of erroneous inferences emerging when the series under investigation has a mean and/or linear trend in its DGP (see Elliott *et al*., 1996). Basically, the DFGLS τ_μ and τ_τ are constructed by estimating the following auxiliary regression of

$$\Delta x_1^m = \beta_0 x_{t-1}^m + \sum_{j=1}^{n} \beta_j \Delta x_{t-j}^m + \varepsilon_t \tag{1}$$

where x_1^m is the locally demeaned and/or detrended process obtained from $x_t^m = x_t - \overline{\beta}' z_t$. Under this condition, $z_t = 1$ for the case of τ_μ while $z_t = (1 \quad t)$ for the case of τ_τ and $\overline{\beta}'$ is the regression coefficient of $\tilde{x}_t$ on $\tilde{z}_t$ for which $(\tilde{x}_1, \tilde{x}_2, ..., \tilde{x}_T) = [x_1 (1-\overline{\rho}L) x_2), ..., (1-\overline{\rho}L) x_T)]$, $(\tilde{z}_1, \tilde{z}_2, ..., \tilde{z}_T) = [z_1, (1-\overline{\rho}L) z_2, ...(1-\overline{\rho}L) z_T]$ under the local alternative of $\overline{\rho} = 1 + (\overline{c}/T)$. The τ_μ (τ_τ) test statistic is given by the usual *t* statistic for testing $\beta_0 = 0$ in the associated ADF type auxiliary regression for the appropriate x_t^m variables shown above. In addition, this procedure requires that the choices of the local to unity parameter $\bar{c}$ through $\bar{\rho} = 1 + (\bar{c} / T)$ are set to -7 in the case of τ_μ and –13.5 in the case of τ_τ (see Elliott *et al*., 1996). For this purpose, the t_μ and t_τ stand for the ADF test statistics while DFGLS denoted by τ_μ and τ_τ with mean (μ) and trend (τ) stationarity.

In contrast, the KPSS procedure tests for level (η_μ) or trend stationarity (η_τ) against the alternative of a unit root. The KPSS test statistic for level (trend) stationary is

$$\eta_\mu(\eta_\tau) = \frac{1}{s^2(k)T^2} \sum_{t=1}^{T} S_t^2 \qquad (2)$$

where $S_t = \sum_{i=1}^{t} u_i, u_t$ are the residuals from the regression of X_t on a constant (a constant and trend) for the level (trend) stationarity, $s^2(k)$ is the non-parametric estimate of the 'long run variance' of u_t while k stands for the lag truncation parameter. The adoption of the three versions of the unit root tests should enable us to mitigate a clear-cut conclusion on the requirement of the order of integration when applying time series data.

3.3 Multivariate cointegration test

The Johansen and Juselius (1990) procedure does not suffer from problems associated with normalization and it is robust to departure from the normality (Cheung and Lai, 1993). The test utilizes two likelihood ratio (LR) test statistics for the number of cointegrating vectors:

$$\tau_{trace}(r) = -T \sum_{i=r+1}^{p} \ln(1-\lambda_1) \quad (3)$$

where λ_I = the p-r smallest squared canonical correlation of v_{0t} with respect to v_{1t} and T is the number of observations. In the trace test the null hypotheses of `r` or less cointegrating vectors where r = 0,1,2,…,p-1,p. In other words, the null hypotheses is r ≤ 0 while the general hypotheses is r ≤ 1, r ≤ 2,…, r ≤p. The second test is the maximum eigenvalue test that examines the null hypotheses of exactly r cointegrating vectors with the test statistic follow as:

$$\tau_{\max}(r, r+1) - T\ln(1-\lambda_{r+1}) \quad (4)$$

In this test the r versus r+1 is tested. Therefore the null hypotheses of r=0 is tested against the specific hypotheses of r = 1,2,…,p-1,p. Critical values for both the maximum eigenvalue and trace tests are tabulated in Osterwald-Lenum (1992).

3.4 Granger causality test

To test the causal interrelationship between government revenues and government expenditures, we adopted the modified WALD (MWALD) test proposed by Toda and Yamamoto (1995). They propose the modified WALD (MWALD) test for testing *Granger non-causality* as it allows causal inference to be conducted in the level VARs that may contain integrated and (non) cointegrated processes. They prove that in the integrated and (non) cointegrated system, the MWALD test for restrictions on the parameters of a VAR (*k*) has an asymptotic χ^2 distribution when a VAR $p = (k + d_{max})$ is estimated, where d_{max} is the maximum order of integration suspected to occur in the system.

