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Asymmetry of Shocks and Convergence in Selected Asean Countries: A Dynamic Analysis

Carlos Cortinhas*

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Abstract

This paper aims to investigate whether structural shocks among ASEAN countries are becoming more symmetrical over time, thus indicating whether this region is becoming better prepared to introduce a common monetary policy. For that purpose a dynamic space-state model that complements the conventional Structural VAR models used in the existing literature was estimated by using the Kalman filter so that the evolution of the degree of shock symmetry and, therefore, the evolution in the degree of convergence could be identified over time, distinguishing between a country's convergence with a regional partner and a more general trend of convergence with the rest of the world.

The results showed that in the majority of cases there has been an increase in the degree of convergence of demand shocks in recent years. More importantly, it also showed an increase in divergence in supply shocks for most cases since the beginning of the 90's even when taking into account the Asian Financial Crisis. This is especially true for the periphery countries suggesting that the Philippines and Thailand are not only not converging but actually diverging from the core group. These results have important implications for the prospects of the creation of a common monetary policy in the region.

Keywords; Optimum currency areas; Monetary integration; Asymmetric shocks; Convergence; Asean.

JEL Classifications: F15; F33; E42

1. Introduction

The political desire for closer economic and monetary cooperation in the Association of Southeast Asian Nations, (ASEAN) has increased in recent years, especially since the 1997-1998 Asian financial crisis and the successful launch of the Euro in 1999[1]. A considerable number of studies have since emerged to study the feasibility of a common

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[1] Notable initiatives to promote regional financial stability and monetary policy cooperation include the establishment of 'Manila Framework Group' in 1997, the 'ASEAN Surveillance Process' in 1998 and the "Chiang Mai Initiative' in 2000. Recent initiatives to promote economic integration include the ASEAN Free Trade Area (1992) and the adoption of the so-called "ASEAN's Vision 2020" in 1997 where a timetable was established to create an ASEAN Economic Region.

currency arrangement not only for ASEAN but also for the whole of East Asia using the Structural VAR (SVAR) approach pioneered by Bayoumi and Eichengreen (1993), which has since become the standard approach to study the asymmetry of shocks amongst any group of countries[2].

Bayoumi and Eichengreen (1994) were the first to apply this method in a study that included a number of Asian countries. Using a two variable SVAR, they identified both a Northeast Asian bloc comprising Japan, Taiwan and Korea and a Southeast Asian bloc comprising Hong Kong, Singapore, Malaysia, Indonesia, and possibly Thailand as having highly correlated shocks. Bayoumi, Eichengreen and Mauro (2000), Yuen (2000) and Bayoumi and Mauro (2001) have updated the analysis in Bayoumi and Eichengreen (1994) and focusing on supply shocks, once again found evidence of the existence of a core, comprising Malaysia, Indonesia and Singapore and a periphery composed of the Philippines and Thailand[3].

Recently, the empirical analysis has moved to the estimation of three-variable SVARs. Ng (2002) developed a three-variable structural VAR, which allows for the determination of external, demand and supply shocks and found evidence of the existence of the same core and periphery countries as those found in the two-variable SVAR models. Zhang, Sato and McAleer (2004) apply the three variable VAR model developed by Clarida and Gali (1994), which allows for the distinction of supply, monetary and real (or demand) shocks. Their results are in line with those of Yuen (2000) and show that for the period of 1980-1997 only Malaysia and Singapore, and Malaysia and Indonesia experience significant positive correlation of supply shocks.

At this point several conclusions can be made. The existing empirical literature seems to agree that if not all of ASEAN5 (or East Asia), at least a sub-group appears to be a feasible

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[2] A number of studies have since expanded Bayoumi and Eichengreen (1993)'s framework allowing for the distinction between a larger number of disturbances. Examples include models that distinguish between supply, monetary and non-monetary shocks (Chamie, DeSerres and Lalonde, 1994), supply, demand (or IS) and monetary (or LM) shocks (Clarida and Gali, 1994), external, demand and supply shocks (Ng , 2002) and global, regional and country-specific shocks (Chow and Kim, 2003).

[3] In Yuen (2000)'s case study, only the pairs Singapore and Malaysia and Malaysia and Indonesia were found to display significant positive correlations of supply shocks. Evidence of a core comprising Indonesia, Malaysia and Singapore was also found in Bayoumi and Eichengreen (1996), who developed an alternative method based on an "OCA index".

monetary union even if it does not fare as well when comparing with the EU countries before the introduction of the euro[4]. Several studies point to the existence of a core and periphery but do not seem to agree on which ASEAN countries comprise each group. Furthermore, the Structural VAR analysis used in most of the previous studies, even if very informative is static in nature and therefore, does not allow for the assessment of the possibility of changing relationships in the symmetry of shocks over the years[5]. This is especially relevant in the recent past, as some studies suggest that the Asian financial crisis seems to have improved the symmetry of shocks in the ASEAN economies.

