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Business Cycles Synchronization in East Asia: A Markov-switching approach

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Abstract

This paper attempts to analyze the relationships between the ASEAN-5 countries' business cycles. We examine the nature of business cycles correlation trying to disentangle between regional spillover effects (expansion and recession phases among the ASEAN-5 are correlated) and global spillovers where the business cycles of other countries (China, Japan and the US) play an important role in synchronizing the activity within the ASEAN-5. We employ a time-varying transition probability Markov switching framework in order to allow the degree of synchronization to fluctuate over time and across the phases of the business cycles. We provide evidence that the signals contained in some leading business cycles can impact the ASEAN-5 countries' individual business cycles.

Keywords: OCA, East Asia, Business Cycle Synchronization, Monetary Union, Markov-Switching
JEL: C32, E32, F33

1. Introduction

The question of monetary integration in East Asia has become a highly debated issue since the Asian 1997-98 crisis. According to many economists, the peg of their currencies to the US dollar was a source of financial fragility which led to the crisis. As a result, the leaders in the region wondered about the necessity of adopting cooperative financial and monetary policies to protect their economies against a new exchange rate crisis.[2] At the same time, the East Asian authorities agreed on the need to promote a collective arrangement in order to stabilize their exchange rates and foster monetary integration. In the early 2000's governments talked about forming a monetary union with several options that included the constitution of a currency bloc anchored to a common monetary standard. Several options have been suggested and among them a collective pegging to a single currency like the US dollar (McKinnon , 2005), the yen (Kwan , 2001), or the yuan (Park , 2010; Hefeker and Nabor , 2005). Some economists have considered

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[2]Some initiatives were undertaken with the adoption of reforms aiming, on the one hand at restructuring and increasing the depth of the financial systems (Asian Bond Fund and Asian Bond Market Initiative), and, on the other hand, at setting up mechanisms of protection against speculative attacks (Chiang Mai Initiative).

the possibility of a basket peg composed of international currencies (Williamson , 2005) or even regional currencies (Ogawa and Shimizu , 2006).

From a theoretical point of view, monetary integration in East Asia has been mainly studied in light of the Optimum Currency Areas theory (OCA) which examines the conditions under which two countries can find a gain in adopting a single currency.[3] From the perspective of the OCA theory, the business cycles synchronization and the symmetry of output shocks are crucial because the cost of losing monetary policy independence is considerably reduced when countries experience positively correlated economic shocks. Concerning East Asian countries, the empirical literature is inconclusive on this point. For instance, Bayoumi and Eichengreen (1994) find that supply shocks are symmetric, on the one hand, among Singapore, Malaysia, Indonesia and Hong Kong, and on the other hand, among Japan, Taiwan and South Korea. Chow and Kim (2003) find that domestic outputs of East Asian countries are strongly influenced by country-specific shocks while regional shocks are far more important in European countries that have joined the Economic and Monetary Union. Additionally, Genberg and Siklos (2010) do not clearly identify a group of countries for which shocks are unambiguously highly correlated, while Lee and Koh (2012) suggest that there is a scope among ASEAN countries for potential monetary integration. Also, the authors underline that symmetry of shocks have increased after the 1997-98 financial crisis. Using cointegration techniques, Sato and Zhang (2006) find that some pair-countries in the region share both long-run and short-run synchronous movements of the real outputs, particularly within the ASEAN economies consisting of Singapore, Thailand and Indonesia, and the Northeast Asian region, which consists of Hong Kong, Korea, Mainland China, Japan and Taiwan. Socorro Gochoco-Bautista (2008) analyzes whether the common output fluctuation in East Asia is statistically significant in regressions explaining each country's output fluctuations. The author's findings indicate that there is a significant regional factor that explains the movement of East Asian business cycles. Moneta and Rüffer (2009) find a significant common growth dynamic inside the region by using a state-space framework where common movement is captured by unobservable variables influencing the evolution of the GDP growths. Allegret and Essaadi (2011) introduce a spectral analysis based on the time-varying coherence function and find the presence of a common cycle in East Asia after the crisis of 1997-98, thus suggesting that East Asian countries constitute an OCA. Lee and Azali (2012) examine regional and country-specific cycles simultaneously with the world business cycle by employing the Bayesian state-space Based approach. The authors find an increasing role of region factor although country-specific factor are significant. Finally, some studies have emphasized the role of trade flows in synchronizing economic fluctuations in East Asia (see, e.g., Shin and Sohn , 2006; Rana , 2007; Lee and Azali , 2010).

This paper provides a new approach of business cycle synchronization in East Asia by considering the asymmetric nature of business cycles. We wonder whether cross-country correlations differ between expansions and contractions, or between high-growth and low-growth regimes. We identify which leading cycles are helpful indicators in the prediction of turning points. To this end, we use a Markov-switching model with Time-Varying Transition Probabilities

[3]The arguments are based on the comparison of the costs and gains of fixed and flexible exchange rate regimes (see Mundell , 1961, Mckinnon, 1963(@ and Kenen, 1969)

(TVTPMS models). There are two potential causes of business correlation which are important for policy purposes. First, we investigate the hypothesis of recessions and expansions in one country spilling over to other ASEAN-5 countries. The driving forces behind such a phenomenon have been investigated in the literature: trade integration within the ASEAN-5, inter- and intra-industry linkages , co-movements in demand components. These factors explain why the juncture in the ASEAN-5 countries could be driven by a regional joint business cycle. In our framework, this means that an individual country's business cycle can be seen as a leading cycle of the other countries' business cycles. We test this and study the extent to which such a synchronization within the ASEAN-5 area fluctuates over time. However, co-movements between the East Asian countries' business cycles could also reflect the impact of increased globalization, the driving factor being a third country's cycle, typically Japan's, the United States' or China's, since these countries are their main trading partners. We thus examine whether the likelihood to observe a simultaneous switch in the movement of the East Asia's business cycles vary over time according to "international" business cycles. For this purpose, time-varying transition probabilities are also expressed as functions of the GDP growth in the US, Japan and China. Given the leadership role of these countries in driving regional integration process, the extent to which the East Asia's business cycles are affected by the cyclical movements in their economic activity need to be investigated. This issue is particularly important in regard to the possibility of a monetary arrangement with a common currency pegged to the Japanese yen, the Chinese yuan or the US dollar.

The remainder of the paper is organized as follows. Section 2 presents the model and describes the data. Section 3 contains the empirical results and Section 4 concludes.

2. Data and methodology

2.1. Data

We use quarterly data of the real GDP growth rate of the ASEAN-5 countries, namely Malaysia, Indonesia, the Philippines, Thailand and Singapore. The data begins in the first quarter of 1975 and ends in the second quarter of 2010. The GDP series are taken from the countries' national offices and from the University of Singapore ASU database. We further consider the real GDP growth rates of the US, Japan and China in order to examine the impact of "global" common business cycles.[4]

2.2. The model

We want to study whether the activity in the ASEAN-5 countries is driven by a joint business cycle. For this purpose, we proceeds in two steps. We first want to know whether the engine of growth lies within the ASEAN-5 area. We therefore firstly begin by studying the correlations among the ASEAN-5's GDP growth. Then, in a second step, we look for "common factors" referred as the business cycles of their main trading partners (China, Japan and the US).

[4]All GDP data have been seasonally adjusted. The GDP series for China begins in 1978:2.

We chose a measure of the business cycle correlation based on a Markov-switching forewarning model as originally proposed by Filardo (1994), Filardo and Gordon (1998) and reconsidered recently by Kim et al. (2008). This model is useful to answer the following question. Is a country's business cycle, taken as a leading business cycle, informative with regard to detecting the expansion and recession phases of another country's business cycle? The Markov-switching nature of the model is motivated by the fact that we are assuming a notion of causality in the GRANGER sense (not only correlation) between business cycles: the business cycle A causes the business cycle B, if the information in A helps predicting B. A is the leading cycle. Assume that A refers to the phases of expansion or recession observed in a country at a given time t and that we want to know their influence on B $t+s$ period ahead. Since the expansion and recession regimes in B are not yet observed when we are in time t, they are considered as hidden states to which we assign a given probability of realization.

2.2.1. The basic model : a regional cycle within the ASEAN-5 area

In the first formulation of the TVTPMS model, we study the co-movements among the business cycles of the ASEAN-5. We consider the effects of expansions and recessions in one country spilling over to the other countries.

