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Chan, Tze-Haw and Lau, Evan

International Medical University

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BUSINESS CYCLES AND THE SYNCHRONIZATION PROCESS: A BOUNDS TESTING APPROACH

Chan Tze Haw
Senior Data Analyst
Medical Education Research Unit (MERU)
International Medical University
Sesama Centre,
Plaza Komanwel, Bukit Jalil,
57000 Kuala Lumpur
Corresponding author: Chan Tze Haw.
Tel: 012-2092653.
E-mail: upmcth@yahoo.com
and

Evan Lau Poh Hock
PhD candidate
Graduate Research Assistant
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia

ABSTRACT

To justify the business cycle synchronization (BCS) process among ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore and Thailand), Japan and the United States, the Autoregressive Distributed Log bounds test and the UECM (Unrestricted Error Correction Model) representation advanced in Pesaran *et al.* (2001) is deployed. Evidently, ASEAN-5 has achieved some important degree of business cycle co-fluctuations, attributed to the improved intra-trading and cross-boarder investments. Nonetheless, the idiosyncratic and common shocks in ASEAN economies are more identical to the Japanese experience rather than the US's. Comparable pattern of economic development and liberalization process have created countries (ASEAN-Japan) with similar economic structures, implying that further economic cooperation and currency arrangements in the region are bright. In addition, our findings demonstrate that the bilateral exchange rate stability may not contribute to the business cycle convergence, as in the ASEAN-US case while bilateral exchange rate dispersion has neither jeopardized the ASEAN-Japan BCS process. Also, price divergences among the ASEAN-US-Japan indicate that scope remained for further price convergence if the Japanese Yen or the US dollar is to be adopted as common currency. Nonetheless, regional policy coordination should focus on narrowing the yen/dollar fluctuation, ahead of forming common currency area or monetary union.

INTRODUCTION

Economic integration among Asian countries and the world has augmented rapidly, mainly driven by the upsurge cross-border investments, increasing intra-regional trade and greater financial integration. 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 Russia and Brazil, while the contraction of IT industry in US had affected the ASEAN outputs severely in 2001. The integration process is likely to deepen over time with the growing preferential trading agreements (PTAs) and regional cooperation arrangements among the Asia Pacific countries.

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 ASEAN+Japan+China+South Korea Free Trade Area (2002).

These events have led to the more interdependence business cycle across countries, and whether business cycle synchronization (BCS hereafter) has become a general phenomenon for Asian countries, has lately become a key issue in open economy macroeconomics.

Business Cycle Synchronisation

The BCS, as precisely regards to the long-and short-run comovement of aggregate economic behaviour (e.g. Loayza *et al,* 2001; Duarte and Holden, 2001), has been the object of a substantial literature, particularly in the European economics. The term ‘synchronicity’ can be associated with the concept of symmetry, which in turn, has been extensively used 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.

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.

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.

Business Cycles

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 (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 business 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.

A Common Cycle

As it was well noted in the literature, presence of a common cycle indicates the perfect synchronization of shocks so that member countries may constitute an optimal currency area. 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. In order to find potential candidates in the region for a currency union, it is necessary to be aware of the changing patterns of business cycle co-movements in the region.

And in fact, some economists (e.g. Mundell, 2003) recently advocate the use of a common currency in Asia preceded by anchoring to an existing currency or a group of currencies. Putting together, we find the need of studying whether the synchronization process has enhanced over time in the ASEAN region, either among themselves or affiliated to the US and (or) Japan. In short, we hope to shed new light on the recent debates that have extended from the espousal of dollarization to the feasibility of common currency and the monetary union among the East Asian countries, in the wake of crisis in 1998 and, by the brainwave of the euro dollar in 1999.

Cointegration

Another major problem with much of 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. After filtering the data, we found that all the series of studied countries are stationary in level.

ARDL Procedure

This study hereby employs the Autogressive Distributed Lag bound testing procedure (ARDL hereafter) advanced in Pesaran *et.al*. (2001) to reconcile the ASEAN business cycle comovement (s) in both long- and short-run based on annual observations from 1960 to 2002. The 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. 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).

Objectives of this study

To this end, we design our study into two components. The first consists of static analysis to view on the economic conditions of respective countries since 1970s. In particular, the cross-country correlations of macroeconomic variables (e.g. real exchange rates, CPI and real GDP) are demonstrated. We then show the graphical presentation of respective ASEAN business cycles affiliated to the US and Japanese cycle. In the second part, we estimate the ARDL models to explore the dynamic properties of cyclical component of the real output series. This will provide measures of persistence of comovement in the system. The corresponding long run coefficients and unrestricted error correction models are reported as well. We also investigate whether the Asian financial crisis has had any impact on the degree of business cycle convergence by subjecting the estimation period to 1960-1996 and 1960-2002 respectively.

