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Abstract
Currency crises and financial instability in the 1990s have increased the needs of regional cooperation, hence leading to the proposition of optimal currency area (OCA). But only if shocks are symmetric, the cost of relinquish the flexible monetary policy is to be outweighed by the benefits of forming OCA. To tackle the issue, this paper studies the extent of business cycle correlation and output linkages among fifteen Asia Pacific economies during 1961-2004. The real outputs series which sourced from the Penn World Data were estimated in standardized international dollars to construct business cycles based on the Christiano-Fitzgerald (2003)'s asymmetric band-pass filtering method. On the whole, the selected APEC members (especially ASEANs and NIEs) have achieved some important degree of business cycle co-fluctuations since the 1990s and further enhanced after 1997, most possibly attributed to the improved intra-trading and cross-boarder investments. For the US-Japan-ASEAN5 series, a dynamic analysis was conducted using the Autoregressive Distributed Log bounds test and the Unrestricted Error Correction Model (UECM) representation advanced in Pesaran *et al.* (2002). Nonetheless, the idiosyncratic and common shocks in ASEAN economies are more identical to the Japanese experience rather than the US's. The overall finding has signified the brighter likelihood of economic cooperation and regional currency arrangements among APEC members.

Keywords: Business Cycle Correlation, Output linkages, Band-pass Filtering, UECM
JEL Classifications: E32, O47, C22, C51

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INTRODUCTION

Similar to the Euro area, economic integration among Asia Pacific economies (APE hereinafter) and the world has also augmented, mainly driven by the increasing cross-border investments and greater intra-trading. Concurrently, the network of trade and capital flows in the region has become comprehensive and intricate, contributing to more rapid transmission of shocks from country to country. In consequence, the Asia crisis 1997/98 had spillover effects on Japan and US, while the contraction of IT industry (2001) and the recent financial turmoil in the US had affected the APE outputs severely. The integration process is likely to deepen over time with the growing preferential trading agreements (PTAs) and regional cooperation arrangements among the APE. The increasing trends of regional PTAs are similar to those in the Latin America, North America and European countries in the late 1980s and early 1990s. At 2000, about 97% of total global trade involves countries that are members of at least one PTA as compared to a 72% share in 1990. Recent PTAs in the ASEAN region include the ASEAN Free Trade Area (1992), The Japan-ASEAN Comprehensive Economic Partnership (2001), the ASEAN-China Free Trade Area (2001), the Singapore-Japan Economic Partnership Agreement (2001), the Singapore-New Zealand bilateral trade agreement (2001), the Chiang Mai Initiative (2002) and the recent ASEAN+3+2+1 road map.

Such events have reflected the regional efforts to promote closer financial and monetary cooperation. After the successful launch of euro, the discussion on OCA and its feasibility among the APE has attracted much more attention. Asia Development Bank (ADB) for instance, has declared to launch Asian Currency Unit (ACU) in 2006 in order to further accelerate cooperation within Asia, hoping that one day the ACU will grow to become the region's legal currency. However, in order to find potential candidates in the region for OCA, it is necessary to be aware of the changing patterns of business cycle co-movements in the region[1]. Only if shocks are symmetric, the cost of relinquish the flexible monetary policy is to be outweighed by the benefits of forming OCA. For that reason, some economists (e.g. Mundell, 2003) have recently advocated the use of a common currency in Asia preceded by anchoring to an existing currency or a group of currencies, on the basis that member countries are bounded by common cycle. Putting together, we find the need to study whether the common Business Cycle presences among the Asia Pacific economies. And if it does, has it enhanced over time, either among the countries or with affiliated to the US's and (or) Japanese cycle? Through this study, we also hope to shed new light on the recent debates that have extended from the espousal of dollarization to the feasibility of common currency area in the Asia Pacific.

This study involves two major analyses on fifteen Asia Pacific economies (APE-15), from 1961-2004. First, we construct the business cycles of APE-15 by means of asymmetric band-pass filtering method put forward by Christiano-Fitzgerald (2003, CF hereinafter) and

[1] Theoretically, comovement of business cycles can be sourced from three aspects. First, country-specific shocks which rapidly transmitted across countries. Second, external shocks that affect all countries in a similar different fashion. Third, shocks specific to a sector of the economy, which is similar in different countries (see e.g. Emerson *et al*, 1992; Girardin, 2002). However, not all countries share the same degree and speed of comovements according to the intensity of economic integration and the transmission mechanisms. Countries may experience different shocks. Or, may respond differently to common shocks, owing to the contrasting policy reactions, differences in the composition of output and differences in the monetary transmission due to diverging financial structures.

investigate the changes of business cycle correlation over years. Second, we employ the Autogressive Distributed Lag bound testing procedure (ARDL hereafter) advanced in Pesaran *et al* (2002) to reconcile the US-Japan-ASEAN business cycle co-movement (s) in both long- and short-run based on annual observations from 1961 to 2004. The CF filter allows a time series to be decomposed into cyclical components falling into a variety of frequency bands. It offers several advantages over other commonly used filters, including the conventional method of Hodrick and Prescott (1980, HP hereinafter)[2] and the band-pass filter introduced by Baxter and King (1999, BP hereinafter). CF dominates the BK filter in terms of their optimality criterion, particularly when estimating cycles in the lower frequency bands, e.g. 8-12 years (see Everts, 2006). In addition, unlike the BK filter, the CF method estimates cycles for the full data sample. On the other hand, ARDL procedure can be applied to models irrespective of whether the regressors are I (0) or I (1) or mutually cointegrated. It avoids the conventional pre-testing procedure of unit roots associated with cointegration analysis and has the advantage of easily understood within the context of traditional error correction modelling approaches. This particular useful for us as the business cycles generated by the band-pass filtering are mostly stationary of I (0). Also, no matter whether the explanatory variables are exogenous or not, the long and short-run parameters, with appropriate asymptotic inferences, can be obtained by applying OLS to an autoregressive distributed lag model with appropriate lag length (see Duarte and Holden, 2001).

REVIEW OF LITERATURE

BCS has been the object of a substantial literature, particularly in the European economics. It has been extensively studied to justify the convergence aspirations imposed for access to the European Union. Extensive literature can be cited via Artis and Zhang (1997, 1999), Beine and Hecq (1997), Frankel and Rose (1998), Beine *et al* (2000) and Sensier *et al* (2002), among others. Though BCS has become a general phenomenon in Europe, the presence of common cycles in Asia is still ambiguous. For instance, Eichengreen and Bayoumi (1996) discover that correlation of supply shocks in the region is especially high for two groups; one consists of Japan and South Korea while the other consists of Indonesia, Malaysia and Singapore. Instead, subsequent study by Loayza *et al* (2001) conclude that Japan, South Korea and Singapore are bounded by common cycle of aggregate demand and supply shocks while Indonesia, Malaysia and Thailand by another, based upon a highly similar trade structure. On the other hand, Bayoumi and Eichengreen (1994) find little difference in the asymmetry of both shocks between Europe and East Asia, whereas Chow and Kim (2000) insist that East Asian countries differ from Western European countries and more likely to be subject to asymmetric shocks. Further, Lee *et al* (2002) improve the methodology of assessing symmetry of shocks and find that the size of regional shocks is comparable to that of Europe.

In relevant studies, Jong (2001), Shin and Wang (2002) and McKinnon and Schnabl (2003) investigate the effect of trade intensity and exchange rate stability on the patterns of Asian business cycles. Having Japan as anchor cycle, Jong (2001) finds increased bilateral trade dependence results in greater correlation of Asian business cycles. Additionally, Shin and Wang

[2] The HP filter is not appropriate for our study because it is strictly a high-pass filter, intended to remove low frequency components of time series leaving only the higher frequency, short-run cyclical component.

(2002) highlights the increased intra-industry trade but not the trade alone that has explained the business cycle fluctuations. McKinnon and Schnabl (2003) further demonstrate that the East Asian cycles are closely linked to the fluctuations of yen/dollar exchange rates, via changes in the export competitiveness, inflows of FDI and intra-ASIAN income effects. Clearly, these studies were motivated by the earlier arguments of Eichengreen (1992) and Krugman (1993) that business cycles may converge by trade integration only if intra-industry trade accounts for most trade. Conversely, if tighter trade integration boosts higher inter-industry trade resulting in higher specialization in industries, the sector-specific shocks may become region-specific shocks and thereby increase the likelihood of asymmetric shocks and diverging business cycles.