Let y_t be the growth rate in a given country at time t and z_t the growth rate in another country at time t. We want to know whether z_t causes y_{t+k} , $k = 0, 1, 2, ...$. Under the assumption that both y and z have ergodic distributions, we can adopt a "backward" reasoning to investigate whether y at time t is the result of the dynamics of z during the preceding k periods. The model has the following parametric form:

$$y_t = \mu_1 + \sum_{m=1}^{M} \phi_m y_{t-m} + \sigma\epsilon_t \quad \text{in regime 1} \tag{1}$$

$$= \mu_2 + \sum_{m=1}^{M} \phi_m y_{t-m} + \sigma\epsilon_t \quad \text{in regime 2} \tag{2}$$

μ_1, μ_2, σ, ϕ_m are real coefficients to be estimated. ϵ is distributed as a Normal law $N(0, 1)$. We define s_t as an unobservable or hidden variable governed by a two-regime Markov-chain of order 1 with the following time-varying transition probability matrix

$$P_{ij}(s_t = i|s_{t-1} = j, z_{t-k}) = \begin{pmatrix} P_{11}(z_{t-k}) & 1 - P_{22}(z_{t-k}) \\ 1 - P_{11}(z_{t-k}) & P_{22}(z_{t-k}) \end{pmatrix}, \tag{3}$$

with P_{ij} the probability of switching from regime j at time $t-1$ to regime i at time t and $i, j = 1, 2$ with $\sum_{j=1}^{2} P_{ij} = 1$ for all $i, j \in \{1, 2\}$. k is a lag. The functional form linking z_{t-k} to P_{ij} is logistic:

$$P_{11}(z_{t-k}) = \frac{\exp(\theta_{1,1} + \theta_{1,2} z_{t-k})}{1 + \exp(\theta_{1,1} + \theta_{1,2} z_{t-k})} \quad \text{and} \quad P_{22}(z_{t-k}) = \frac{\exp(\theta_{2,1} + \theta_{2,2} z_{t-k})}{1 + \exp(\theta_{2,1} + \theta_{2,2} z_{t-k})}, \tag{4}$$

These probabilities provide information about the likelihood of staying or switching from a given regime (either regime 1 or regime 2) k periods after a change has occurred in z. Since y and z are growth rates, regimes 1 and 2 capture expansions and recessions, or low- and high-growth rate regimes. The latter are not selected *a-priori*, but determined endogenously by the data. Let us consider an example. Suppose that the data yields an estimated coefficient μ_1 which is a positive and an estimate of μ_2 which is negative. This would indicate that regime 1 can be interpreted as one of expansion and regime 2 as one of recession. Assume further that in Eq. (4) $\theta_{1,2}$ is positive. This means that any increase (resp. decrease) in z increases P_{11}, i.e. the probability that y stays in regime 1 (resp. $1 - P_{11}$, i.e the probability that y switches from regime 1) k periods later: an expansion (resp. recession) in a leading country yields an expansion (resp. recession) in another country. A negative coefficient would indicate that an expansion in a leading country causes a recession in another country or reduces the likelihood that the country will continue to evolve in a regime of expansion. We have a similar interpretation for $\theta_{2,2}$. For instance a negative coefficient would indicate that any decrease (resp. increase) in z increases the probability of staying in regime 2 (resp. switching from regime 2). It can happen that both coefficients $\theta_{1,2}$ and $\theta_{2,2}$ are insignificant. This would mean that the business cycle in a leading country is uninformative of the occurrence of expansions and recessions in another country. This assumption is also tested using a log-likelihood ratio test with the following statistic

$$LR = 2 \times [L_{TVTP}(\Theta) - L_{FTP}(\Theta)]$$

where $L_{TVTP}(\Theta)$ and $L_{FTP}(\Theta)$ are respectively the log-likelihood of the TVTPMS model and the fixed transition probabilities (FTPMS) model of Hamilton (1989). If the null hypothesis of fixed transition probabilities is not rejected at conventional significance levels, the TVTPMS model converges to the FTPMS model. In such a case, the information variable does not help predict future changes in regimes.

2.2.2. The extended model

In the basic model, we assumed that the business cycle in a country is driven by a "regional" business cycle. This means that in the basic model the countries considered to examine the business cycle correlation are members of the ASEAN-5. But co-movements in their business cycles can also result from a common cycle outside their region. We therefore consider the following extended model:

$$\begin{aligned} y_t &= \mu_1 + \sum_{m=1}^{M} \phi_m y_{t-m} + \beta_1 x_t + \sigma\epsilon_t \quad \text{in regime 1} \qquad (5) \\ &= \mu_2 + \sum_{m=1}^{M} \phi_m y_{t-m} + \beta_2 x_t + \sigma\epsilon_t \quad \text{in regime 2} \qquad (6) \end{aligned}$$

The transition probabilities are defined in a similar way as in the basic model. In Eq. (6) y and x refers to the GDP growth rate of two ASEAN-5 countries and their degree of synchronization are captured by the coefficients β_1 and

β_2. The signs of the constants μ_1 and μ_2 still indicate whether the observed regimes correspond to expansions and recessions, or high and low-growth regimes. The variable z refers to the GDP growth rate of China, Japan or the US.

2.2.3. Estimation

We present the estimation procedure for the extended model since the latter encompasses the basic specification. We employ the maximum likelihood method to provide estimates of the parameters[5]. We define the vector of all the parameters in the model as θ , $\xi_t = (y_t, y_{t-1}, \cdots, y_1)'$, the complete history of the endogenous variable y observed through date t and $\Omega_t = (X_t', Z_t')'$, the vector observations of the exogenous variable x and the information variable z through date t. The conditional log-likelihood function of the observed data is given by the log-density of y_t given ξ_{t-1} and Ω_t,

$$L(\theta) = \sum_{t=1}^{T} \ln f(y_t|\Omega_t, \xi_{t-1}; \theta) \tag{7}$$

obtained using the following joint density-distribution,

$$\begin{aligned} f(y_t|\Omega_t, \xi_{t-1}; \theta) &= \sum_i \sum_j f(y_t, s_t = i, s_{t-1} = j|\Omega_t, \xi_{t-1}; \theta) & (8) \\ &= \sum_i \sum_j f(y_t|s_t = i, s_{t-1} = j, \Omega_t, \xi_{t-1}; \theta) \cdot P(s_t = i, s_{t-1} = j|\Omega_t, \xi_{t-1}; \theta) & (9) \end{aligned}$$

We also have

$$P(s_t = i|\Omega_t, \xi_t) = \frac{\sum_j f(y_t = i, s_{t-1} = j|\Omega_t, \xi_{t-1}; \theta)}{f(y_t|\Omega_t, \xi_{t-1}; \theta)} \tag{10}$$

that describes how time variation in the transition probabilities affects the probability of the unobserved regimes of the economy at time t (probability of being in either regime 1 or regime 2). Finally we need the regime-dependent conditional density function. Under the assumption that ϵ_t is distributed as a Normal law, the density of y_t conditional to s_t is

$$f(y_t|s_t = 1, s_{t-1} = j, \Omega_t, \xi_{t-1}; \theta) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{-\frac{1}{2}\left(\frac{(y_t - \hat{y}_t)}{\sigma}\right)^2\right\} \tag{11}$$

$$f(y_t|s_t = 2, s_{t-1} = j, \Omega_t, \xi_{t-1}; \theta) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{-\frac{1}{2}\left(\frac{(y_t - \hat{y}_t)}{\sigma}\right)^2\right\} \tag{12}$$

[5]The BFGS algorithm is used to perform nonlinear optimization

with

$$(y_t - \hat{y}_t) = \frac{y_t - \mu^{s_t} - \beta^{s_t} x_t - \phi_m (y_{t-m} - \mu^{s_{t-1}} - \beta^{s_{t-1}} x_t)}{\sigma} \tag{13}$$

Finally, the lags in the model are chosen using the Akaike information criterion. Furthermore, we perform the Ljung-Box (LB) test to check that is no residual autocorrelation. In all cases, the Q-statistics indicate that residuals are independently distributed.[6]

3. Empirical Results

3.1. Preliminary evidence of business cycle synchronization

Figures 1 till 5 provide some preliminary evidence of business cycle commonalities in the ASEAN-5 (see Appendix 1). The figures display the smoothed probabilities P_{22} estimated from a standard Hamilton (1989) model. We note that, in general, the computed probabilities overlap periods usually referred as times of contractions in the GDP growth especially during the years 1984-1985, 1997-1998 and 2008-2009. Besides, the five countries share episodes of continuous growth expansion over the years 1986-1995 and the mid-2000s. The results suggest that business cycles in the ASEAN-5 are well-tied together. Table 1 reports the dating of regimes based on the smoothed probabilities. The average duration of expansions is approximately five years for Singapore and Malaysia, four years for Indonesia and three years for Thailand and the Philippines. Conversely, the average duration of contractions is less than one year for all the countries except Malaysia. This reveals some evidence of a symmetry between the expansion and contraction phases.

3.2. Results from the basic TVTPMS model

Tables 2 till 6 report the estimates of the TVTPMS basic model by country. We find significantly positive μ_1 and negative μ_2 which correspond to a situation of distinct expansion and recession regimes. Regarding the values of the coefficients, the positive coefficients captures increases in the GDP growth from 1,1 per cent per quarter (in the Philippines) to 2,2 per cent (in Singapore) on average, which amounts to annual growth rates ranging on average from 4,4 per cent to 9 per cent. Indonesia seems to experience recessions of a larger magnitude (8 percent on average per quarter) than the other countries (the smallest amplitude is observed for the Philippines with an average of 1,3 per cent per quarter). The evidence of an asymmetry among the magnitude of expansions and recessions can be explained by the fact that the latter incorporates the years corresponding to the 1997-1998 and 2008-2009 crises.

[6] Results are reported in the next section.