METHODOLOGY

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. Though numerous de-trending techniques have emerged recently, the conventional filtering method proposed by Hodrick and Prescott (1980) is employed here due to its simplicity and its wide application in the literature (e.g. Frankel and Rose, 1998; Inklaar and De Hann, 2001, to name a few). For instance the quadratic trend model, the first-differences method and the band-pass filter advocated by Baxter and King (1999) and Ahumada and Garegnani (2000). The procedure works by minimizing fluctuations in actual output around trend output, subject to a constraint on the variation of the growth rate of trend output. Or, in formal terms, it provides a method of fitting a smooth trend, τ_t, to a series y_t, as the solution to the following minimization problem:

$$\text{Min} \sum_{t=1}^{n} \{(y_t - \tau_t)^2 + \lambda[(1-L)^2 \tau_t]^2\} \quad (1)$$

The first quadratic term measures the degree of fit between y_t and τ_t, while the second term measures the degree of smoothness in τ_t. The factor λ will determine the trade-off between fitness and smoothness. When λ goes to infinity, the formula converges to a linear trend. When λ goes to 0, fluctuations around the trend are in effect minimized without a constraint. In that case, the trend follows the original series perfectly. Though the selection of value for λ is arbitrary, λ=100 is used for our annual real output as suggested by the literature.

ARDL Modeling

The second step of assessing the degree of business cycle synchronization is conducted via the ARDL modeling. Following Pesaran *et al.* (2001), the augmented Autoregressive Distributed Lag (ARDL) model can be presented as:

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

where

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

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

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:

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

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:

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

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:

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

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 incorporate the US, Japan and ASEAN-5 countries, namely Indonesia, Malaysia, Philippines, Singapore and Thailand. For the purpose of static analysis, monthly real exchange rates and consumer price index of respective countries are deployed from 1973 to 2002. While for real outputs, only annual observations covering 1960 to 2002 are utilized due to the fact that higher frequency data are not available for ASEAN countries prior to 1990. Then again, since the deflators are also unobtainable from these countries, the real outputs are proxied by national outputs at constant price (1995=100). In the dynamic analysis, real outputs are decomposed into trends and cycles. The cyclical components are then utilized in the ARDL estimation. To investigate the effect of financial turmoil 1997/98, we have the sample period divided into two: i) 1973M1-1996M12 and 1997M1-2002M12 (as for real exchange rates and the Consumer Price Index (CPI)); ii) 1960-1997 and 1960-2002 (as for real outputs).

RESULTS AND DISCUSSION

Static Analysis

Figure 1 plots the evolution of the natural logarithm of real output and trend component for US, Japan and ASEAN-5 during 1960-2002. The Hodrick-Prescott (1980) filtering method with λ=100 is used to extract the cyclical component of real outputs for the purpose of analysis. 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.

[Insert Figure 1 and 2]

On the whole, four major economic turmoil are more noticeable in the historical developments of ASEAN economics over 1970-2002 (see Figure 2). 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 late 1980s through 1996 have been remarkable years for the ASEAN-5. Along with members of East Asian, the ASEANs (except Philippines) have achieved the highest growth rates in the world. According to World Bank (1993), the group of eight East Asian countries that include Japan, 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'. However, the fourth wave of crisis in 1997/98 has severely affected all the ASEAN-5 (and, including Japan) in substantial ways. 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. The observed similarities of cyclical components within the ASEAN countries have demonstrated an early sign of common business cycle in the region.

[Insert Figure 1 and Figure 2]

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 3). 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 3 and Figure 4]

The results of real outputs correlation are comparable to the graphical presentation (see Table1a-1d). The correlations among Malaysia, Philippines, Singapore and Thailand are noticeably high but uneven, ranging from 0.2 to 0.8. However, Indonesia records negative correlations with other member countries and Japan, indicating some degree of divergence in real outputs. The cycle convergence sustain when the post-crisis period is included. Then, the ASEAN-US correlation is somewhat irregular. The correlation of Malaysia-US (0.63) and Thailand-US (0.61) are considerably high, followed by Singapore-US (0.44), whereas Indonesia and the Philippines are more loosely attached to the US. During 1960-1996, the real output links between ASEAN and Japan are consistent (0.5 to 0.67). In fact, the real output correlations are higher over 1960-2002, showing some increase of income convergence towards Japan after the Asia crisis 1998.