This procedure imposes (non-) linear restrictions on the parameters of the VAR models without having to pretest for unit root and cointegrating rank. Rambaldi and Doran (1996) shows that Seemingly Unrelated Regression (SUR) could easily compute the MWALD test. Thus, causal ordering among the variables can be established without *prior* restrictions of exogeneity.

Following Toda and Yamamoto (1995) Granger non-causality test, these variables can be causally linked in a two-dimensional VAR system (assuming p=3):

$$\begin{bmatrix} CHINA_t \\ INDO_t \\ MSIA_t \\ PHILI_t \\ SPORE_t \\ THAI_t \end{bmatrix} = \mathrm{A}_0 + \mathrm{A}_1 \begin{bmatrix} CHINA_{t-1} \\ INDO_{t-1} \\ MSIA_{t-1} \\ PHILI_{t-1} \\ SPORE_{t-1} \\ THAI_{t-1} \end{bmatrix} + \mathrm{A}_2 \begin{bmatrix} CHINA_{t-2} \\ INDO_{t-2} \\ MSIA_{t-2} \\ PHILI_{t-2} \\ SPORE_{t-2} \\ THAI_{t-2} \end{bmatrix} + \mathrm{A}_3 \begin{bmatrix} CHINA_{t-3} \\ INDO_{t-3} \\ MSIA_{t-3} \\ PHILI_{t-3} \\ SPORE_{t-3} \\ THAI_{t-3} \end{bmatrix} + \begin{bmatrix} \varepsilon_{CHINA} \\ \varepsilon_{INDO} \\ \varepsilon_{MSIA} \\ \varepsilon_{PHILI} \\ \varepsilon_{SPORE} \\ \varepsilon_{THAI} \end{bmatrix} \quad (5)$$

where A_0 acts as an identity matrix. To test whether INDO income does not Granger cause movement in CHINA income (if k=2 and d_{max}=1), the null hypothesis H_0: $\beta_{12}^{(1)} = \beta_{12}^{(2)} = 0$ where $\beta_{12}^{(i)}$ are the coefficients of INDO_{t-i}, i=1,2,…, in the first equation of the system. The existence of the causality from RG to RR can be established through rejecting the above null hypothesis, which requires finding the significance of the MWALD statistics for INDO_{t-1} and INDO_{t-2} identified above while INDO_{t-3} is left unrestricted as a long run correction mechanism. These restrictions imply a long run causal inference since, unlike ordinary first difference VAR, this formulation involves only variables appearing in their levels. Similar analogous restrictions and testing procedure can be applied in testing the hypothesis that CHINA income does not Granger cause movement in INDO income, i.e. to test H_0: $\beta_{21}^{(1)} = \beta_{21}^{(2)} = 0$ where $\beta_{21}^{(i)}$ are the coefficients of $CHINA_{t-i}$, i=1,2,…, of the second equation of the system (Equation 5). This procedure can be easily generalized for a larger number of lags following the VAR system.

3.5 Data description

Annual data of real Gross Domestic Product (GDP) per capita for China and ASEAN-5 countries over the period 1960-2000 are obtained from from the Penn World Table (PWT) 6.1, a latest version developed by Heston *et al.* (2002). The Penn World Table (PWT) accounts for economic time series covering around 167 countries. Each of the variables is denominated in a common set of prices in a common currency so that *real* quantity comparisons can be made, both between countries and over time. The project start in 1978 with the publication of the paper entitled "Real GDP Per Capita for More Than One Hundred Countries," by Irving Kravis, Robert Summers and Alan Heston for the purpose of deriving the data sets for international comparison between countries. Following this reason, we used the PWT data sets for empirically evaluate the interdependence between ASEAN-5 and China.