Despite the major findings mentioned above, some methodological issues arise along the review of literature, e.g. the earlier studies of business cycle concerns the OLS estimation on non-stationary series. The coefficient estimates follow nonstandard distribution and subject to spurious regression. To overcome, researchers used to first difference each series and redo the regression. Some authors choose to test the correlation rather than examining the dynamic relationships of business cycle variables. Artis and Zhang (1997, 1999) for instance developed a cyclical index for industrial production and applied by subsequent studies of Inklaar and De Haan (2001) and Loayza *et al* (2001). This practice, however, has caused the lost of valuable long-run information. Latterly, one would apply the cointegration techniques developed by Engle and Granger (1987), and in maximum likelihood context, by Johansen and Juselius (1990). These techniques identify and provide robust estimates of stationary linear combinations of the variables that individually follow non-stationary processes. Such linear combination is fundamentally interpreted as long run equilibrium relationship.

Nevertheless, problems with the Engle-Granger approach are well noted. First, the cointegration result depends on the choice of the dependent variable, which itself, is an arbitrary process. Second, in cases with more than unique cointegrating vector, the Engle-Granger approach may produce an estimate, which is a linear combination of these several vectors, thus raising an identification problem. Third, the approach is static and does not account for dynamic interrelationships among the variables. Finally, the estimated cointegrating coefficients have nonstandard distributions and therefore cannot be used for tests of hypotheses on true coefficient values. Likewise, the Johansen (1988) and Johansen and Juselius (1990) procedure is also somewhat restrictive as it requires the classification of series into $I(1)$ and $I(0)$. Johansen and Juselius (1990) proposed a multivariate cointegration approach that does not require the prior choice of the dependent variable. It tests for the number of the cointegrating vectors and yields maximum likelihood estimates of these vectors. At very least, wrongly including an $I(0)$ in the Johansen VAR as $I(0)$ would result in an overestimation of the number of cointegraing vectors. Accordingly, we will often reject the hypothesis of no relationship between them even when none exists, especially in small samples. In addition, the business cycles extracted from the filtered output are often $I(0)$ in nature (as in our case) and do not fit the conventional cointegration procedures.

RESEARCH METHODOLOGY

Business Cycle Synchronization, as precisely regards to the long-and short-run co-movement of aggregate economic behavior (e.g. Loayza *et al*, 2001; Duarte and Holden, 2001), has been the key issue of open economy macroeconomic lately. The term 'synchronicity' can be associated with the concept of symmetry, which in turn, has been extensively used in the 1990s to justify the convergence aspirations imposed for access to the European Union. In other worlds, the presence of a common cycle would indicate the perfect synchronization of shocks so that member countries may constitute an optimal currency area[3].

Real Output Filtering

The definition of business cycle has evolved numerous times since 1920s. Modern definition of business cycle put forward by Lucas (1977) refers to the deviations of aggregate real output from its trend or cyclical component. Thus, the necessary first step of our dynamic analyses is to decompose the real outputs of respective countries into trend and cycle. To obtain more reliable results, we utilise the latest filtering method proposed by Christiano-Fitzgerald (2003). Say, we want to construct the business cycles of 8-12 year frequency in a time series and an orthogonal decomposition exists:

$$x_t = y_t + \tilde{x}_t \tag{1}$$

The y_t component is the series of interest and has power only in the business cycle frequencies while the $\tilde{x}_t$ component has no power in these frequencies. CF shows that an estimate, $\hat{y}_t$ of the y_t component can be obtained in the frequency domain by minimizing the conditional expected mean squared error such that $Min: E\langle (y_t - \hat{y}_t)^2 \left| \{x_t\} \right\rangle.$, where the $\hat{y}_t$ represents the filtered real output series.

ARDL Modelling

The second step of assessing the degree of business cycle synchronization is conducted via the ARDL modelling. Following Pesaran *et al*. (2002), the augmented Autoregressive Distributed Lag (ARDL) model can be presented as:

$$\phi(L,p)y_t = \sum_{i=1}^{k} \beta_i(L,q_i)x_{it} + \delta' w_t + \mu_t \tag{2}$$

where

$$\phi(L,p) = 1 - \phi_1 L - \phi_2 L^2 - . \quad . \quad . - \phi_p L^p \tag{3}$$

$$\beta_i(L,q_i) = 1 - \beta_{i1} L - \beta_{i2} L^2 - . \quad . \quad . - \beta_{iq} L^{qi}, \qquad for \quad i = 1,2. \quad . \quad ., k \tag{4}$$

[3] As pointed by Mundell (1961), member countries with common currency must yield their independent monetary policies to a supranational authority. When asymmetric macroeconomic shocks occur across the member countries, monetary policy cannot be tailored to an individual economy's particular disturbances. Hence it is less costly for the economies to form a common currency if their business cycles are synchronized.

L is a lag operator such that $Ly_t = y_{t-1}$, and w_t is a $s \times 1$ vector of deterministic variables such as the intercept term, seasonal dummies, time trends or exogenous variables with fixed lags. All possible values of $p = 0,1,2,..., m; q_i = 0,1,2,..., m; i = 1,2,..., k$ with a total of $(m+1)^{k+1}$ ARDL models can be estimated by OLS. In short, the long run coefficients for the response of y_t to a unit change in x_{it} are estimated by:

$$\hat{\theta}_i = \frac{\hat{\beta}_i(1,\hat{q}_i)}{\hat{\phi}(1,\hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + ... + \hat{\beta}_{i\hat{q}_i}}{1 - \hat{\phi}_1 - \hat{\phi}_2 - ...... - \hat{\phi}_{\hat{p}}}, \qquad i = 1,2,......,k \tag{5}$$

where $\hat{p}$ and $\hat{q}_i, i = 1,2,......,k$ are the selected (estimated) values of p and $q_i, i = 1,2,......,k$.
And the corresponding 'unrestricted error correction model' is given by:

$$\Delta y_t = -\phi(1,\hat{p})EC_{t-1} + \sum_{i=1}^{k} \beta_{i0}\Delta x_{it} + \delta^{'}\Delta w_t - \sum_{j=1}^{\hat{p}-1} \phi_j^* \Delta y_{t-j} - \sum_{i=1}^{k} \sum_{j=1}^{\hat{q}_i-1} \beta_{ij}^* \Delta x_{i,t-j} + \mu_t \tag{6}$$

where $EC_t = y_t - \sum_{i=1}^{k} \hat{\theta}_i x_{it} - \hat{\psi}^{'} w_t$

A specified 'unrestricted error correction model' of our ARDL model is then given by:

$$\Delta Y_t = a_0 + \sum_{i=1}^{k} b_i \Delta Y_{t-i} + \sum_{i=1}^{k} c_i \Delta USY_{t-i} + \sum_{i=1}^{k} d_i \Delta JPY_{t-i} + \delta_1 Y_{t-1} + \delta_2 USY_{t-1} + \delta_3 JPY_{t-1} + \mu_t \tag{7}$$

where Y, USY, JPY are detrended real output of ASEAN countries, United States and Japan respectively. We can test the null hypothesis of non-existence of the long run relationship which is defined as:

$$H_0 : \delta_1 = \delta_2 = \delta_3 = 0 \text{ against } \quad H_0 : \delta_1 \neq 0, \quad \delta_2 \neq 0, \quad \delta_3 \neq 0, \tag{8}$$

The critical value bounds of the F-statistics for different numbers of regressors (*k*) are tabulated in Pesaran *et al*. (1996). Two sets of critical values are provided, with an upper bound calculated on the basis that the variables in E are I*(0)* and , a lower bound on the basis that they are I*(1)*. The critical values for this bounds test are generated from an extensive set of stochastic simulations under differing assumptions regarding the appropriate inclusion of deterministic variables in the ECM. Cointegration is confirmed irrespective of whether the variables are *I*(1) or *I*(0) if the computed F-statistic falls outside the upper bound; and rejected if falls outside the lower bound. Nevertheless, if F-statistic falls within the critical value band, no conclusion can be drawn without knowledge of the time series properties of the variables.