[Insert Table 1a to Table 1d]

The availability of higher frequency data enables us to analyse the behaviours of exchange rates and price index more precisely before (1973M1 to 1996M12) and after (1997M1 to 2002M9) the recent crisis. Table 2a-2d report the correlations of real exchange rates between ASEAN-US and ASEAN-Japan respectively. The results show that the real exchanges rates association are pronounced and similar for ASEAN countries vis-à-vis US during 1973-1996. This is reflecting the facts that all ASEAN-5 countries tend to stabilize their exchange rate against the US dollar in non-crisis period, leading to the so-called 'East Asian Dollar Standard' (see McKinnon and Schnabl, 2003). Since the US dollar has been the dominant currency for invoicing intra-regional trade and denominating international capital flows, the ASEAN economies peg to the US dollar to reduce payments risk and to anchor their domestic price levels. But this leaves them vulnerable to changes in the yen/dollar exchange rate. The ASEAN-US currency pegs are more on a high frequency day-to-day or week-to-week basis, but with some drift at lower frequencies of observation. On the other hand, real exchange rates movements of ASEAN-Japan are drifting far from positive correlation. The ASEAN-Japan business cycle could have diverged due to the asymmetric impact of changes in the yen/dollar exchange rate, despite the fact that ASEAN-Japan real outputs are highly correlated. A stronger Yen will depress growth in Japan but stimulate exports of ASEAN countries. A weaker Yen will stimulate the Japanese economy but depress output growth of ASEANs. On a whole, the exchange rate practice evidently does not contribute to the contemporaneous movements of ASEAN-US and ASEAN-Japan business cycle, at least during 1973-1996, thus opposing the findings by Artis and Zhang (1997, 1999) that increased exchange rate stability has led to business cycle synchronization.

There has been a drastic change of exchange rate practice in the post-crisis age. The ASEAN-US pegged system was removed instantaneously in the aftermath of the speculative attacks in 1997/98. Market adjustments have forced the exchange rates to depreciate to the levels that are explained fairly by relative price movements. Such adjustments have resulted in a much lower correlation of ASEAN-US real exchange rates (0.11 to 0.47). Conversely, the Japanese Yen-ASEAN exchange rate become more associated (0.29-0.52), suggesting a more significant role of Japanese Yen in the regional transactions and national reserves.

[Insert Table 2a to Table 2d]

Looking at the results reported in Table 3a-3d, price convergence has taken part in neither ASEAN-US nor ASEAN-Japan (except Singapore), especially after the crisis. This is due to the price upsurge in some of the crisis-affected countries, resulting cross-country differences of inflation. The price divergence is particularly evident for traded goods. During that time, the US has remained low inflation while Japan experienced deflation in some quarters of 1999 and 2000. But among the ASEAN members, price levels became less dispersed as the price correlations have enhanced significantly from as low as 0.06-0.12 to 0.37-0.76. Singapore is the exception case as the inflation has always been low and invariant. Alternatively, we may view the dispersion in price levels and purchasing powers as suggesting that the process towards business cycle synchronization has not built on a concrete platform. Theoretical and empirical research has provided strong arguments that countries at different development levels may converge in income per capita. This income convergence is mainly due to the catching up in productivity, or the technological progress. However, when the technological progress differs across sectors of an economy, it also implies movements in the relative price of the goods they produce.

[Insert Table 3a to Table 3d]

Dynamic 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. 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 4c). 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. 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).

[Insert Table 4a to Table 4c]

To assses the features of common business cycles in affiliation to the US and Japan, we rely on Table 5a-5d. As reported, the *F*-statistics are conclusively outside the upper range of critical values, while only Indonesia fell inside the indeterminate zone (see Table 5a). 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 5b 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 5c. 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 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 5a to 5c]

CONCLUSION

This article has highlighted the main features of business cycle in ASEAN-5, US and Japan. The major findings of our study are five-fold: First, ASEAN are closely linked among themselves while the ASEAN-Japan real output correlations are regularly high and enhanced after 1997. Second, the ASEAN-US real exchanges rates are highly associated due to the pegging system. The role of Japanese Yen is more significant only after 1997. Third, no price convergence is taken part between ASEAN-US and ASEAN-Japan (except Singapore). After 1997, price divergences enlarge further. Forth, the cyclical components of real outputs among ASEANs are 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. Fifth, 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 ASEAN 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 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, probably the Japanese yen.

Then, the second finding leads to the implication that bilateral exchange rate stability may not contribute to the business cycle convergence at least in the ASEAN-US case. On the other hand, extraneous dispersion 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.