Table 1: Duration of expansions and recessions

	Growth-expansion regime		Growth-contraction regime	
Singapore	1977:02-1985:01	2001:04-2003:01	1985:02-1985:04	2003:02
	1986:01-1997:03	2003:03-2008:01	1997:04-1998:03	2008:02-2009:01
	1998:04-2000:04	2009:02-2010:02	2001:01-2001-03	
Average duration	19,6 quarters		3 quarters	
Thailand	1977:02-1979:02	1995:04-1996:03	1979:03	1996:04-1997:01
	1979:04-1980:01	1997:02	1980:02	1997:03-1998:03
	1980:03-1985:02	1998:04-2008:02	1985:03	2008:03-2009:01
	1985:04-1991:03	2009:02-2010:01	1991:04	2010:02
	1992:01-1995:02		1995:03	
Average duration	13 quarters		1,77 quarters	
The Philippines	1977:02-1979:03	1992:03-1997:04	1977:02	1991:01-1991:02
	1980:02-1981:01	1999:01-2000:03	1979:04-1980:01	1992:02
	1981:03-1983:01	2001:04-2008:02	1981:02	1998:01-1998:04
	1986:01-1990:04	2009:02-2010:02	1983:02-1985:04	2000:04-2001:03
	1991:03-1992:01		1986:04	2008:03-2009:01
Average duration	12,1 quarters		2,66 quarters	
Malaysia	1978:03-1984:02	2001:04-2008:02	1977:02-1978:02	2000:04-2001:03
	1986:02-2000:03	2009:01-2010:02	1984:03-1986:01	2008:03-2008:04
Average duration	22 quarters		4,6 quarters	
Indonesia	1977:02-1982:03	1995:01-1996:03	1982:04-1983:01	1994:01-1994:04
	1983:02-1984:04	1997:02	1985:01-1985:02	1996:04-1997:01
	1985:03-1992:01	1999:02-2010:02	1992:02-1992:04	1997:03-1999:01
	1993:01-1993:04			
Average duration	16,1 quarters		3,33 quarters	

For purpose of illustration, we proceed to comment upon the estimated results when the Malaysian business cycle is considered as the leading cycle (the variable z_{t-k}). The coefficient $\theta_{1,2}$ is insignificant in the case of Thailand and Indonesia, thereby implying that a higher growth rate in Malaysia is not informative of the changes observed in these countries' GDP growth during expansions. For the Philippines and Singapore this coefficient is significantly positive, which is indicative of the fact that an expansion in Malaysia increases the probability that these countries will evolve in an expansion regime (i.e P_{11}). Alternatively, it means that a recession in Malaysia increases the probability that these countries will fall into the contraction regime (i.e. $1 - P_{11}$). We see that $\theta_{2,2}$ is never significant. This suggests that the Malaysian cycle can never be considered as a leading indicator of the future state of the cycle in the other ASEAN-5 countries when they are already in the contraction regime. Figure 6 plots the value of the time-varying probabilities P_{11} of Thailand, Indonesia, the Philippines and Singapore implied by changes in the GDP growth of Malaysia (see Appendix 1). The results show that Malaysia is not predictive of the probability of staying in the growth-expansion regime of Thailand and Indonesia because the probability P_{11} remains fairly high regardless of innovations in z_{t-k}. This is not a surprising result when considering that $\theta_{1,2}$ is not statistically significant for these countries. For the situation of other countries, we see that a decrease in the GDP growth decreases the probability P_{11}, thereby suggesting that a shift from regime 1 is more likely to occur following a contraction of economic activity in Malaysia. When examining the slop of the logistic trend functions, it seems that Singapore is less sensitive to negative changes than the Philippines.

The interpretation of the coefficients $\theta_{1,2}$ and $\theta_{2,2}$ is similar when the other countries are considered as the leading countries (in terms of business cycle fluctuations). Taken as a whole, the information conveyed by the different ASEAN-5 growth variables for the expansion and recession phases in a given country is the following. For each country, we look at the significance of the parameters $\theta_{1,2}$ and $\theta_{2,2}$. There are two striking features from the estimates. First, spillover business cycle effects in the ASEAN-5 explain little the expansion phases in Indonesia, since for this country the coefficients $\theta_{1,2}$ are insignificant when the other countries' GDP growths are considered as the leading indicators. However, its business cycle contribute in general to the observed changes during expansions in the other countries. For Indonesia these observations suggest an unidirectional causality from its business cycle to the others.

Table 2: Estimations results for Malaysia as endogenous and regional cycles

z Lag k	Indonesia $t-0$	The Philippines $t-2$	Thailand $t-0$	Singapore $t-1$
μ_1	1,821***	1,809***	1,807***	1,811***
	(14,41)	(15,27)	(16,20)	(15,87)
μ_2	-2,721***	-2,972***	-2,992***	-2,884***
	(-5,94)	(-6,46)	(-6,16)	(-5,43)
ϕ	0,10	0,06	0,06	0,05
	(1,28)	(0,72)	(0,75)	(0,58)
σ	1,247***	1,237***	1,236***	1,243***
	(18,58)	(17,64)	(18,00)	(16,87)
$\theta_{1,1}$	3,28***	3,844***	4,095***	2,976***
	(4,76)	(5,76)	(3,94)	(4,95)
$\theta_{2,1}$	1,92	0,54	1,69	0,48
	(0,91)	(0,66)	(1,46)	(0,44)
$\theta_{1,2}$	**0,839***	**0,56****	**0,987*****	**0,973****
	(1,91)	(2,44)	(3,09)	(2,43)
$\theta_{2,2}$	-1,33	0,88	**-1,626****	-0,01
	(-0,95)	(1,22)	(-2,09)	(-0,01)
LR	11,23	6,45	20,40	7,00
	[0,00]	[0,04]	[0,00]	[0,03]
$Q(1)$	0,10	0,25	0,22	0,17
	[0,75]	[0,62]	[0,64]	[0,68]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.]

Table 3: Estimations results for the Philippines as endogenous and regional cycles

z Lag k	Malaysia $t-1$	Indonesia $t-0$	Thailand $t-2$	Singapore $t-0$
μ_1	1,119***	1,135***	1,135***	1,072***
	(8,46)	(8,83)	(8,76)	(7,43)
μ_2	-1,753***	-1,109***	-1,339***	-1,323**
	(-3,51)	(-2,87)	(-3,48)	(-2,49)
ϕ	-0,19**	-0,179***	-0,216**	-0,167**
	(-2,18)	(-2,90)	(-2,61)	(-2,48)
σ	1,67***	1,696***	1,683***	1,729***
	(15,75)	(16,77)	(16,15)	(16,63)
$\theta_{1,1}$	2,879***	5,912**	3,59***	4,95***
	(3,06)	(1,99)	(3,47)	(2,90)
$\theta_{2,1}$	0,10	3,224*	2,43	1,784*
	(0,08)	(1,85)	(1,38)	(1,69)
$\theta_{1,2}$	**1,438****	**3,652***	**0,987****	-0,19
	(2,30)	(1,66)	(2,27)	(-0,32)
$\theta_{2,2}$	1,10	-0,73	7,14	0,21
	(0,76)	(-1,30)	(0,84)	(0,24)
LR	6,66	8,35	7,31	0,15
	[0,04]	[0,02]	[0,03]	[0,93]
$Q(1)$	1,10	0,28	0,23	0,43
	[0,31]	[0,60]	[0,63]	[0,51]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 4: Estimations results for Singapore as endogenous and regional cycles

z Lag k	Malaysia $t-1$	Indonesia $t-0$	The Philippines $t-1$	Thailand $t-1$
μ_1	2,194***	2,184***	2,215***	2,195***
	(17,39)	(17,02)	(17,19)	(17,48)
μ_2	-1,561***	-1,512***	-1,274***	-1,482***
	(-3,94)	(-3,38)	(-3,27)	(-3,47)
ϕ	0,03	0,01	-0,02	0,02
	(0,25)	(0,05)	(-0,18)	(0,16)
σ	1,344***	1,364***	1,365***	1,355***
	(15,51)	(15,45)	(16,03)	(15,41)
$\theta_{1,1}$	2,048***	2,507***	3,178***	2,611***
	(3,55)	(4,05)	(5,15)	(4,73)
$\theta_{2,1}$	0,50	0,79	0,99	0,52
	(0,87)	(1,28)	(1,62)	(0,78)
$\theta_{1,2}$	**0,908****	**0,813***	**0,5****	0,45
	(2,31)	(1,82)	(1,98)	(1,38)
$\theta_{2,2}$	-0,18	-0,20	0,12	-0,42
	(-0,67)	(-0,65)	(0,25)	(-1,15)
LR	5,46	5,39	2,54	3,85
	[0,07]	[0,07]	[0,28]	[0,15]
$Q(1)$	0,001	0,03	0,002	0,001
	[0,98]	[0,85]	[0,96]	[0,98]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 5: Estimations results for Indonesia as endogenous and regional cycles

z Lag k	The Philippines $t-1$	Thailand $t-2$	Singapore $t-2$	Malaysia $t-1$
μ_1	1,454***	1,454***	1,454***	1,45***
	(15,76)	(15,94)	(15,77)	(16,04)
μ_2	-7,927***	-7,927***	-7,927***	-7,92***
	(-9,74)	(-9,83)	(-9,79)	(-11,17)
ϕ	-0,11	-0,11	-0,112*	-0,108*
	(-1,30)	(-1,31)	(-1,72)	(-1,92)
σ	1,197***	1,197***	1,197***	1,189***
	(16,57)	(16,64)	(20,25)	(20,66)
$\theta_{1,1}$	5,269***	4,684***	5,236***	4,701***
	(3,88)	(4,48)	(3,25)	(6,92)
$\theta_{2,1}$	3,05	2,17	3,42	-65,75
	(0,88)	(0,56)	(1,28)	(-0,01)
$\theta_{1,2}$	-0,20	0,51	-0,10	0,15
	(-0,37)	(1,21)	(-0,15)	(1,44)
$\theta_{2,2}$	2,41	0,51	2,36	-14,56
	(0,86)	(0,56)	(1,21)	(-0,01)
LR	0,55	1,40	1,76	2,84
	[0,76]	[0,50]	[0,41]	[0,24]
$Q(1)$	1,06	1,06	1,06	0,99
	[0,30]	[0,30]	[0,30]	[0,32]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 6: Estimations results for Thailand as endogenous and regional cycles

z Lag k	Malaysia $t-1$	Indonesia $t-0$	The Philippines $t-1$	Singapore $t-1$
μ_1	1,713***	1,683***	1,712***	1,771***
	(12,16)	(14,32)	(12,22)	(12,61)
μ_2	-3,428***	-4,062***	-3,456***	-2,908***
	(-3,52)	(-5,52)	(-3,70)	(-4,40)
ϕ	0,02	-0,02	0,02	-0,05
	(0,18)	(-0,25)	(0,21)	(-0,43)
σ	1,449***	1,457***	1,449***	1,42***
	(15,16)	(17,29)	(15,15)	(13,90)
$\theta_{1,1}$	3,775***	2,839***	3,545***	2,592***
	(3,68)	(5,64)	(5,58)	(3,97)
$\theta_{2,1}$	-0,08	-54,98	0,10	-0,13
	(-0,06)	(0,00)	(0,11)	(-0,16)
$\theta_{1,2}$	-0,09	**0,849***	0,12	**0,678**
	(-0,18)	(19,73)	(0,37)	(1,98)
$\theta_{2,2}$	-0,06	-12,40	-0,15	-0,29
	(-0,17)	(0,00)	(-0,39)	(-0,68)
LR	0,07	6,15	0,32	3,04
	[0,97]	[0,05]	[0,85]	[0,22]
$Q(1)$	0,02	0,06	0,03	1,03
	[0,88]	[0,80]	[0,86]	[0,31]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