Data Description

Our analyses of APE-15 incorporate the US, Japan, Australia, New Zealand, China, Hong Kong Taiwan, South Korea, India, Sri Lanka and ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore and Thailand). For real outputs of each economy, only annual observations covering 1961 to 2004 are utilized due to the fact that higher frequency data are not available for some of the APE prior to 1990. In the analysis, real outputs are decomposed into trends and cycles. The cyclical components are then utilized for correlation estimation and the ARDL models. To investigate the effect of financial turmoil 1997/98, we have the sample period divided into two: 1961-1996 and 1961-2004. All data, including the per capita income, real GDP and prices are sourced from the Penn World Tables (PWT) 6.2, a latest version developed by Heston, Summers and Aten (2006). The unique feature of PWT is that all economic variables are dominated 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 variables are constructed in international dollar adjusted for purchasing power parity with year 2000 taken base year.

RESULTS AND DISCUSSION

Preliminary Analysis

The late 1980s through 1996 have been remarkable years for the East Asians. According to World Bank (1993), the group of eight East Asian countries that include Japan, South Korea, Taiwan, Singapore, Hong Kong, Malaysia, Thailand, and Indonesia, grew twice as fast as other Asian countries, three times as fast as Central and South American countries, and five times as fast as sub-Saharan countries in Africa. Their subsequent rapid export-led economic growth with fiscal balance and relative price-level stability led to the so-called 'East Asian Miracle'. Table 1.1 shows that the per capita incomes of the 15 Asia Pacific economies selected in this study have grown more than 10 times in 1991-2000 as compared to 1961-1970. Of all, China, Taiwan and South Korea have grown more than 20 times. However, the fourth wave of crisis in 1997/98 has severely affected all the East Asian and Japan in substantial ways.

[Table 1.1]

These countries experienced a drastic fall in the value of exchange rates and stock price indexes and the output distortion prolonged until 2001 when the market demand was further descended by the contraction of US IT industry. In terms of output growth variability, the changes are around 35%-72.5%, with the US being the most stable economy whilst Indonesia being the most unstable economy. On the whole, four major economic turmoil are more noticeable in the historical developments of Asia Pacific economics over 1961-2004. Two were during the 1970s where the output gaps are obviously greater than other periods, attributed to the two oil crises in 1973 and 1978 that had led to rampant panic in the world economic. The third chaos was during mid 1980s with lead-lag length among the countries. The observed similarities of cyclical components within the Asia Pacific have demonstrated an early sign of common business cycle in the region.

[Table 1.2]

Figure 1 plots the evolution of the natural logarithm of real output and trend component for US, Japan and thirteen Asia Pacific economies from 1961-2004. The left hand scales are meant for the business cycle whereas the right hand scales are for the real output and trend (non-cyclical) component of respective economies. The application of unit root tests indicates that these cyclical components are characterized by stationary process with the null hypothesis of unit root rejected at level form. Though not reported here, the unit root results are available upon request. In this regard, the use of the standard cointegration techniques in assessing the business cycle co-fluctuation is inappropriate and instead the ARDL approach is adopted as shown in the dynamic analysis.

[Figure 1]

To assess the extent of integration of regional business cycles over time, we refer to the sub-period contemporaneous correlations for the cycle components presented in Table 2a-2d. The cycle component is obtained by applying the asymmetric Christiano and Fitzgerald (2003) band-pass filter to extract periods between 8 and 12 years from the real ouput series. The balanced sample 1961–2004 is used. Significance at the 5% level with $r \geq 0.50$ is indicated by shaded column, based on the asymptotic standard errors. Overall, business cycles are not well-correlated in the 70s and 80s. Many countries recorded irregular and negative correlations with others, indicating some degree of divergence in real outputs. In contrast, the correlation statistics have improved much throughout the whole 1990s to the new millennium especially after the Asian crisis 1997/98.

The correlations among countries are noticeably high but uneven, ranging from 0.09 to 0.97. Table 2e verified the finding that as much as 96 cases of intra-correlation ($r \geq 0.50$) found in the post crisis period as compared to only 30 cases in the 1970s. Prior to the crisis, business cycles of Malaysia, Thailand, South Korea and Singapore are among the ones that correlated most with others in the region. After the crisis, China, Japan and the Oceania show higher numbers of correlation. But of all, ASEAN seems to be more integrated among themselves and with Japan since 1970s whereas the Oceania and NIEs are more integrated with the US.

[Insert Table 2a-2e]

Graphically, as we affiliate the ASEAN cycles to the US and Japanese cycles, a few features emerge. First, the ASEAN-5 cycles are less likely to fluctuate in parallel with the US cycle, especially for Indonesia and Philippines (see Figure 2). The co-fluctuations are only identified during the two oil crises in 1970s and the world recession in mid-1980s but less favourable for the rest of 1990s. Conversely, there is a more regular pattern of fluctuations as for ASEAN-Japan. This fact becomes more evident for the post-Bretton wood era. However, Indonesia has shown least sign of contemporaneous movements with either US or Japan.

[Insert Figure 2-4]

ARDL and UECM Analysis

In this section, the dynamic linkages of business cycle are investigated. First, within the ASEAN-5 countries and second, within the ASEAN+US+Japan framework. We begin with a general dynamic ARDL model in equation (6) relating changes in the cyclical components of each ASEAN-5, to past changes of itself and other variables (US and Japan), and also the lagged levels of these variables. Estimation allows tests to be performed for evidence of a long run relationship among the variables and also for the existence of an unrestricted error correction model (UECM).

Via ARDL bound test, the contemporaneous movements of ASEAN cycles are confirmed where the null hypothesis of no level relationship is highly rejected. However, Indonesia and Philippines fail to provide strong evidence in support for cointegration as the computed *F*-statistics fall within the indeterminate zone of the critical bounds, as in 1960-1996. The presence of common cycle is more evident when the post-crisis period is being considered (see Table 3a). To further investigate the possibility of cointegration, we re-estimate the unrestricted error correction model in equation (6) using the Akaike Information Criterion (AIC) for appropriate lag selection (see Table 3c). The significant and negative signed error correction terms (ECT_{t-1}) have implied that the business cycles of ASEAN-5 are endogenously determined and in fact cointegrated in the sense that the short run dynamics are adjusting towards long run equilibrium[4]. The finding is in line with the facts that ASEAN's economic integration has expanded and regained its upward trend in intra-trade after the 97/98. As of 2006, about 25.1% (US$ 353 billion) of total trade from ASEAN are intra-trading. The intra-ASEAN FDI ratio to total net inflow also increased by 65.8% during 2005-06 and achieved US$6.2 billion as compared to only US$ 2.8 billion in 2004 (ASEAN Statistics, 2007).

[Insert Table 3a to Table 3c]

Despite the European counterparts, Japan and the US continue to play their major role in ASEAN. In 2006, both nations have contributed a total trade of 23% to ASEAN with the US being the key export destination. In terms of FDI inflows during 2002-2006, Japan contributed a total US$ 30.8 billion (18%) while the US supplied US$13.7 billion (8%). To assess the features of common business cycles in affiliation to the US and Japan, we rely on Table 4a-4d. As reported, the *F*-statistics are conclusively outside the upper range of critical values, while only Indonesia fell inside the indeterminate zone (see Table 4a). But the corresponding UECM with significant ECT_{t-1} again suggests that Indonesia is somewhat along the cointegration path. This would imply that the ASEANs are at least bounded by a long run comovement with either the US or Japanese cycle. Though not reported here, the exogenous test for US and Japanese cycles are conducted and thus confirming their role as ‘forcing variables’. The results can be obtained upon request. The fact is valid with and without the crisis taken into account.

Several points in Table 4b are noteworthy. Long run parameter values are of positive sign in respond to both the US and Japanese cycle (except Indonesia). However, the Japanese cycle is overwhelmingly significant and shows greater degree of influence, implying that the idiosyncratic cycle in ASEAN economies are more identical to the Japanese experience, at least in the long run. This result coincides part of the findings by McKinnon and Schnabl (2003) that Japan has an important role for the business cycle of its smaller neighbouring countries. Thus, future cyclical fluctuations can be determined or forecasted, using a bigger proportion of the information set provided by the Japanese cycle.