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Figure 1. Real Outputs and Trend Components, 1960-2002

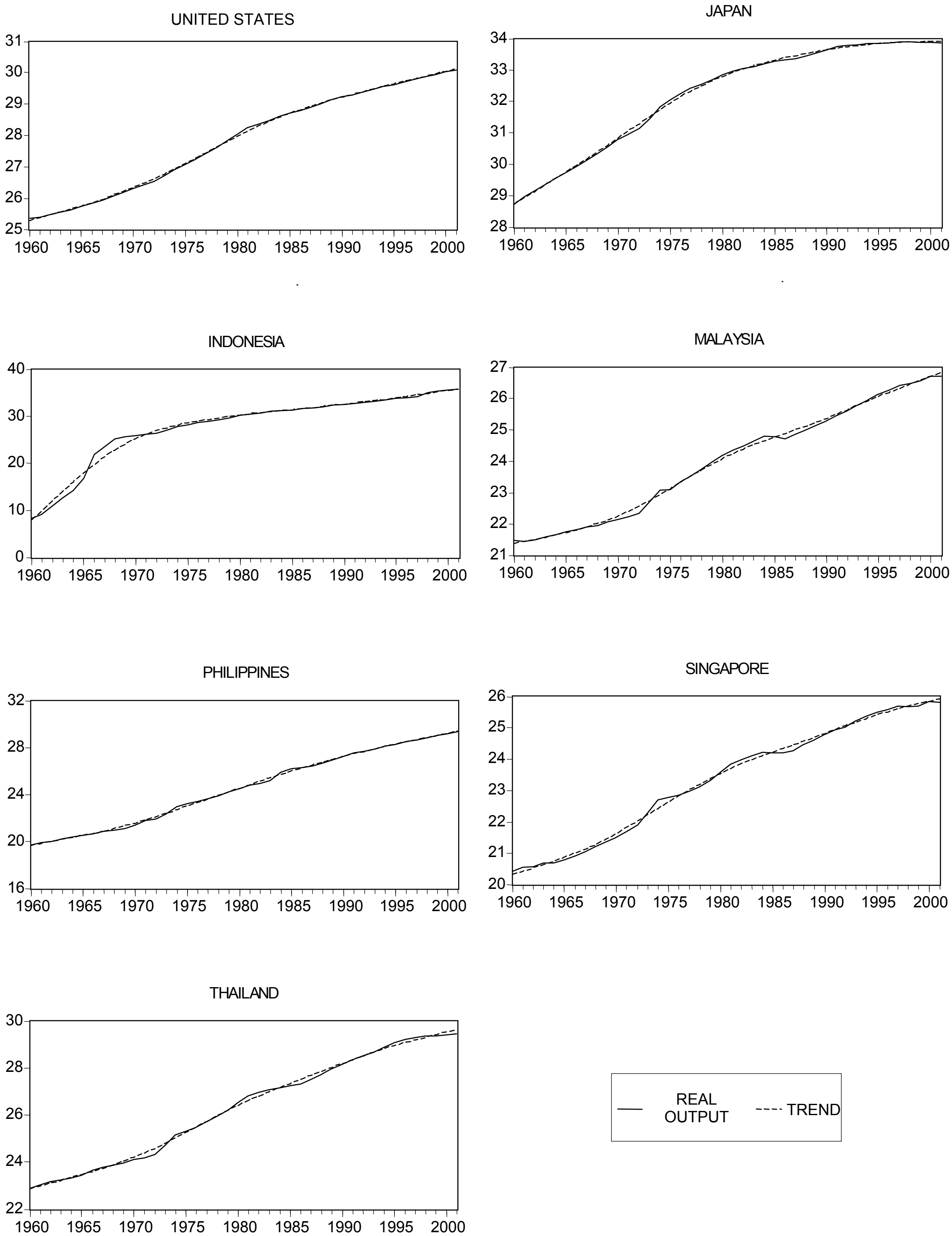