The second striking results is that, in general, recessions in any country have no discernible effects on other countries when they are already into recession. Indeed, most of the time, the coefficient $\theta_{2,2}$ is insignificant, thereby implying that any change in a given GDP growth does not help predict whether other economies will stay into or escape from recessions. This second finding is consistent with two potential explanations. While the increasing economic interdependence -through intra-regional trade and direct investments- tends to strengthen output co-movements when the countries are already in the expansionary state, the shift from recessions to recovery are mainly due to idiosyncratic policies (e.g. monetary, fiscal and wage policies). Nevertheless, this does not exclude the possibility for countries' cycle to be correlated during turbulent periods as demonstrated in 1997-98. This finding is supported by some studies which claim that the East Asian countries still need cooperative mechanisms to strengthen their ability to manage crises, and insulate countries from policy spillovers such as "beggar-thy-neighbor" competitive devaluations (see, e.g., Plummer , 2006 and Volz , 2006). An alternative explanation may be that there do exist a correlation among the contraction phases of the business cycles caused by a global factor that is not accounted for here. We now look at this second explanation.

3.3. Results from the extended model

Tables 8 till 12 report the estimation for the extended model (see Appendix 2). The main difference with the basic model is that the leading cycles are now those of Japan, China and the US, and, the ASEAN-5 growth rates enter as exogenous variables in each country regression. Studies on macroeconomic linkages among the East Asian countries highlight that East Asian business cycles have become more responsive to the economic cyclicality of the developed countries where Asian exports are mainly consumed. Indeed, global economic linkages among the East Asian countries and the rest of the world are especially explained by the heavy dependence on final demand in industrial economies, especially with China, the US and Japan (see Table 7 in Appendix 2).

The TVTP model allows taking into consideration how the economic cyclicality of a third country affects business cycles synchronization in the ASEAN-5. The model still dichotomizes between two regimes of expansion and recession, since we find statistically significant positive and negative values for the coefficients μ_1 and μ_2. The coefficients β_1 and β_2 capture the correlation among the ASEAN-5's business cycles and the latter are assumed to be different during recessions and expansions. It is found that the correlations among the ASEAN-5's cycles are stronger during contractions than during expansions (the estimated coefficients β_2 are much larger than β_1). Therefore, a drop in the growth rate of Japan, the US and China, could explain that the ASEAN-5 countries fall into recession a few quarters later. This would be suggestive of a global international cycle driving recessions in these countries.

Regarding the influence of the Japanese, Chinese and American cycles on the ASEAN-5 business, we summarize in Table 13 (see Appendix 2) our main findings based on the significance of the estimated coefficients $\theta_{1,2}$ and $\theta_{2,2}$. The results shows a great heterogeneity of situations. In some cases, the "international" cycles do not provide significant content in explaining the ASEAN-5 business cycle contractions and expansions, because some useful information about the dynamics of the growth rate is already provided by another ASEAN-5 country's business cycle. This suggests a dominance of a regional cycle over a global cycle. For instance, this happens in Malaysia. Considering the regression in which Singapore's growth rate enters as an explanatory variable, we find significant coefficients β_1 and β_2 and an insignificant coefficient $\theta_{1,2}$ when the Japanese' cycle is chosen as the leading international business cycle. But, this coefficient become statistically significant when the leading cycle is the Chinese's and the American's.

In most regressions, the Indonesian cycle captures only part of the influence of the external growth on the ASEAN-5 countries' growth rates when one also considers the role of the American and Chinese cycles. Indeed, the parameter $\theta_{1,2}$ are significant in the regressions. However, the Indonesian cycle captures the influence of the Japanese business cycle on the growth rates of the ASEAN-5 countries (in this case, the coefficient is insignificant). We see that the business cycle in Thailand captures most of the influence of the "international" cycles, since in a majority of regressions in which the growth rate of this country enters as an explanatory variables, the parameter $\theta_{1,2}$ is insignificant. A similar argument applies for the Philippines. These observations play in favor of the view that the business cycles among the ASEAN-5 are correlated through a regional common cycles, rather through an influence of a common "international cycle". Accordingly, the synchronization process is enhanced by strong intra-regional linkages (e.g. through capital, intermediate goods, services and labor markets) that transmit macroeconomic fluctuations among interdependent partners, from larger economies to smaller one. This view is consistent with the findings that the synchronization process is mainly driven by major economies -in terms of PPP-based GDP- in Southeast Asia, that is Indonesia and to a lesser extent Malaysia and Thailand. Moreover, changes in the Chinese, Japanese and American cycles are uninformative of the likelihood to evolve in or escaping from a regime of contraction in the countries since the parameter $\theta_{1,2}$ is most often insignificant. The fact that "international cycle" are uninformative during contraction episodes leads to conclude that the adjustment process in response to shocks display idiosyncratic features as suggested by our preceding results.

4. Conclusion

The analysis in this paper suggests that a regional cycle of the ASEAN-5 could provide significant informational content in predicting the future state of the economies only when they are already into the expansionary state. Thus the causality between the business cycles is asymmetric. Accordingly, an ASEAN-5 monetary union appears to be premature since the Southeast Asian countries are not fully synchronized with each other despite evidence of business cycle transmission and interdependence within the region. This calls for a deeper regional economic cooperation, including intra-exchange rate stability and macroeconomic policy coordination, before turning on to a full-fledged monetary union. Furthermore, our finding plays against the idea according to which the ASEAN-5 countries' economies are characterized by a strong dependence on external demand. The estimates appear to suggest that they instead share a common region-specific business cycle, with a driving role for Indonesia, the country with the highest GDP within the region. The Asian regional trade may have played an increasingly role in strengthening the business correlation within the group. This provides support to the arguments that the ASEAN-5 could decouple from the biggest countries and manage to generate a self-sustaining growth path. There are several directions in which this study could be extended. First, it would be interesting repeating a similar exercise with the components of the GDP growth (trade, investment, consumption) and with monetary and financial variables in order to investigate other sources of correlation between the countries. Secondly, our model focus on cross-country spillover effects within the region. It would be interesting looking at the effects of common exogenous shocks by adding features on impulse response functions from Markov-switching models.

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Appendix 1

Figure 1: Smoothed probabilities of being in a regime of contraction: Singapore. Upper panel: GDP growth rate, lower panel: smoothed probabilities

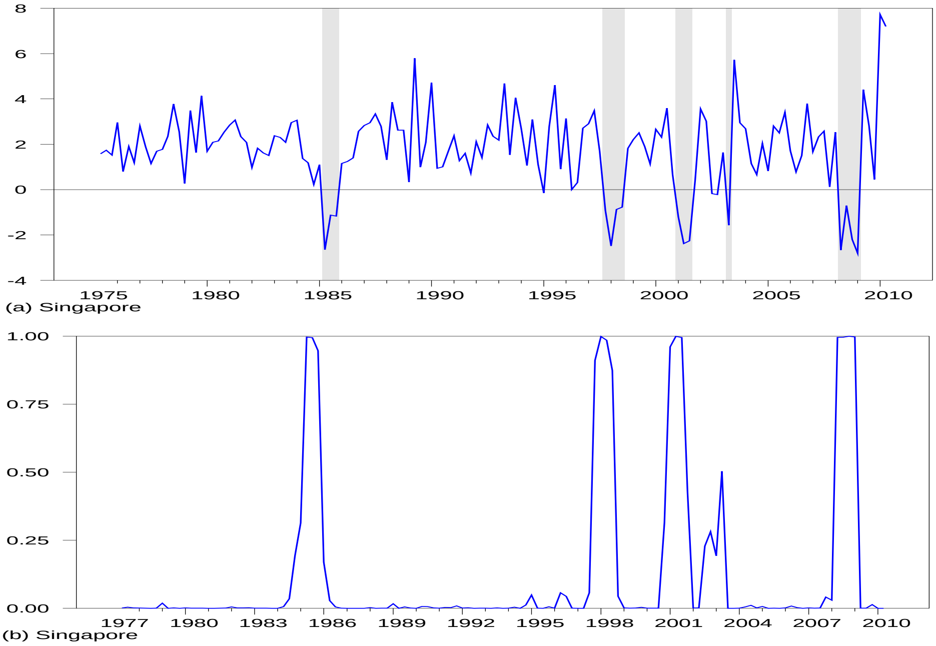


Figure 2: Smoothed probabilities of being in a regime of contraction: Malaysia. Upper panel: GDP growth rate, lower panel: smoothed probabilities