Next, the modeling of short run dynamics is presented in Table 4c. Lagged changes of the Japanese cycle are active with positive and significant coefficients while the US coefficients are somewhat weaker and insignificant. In addition, the lagged error correction term (ECT_{t-1}) carries its expected negative sign and highly significant coefficient for all cases, indicating that the system, once being shocked, will necessarily adjust back to the long run equilibrium. Based on the coefficient size of ECT, Malaysia gains the highest speed of adjustment, approximately less than 1.5 year. Philippines, Singapore and Thailand are on the moderate speed, probably at 2 to 2.5 years. Indonesia somehow poses some difficulties in our interpretation. Despite the fact that

[4] Kremer *et al.* (1992) showed that a significant lagged error correction term is a relatively more efficient way of establishing cointegration. This was further noted in Bahmani-Oskooee (2001)

the error correction term (ECT_{t-1}) is significant (but slow in adjustment, approximately by 5 years), the long run estimation fits poorly and the short run dynamic is less evident as neither the first-differenced US nor Japanese output shows significant explanatory power. In this regard, the degree of synchronization is variable and generally small as for Indonesia. As far as the ARDL results are concerned, our findings are more favorable for the ASEAN-Japan common cycle but less pronounced for the ASEAN-US common cycle, but the inclusion of post-crisis period has not resulted in drastic change of the cycle patterns.

[Insert Table 4a to 4c]

CONCLUSION AND POLICY IMPLICATION

This article has highlighted the main features of business cycle in 15 Asia Pacific economies. The major findings of our study are five-fold: First, business cycles of Asia Pacific economies are significantly correlated since the 1990s correlations are regularly high and enhanced after 1997. Second, ASEAN seems to be more integrated among themselves and with Japan since 1970s whereas the Oceania and NIEs are more integrated with the US. Third, using ARDL analysis, the cyclical components of real outputs among ASEANs are found bounded in a common cycle, suggesting that future financial instability in the member country would be highly transmissible to others. Similar results are obtained on the ASEAN+US+Japan case that possible synchronization of business cycle is bright. Fourth, the long- and short-run ARDL coefficients are significant for ASEAN-Japan but not for ASEAN-US, confirming the presence of ASEAN-Japan common cycle. However, our findings also underline the special position of Indonesia which has loosely attached to the cycle.

The first finding suggests that the Asia Pacific members have achieved some important degree of business cycle co-fluctuations. This is probably attributed to the improved intra-trading and cross-boarder investment since the 1980s. Also, the similar pattern of economic development and liberalization process especially among the ASEAN has created countries with very similar economic structures. Having the political issue aside, our findings are in parallel of that by Bayoumi and Eichengreen (1996) and Loayza *et al* (2001). As suggested in the literature, this high degree of integration and symmetry would indicate an ideal environment for the implementation of a common currency area.

Then, the second finding leads to the implication that bilateral exchange rate stability may not contribute to the business cycle convergence. Most countries in the Asia Pacific have practiced at the soft dollar-pegged system which they refer as manage floating. On the other hand, high variation of bilateral exchange rate movements has neither jeopardized the business cycle synchronization process, as in the ASEAN-Japan case. This possibly will contradict the findings by Artis and Zhang (1997, 1999). According to them, successful exchange rate regimes impose policy disciplines that are likely to lead to conformity in the business cycles of the participating countries, based on the experience of ERM member countries. However, Europe and Asia are at different path of development. In Europe, it was of utmost importance to defend regional parities given the high degree of regional trade interdependence. In the ASEAN perspective, despite increasing the intra-regional trade dependence, a search for a regional cooperative mechanism that could help secure financial stability in the region is more in surge.

A smooth transition towards monetary union requires member countries to exhibit high degree of inflation convergence. The fact that ASEAN-Japan share a common cycle but prices have departed greatly raise the question whether the process towards business cycle synchronization has not built on a concrete platform. The exchange rates misalignments, non-tariff trade barriers and transaction costs have all resulted in price disparity. However, as goods and labor are expected to become increasingly mobile in the future due to the implementation of AFTA, we may anticipate some convergence of price movements. Yet, scope remained for further price convergence if the Japanese Yen or US dollar is to be adopted as common currency. This is particular vital for Indonesia which has experienced hyperinflation over the past few years.

Dynamic analyses based on ARDL estimation have convinced us that the idiosyncratic and common shocks in ASEAN economies are more identical to the Japanese experience rather than the US. Notably, countries with highly and positively correlated business cycles are more likely to join a monetary union. In addition, since business cycle correlation is closely related to trade intensity among countries, by affecting trade intensity among member countries, a monetary union can also alter the costs of sacrificing independent monetary policy *ex post facto*. These events lead to another important implication for adopting a common currency. Still, the construction of a new currency for Asia would be difficult and impractical at the moment. Based on our findings, the currency area should anchor to an existing currency, which is the Japanese Yen.But since Japanese yen has been highly fluctuated against US dollar, many have questioned the adoption of Japanese Yen alone as common currency. The harm of unstable yen/dollar on the Japanese neighbouring countries was well noted by Mundell (2003) and McKinnon and Schnabl (2003). The lower yen against dollar during 1995-1998 has shut off Japanese foreign direct investment in South East Asia and closed down its engine of growth. At the same time the rising dollar appreciated *pari passu* the ASEAN currencies to overvalued positions that made them vulnerable to speculation attacks. Thus, a necessary surge of regional policy coordination should focus on narrowing the yen/dollar fluctuation, ahead of forming common currency area or monetary union. Only by stabilizing the yen/dollar itself would match the view that increased exchange rate stability enhances further economic integration and business cycle synchronization. In a nutshell, our findings uphold the potential and the need of having closer economic cooperation and currency arrangements to provide a collective defence mechanism against systemic failures and regional monetary instability. Also, ASEAN shall build upon opportunities for mutually beneficial regional integration arising from its existing initiatives and those with partners, through enhanced trade and investment links arise from the ASEAN Framework Agreement on Services (AFAS), ASEAN Investment Area (AIA) and the ASEAN+3+2+1 roadmap.

REFERENCES

Artis, M. and Zhang, W. (1997). International Business Cycles and the ERM: Is there a European Business Cycle? *International Journal of Finance and Economics.* 2(1), 1-16.

Artis, M. and Zhang, W. (1997). Further evidence on the International Business Cycles and the ERM: Is there a European Business Cycle? *Oxford Economic Papers.* 51(1), 120-132.

ASEAN Statistics (2007) http://www.aseansec.org/19230.htm

Baxter, M. and King, R. (1999). Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series. *Review of Economics and Statistics.* 81(4), 575-593.

Bayoumi, Tamim and Eichengreen, Barry (1994). *One Money or Many? Analyzing the Prospects for Monetary Unification in Various Parts of the World*. Princeton, N.J.: International Finance Section, Department of Economics, Princeton University.

Bayoumi, T., and Eichengreen, B. (1997). Ever Close to Heaven? An Optimum-Currency-Area Index for European Countries. *European Economic Review* 41. 761-770.

Beine, M. and Hecq, A. (1997). Asymmetric shocks inside future EMU. *Journal of Economic Integration*, 12, 131-140.

Beine, M., Candelon, B. and Hecq, A. (2000). Assessing a perfect European Optimal Currency Area: A Common Cycle Approach. *Empirica.* 27, 115-132.

Christiano, L. J. and T. J. Fitzgerald (2003) The Band Pass Filter. *International Economic Review*, 44 (2), 435-465.

Chow, H. K., and Kim, Y. (2000). A Common Currency Peg in East Asia? Perspectives from Western Europe. Unpublished manuscript.

Duarte, A. and Holden, K. (2001). The Business Cycle in the G-7 Economies. *Facultad de Ciencias Economicas Empredsriales Working Paper.* Universidad de Alicante.

Everts, M. (2006) Band-pass filters. Unpublished working paper, Munich Personal RePEc Archive, paper #2049.

Eichengreen, B. (1992). Is Europe an Optimum Currency Area? in H. Grubel and S. Borner, eds., *The European Community after 1992: Perspectives from the Outside.* Basingstoke, England: Macmillan, 138-61.

Eichengreen, B. and Bayoumi, T. (1996). Is Asia an Optimum Currency Area? Can It Become One? Regional, Global and Historical Perspectives on Asian Monetary Relations. *Center for International and Development Economics Research (CIDER) Working Paper C96-081*.

Engle, R. F., and Granger, C. W. J. (1987). Cointegration and Error Correction: Representation Estimation and Testing. *Econometrica*. 55, 251-276.

Frankel, J. A. (1992). Is Japan Creating a Yen Bloc in East Asia and Pacific? *NBER Working Paper No. 4050*.

Frankel, J.A. and Rose, K. A. (1998). The Endogeneity of the Optimum Currency Area Criteria. *Economic Journal* 108, 1009-1025.