Figure 2. Business Cycles of Five ASEAN Countries, 1970-2002

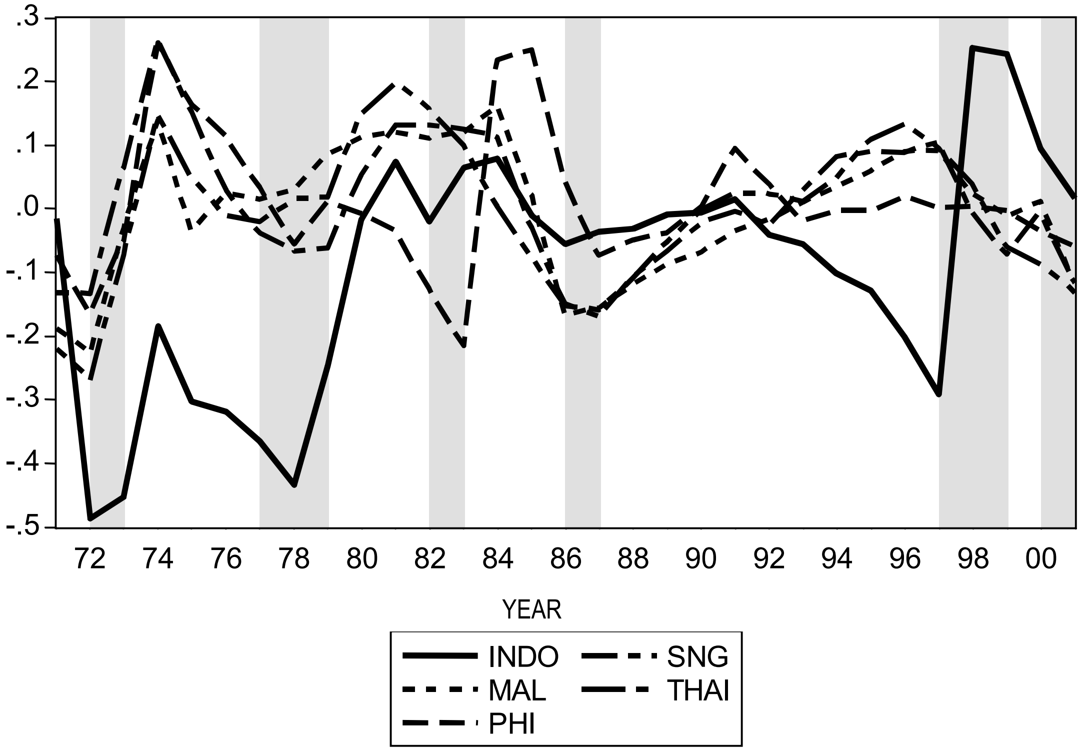


Figure 3. Business Cycles