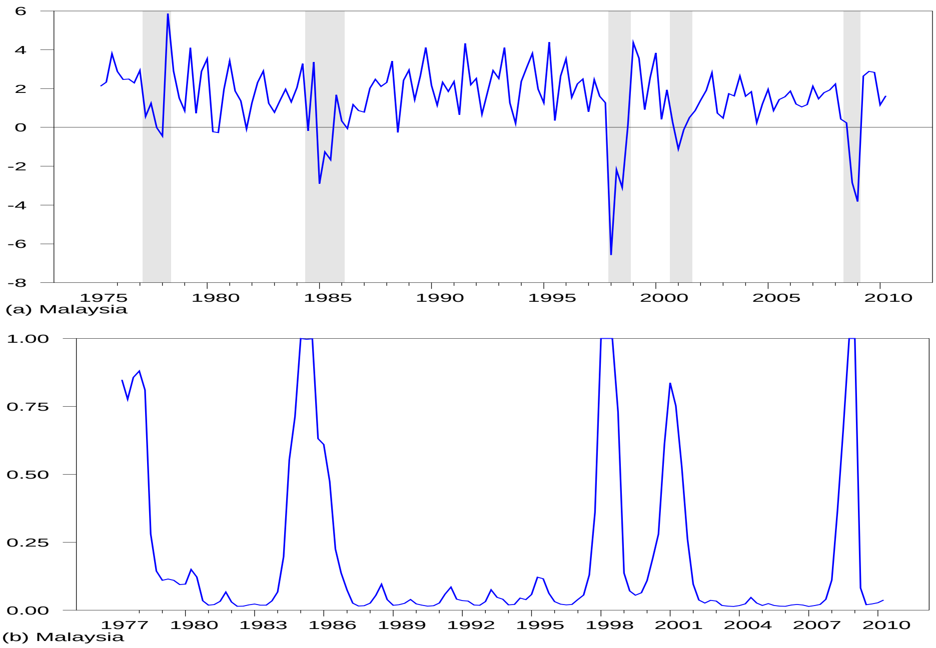


Figure 3: Smoothed probabilities of being in a regime of contraction: the Philippines. Upper panel: GDP growth rate, lower panel: smoothed probabilities

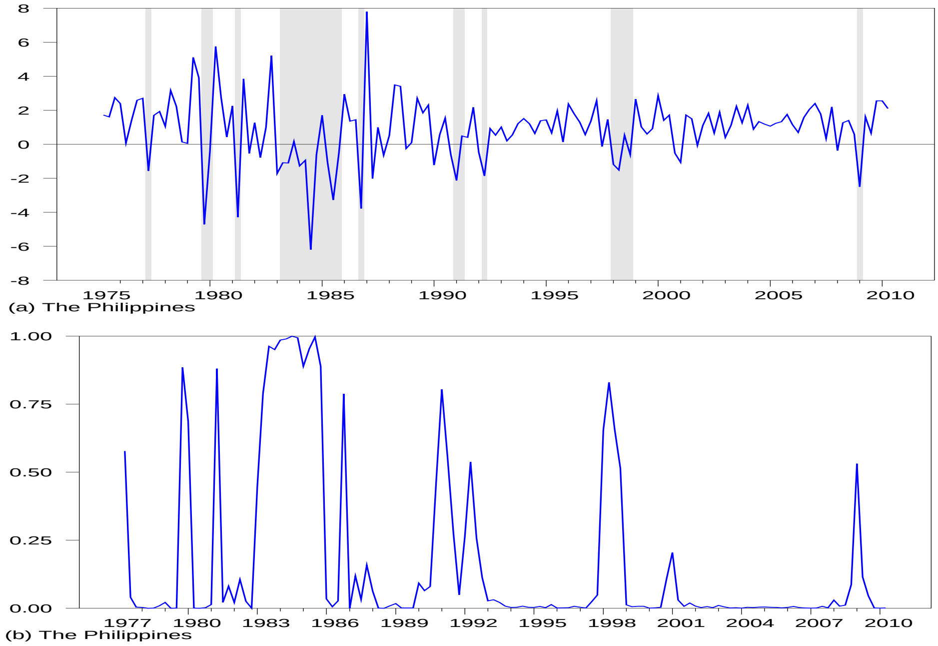


Figure 4: Smoothed probabilities of being in a regime of contraction: Thailand. Upper panel: GDP growth rate, lower panel: smoothed probabilities

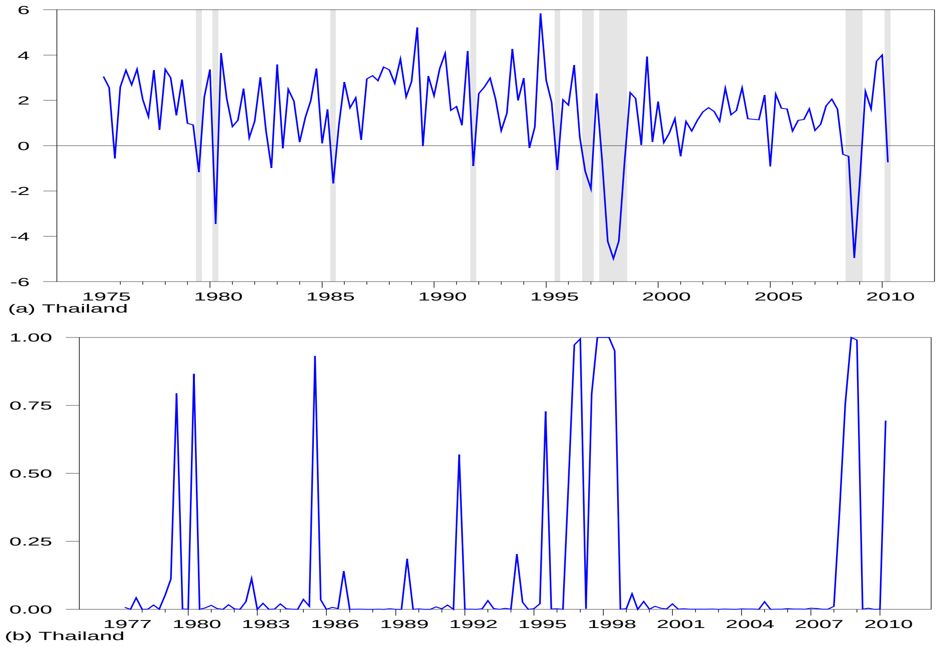


Figure 5: Smoothed probabilities of being in a regime of contraction: Indonesia. Upper panel: GDP growth rate, lower panel: smoothed probabilities

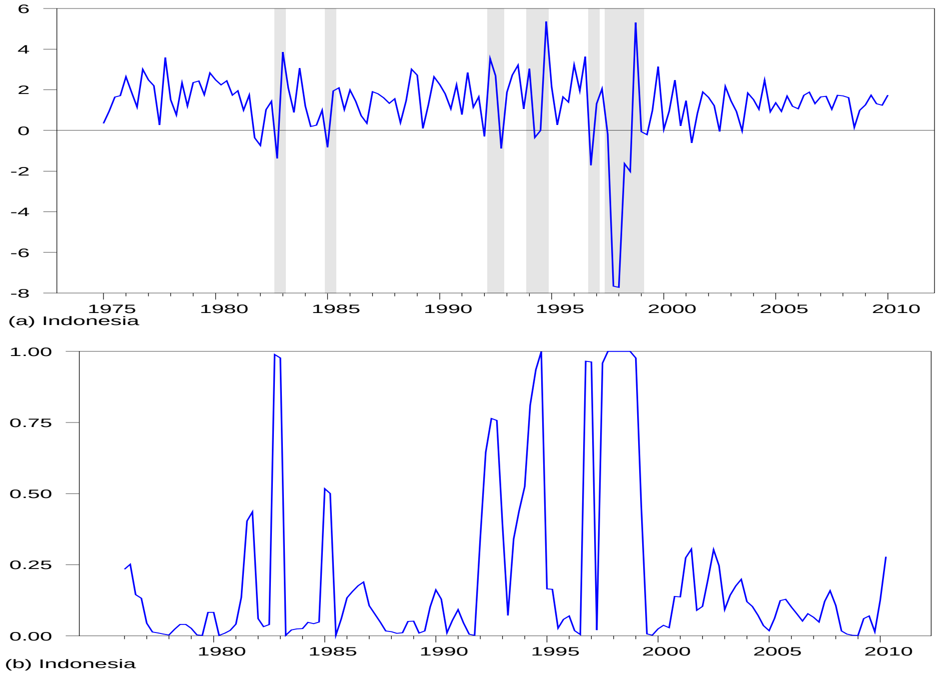
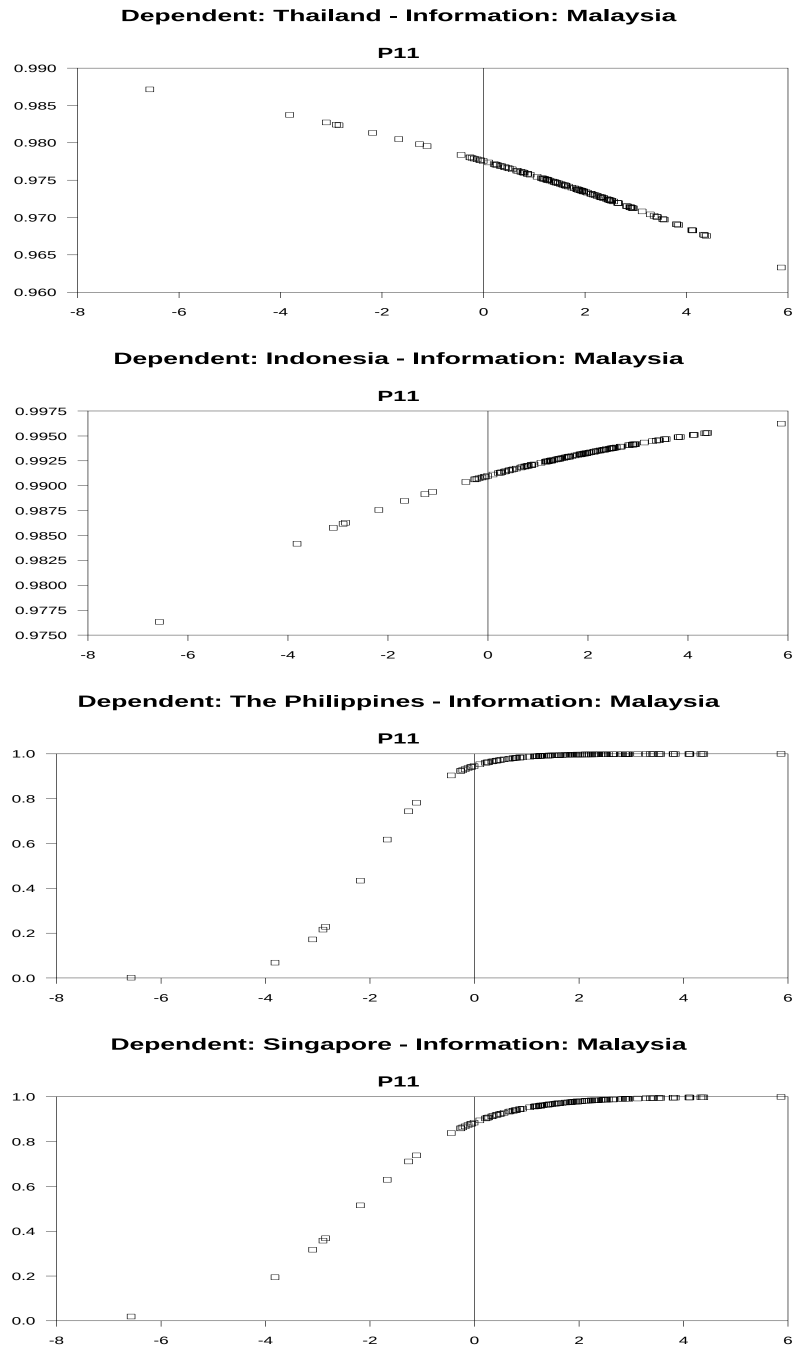