4. Empirical Results

4.1 Correlation coefficients results

Before proceeding to undertake the empirical analysis to test for the interdependence of income, a simple correlation analysis is conducted. The results are displayed in the matrix form in Table 1. It is evident from Table 1 that all the coefficients of correlation show a highly positive value. The high positive value implies that an increase in one country's GDP would also increase the other country's GDP. Specifically, China and Indonesia has a correlation coefficient of 0.987; the China and Malaysia correlation coefficient is 0.992 while the correlation coefficient is valued at 0.975 for China and the Philippines. Meanwhile, the correlation coefficient of China and Singapore is 0.984 while China and Thailand has a correlation coefficient of 0.993.

[Insert Table 1]

The conclusion made from the simple correlation analysis is that there is strong association amongst ASEAN-5 countries and China indicating strong interdependence. As the correlation coefficient measures how strong two variables are related or associated, the interpretation of a strong correlation however does not mean the evidence of cointegration or even causality. The most a researcher can say is that the variables share something in common; or are related in some way. With this in mind, we adopt a more formal and precise methodology in order to examine the interdependence of income amongst this set of countries.

4.2 Integrational tests results

Since the data-dependent methods are sensitive in lag selection criteria (k), we follow the recursive t-statistic procedure suggested by Ng and Perron (1995) with an upper bound of k_{max} on k. We set $k_{max}$to be 6 to overcome this shortcoming. If the last included lag was significant, we would choose $k = k_{max}$. If not, we would reduce k by one until the last lag becomes significant. If no lags are significant then k is set to zero (k=0). The 5 percent value of the asymptotic normal distribution, 1.96 was used to assess the significance of the last lag. The procedure adopted here falls into the category of the general to specific sequential procedure. Panel A, Table 2 summarizes the outcome of the ADF, DFGLS and KPSS testing in level and first differences performed on the Real GDP in the six countries. Overwhelmingly, all the testing procedures suggest the existence of unit root or nonstationarity in level or *I(1)* for all the variables. The findings that all the variables have the same order of integration allow us to proceed on with the Johansen multivariate cointegration analysis.

Before testing for the existence of any cointegrating relationship between the six-dimensional variables using Johansen procedure, it is necessary to determine the dynamic specification of the VAR model. It is widely known that the lag length order (k) can affect the number of cointegrating vectors and the causality pattern. For this purpose, multivariate generalization of Akaike Information Criteria (AIC) proposed by Gonzalo and Pitarakis (2002) is used to determine the optimal lag length for the vector autoregressive (VAR). This procedure is chosen due to its superiority as the best performing criterion in lag selection techniques when the system dimension increases (Gonzalo and Pitarakis, 2002).

Additionally, we rely on multivariate diagnostic tests for autocorrelation, constant variance and normal distribution to finally arrive at the optimal lag length of the VAR model. Due to the limited time series data, we estimate the maximum lag length structure up to 4. The results tabulated in Panel B, Table 2, indicate that VAR (2) is most appropriate for the VAR estimation.

[Insert Table 2]

4.3 Cointegration and hypothesis testing results

Results of the cointegration procedure are presented in Panel A, Table 3. The null hypothesis of no cointegrating vector (r=0) in favor of at least one cointegrating vector is rejected at 5 percent significance level. We note that both the trace and the maximum eigenvalue test leads to the same conclusion—the presence of one cointegrating vector. Rejecting the null hypothesis of no cointegration implies that the four variables do not drift apart and share at least a common stochastic trend in the long run. In other words, there is one stochastic trend shared among the six variables in the system. Eventually, China and ASEAN-5 income are seen to be moving together towards the long run equilibrium.

At this point, it is important to find out if each of the variables in the six-dimensional system of VAR enters significantly in the cointegrating relationship. By using zero restriction on each of the variable derived from the Johansen procedure, we are able to ascertain that the variable enters in the cointegrating space. We apply the log-likelihood ratio (LR) test for the exclusion of each of the individual variable in the system (i.e., imposing zero restrictions on respective coefficients) as discussed in (Johansen and Juselius, 1990, 195). Panel B, Table 3 provides the test results of the exclusion restriction on CHINA, INDO, MSIA, PHILI, SPORE and THAI. The null of restricting the coefficients of CHINA, INDO, MSIA, PHILI, SPORE and THAI to zero can be easily rejected at the 5 percent significance level. This is shown from the probability of rejection in the parenthesis. Clearly, all the variables belong to the cointegrating space and cannot be ruled out from the analysis. Overall, the results indicate that all the variables share a long run co-movement that is bounded by their long run equilibrium relationship indicating interdependence of income among the core members of ASEAN and China.