Girardin, E. (2002). Does Japan Share a Common Business Cycle with Other East Asian Countries? Mimeo cited by Lee, J., Park, Y. and Shin, K.

Hodrick, R.J. and Prescott, E.C. (1980). Postwar U.S. Business Cycles: an Empirical Investigation. *Discussion Paper No. 451*. Carnegie-Mellon University.

Inklaar, R. and De Haan, J. (2001). Is there really a European Business Cycle? A Comment. *Oxford Economic Papers.* 53, 215-220.

Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Applications to Money Demand, *Oxford Bulletin of Economics and Statistics*. 52, 169-210.

Jong, I1 Choe (2001). An Impact of Economic Integration Through Trade: on Business Cycles for 10 East Asian Countries. *Journal of Asian Economics.* 12, 569-586.

Kim, K-H and Choi, Y.Y. (1997). Business Cycle in Korea: Is There Any Stylized Feature? *Journal of Economic Studies.* 24, 275-93.

Krugman, P. (1993). Lessons of Massachusetts for EMU. in *The Transition to Economic and Monetary Union in Europe*, F. Giavazzi and F. Torres. (eds.). New York: Cambridge University Press, 241-61.

Lee, J., Park, Y. and Shin, K. (2002). A Currency Union in East Asia. mimeo.

Loayza, N., Lopez, H. and Ubide, A. (2001). Comovements and Sectoral Interdependence: Evidence for Latin America, East Asia, and Europe. *IMF Staff Paper*, 48(2), 367-396.

Lucas, R.E. (1977). Understanding Business Cycles. in *Stabilization of the Domestic and International Economy*, ed. K. Brunner and A.H. Meltzer. Amsterdam: North Holland, 215-239

McKinnon, R. and Schnabl, G. (2003). Synchronized Business Cycle in East Asia and Fluctuations in the Yen/Dollar Exchange Rate. *The World Economy*, (forthcoming).

Mundell, R. (1961). A Theory of Optimum Currency Areas. *American Economic Review*. 51, 657-65.

Mundell, R. (2003). Prospects for an Asian Currency Area. *Journal of Asian Economies.* 14, 1-10.

Pesaran, M.H., Shin, Y. and Smith, R.J. (1996). Testing for the Existence of a Long Run Relationship. *DAE Working Paper, No. 9622,* Department of Applied Economics. University of Cambridge.

Pesaran, M.H., Shin, Y. and Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *DAE Working Paper, No. 9907, Third Revision.* Department of Applied Economics. University of Cambridge.

Sensier, M., Artis, M.J., Osborn, D. R. and Birchenhall, C. R. (2002). Domestic and International Influences on Business Cycle Regimes in Europe. *Centre for Growth and Business Cycle Research Discussion Paper Series*, University of Manchester, No. 11. http://www.ses.man.ac.uk/cgbcr/discussi.htm

Shin, K., and Wang, Y. (2002). Trade Integration and Business Cycle Co-movements: The Case of Korea with Other Asian Countries. *KIEP Working Paper No. 02-08,* Korea Institute for International Economic Policy.

Figure 1: Real Outputs Asymmetric (time-varying) Filtering and Business Cycles of Selected APEC Economies, 1961-2004

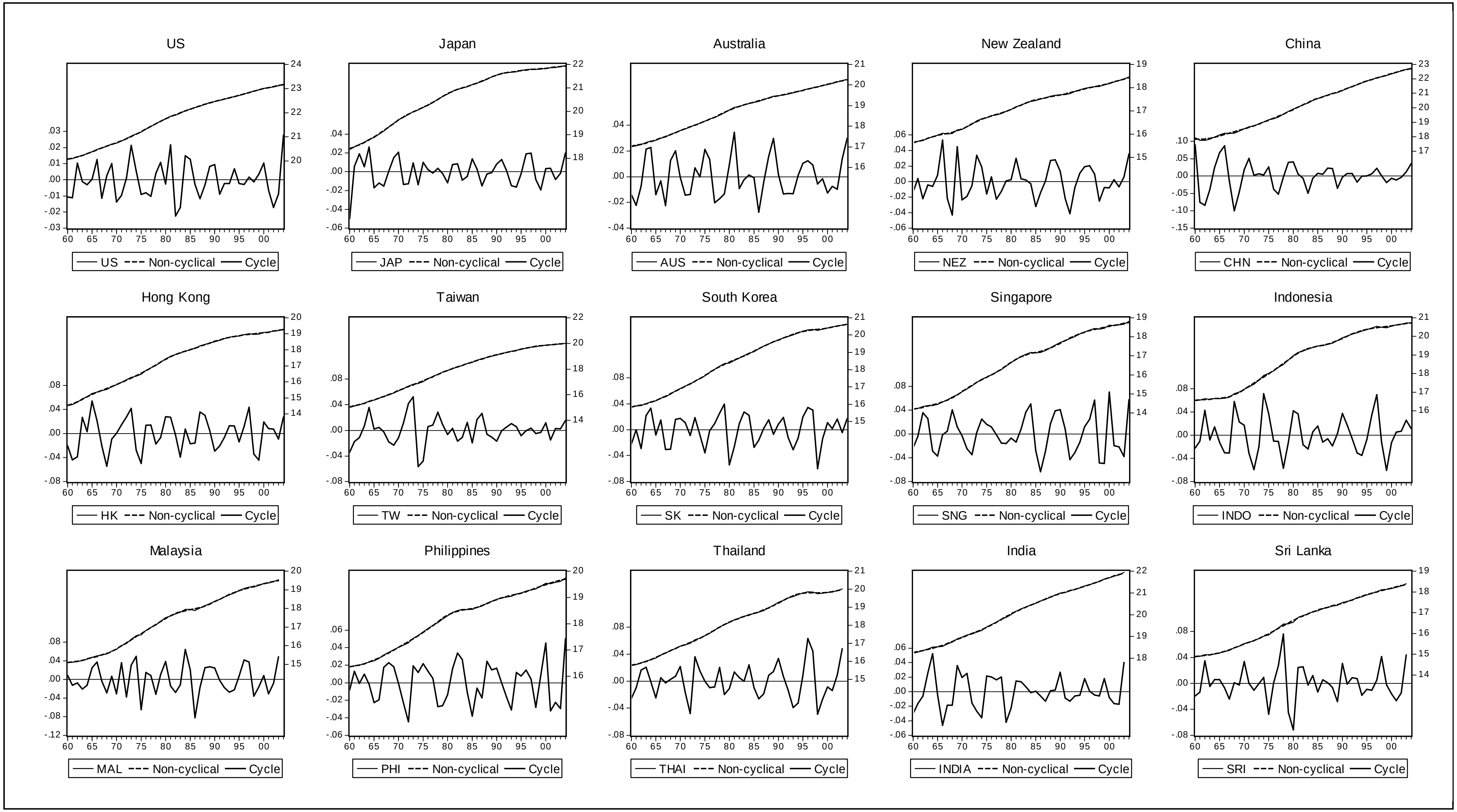


Table 1.1: Average Real Per capita Income of Selected APEC Economies (Adjusted for PPP), 1961-2004

Period	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI
1961-1970	3773.3	1921.8	3118.7	3259.1	102.6	1228.5	510.4	442.4	1180.1	171.2	512.7	532.8	379.1	238.9	335.7
1971-1980	8180.0	5711.5	6659.9	6143.6	260.6	4117.2	1908.6	1563.2	4007.8	574.6	1617.7	1173.7	1009.5	486.2	714.9
1981-1990	17646.9	13376.6	13890.4	11976.2	924.9	13226.9	6429.3	5331.6	11300.2	1721.4	4115.7	2163.9	2732.2	1153.8	1738.4
1991-2000	28249.9	21854.7	21495.7	17326.3	2709.4	24819.8	14962.4	12992.7	23727.4	3339.9	8809.0	3079.5	6133.9	2051.0	3237.0
2001-2004	36975.3	25353.0	29654.9	23709.9	5082.4	29481.7	20404.8	17856.1	28650.1	4114.7	12336.9	3947.2	7121.6	2974.7	4551.1
1961-00 (%)	648.7	1037.2	589.3	431.6	2540.7	1920.3	2831.5	2836.9	1910.6	1850.9	1618.2	478.0	1518.0	758.5	864.3

Table 1.2: Output Growth Variability of Selected APEC Economies (Adjusted for PPP), 1961-2004