of Five ASEAN Countries and United States, 1960-2002

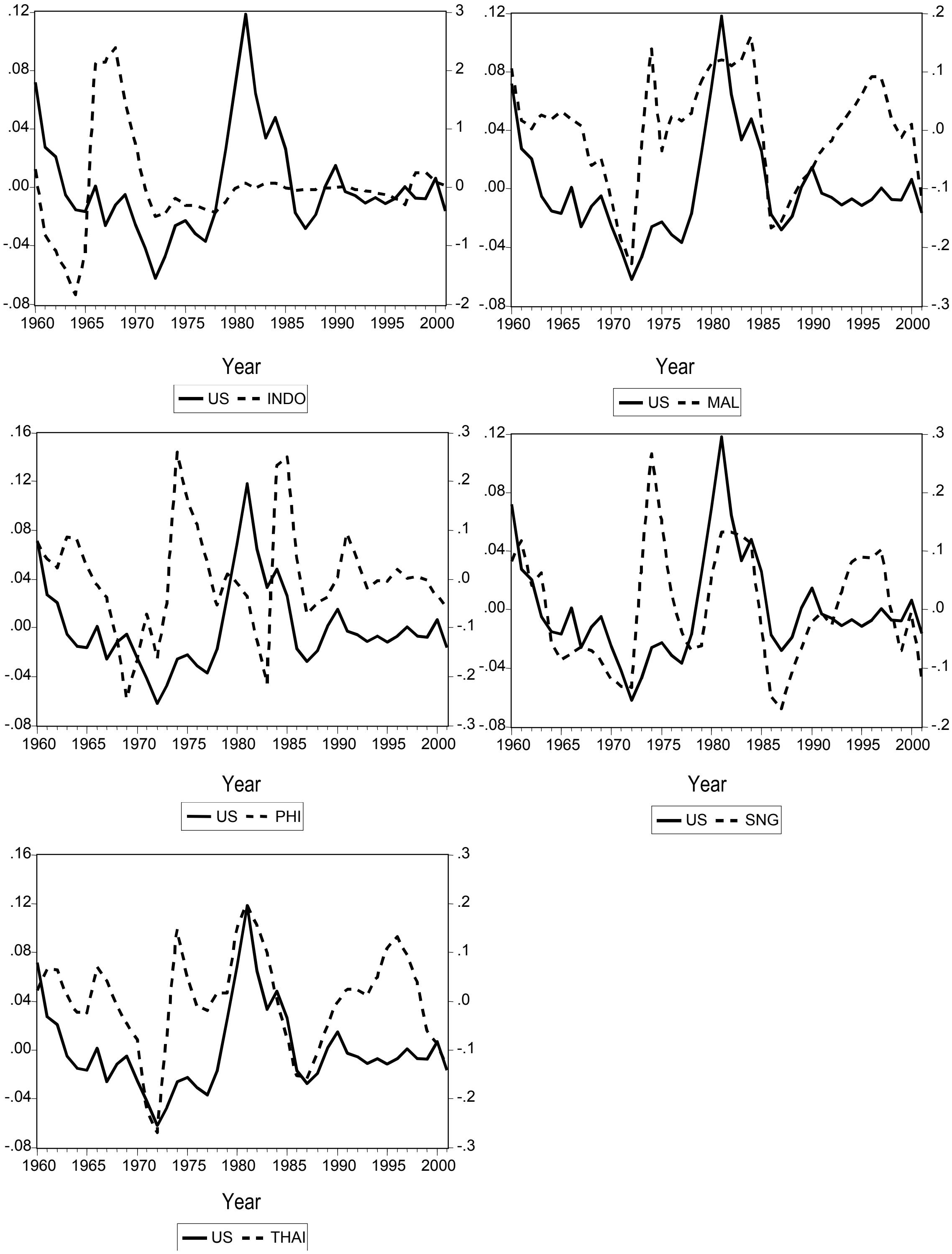
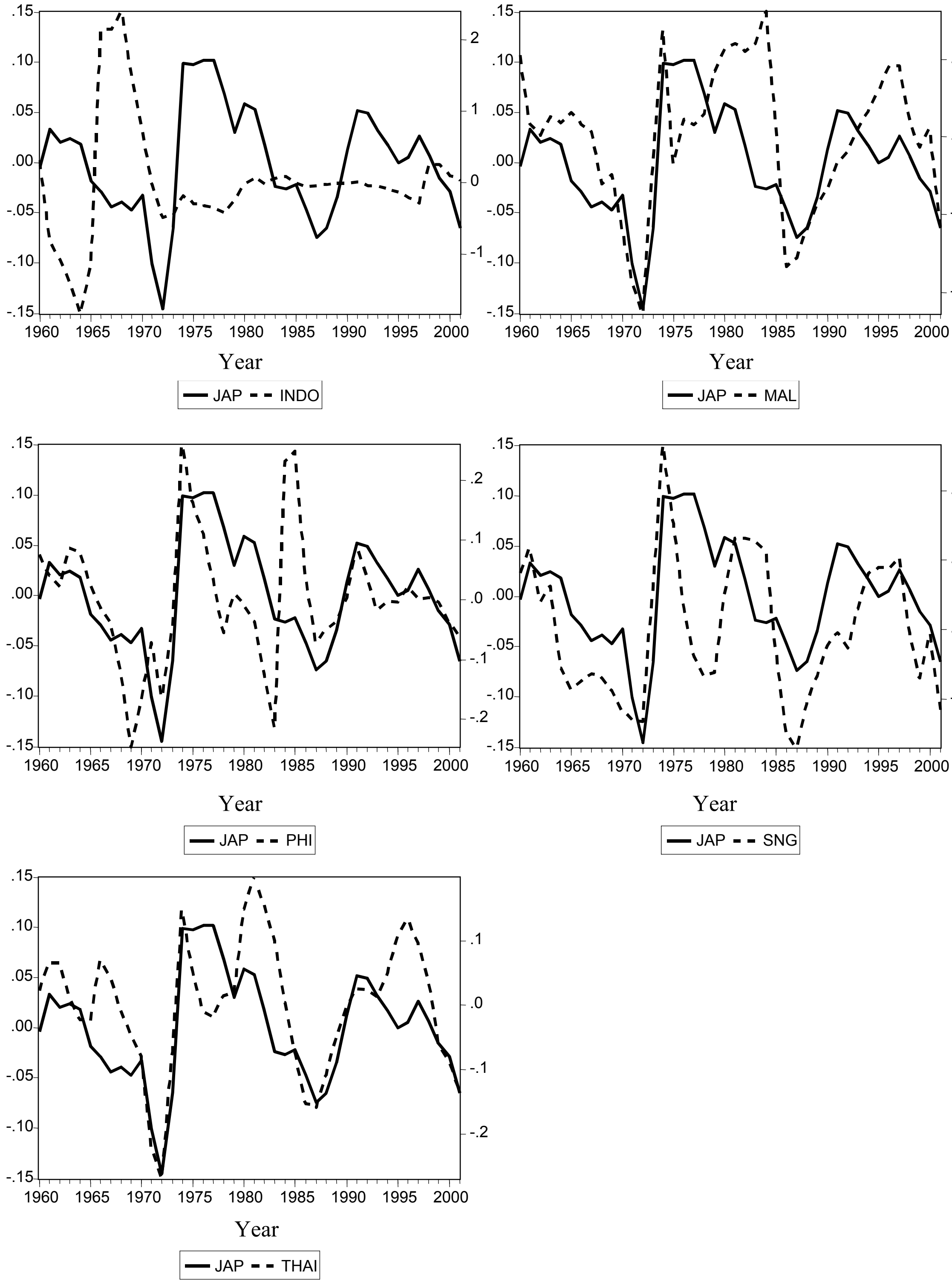