Figure 6: Time-varying probabilities of Southeast Asian business cycles and changes in the GDP growth of Malaysia.



Appendix 2

Table 7: Stylized facts on the trade integration in East Asia.

	75-80	80-85	85-90	90-95	95-00	00-05	05-10
Intra-regional trade	30,72	33,74	37,02	42,45	44,71	47,01	45,92
Share of China	9,79	11,57	17,40	19,81	23,73	27,38	30,51
Share of Japan	35,06	33,50	30,86	26,87	24,58	22,42	18,84
Total trade with US							
Singapore	14,12	14,42	19,05	17,97	17,80	14,35	10,04
Indonesia	16,72	11,83	11,33	7,51	8,30	8,43	5,87
Malaysia	15,25	14,71	16,82	17,56	18,72	18,05	13,18
Thailand	12,55	13,67	15,75	15,75	15,87	14,59	9,69
Philippines	26,25	27,56	28,59	26,54	25,90	21,83	15,53
Total trade with Japan							
Singapore	13,92	14,30	14,78	14,95	12,76	9,89	6,53
Indonesia	37,28	39,67	36,57	29,07	21,14	19,46	15,70
Malaysia	21,03	23,00	21,16	19,98	17,31	14,69	11,21
Thailand	27,37	20,33	21,71	24,19	20,19	18,93	15,84
Philippines	26,40	19,68	17,78	19,87	18,49	17,84	14,50
Total trade with China							
Singapore	1,93	2,29	3,89	2,54	3,62	6,40	10,20
Indonesia	0,00	0,65	2,21	3,48	3,94	6,05	10,33
Malaysia	2,35	1,63	2,02	2,29	2,65	6,09	10,91
Thailand	1,81	2,99	3,12	2,14	3,27	6,36	10,53
Philippines	1,72	1,93	2,40	1,32	2,14	4,02	8,78

Source: Own calculations with data from IMF DOTS.

Table 8: Estimations results for Malaysia as endogenous and global cycles

z	USA				Japan				China			
x	Sing.	Indo.	Thai.	Phil.	Sing.	Indo.	Thai.	Phil.	Sing.	Indo.	Thai.	Phil.
Lag k	$t-0$	$t-0$	$t-3$	$t-3$	$t-3$	$t-1$	$t-0$	$t-2$	$t-2$	$t-4$	$t-2$	$t-0$
μ_1	1,44***	1,34***	1,79***	1,77***	1,45***	1,37***	1,72***	1,77***	1,43***	1,24***	1,22***	1,78***
	(6,44)	(6,88)	(10,07)	(13,86)	(6,33)	(7,41)	(8,98)	(13,56)	(7,94)	(6,51)	(6,25)	(13,44)
μ_2	-1,63***	-2,11***	-0,63**	-3,01***	-1,4**	-1,98***	-0,75*	-3,05***	-1,42***	-2,82***	-0,71	-3,1***
	(-2,92)	(-3,80)	(-2,06)	(-8,11)	(-2,29)	(-3,92)	(-1,85)	(-5,63)	(-3,88)	(-3,66)	(-1,18)	(-9,30)
ϕ	0,07	0,15	0,01	0,06	0,05	0,12	-0,02	0,07	0,05	0,15	0,21***	0,07
	(0,67)	(1,38)	(0,05)	(0,75)	(0,62)	(1,21)	(-0,20)	(0,76)	(0,53)	(1,56)	(2,64)	(0,76)
σ	1,21***	1,14***	1,2***	1,24***	1,21***	1,16***	1,21***	1,24***	1,17***	1,17***	1,23***	1,19***
	(15,04)	(14,02)	(15,79)	(17,29)	(15,65)	(13,33)	(15,75)	(17,55)	(13,98)	(14,95)	(14,32)	(15,48)
β_1	0,2**	0,31***	0,1	0,04	0,19**	0,31***	0,12	0,04	0,18**	0,31***	0,22***	0,01
	(2,57)	(4,13)	(1,34)	(0,63)	(2,33)	(3,97)	(1,49)	(0,63)	(2,59)	(4,30)	(3,07)	(0,09)
β_2	0,99***	0,57***	0,77***	-0,04	1,07***	0,6***	0,78***	-0,05	1,12***	0,46***	1,13***	-0,06
	(5,16)	(4,59)	(6,93)	(-0,13)	(5,18)	(4,67)	(6,55)	(-0,15)	(6,60)	(2,65)	(5,46)	(-0,27)
$\theta_{1,1}$	2,28***	2,3***	3,8***	4,15***	2,43***	2,51***	3,05***	3,59***	3,76***	4,96***	2,45**	5,24***
	(3,07)	(3,63)	(3,50)	(4,69)	(3,14)	(3,67)	(3,51)	(6,03)	(2,96)	(3,42)	(2,31)	(4,35)
$\theta_{2,1}$	0,53	0,01	0,44	-0,19	-0,16	-0,34	1,14	0,48	1,64	0,46	-37,72	2,64
	(0,51)	(0,01)	(0,55)	(-0,17)	(-0,16)	(-0,49)	(1,56)	(0,66)	(0,62)	(0,31)	(0,00)	(1,21)
$\theta_{1,2}$	**1,42****	**1,12***	-1,01	-0,49	-0,09	**1,35***	**1,42****	0,43	**-0,47***	**-0,46***	-0,2	**-0,47***
	(2,01)	(1,88)	(-1,20)	(-0,72)	(-0,18)	(1,97)	(2,27)	(1,18)	(-1,75)	(-1,71)	(-0,66)	(-1,92)
$\theta_{2,2}$	-0,6	-0,76	1,22	1,15	-0,5	0,19	-0,2	0,02	-1,06	-0,39	0,04	-0,8
	(-0,67)	(-0,89)	(1,18)	(0,92)	(-0,58)	(0,59)	(-0,44)	(0,03)	(-0,75)	(-0,57)	(0,00)	(-1,10)
LR	4,81	6,16	4,05	1,49	0,54	5,54	6,11	1,10	4,55	10,28	2,77	5,09
	[0,09]	[0,05]	[0,13]	[0,48]	[0,76]	[0,06]	[0,05]	[0,58]	[0,10]	[0,01]	[0,25]	[0,08]
$Q(1)$	4,17	2,86	2,21	0,18	4,78	1,48	0,68	0,21	2,65	1,14	0,00	0,42
	[0,04]	[0,09]	[0,14]	[0,67]	[0,03]	[0,22]	[0,41]	[0,65]	[0,10]	[0,28]	[0,95]	[0,52]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 9: Estimations results for Thailand as endogenous and global cycles