[Insert Table 3]

4.4 Granger causality results (MWALD Test)

In this paper the main emphasis is on the channel through which the interdependence of income amongst ASEAN-5 and China exist. The causal interplay between the China and ASEAN-5 income would provide useful mechanism into how these economies could explore the possibility towards regional integration. Results of the MWALD test for the system are given in Table 4. We adopt the same lag structure as in Johansen test of VAR (2) for this purpose. To ensure the robustness and insensitivity of the Toda-Yamamoto technique, we present both d=1 and d=2 model due to the fact that most economic time series encountered in empirical studies to be at most *I(2)*. In their study, Toda and Yamamoto (1995, 233) assume only for the case of d=2. However, in this paper, we generalize their reasoning by assuming that d=1 (Panel A) and d=2

(Panel B) where the series can take either *I(1)* or *I(2)*variables. In this manner, the robustness and consistency of testing procedure is tested.

[Insert Table 4]

The major findings are summarized as follows; one-way causality is detected running from all the ASEAN-5 countries to China. This implies that the ASEAN-5 countries are focusing towards China where investors channel their investment to China. Feedback causality are found (China $\rightarrow$ ASEAN-5) in three out of five countries (MSIA, SPORE and THAI). This provides an indication that closer ties exist between China and the three countries. Strong investment and trade opportunities partly explain the bi-directional causality pattern between their real GDP. This eventually will benefit both parties. Bi-directional causality is found among the three ASEAN countries, which can be seen through the rejection of the null hypothesis in the three ASEAN countries' (MSIA, SPORE and THAI) income which indicates that it Granger cause each other's income and vice versa. Using these results as a guide, we can acknowledge the closeness between these three countries especially in terms of economics relationships. The economic linkages found from this finding may be termed by the growth economists as the evidence of convergence clubs.

The absence of causality for INDO and PHILI to the other three ASEAN countries might be due to the political and economic instability that separates these two nations from the rest. In addition, we also find that the causality running from CHINA to INDO and PHILI are not pronounced. Following the convergence clubs theory we can separate the ASEAN-5 countries into two clubs respectively. Club 1 comprises of Malaysia, Singapore and Thailand while Club 2 includes Indonesia and the Philippines. Although two convergence clubs do exists, they eventually shown to have a strong interdependent links with China. In other words, China is the key factor in influencing growth and interdependence in this region. As such, China one way or another marks the resemblance of the income amongst these economies. The dynamic causal interactions of the interdependence among the income summarized from Tables 4 are visually explained in terms of a flow diagram in Figure 1.

[Insert Figure 1]

5. Concluding Remarks

Rather than focusing on the relationship between two particular economies, this paper empirically examines the interdependence of income by considering China and ASEAN-5 economies. The advantage of this approach is that it provides a conclusion that is more general than those of specific country studies. Our empirical results lead us to several important conclusions. From the simple correlation analysis, one could clearly see that the economies are closely integrated in the estimation period. Moreover, the highly bilateral positive output correlation coefficient can provide an indication that the there are common shocks affecting these economies. In this case, we expect that countries with similar economic structure and policy are more likely to be highly correlated.

The multivariate cointegration test indicates that these countries are moving towards long run equilibrium. This evidence brings a positive implication towards the establishment of the China-ASEAN Free Trade Area (CAFTA), in order to enhance the economic and integration between the two. For many of the ASEAN countries, the Asian crisis has weakened their own economies, but the linkage of both sides focusing on regional and sub-regional for high growth and investment could help them to grow further in the regional context and also in a global economy. Among the cooperation in the framework, includes the trade and investment facilitation that would remove the barriers to trade, working together towards various areas such as finance, tourism, agriculture, environment and appropriate institutions to carry out the framework of cooperation (Chirathivat, 2002). On the other hand, Eichengreen and Tong (2006) argue that the foreign direct investment (FDI) flowing toward other Asian countries seems to be stimulated rather than depressed by FDI flows into China. The reason being that these countries are producers of inputs for the Chinese manufacturing sector, they are part of the same global supply chain and regional production network.