Period	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI	AVG
1961-1970	28.3	24.4	36.9	87.7	173.5	39.3	20.4	45.5	50.3	110.2	56.7	43.1	25.6	55.4	62.9	57.3
1971-1980	14.6	16.3	19.4	39.8	32.2	26.8	29.2	33.2	15.6	29.6	37.9	21.1	32.7	34.2	54.1	29.1
1981-1990	31.7	24.9	40.9	42.6	27.3	32.9	22.5	16.7	57.2	44.0	70.6	67.7	31.3	20.4	52.7	38.9
1991-2000	16.5	70.2	19.1	55.3	19.5	80.0	22.7	74.7	63.9	80.8	39.3	46.8	125.8	30.3	38.2	52.2
2001-2004	29.2	46.0	20.9	17.7	7.5	57.7	55.1	32.0	159.3	28.3	45.6	108.0	46.1	31.3	39.4	48.3
1961-2004	35.0	55.0	36.4	56.6	58.0	53.6	40.8	48.3	56.1	72.5	60.5	55.0	52.8	37.7	54.5	51.5

Table 2a: Intra-correlation of APEC Business Cycles, 1971-1980

	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI
US	1.00														
JAP	0.20	1.00													
AUS	-0.04	0.38	1.00												
NEZ	0.78	0.10	0.41	1.00											
CHN	0.17	-0.28	0.11	0.02	1.00										
HK	0.23	-0.21	-0.18	0.30	-0.10	1.00									
TW	0.38	0.13	-0.44	0.10	-0.13	0.75	1.00								
SK	0.43	0.22	-0.63	0.05	-0.17	0.08	0.50	1.00							
SNG	-0.03	0.36	0.67	0.37	-0.30	-0.46	-0.69	-0.30	1.00						
INDO	-0.10	-0.13	0.59	0.28	0.16	-0.41	-0.86	-0.59	0.78	1.00					
MAL	0.22	-0.45	-0.04	0.50	0.09	0.44	-0.04	0.08	0.18	0.34	1.00				
PHI	-0.02	0.54	0.69	0.36	-0.33	-0.23	-0.46	-0.23	0.91	0.60	0.16	1.00			
THAI	0.47	0.54	0.28	0.49	-0.12	-0.18	-0.09	0.17	0.58	0.26	0.23	0.62	1.00		
INDIA	-0.74	0.28	-0.01	-0.69	-0.30	-0.19	0.00	-0.06	-0.02	-0.31	-0.42	0.11	-0.04	1.00	
SRI	0.05	0.15	-0.53	-0.13	-0.57	-0.06	0.31	0.57	-0.07	-0.49	-0.08	-0.07	0.38	0.40	1.00

Table 2b: Intra-correlation of APEC Business Cycles, 1981-1990

	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI
US	1.00														
JAP	0.39	1.00													
AUS	0.53	0.05	1.00												
NEZ	0.12	-0.17	0.76	1.00											
CHN	0.17	0.14	-0.11	-0.12	1.00										
HK	0.14	-0.31	0.46	0.45	0.60	1.00									
TW	0.00	-0.61	-0.23	-0.06	0.40	0.52	1.00								
SK	-0.49	-0.57	-0.17	0.19	-0.36	-0.15	-0.03	1.00							
SNG	0.08	-0.18	0.42	0.46	-0.56	-0.17	-0.42	0.70	1.00						
INDO	0.82	0.53	0.44	0.15	0.19	0.01	-0.15	-0.49	0.06	1.00					
MAL	0.48	-0.05	0.51	0.21	-0.10	0.12	-0.29	0.33	0.75	0.32	1.00				
PHI	-0.38	-0.03	0.28	0.72	-0.40	-0.06	-0.36	0.46	0.48	-0.22	-0.10	1.00			
THAI	0.44	0.19	0.56	0.56	-0.25	-0.04	-0.43	0.36	0.84	0.50	0.72	0.44	1.00		
INDIA	0.19	0.57	0.29	0.38	-0.26	-0.39	-0.68	0.08	0.46	0.53	0.17	0.58	0.71	1.00	
SRI	0.01	0.29	-0.18	0.10	0.24	-0.07	0.05	0.12	0.03	0.38	-0.17	0.30	0.34	0.60	1.00

Table 2c: Intra-correlation of APEC Business Cycles, 1991-2000

	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI
US	1.00														
JAP	-0.33	1.00													
AUS	0.04	0.29	1.00												
NEZ	0.23	0.16	0.83	1.00											
CHN	-0.27	0.80	0.37	0.09	1.00										
HK	0.32	0.47	0.23	0.43	0.43	1.00									
TW	0.45	-0.02	-0.50	-0.16	-0.14	0.65	1.00								
SK	-0.07	0.75	0.49	0.55	0.50	0.48	-0.02	1.00							
SNG	0.29	0.69	0.30	0.50	0.45	0.70	0.28	0.78	1.00						
INDO	-0.32	0.94	0.40	0.24	0.89	0.58	-0.03	0.63	0.63	1.00					
MAL	-0.01	0.83	0.63	0.60	0.57	0.56	-0.04	0.91	0.80	0.78	1.00				
PHI	0.60	0.27	0.26	0.45	0.05	0.29	0.16	0.64	0.73	0.09	0.56	1.00			
THAI	-0.21	0.88	0.63	0.53	0.64	0.48	-0.13	0.90	0.68	0.82	0.97	0.42	1.00		
INDIA	0.05	-0.30	0.57	0.51	-0.37	-0.42	-0.65	0.16	-0.11	-0.32	0.12	0.20	0.08	1.00	
SRI	-0.37	-0.11	-0.25	-0.57	0.09	-0.37	-0.27	-0.68	-0.52	0.05	-0.45	-0.78	-0.38	-0.24	1.00

Table 2d: Intra-correlation of APEC Business Cycles, 1998-2004

	US	JAP	AUS	NEZ	CHN	HK	TW	SK	SNG	INDO	MAL	PHI	THAI	INDIA	SRI
US	1.00														
JAP	0.61	1.00													
AUS	0.58	0.59	1.00												
NEZ	0.58	0.79	0.84	1.00											
CHN	0.55	0.78	0.87	0.75	1.00										
HK	0.33	0.85	0.24	0.63	0.50	1.00									
TW	0.62	0.51	0.48	0.49	0.64	0.53	1.00								
SK	0.18	0.50	0.22	0.66	0.23	0.79	0.47	1.00							
SNG	0.70	0.76	0.23	0.52	0.44	0.82	0.75	0.62	1.00						
INDO	-0.14	0.65	0.37	0.44	0.63	0.64	0.19	0.33	0.22	1.00					
MAL	-0.09	0.26	0.67	0.61	0.61	0.26	0.61	0.42	0.21	0.45	1.00				
PHI	0.88	0.49	0.34	0.48	0.36	0.46	0.80	0.45	0.85	-0.21	0.14	1.00			
THAI	-0.47	0.35	0.61	0.80	0.58	0.44	0.35	0.61	0.09	0.66	0.89	-0.16	1.00		
INDIA	0.06	-0.25	0.92	0.37	0.39	-0.45	0.18	-0.13	-0.35	-0.01	0.71	-0.06	0.51	1.00	
SRI	-0.07	-0.19	0.70	-0.25	0.73	-0.55	0.08	-0.69	-0.49	0.21	0.34	-0.37	0.13	0.64	1.00

Table 2e: Cumulative Frequencies of Intra-correlation ≥ 0.50, 1971-2004

	1971-1980	1981-1990	1991-2000	1998-2004
US	1	2	1	7
JAP	2	2	6	9
AUS	3	4	4	8
NEZ	2	3	6	9
CHN	0	1	5	10
HK	1	2	4	7
TW	2	1	1	7
SK	2	1	8	5
SNG	4	3	8	7
INDO	3	4	7	4
MAL	1	3	10	6
PHI	5	2	4	3
THAI	3	6	8	7
INDIA	0	4	2	4
SRI	1	0	0	3
Total	30	38	74	96