z	USA				Japan				China			
x	Mal.	Sing.	Indo.	Phil.	Mal.	Sing.	Indo.	Phil.	Mal.	Sing.	Indo.	Phil.
Lag k	$t-0$	$t-0$	$t-0$	$t-0$	$t-2$	$t-4$	$t-4$	$t-3$	$t-3$	$t-1$	$t-2$	$t-1$
μ_1	1,3***	1,4***	1,43***	1,62***	1,31***	1,46***	1,52***	1,67***	1,35***	1,3***	1,55***	1,64***
	(7,39)	(8,06)	(7,21)	(12,15)	(7,15)	(8,26)	(8,10)	(11,29)	(6,70)	(7,31)	(8,11)	(10,96)
μ_2	-2,06***	-2,98***	-3,32***	-4,35***	-1,7***	-2,29***	-2,24***	-3,69***	-1,17***	-3,28***	-2,02***	-3,34***
	(-4,05)	(-5,90)	(-3,03)	(-5,11)	(-3,50)	(-5,77)	(-3,48)	(-4,81)	(-3,04)	(-5,55)	(-3,07)	(-3,82)
ϕ	-0,05	-0,03	-0,03	0,02	-0,13*	-0,14*	-0,12	0,03	-0,06	-0,07	-0,13	0,01
	(-0,51)	(-0,36)	(-0,23)	(0,21)	(-1,68)	(-1,66)	(-1,18)	(0,22)	(-0,66)	(-0,74)	(-1,36)	(0,07)
σ	1,38***	1,39***	1,43***	1,45***	1,43***	1,45***	1,38***	1,44***	1,45***	1,36***	1,37***	1,47***
	(16,35)	(17,84)	(16,37)	(16,30)	(17,14)	(16,57)	(11,55)	(15,59)	(15,63)	(14,55)	(10,84)	(14,99)
β_1	0,29***	0,2***	0,2*	0,07	0,3***	0,19**	0,22*	0,05	0,24**	0,24***	0,2	0,02
	(3,40)	(2,73)	(1,78)	(1,00)	(3,25)	(2,14)	(1,86)	(0,61)	(2,26)	(2,91)	(1,54)	(0,25)
β_2	0,69***	0,95***	0,19	0,14	0,66***	0,68***	0,36**	-0,03	0,82***	0,72***	0,39***	-0,03
	(3,91)	(4,45)	(0,94)	(0,49)	(3,92)	(5,31)	(2,58)	(-0,08)	(5,79)	(4,01)	(2,70)	(-0,09)
$\theta_{1,1}$	3,22***	3,28***	3,57***	3,77***	4,17***	3,78***	3,24***	3,68***	2,34***	3,84***	4,44***	3,67***
	(3,71)	(3,98)	(3,89)	(4,51)	(4,57)	(5,32)	(4,62)	(6,35)	(3,30)	(3,83)	(3,34)	(3,80)
$\theta_{2,1}$	-0,95	-0,91	0,04	-1,01	3,2*	1,51	0,19	-0,54	-5,2	3,66**	1,21	-0,36
	(-0,59)	(-0,61)	(0,04)	(-0,57)	(1,70)	(1,13)	(0,20)	(-0,43)	(-0,91)	(2,03)	(0,70)	(-0,31)
$\theta_{1,2}$	**1,82*** **	**2,02*** **	**1,91** **	**2,04*** **	0,05	**0,85* **	-0,02	-0,09	**0,78** **	-0,26	**-0,49* **	-0,04
	(2,63)	(2,68)	(2,51)	(2,93)	(0,06)	(1,87)	(-0,03)	(-0,18)	(2,03)	(-0,89)	(-1,91)	(-0,12)
$\theta_{2,2}$	2,26	2,18	-0,05	1,28	2,15	2,34	0,54	-1,35	5,5	**-2,17** **	-0,44	0,35
	(1,25)	(1,34)	(-0,04)	(0,69)	(1,54)	(1,21)	(0,48)	(-0,90)	(1,05)	(-2,00)	(-0,85)	(0,66)
LR	7,63	11,71	5,28	10,51	3,12	5,28	2,91	1,31	10,17	3,83	5,87	0,43
	[0,02]	[0,00]	[0,07]	[0,01]	[0,21]	[0,07]	[0,23]	[0,52]	[0,01]	[0,15]	[0,05]	[0,81]
$Q(1)$	0,75	0,00	0,05	0,36	0,23	0,31	0,08	0,01	0,03	0,03	0,01	0,00
	[0,39]	[0,99]	[0,82]	[0,55]	[0,63]	[0,58]	[0,78]	[0,92]	[0,86]	[0,85]	[0,94]	[0,98]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 10: Estimations results for Indonesia as endogenous and global cycles

z	USA				Japan				China			
x	Mal.	Sing.	Thai.	Phil.	Mal.	Sing.	Thai.	Phil.	Mal.	Sing.	Thai.	Phil.
Lag k	$t-4$	$t-2$	$t-1$	$t-4$	$t-4$	$t-1$	$t-2$	$t-1$	$t-2$	$t-2$	$t-1$	$t-1$
μ_1	1,39***	1,27***	1,29***	1,49***	1,33***	1,27***	1,33***	1,5***	1,27***	1,23***	1,29***	1,44***
	(9,77)	(9,68)	(9,37)	(16,31)	(10,20)	(13,08)	(10,34)	(15,57)	(8,89)	(9,03)	(8,87)	(14,57)
μ_2	-1,4***	-8,22***	0,3	-2,8***	-1,25***	-8,29***	-0,52	-2,77***	-1,31***	-8,29***	0,36	-2,78***
	(-4,90)	(-4,91)	(0,35)	(-7,50)	(-4,94)	(-5,37)	(-1,09)	(-7,84)	(-3,93)	(-5,07)	(0,36)	(-6,42)
ϕ	-0,08	-0,11	0,03	-0,05	-0,08	-0,12*	-0,08	-0,04	-0,08	-0,13*	0,05	-0,05
	(-1,16)	(-1,17)	(0,22)	(-0,64)	(-1,05)	(-1,96)	(-0,86)	(-0,60)	(-1,01)	(-1,84)	(0,29)	(-0,63)
σ	1,12***	1,19***	1,08***	1,11***	1,15***	1,19***	1,08***	1,11***	1,15***	1,19***	1,08***	1,12***
	(16,05)	(16,86)	(15,97)	(18,68)	(20,91)	(20,94)	(17,70)	(19,05)	(18,72)	(19,56)	(14,61)	(17,67)
β_1	0,14*	0,12**	0,09	0,02	0,13*	0,12**	0,08	0,02	0,16**	0,12**	0,06	0,02
	(1,91)	(2,01)	(1,44)	(0,32)	(1,97)	(2,54)	(1,21)	(0,25)	(2,30)	(2,01)	(0,98)	(0,36)
β_2	1,08***	-0,21	1,71***	2,93***	1,12***	-0,25	1,63***	2,77***	1,1***	-0,25	1,7***	2,96***
	(10,50)	(-0,22)	(9,96)	(8,68)	(9,64)	(-0,28)	(9,62)	(8,14)	(10,54)	(-0,26)	(9,62)	(8,24)
$\theta_{1,1}$	2,22**	5,87***	3,83***	5,52***	4,5***	4,82***	2,45***	4,59***	4,12***	4,62***	2,78***	4,31***
	(2,32)	(3,37)	(4,01)	(3,31)	(4,27)	(4,62)	(3,45)	(4,69)	(2,69)	(3,45)	(3,67)	(4,11)
$\theta_{2,1}$	-12,04	4,8	-1,27	3,97	2,26**	-40,56	-0,58	3,45	0,41	2,94	0,4	0,94
	(-0,93)	(0,92)	(-0,51)	(1,37)	(2,30)	(0,00)	(-0,57)	(1,50)	(0,23)	(1,07)	(0,16)	(0,21)
$\theta_{1,2}$	**2,57***	-0,87	-0,72	-0,62	0,09	0,19	0,72	0,7	0,06	0,19	0,15	0,25
	(1,97)	(-0,83)	(-1,18)	(-0,53)	(0,10)	(0,25)	(1,39)	(0,82)	(0,11)	(0,36)	(0,63)	(0,58)
$\theta_{2,2}$	16,83	-5,81	0,93	-1,89	-0,38	-34,73	-1,51	-3,37	1,21	-2,57	-0,47	0,48
	(1,02)	(-0,93)	(0,36)	(-0,80)	(-0,23)	(0,00)	(-1,07)	(-0,97)	(0,85)	(-1,08)	(-0,37)	(0,18)
LR	5,51	1,08	1,39	2,60	2,18	2,84	3,02	1,81	3,07	3,86	0,47	0,30
	[0,06]	[0,58]	[0,50]	[0,27]	[0,34]	[0,24]	[0,22]	[0,40]	[0,21]	[0,15]	[0,79]	[0,86]
$Q(1)$	2,95	0,41	1,27	0,01	4,05	0,41	0,97	0,05	4,22	0,56	1,17	0,06
	[0,09]	[0,52]	[0,26]	[0,94]	[0,04]	[0,52]	[0,32]	[0,83]	[0,04]	[0,46]	[0,28]	[0,80]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 11: Estimations results for Singapore as endogenous and global cycles