There are two major pattern of causality among these countries. The first pattern is that all the countries channel their investment and business opportunities to China and the second is that only three countries (MSIA, SPORE and THAI) pronounced bi-directional causality with China. From the economics perspective, this means that these countries, namely, Malaysia, Singapore and Thailand complement each other while addressing on the existing strengths. To a certain extent, these groupings are considered as the dominant club in the China-ASEAN-5 economic relationship while the second group that consists of Indonesia and the

Philippines are considered as diverges from the dominant group. However, China is the key factor in connecting the two groups of countries in the ASEAN-5 region. As such, China one way or another marks the resemblance of the income amongst these economies.

Whether the current level of China-ASEAN-5 interdependence is high or not, is a secondary issue. What is important is the degree of commitment these countries would provide and the strong tendency of the intra-blocs of the other regions in the world. As the direction of the journey is rather clear for the China-ASEAN-5 relationship that would be an interesting excise towards to the concept of the "Asian Economic Community" (Dutta, 2002). Another important policy implication is the promotion of the macroeconomic sustainability in a regional context. This would not only provide close ties between them but it also would bridge the road towards broader desire for economic, monetary and financial cooperation in the East Asian Community.

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Table 1: Correlation analysis

Countries	CHINA	INDO	MSIA	PHILI	SPORE	THAI
CHINA	1.000	0.987	0.992	0.975	0.984	0.993
INDO		1.000	0.996	0.990	0.992	0.991
MSIA			1.000	0.991	0.993	0.994
PHILI				1.000	0.992	0.985
SPORE					1.000	0.993
THAI						1.000

Notes: The following notations applies: CHINA = China, INDO = Indonesia, MSIA = Malaysia, PHILI = Philippines, SPORE = Singapore and THAI =Thailand. The real GDP for all the countries are sourced from Penn World Table (PWT) version 6.1 (see, Heston *et al.,* 2002).

Table 2: Unit root tests and lag selection for VAR

Panel A: Unit Root Tests

	Test Statistics					
	t_μ	t_τ	τ_μ	τ_τ	η_μ	η_τ
			A: Level			
CHINA	-1.527(2)	-1.699(2)	-1.166(3)	-1.659(3)	0.636(3)*	0.236(3)*
INDO	-2.508(2)	-2.438(2)	-1.577(3)	-1.550(3)	0.676(3)*	0.273(3)*
MSIA	-2.001(2)	-2.711(2)	-1.424(1)	-1.859(1)	1.128(1)*	0.210(1)*
PHILI	-0.197(2)	-1.725(2)	-0.533(2)	-1.905(2)	1.248(2)*	0.265(2)*
SPORE	-1.522(1)	-1.391(1)	-0.644(1)	-1.583(1)	1.118(3)*	0.220(3)*
THAI	-1.370(1)	-1.202(1)	-0.152(1)	-1.864(1)	2.127(1)*	0.285(1)*
			B: First Differences			
ΔCHINA	-6.533(2)*	-6.614(2)*	-4.098(3)*	-4.175(3)*	0.108(3)	0.043(3)
ΔINDO	-14.70(2)*	-14.77(2)*	-4.075(3)*	-5.668(3)*	0.062(3)	0.047(3)
ΔMSIA	-4.721(2)*	-4.870(2)*	-5.381(1)*	-5.492(1)*	0.188(1)	0.072(1)
ΔPHILI	-5.828(2)*	-5.930(2)*	-5.607(2)*	-5.776(2)*	0.156(2)	0.065(2)
ΔSPORE	-5.445(1)*	-5.666(1)*	-5.088(1)*	-5.787(1)*	0.282(3)	0.055(3)
ΔTHAI	-3.446(1)*	-3.656(1)*	-3.949(1)*	-3.450(1)*	0.287(1)	0.053(1)