Figure 2: Business Cycles of Five ASEAN Countries

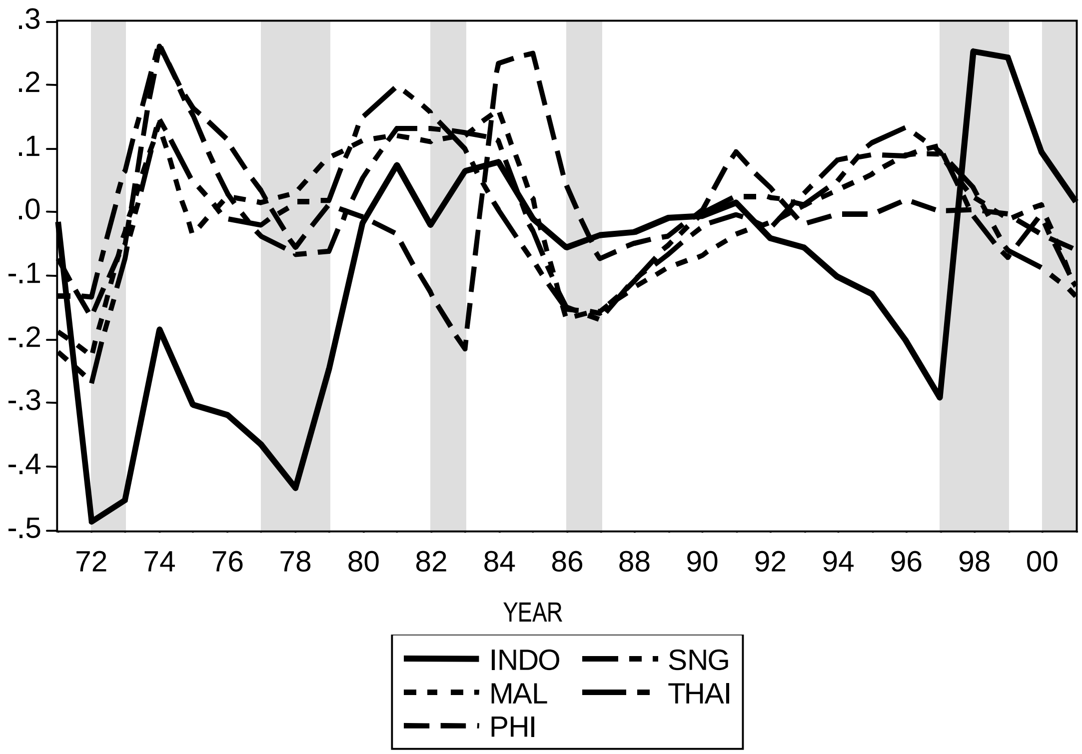


Figure 3: Business Cycles of Five ASEAN Countries and the US

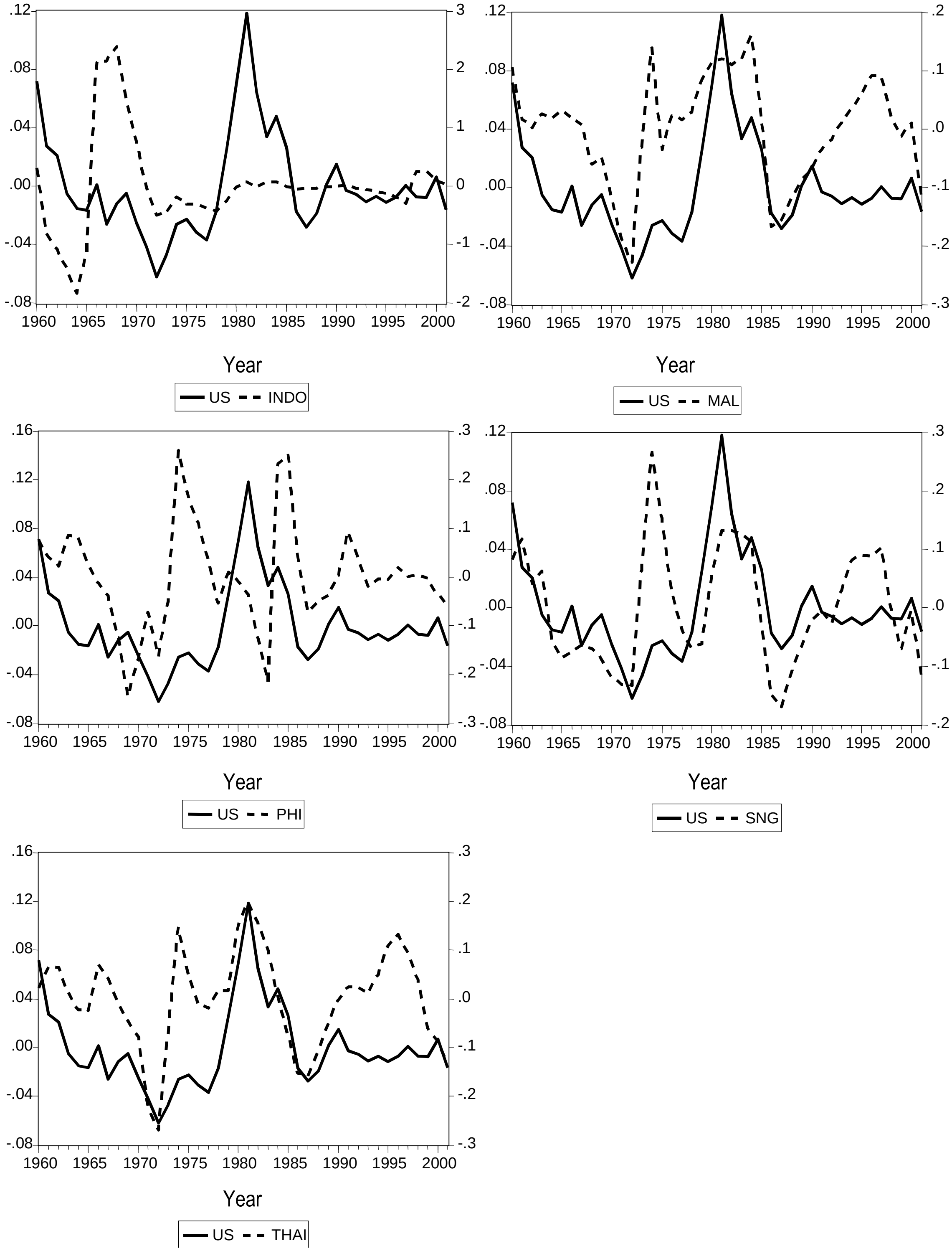
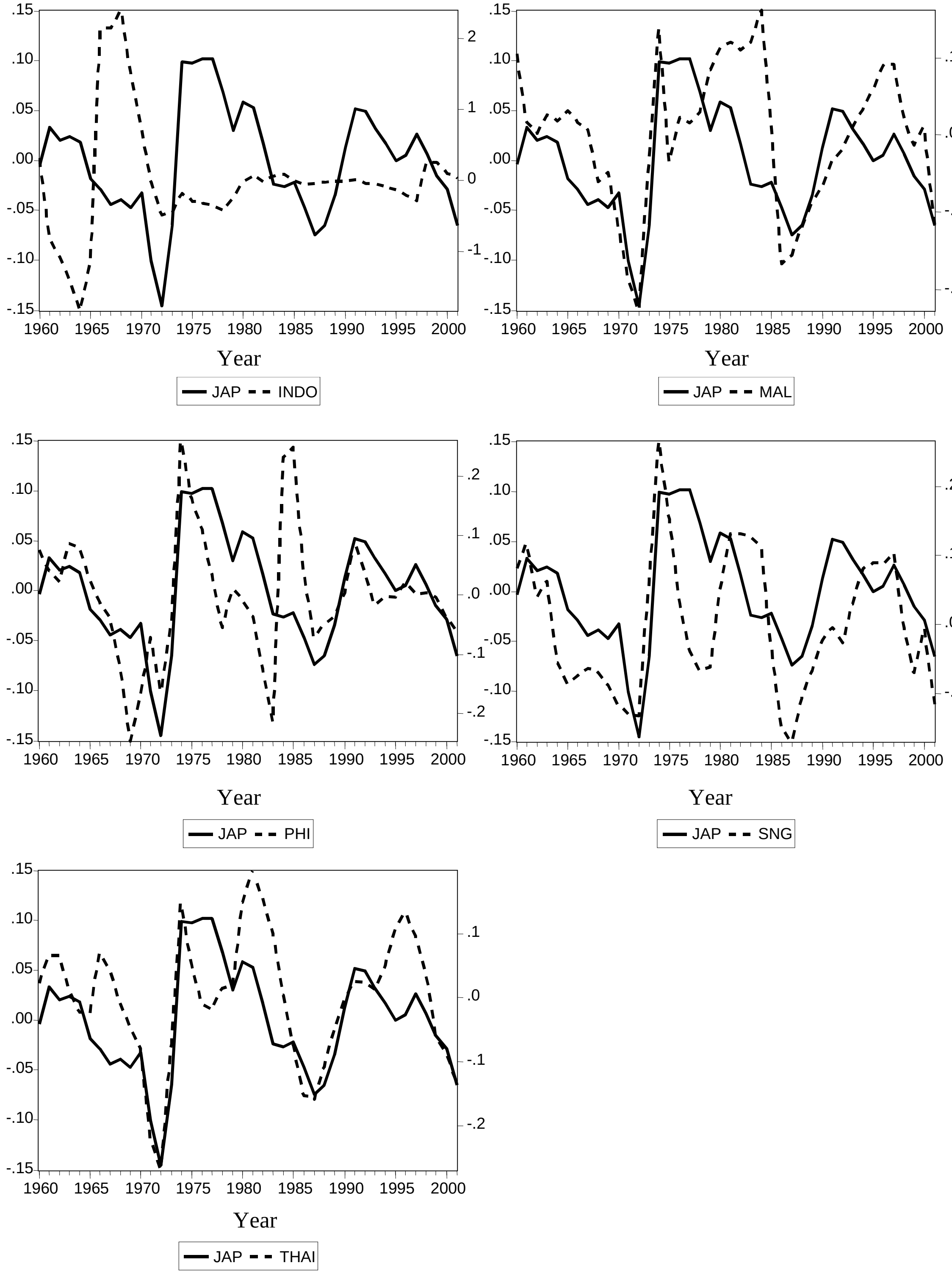