Figure 4. Business Cycles of Five ASEAN and Japan, 1960-2002



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

STATIC ANALYSES

Table 1a. Correlation of Japan and ASEAN-5 on Real GDP, 1960 – 1996

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	-0.273032	-				
MAL	0.592151	-0.088055	-			
PHI	0.498675	-0.346719	0.369645	-		
SNG	0.573239	-0.216036	0.758209	0.412771	-	
THAI	0.671467	0.042857	0.852636	0.202104	0.766698	-

Notes: 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 1b. Correlation of Japan and ASEAN-5 on Real GDP, 1960 – 2002

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	-0.272727	-				
MAL	0.606136	-0.092947	-			
PHI	0.504946	-0.345005	0.372171	-		
SNG	0.589959	-0.222800	0.769087	0.412885	-	
THAI	0.688634	0.027476	0.848735	0.217721	0.775040	-

Note: See Table 1a for details.

Table 1c. Correlation of US and ASEAN-5 on Real GDP, 1960 – 1996

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	0.026070	-				
MAL	0.631964	-0.088055	-			
PHI	0.089769	-0.346719	0.369645	-		
SNG	0.447782	-0.216036	0.758209	0.412771	-	
THAI	0.613395	0.042857	0.852636	0.202104	0.766698	-

Note: See Table 1a for details.

Table 1d. Correlation of US and ASEAN-5 on Real GDP, 1960 – 2002

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	0.022640	-				
MAL	0.623178	-0.092947	-			
PHI	0.094197	-0.345005	0.372171	-		
SNG	0.447318	-0.222800	0.769087	0.412885	-	
THAI	0.593964	0.027476	0.848735	0.217721	0.775040	-

Note: See Table 1a for details.

STATIC ANALYSES

Table 2a. Correlation of Japan and ASEAN-5 on Real Exchange Rates, 1973M1 – 1996M12

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	-0.683771	-				
MAL	-0.686488	0.902333	-			
PHI	-0.325434	0.734035	0.721578	-		
SNG	0.047784	0.308150	0.444036	0.585483	-	
THAI	-0.421819	0.821312	0.824480	0.832406	0.628780	-

Notes: 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 2b. Correlation of Japan and ASEAN-5 on Real Exchange Rates, 1997M1 – 2002M12

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	0.406785	-				
MAL	0.292953	0.812958	-			
PHI	0.522936	0.683350	0.842878	-		
SNG	0.455851	0.548289	0.803641	0.910362	-	
THAI	0.460365	0.701041	0.860068	0.938252	0.832458	-

Note: See Table 1a for details.

Table 2c. Correlation of US and ASEAN-5 on Real Exchange Rates, 1973M1 – 1996M12

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	0.755970	-				
MAL	0.864204	0.959095	-			
PHI	0.866386	0.921225	0.954341	-		
SNG	0.901185	0.841524	0.925324	0.939294	-	
THAI	0.849588	0.956000	0.982461	0.961618	0.922998	-

Note: See Table 1a for details.

Table 2d. Correlation of US and ASEAN-5 on Real Exchange Rates, 1997M1 – 2002M12

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	-0.099300	-				
MAL	0.407450	0.681381	-			
PHI	0.111361	0.586633	0.813385	-		
SNG	0.473726	0.344066	0.826287	0.827963	-	
THAI	0.168828	0.604611	0.837833	0.921727	0.763958	-

Note: See Table 1a for details.