z	USA				Japan				China			
x	Mal.	Indo.	Thai.	Phil.	Mal.	Indo.	Thai.	Phil.	Mal.	Indo.	Thai.	Phil.
Lag k	$t-1$	$t-0$	$t-3$	$t-1$	$t-2$	$t-0$	$t-2$	$t-2$	$t-3$	$t-1$	$t-1$	$t-0$
μ_1	4,87***	1,76***	2,27***	2,16***	3,55***	1,76***	2,26***	2,16***	4,93***	1,81***	2,65***	2,22***
	(4,05)	(9,54)	(11,20)	(15,63)	(5,21)	(9,86)	(10,78)	(14,83)	(3,02)	(10,31)	(7,67)	(15,49)
μ_2	0,8***	-2,02***	-0,68*	-1,29***	0,76***	-1,98***	-0,71*	-1,27***	0,78***	-1,84***	0,51*	-1,18***
	(3,87)	(-2,73)	(-1,80)	(-2,93)	(3,43)	(-2,75)	(-1,93)	(-2,71)	(3,41)	(-2,94)	(1,94)	(-3,01)
ϕ	0,21**	0,13	-0,01	0,01	0,27***	0,14	-0,01	0,02	0,21**	0,11	0,21***	-0,02
	(2,59)	(1,03)	(-0,09)	(0,12)	(3,53)	(1,06)	(-0,01)	(0,14)	(2,54)	(0,98)	(2,80)	(-0,18)
σ	1,32***	1,39***	1,35***	1,35***	1,3***	1,4***	1,35***	1,35***	1,37***	1,44***	1,49***	1,38***
	(15,46)	(22,21)	(16,80)	(15,58)	(13,59)	(20,63)	(17,40)	(15,55)	(12,59)	(15,16)	(19,04)	(16,98)
β_1	1,14	0,24***	0,03	0,07	1,42***	0,24***	0,03	0,07	1,07	0,25***	-0,19	0,08
	(1,51)	(2,95)	(0,24)	(1,11)	(3,91)	(2,88)	(0,24)	(1,14)	(1,12)	(3,05)	(-1,60)	(1,16)
β_2	0,43***	0,52	0,33**	0,19	0,39***	0,5	0,32**	0,19	0,44***	0,66	0,59***	0,29
	(5,82)	(1,07)	(2,38)	(0,68)	(5,53)	(1,09)	(2,34)	(0,70)	(6,80)	(1,50)	(5,88)	(1,24)
$\theta_{1,1}$	3,76	2,98***	3,24***	2,88***	-2,7	3,17***	2,78***	2,95***	-4,99	2,91***	5,3***	3,47***
	(0,52)	(4,71)	(3,63)	(4,95)	(-0,95)	(5,26)	(5,56)	(5,76)	(-0,45)	(3,15)	(3,05)	(3,15)
$\theta_{2,1}$	3,83***	0,92	0,3	0,83	3,15***	0,75	1,18**	0,97	4,14***	-10,87***	3,83*	2,98*
	(4,04)	(1,32)	(0,42)	(1,46)	(3,91)	(0,86)	(2,02)	(1,51)	(2,88)	(-4,47)	(1,89)	(1,92)
$\theta_{1,2}$	-4,7	0,42	-0,45	0,32	1	0,04	0,33	0,36	1,64	0,08	**-0,61****	-0,18
	(-0,59)	(0,62)	(-0,59)	(0,54)	(0,64)	(0,09)	(0,93)	(1,07)	(0,37)	(0,22)	(-1,99)	(-0,55)
$\theta_{2,2}$	-0,26	-1,03	1,37	-0,03	**1,73****	-1,13	0,76	0,63	-0,2	**6,44*****	1,94	-0,81
	(-0,38)	(-1,35)	(1,37)	(-0,03)	(2,07)	(-1,33)	(1,43)	(1,19)	(-0,68)	(4,03)	(1,32)	(-1,54)
LR	0,38	2,42	2,91	0,28	7,53	3,83	3,15	2,76	0,65	5,04	14,99	2,47
	[0,83]	[0,30]	[0,23]	[0,87]	[0,02]	[0,15]	[0,21]	[0,25]	[0,72]	[0,08]	[0,00]	[0,29]
$Q(1)$	0,68	0,91	0,21	0,07	0,00	0,96	0,31	0,18	0,00	0,53	0,23	0,07
	[0,41]	[0,34]	[0,65]	[0,79]	[0,95]	[0,33]	[0,58]	[0,67]	[0,94]	[0,46]	[0,63]	[0,79]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) while p-values of LR and LB tests are displayed in brackets [.].

Table 12: Estimations results for the Philippines as endogenous and global cycles

z	USA				Japan				China			
x	Mal.	Sing.	Indo.	Thai.	Mal.	Sing.	Indo.	Thai.	Mal.	Sing.	Indo.	Thai.
Lag k	$t-1$	$t-4$	$t-4$	$t-2$	$t-3$	$t-4$	$t-3$	$t-2$	$t-1$	$t-2$	$t-2$	$t-1$
μ_1	1,04***	0,67***	0,9***	1,16***	0,83***	0,67***	0,88***	1,01***	0,75***	0,72***	0,99***	1***
	(4,81)	(4,14)	(5,81)	(8,04)	(6,05)	(3,60)	(7,01)	(6,81)	(3,73)	(5,59)	(6,64)	(5,47)
μ_2	-1,99***	-3,78**	-1,36**	-1,16**	-1,35***	-3,94***	-1,42**	-1,32**	-5**	-2,74***	-0,82*	-1,18**
	(-3,22)	(-2,49)	(-2,36)	(-2,00)	(-2,76)	(-2,70)	(-2,47)	(-2,02)	(-2,32)	(-3,50)	(-1,73)	(-2,33)
ϕ	-0,15	-0,02	-0,17**	-0,16*	-0,18**	-0,03	-0,19**	-0,17**	0,08	-0,31***	-0,28***	-0,17*
	(-1,55)	(-0,15)	(-2,10)	(-1,80)	(-2,15)	(-0,23)	(-2,60)	(-2,16)	(0,55)	(-3,80)	(-3,61)	(-1,86)
σ	1,54***	1,54***	1,67***	1,68***	1,7***	1,54***	1,7***	1,73***	1,59***	1,54***	1,58***	1,74***
	(14,42)	(19,16)	(21,44)	(15,40)	(16,49)	(19,85)	(17,58)	(17,34)	(15,30)	(14,96)	(17,67)	(18,93)
β_1	0,18**	0,24***	0,19**	0,06	0,19***	0,24***	0,18**	0,06	0,17**	0,3***	0,23**	0,06
	(2,00)	(4,10)	(2,13)	(0,81)	(2,75)	(3,02)	(2,42)	(0,81)	(1,98)	(4,72)	(2,56)	(0,58)
β_2	0,44*	-0,14	-0,05	0,13	-0,05	-0,09	0,07	-0,05	0,33	0,67***	-0,01	-0,01
	(1,75)	(-0,27)	(-0,15)	(0,44)	(-0,15)	(-0,18)	(0,19)	(-0,11)	(0,27)	(2,70)	(-0,01)	(-0,02)
$\theta_{1,1}$	2,03***	2,97***	12,65**	2,06*	5,02***	3,68***	5,12***	4,93***	3,06***	1,76*	1,07	3,64***
	(3,02)	(4,51)	(2,03)	(1,91)	(3,29)	(4,80)	(3,41)	(3,77)	(5,37)	(1,93)	(0,98)	(2,75)
$\theta_{2,1}$	-13,52	-75,62	0,67	-0,93	4,13*	-35,42	4,31**	3,28	-28,3	0,55	0,4	0,81
	(-1,09)	(0,00)	(0,81)	(-0,69)	(1,83)	(0,00)	(2,09)	(1,11)	(0,00)	(0,35)	(0,46)	(0,48)
$\theta_{1,2}$	0,71	0,36	**7,55****	4,31	-0,45	-0,51	-0,43	-0,32	0,11	**2,12****	**2,39***	0,57
	(1,21)	(0,64)	(2,02)	(1,47)	(-0,41)	(-1,16)	(-0,37)	(-0,35)	(0,52)	(2,33)	(1,95)	(1,34)
$\theta_{2,2}$	13,75	0,05	1,29	2,09	-1,7	0,06	-1,73	-1,01	0,02	-0,07	0,35	0,35
	(1,04)	(0,00)	(1,42)	(1,56)	(-1,33)	(0,00)	(-1,45)	(-0,60)	(0,00)	(-0,18)	(0,86)	(0,63)
LR	1,76	3,60	13,85	3,30	3,65	4,36	1,98	3,41	0,17	8,57	7,17	1,75
	[0,42]	[0,17]	[0,00]	[0,19]	[0,16]	[0,11]	[0,37]	[0,18]	[0,92]	[0,01]	[0,03]	[0,42]
$Q(1)$	1,56	1,26	0,49	0,11	1,35	1,12	0,74	0,42	3,00	0,17	0,03	0,94
	[0,21]	[0,26]	[0,48]	[0,75]	[0,24]	[0,29]	[0,39]	[0,52]	[0,08]	[0,68]	[0,86]	[0,33]

Notes: *,**,*** denote significance at 10, 5 and 1 % respectively. Student-t statistics of parameters are reported in parentheses (.) and p-values of LR and LB tests are displayed in brackets [.].

Table 13: Summary of the relationships among the East Asian countries and the global cycles

z	USA					Japan					China				
x	Mal.	Thai.	Phil.	Sing.	Indo.	Mal.	Thai.	Phil.	Sing.	Indo.	Mal.	Thai.	Phil.	Sing.	Indo.
Mal.	-	No	No	Yes	Yes	-	Yes	No	No	Yes	-	No	Yes	Yes	Yes
Thai.	Yes	-	Yes	Yes	Yes	No	-	No	Yes	No	Yes	-	No	Yes	Yes
Phil.	No	No	-	No	Yes	No	No	-	No	No	No	No	-	Yes	Yes
Sing.	No	No	No	-	No	Yes	No	No	-	No	No	Yes	No	-	Yes
Indo.	Yes	No	No	No	-	No	No	No	No	-	No	No	No	No	No

Notes: These results are based on the significance of coefficients $\theta_{1,2}$ and $\theta_{2,2}$.