Figure 4: Business Cycles of Five ASEAN and Japan



(Note: the units on the y axis are the cyclical component which were de-trended from real output based on the HP filtering method).

Table 3a: ARDL Cointegration Test for ASEAN-5, 1961-2004

Model	1961-1996	1961-2004
	F(X| ASEAN)	
IND	3.2350	3.6385
MAL	6.4761 *	6.8858 *
PHI	3.9240	5.1104 *
SNG	5.6214 *	5.7280 *
THAI	6.1225 *	6.8671 *

Notes: Asterisk * denotes rejection of null hypothesis at 5% significant level. The estimated ARDL models contain intercepts without trends. For each country, the cyclical comovement is examined by having the other ASEAN-4 as 'forcing variables'. The appropriate critical values bounds of the ARDL F-statistics are 3.219 and 4.738 at 95% confidence level, as tabulated in Pesaran *et al*. (1996). The following notations apply for all tables: US=United States of America, JAP=Japan, IND=Indonesia, MAL=Malaysia, PHI=Philippines, SNG=Singapore and THAI=Thailand.

Table 3b: ARDL Long Run Coefficients of ASEAN-5 Model

	C	IND	MAL	PHI	SNG	THAI
			1961-1996			
IND	0.03	-	5.29	-3.50 **	-4.89	-4.59
	[0.50]		[1.27]	[-2.82]	[-1.57]	[-1.20]
MAL	-0.00	-0.03 **	-	-0.09	0.15	0.94 ***
	[-0.14]	[-2.52]		[0.90]	[1.09]	[7.24]
PHI	0.01	0.01	3.57 **	-	0.80	-4.14 **
	[0.46]	[0.18]	[2.53]		[1.24]	[-2.51]
SNG	0.01	-0.02	1.07 ***	0.07	-	-0.78 **
	[0.33]	[-0.22]	[4.56]	[0.45]		[-0.41]
THAI	0.00	0.01	0.89 ***	0.04	0.03	-
	[0.36]	[1.39]	[7.92]	[0.36]	[0.26]	
			1961-2004			
IND	0.02	-	4.29	-3.40 **	-4.89	-4.39
	[0.45]		[1.57]	[-2.72]	[-1.57]	[-1.30]
MAL	-0.00	-0.03 **	-	-0.09	0.22 *	0.88 ***
	[-0.24]	[-2.62]		[-0.93]	[1.76]	[7.40]
PHI	0.00	0.01	3.23 **	-	0.65	-3.65 **
	[0.13]	[0.13]	[2.57]		[1.13]	[-2.55]
SNG	0.00	0.02	0.80 ***	0.07	-	-0.03
	[0.10]	[1.57]	[6.73]	[0.55]		[-0.31]
THAI	0.01	0.02	0.98 ***	0.04	0.04	-
	[0.46]	[1.29]	[6.92]	[0.50]	[0.32]	

Notes: Asterisks *, ** and *** denote significant at 10%, 5% and 1% level respectively. T-statistics are reported in the parentheses. The selection of optimal lags is based on the Akaike Information Criterion.

Table 4a: ARDL Cointegration Test for ASEAN+US+Japan

Model	1961-1996	1961-2004
	F(ASEAN| US, JAP)	
IND	3.4900	4.1456
MAL	6.1760 *	7.1399 *
PHI	4.9688 *	4.8358 *
SNG	5.4448 *	5.8448 *
THAI	4.7488 *	5.9340 *

Notes: Refer to table 4a for details.

Table 4b: ARDL Long Run Coefficients of ASEAN+US+ JAPAN

	C	US	JAP
		1961-1996	
IND	0.05 [0.36]	1.51 [0.73]	-4.43 [-1.71]
MAL	-0.00 [-0.14]	1.02 [1.90]*	1.55 [3.25]***
PHI	-0.00 [-0.14]	0.32 [0.51]	0.85 [1.99]*
SNG	-0.01 [-0.50]	0.98 [1.68]	1.18 [3.94]***
THAI	-0.00 [-0.13]	0.60 [1.64]	1.17 [4.67]***
		1960-2002	
IND	0.04 [0.31]	1.35 [0.33]	-4.14 [-1.73]*
MAL	-0.00 [-0.08]	1.05 [2.13]**	1.59 [3.64]***
PHI	-0.00 [-0.20]	0.68 [1.06]	0.83 [1.90]*
SNG	-0.00 [-0.32]	0.88 [1.63]	1.13 [4.04]***
THAI	-0.00 [-0.13]	0.64 [1.72]*	1.19 [4.69]***

Notes: refer for Table 3b for details.

Table 4c: Unrestricted Error Correction Representation for the ASEAN+US+ JAPAN Model, 1961-1996

Dependent Variable	Independent Variables						
	C	D_{-1}	D_{-2}	ΔUS_{-1}	ΔUS_{-2}	ΔJAP_{-1}	ΔJAP_{-2}	ECT_{-1}
ΔIND	0.03	0.46***	0.36*	0.92	-	-2.70	-	-0.21[-2.29]**
ΔMAL	-0.01	0.36***	-	0.28	-1.22*	1.73***	-	-0.81[-5.47]***
ΔPHI	-0.00	-	-	0.47	-	1.47***	-1.02***	-0.46[-3.41]***
ΔSNG	-0.01	0.61***	-	0.14	-	1.09***	-0.97***	-0.43[-4.00]***
ΔTHAI	-0.00	0.72***	-	0.31	-	1.23***	-1.38***	-0.52[-5.34]***

Notes: Asterisks *, ** and *** denote significant at 10%, 5% and 1% level respectively. T-statistics are reported in the parentheses. Significant and negative signed error correction terms (ECTs) indicate that the system once being shocked, there will be adjustments back to the long run equilibrium.

Table 4d: Unrestricted Error Correction Representation for the ASEAN+US+ JAPAN Model, 1961-2004

Dependent Variable	Independent Variables							
	C	D_{-1}	D_{-2}	ΔUS_{-1}	ΔUS_{-2}	ΔJAP_{-1}	ΔJAP_{-2}	ECT_{-1}
ΔIND	0.02	0.46***	0.35**	0.82	-	-2.51	-	-0.21[-2.57]**
ΔMAL	-0.00	0.35	-	0.15	-1.03	1.61***	-	-0.82[-5.79]***
ΔPHI	-0.00	-	-	0.49*	-	1.52***	-1.04***	-0.47[-3.91]***
ΔSNG	-0.00	0.47***	-	0.30	-	1.26***	-0.87***	-0.44[-4.05]***
ΔTHAI	-0.00	0.64***	-	0.21	-	-1.22***	-0.26***	-0.48[-5.62]***

Notes:
See Table 4c for details.