STATIC ANALYSES

Table 3a. Correlation of Japan and ASEAN-5 on Consumer Price Index, 1973M1 – 1996M12

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	0.104540	-				
MAL	0.256273	0.085676	-			
PHI	0.206232	0.057264	0.137460	-		
SNG	0.336510	0.061210	0.726958	0.224218	-	
THAI	0.618983	0.123691	0.363261	0.101811	0.536292	-

Note: See Table 1a for details.

Table 3b. Correlation of Japan and ASEAN-5 on Consumer Price Index, 1997M1 – 2002M12

	JAP	IND	MAL	PHI	SNG	THAI
JAP	-					
IND	-0.106421	-				
MAL	-0.228038	0.756632	-			
PHI	-0.070318	0.766025	0.604838	-		
SNG	0.181422	-0.746099	-0.602173	-0.328491	-	
THAI	0.241277	0.374902	0.451801	0.452178	-0.014659	-

Note: See Table 1a for details.

Table 3c. Correlation of US and ASEAN-5 on Consumer Price Index, 1973M1 – 1996M12

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	-0.047671	-				
MAL	0.144225	0.085676	-			
PHI	0.298514	0.057264	0.137460	-		
SNG	0.368706	0.061210	0.726958	0.224218	-	
THAI	0.510675	0.123691	0.363261	0.101811	0.536292	-

Note: See Table 1a for details.

Table 3d. Correlation of US and ASEAN-5 on Consumer Price Index, 1997M1 – 2002M12

	US	IND	MAL	PHI	SNG	THAI
US	-					
IND	-0.557672	-				
MAL	-0.472085	0.756632	-			
PHI	-0.273333	0.766025	0.604838	-		
SNG	0.644058	-0.746099	-0.602173	-0.328491	-	
THAI	-0.128479	0.374902	0.451801	0.452178	-0.014659	-

Note: See Table 1a for details.

DYNAMIC ANALYSES

Table 4a. ARDL Cointegration Test for ASEAN-5

Model	1960-1996	1960-2002
	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).

Notes: 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 4b. ARDL Long Run Coefficients of ASEAN-5 Model

	C	IND	MAL	PHI	SNG	THAI
			1960-1996			
IND	0.03 [0.50]	-	5.29 [1.27]	-3.50 ** [-2.82]	-4.89 [-1.57]	-4.59 [-1.20]
MAL	-0.00 [-0.14]	-0.03 ** [-2.52]	-	-0.09 [0.90]	0.15 [1.09]	0.94 *** [7.24]
PHI	0.01 [0.46]	0.01 [0.18]	3.57 ** [2.53]	-	0.80 [1.24]	-4.14 ** [-2.51]
SNG	0.01 [0.33]	-0.02 [-0.22]	1.07 *** [4.56]	0.07 [0.45]	-	-0.78 ** [-0.41]
THAI	0.00 [0.36]	0.01 [1.39]	0.89 *** [7.92]	0.04 [0.36]	0.03 [0.26]	-
			1960-2002			
IND	0.02 [0.45]	-	4.29 [1.57]	-3.40 ** [-2.72]	-4.89 [-1.57]	-4.39 [-1.30]
MAL	-0.00 [-0.24]	-0.03 ** [-2.62]	-	-0.09 [-0.93]	0.22 * [1.76]	0.88 *** [7.40]
PHI	0.00 [0.13]	0.01 [0.13]	3.23 ** [2.57]	-	0.65 [1.13]	-3.65 ** [-2.55]
SNG	0.00 [0.10]	0.02 [1.57]	0.80 *** [6.73]	0.07 [0.55]	-	-0.03 [-0.31]
THAI	0.01 [0.46]	0.02 [1.29]	0.98 *** [6.92]	0.04 [0.50]	0.04 [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.

Notes: 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.

DYNAMIC ANALYSES

Table 5a. ARDL Cointegration Test for ASEAN+US+Japan

Model	1960-1996	1960-2002
	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:
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 US and Japan 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).

Cointegration refers to stationary linear combinations of the variables that individually follow non-stationary processes. Such linear combination is fundamentally interpreted as long run equilibrium relationship. The concept of cointegration is advocated by Engle and Granger (1987) who have recently won the Nobel price in 2003.

Table 5b. ARDL Long Run Coefficients of ASEAN+US+ JAPAN

	1960-1996		
	C	US	JAP
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:
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.

DYNAMIC ANALYSES

Table 5c. Unrestricted Error Correction Representation for the Selected ARDL Model, 1960-1996

Dependent	Independent Variables							
Variable	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 5d. Unrestricted Error Correction Representation for the Selected ARDL Model, 1960-2002

Dependent	Independent Variables							
Variable	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 5c for details.