Panel B: Lag Selection based on Multivariate AIC

Lag	AIC
1	373.820
2	416.103*
3	393.836
4	370.176

Notes: The t, τ, and η statistics are for ADF, DFGLS and KPSS respectively. The subscript μ in the model allows a drift term while τ allows for a drift and deterministic trend. Asterisk (*) indicates statistically significant at 5 percent level. Figures in parentheses are the lag lengths. The asymptotic and finite sample critical values for ADF is obtained from MacKinnon (1996) while the KPSS test critical values is obtained from Kwiatkowski *et al*. (1992, Table 1, 166). The DFGLS for the drift term (μ) follows the MacKinnon (1996) critical values while the asymptotic distributions for the drift and deterministic trend (τ) is obtained from Elliott *et al*. (1996, Table 1, 825). Both the ADF and DFGLS test examine the null hypothesis of a unit root against the stationary alternative. KPSS tests the null hypothesis that the series is stationary against the alternative hypothesis of a unit root. Δ denotes first different operator. The multivariate generalization of AIC is chosen due to its superiority as the best performing criterion in lag selection techniques when the system dimension increases (Gonzalo and Pitarakis, 2002). (**) indicates the optimal lag selected for the VAR estimation.

TABLE 3: Cointegration test and hypothesis testing

Panel A: Johansen Multivariate Test

Null	Alternative	k=2 r=1			
		λmax		**Trace**	
			95% C.V.		95% C.V.
r = 0	r = 1	41.9365*	39.8300	97.5762	95.870
r<= 1	r = 2	24.7022	33.6400	55.6397	70.490
r<=2	r = 3	15.5771	27.420	30.9375	48.880
r<=3	r = 4	8.8198	21.120	15.3605	31.540
r<=4	r = 5	5.7845	14.880	6.5406	17.860
r<=5	r = 6	0.75610	8.070	0.75610	8.070

Panel B: Test of Exclusion Restrictions based on Johansen Procedure

Variables	**χ^2-statistics (p-value)**
CHINA	25.331(0.000)*
INDO	17.230 (0.000)*
MSIA	16.070 (0.000)*
PHILI	6.224 (0.013)*
SPORE	7.558 (0.006)*
THAI	6.770 (0.009)*

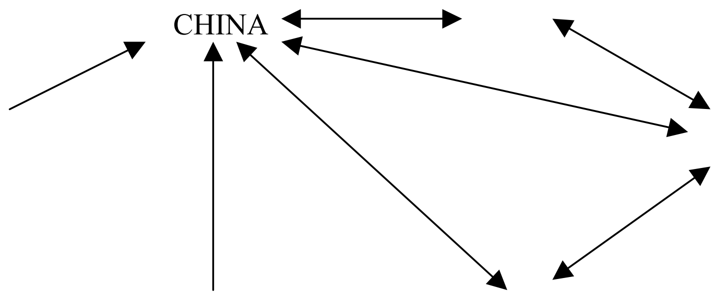
Notes: Asterisk (*) denote statistically significant at 5 percent level. The k is the lag length and r is the cointegrating vector(s). Chosen r: number of cointegrating vectors that are significant under both tests. The exclusion test is based on a likelihood ratio test and has a $\chi2$ (r) distribution, where the degree of freedom is r, the number of cointegrating vector.

Table 4: Granger Causality Results

Dependent Variable	**CHINA**	**INDO**	**MSIA**	**PHILI**	**SPORE**	**THAI**
			MWALD (χ^2-statistics)			
Panel A: (k=2 d=1)						
CHINA	-	18.628 *	22.186*	21.700 *	16.038*	11.664*
INDO	3.976	-	3.0782	1.641	4.426	2.749
MSIA	23.859*	1.693	-	5.130	12.743*	20.836*
PHILI	1.2084	2.956	1.438	-	2.697	0.956
SPORE	10.637*	3.305	10.050*	4.175	-	7.512
THAI	22.476*	4.217	8.431*	4.252	4.245	-
Panel B: (k=2 d=2)						
CHINA	-	25.032*	21.220*	9.668*	17.899*	9.6217*
INDO	5.617	-	3.849	0.283	3.262	3.079
MSIA	19.679*	1.144	-	4.969	34.964*	15.759*
PHILI	5.587	4.183	1.220	-	2.521	2.710
SPORE	11.633*	4.165	10.541*	4.991	-	3.031
THAI	24.162*	7.138	12.968*	4.224	4.146	-

Notes: k = optimum lag and d = maximal order of integration. Asterisk (*) indicate statistically significant at 5 percent level.

Figure 1: Flow diagram of causality linkages summarized from Table 4



CHINA → MSIA implies one-way causality

CHINA ↔ MSIA indicates the bi-directional causality