The main purpose of this paper is to fill this gap by applying a dynamic analysis of the symmetry of the shocks in ASEAN in the context of a state-space model that complements the SVAR analytic framework. This analysis, based on a model first applied by Boone (1997), allows for the study of the evolution of the degree of symmetry of shocks over time, distinguishing a country's convergence with a regional partner from a more general trend of convergence with the rest of the world.

The paper is organised as follows. The next section will explain the empirical methodology. Section 3 presents the data and empirical results and the last section concludes the paper.

2. Empirical Methodology

In order to assess whether or not ASEAN countries are converging and therefore better fulfilling the optimum currency area criteria, a state-space model developed by Boone (1997) is applied[6].

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[4] Most studies seem to agree that the whole of East Asia is not well positioned for a monetary union, especially when comparing with the European countries before the launch of the euro (e.g., Bayoumi, Eichengreen and Mauro, 2000, Bayoumi and Mauro, 2001, Chow and Kim, 2003). However, there are also those who support the opposite view (e.g. Brito, 2004).

[5] Some dynamics could be created by dividing the sample into sub-periods. Even then, however, the study of temporal relationships in shocks would be very limited.

[6] Also known as the structural time-series approach. Ramos, Clar and Surinach (2003), Babestkii, Boone and Maurel (2004), Zhang and Sato (2005) are recent examples of studies applying this type of method. Haldane and Hall (1991) were the first to use this kind of model to measure to the dynamic linkages of the British pound with the US dollar and the Deutschmark for the period between 1976 and 1989.

The estimated (measurement or signal) equation is defined as:

$$\left(\varepsilon_t^i - \varepsilon_t^j\right) = \alpha_t + \beta_t\left(\varepsilon_t^i - \varepsilon_t^k\right) + \omega_t, \qquad (1)$$

where ε represents the structural shocks, estimated by applying the trivariate SVAR model developed by Clarida and Gali (1994), which allows for estimation of the series of supply, demand (or IS) and monetary (or LM) shocks. The model, which is a stochastic version of the Mundell-Fleming-Dornbush model, is formally presented in Appendix A[7]. Superscripts i and j denote ASEAN country i and j, and k denotes the rest of the world, here proxied by the USA, and ω_t is an independent, normally distributed error term with zero mean and a constant variance H. α_t and β_t are time-varying coefficients defined in matrix form as (state or transition equations):

$$A_t = T_t . A_{t-1} + \eta_t, \qquad (2)$$

where $A_t = (\alpha_t, \beta_t)$, $T_t = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $\eta_t = \left(\eta_{1t}, \eta_{2t}\right)$, which are random error terms with zero mean and variance/covariance matrix Q.

The time-varying coefficients in (2) are estimated by using the Kalman filter and describe the dynamics of the system[8]. α_t is expected to tend towards zero in the long-run as the variables considered here are expected to be white noise[9]. β_t is the important coefficient and measures the temporal relationship in structural shocks among countries i, j and k. Countries i and j will be converging if β tends toward zero, with the opposite being true when β tends towards one[10].

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[7] Nikolakaki (1997) and more recently Brito (2004) extended Clarida and Gali (1994)'s analysis. The latter, extends the model to encompass the Balassa-Samuelson-effect that contradicts Clarida and Gali (1994)'s predictions that positive supply shocks induce disinflation and real depreciation.

[8] The Kalman Filter is a tool that enables the estimation of the state variables and the parameters in a time-varying parameter model using maximum likelihood. For an explanation of the Kalman filter applied to the estimation of time-varying parameters, see for example Boone (1997, 2000).

[9] The time-varying parameter α is not crucial to this model. Ramos, Car and Surinach (2003) apply a version of this model where α is dropped from (2). In this paper, parameter α is included as it provides information on the robustness of the results, given that in a well constructed model α should quickly tend towards zero.

[10] Babestskii, Boone and Maurel (2004) define 'weak' convergence if either α is constant but not necessarily zero and β declines towards zero, or if β shows no tendency to decline in the most recent observations and is defined as 'unclear' if either α or β show an erratic pattern even if β is trending downwards.

When employing the Kalman filter, two key variables assume great importance as they may affect the estimated results. Firstly, the starting values of the state equations have to be guessed and, if too far from their true value, they could significantly alter the results, especially in small samples. Following Zhang and Sato (2005), constant parameter estimation by OLS is performed, and then the OLS estimates are used as the starting values of the state coefficients. Similarly, the variance-covariance matrix obtained by OLS is used in the specification of the variance-covariance matrix of the state equations. Another key variable for the estimation of these variables is the ratio of the variance of the transition to the measurement equation residuals, known as the "signal-to-noise ratio" (Q/H). The higher the signal-to-noise ratio, the more explanatory power is given to the unobserved variables, and the better the fit of the measurement equation. As pointed out by Gordon (1997) and Boone (2000), if no limit is placed on the value of Q (i.e., if it is very large), the unobserved variable will soak up all the residual variation in the measurement equation. Alternatively, if Q is zero (or very small), then the time-varying coefficient will be estimated as a constant.

There appears to be no set rule in fixing the signal-to-noise ratio and the common practice seems to be that the Q/H ratio is fixed "so that the estimated unobserved variable is relatively smooth, with fluctuations which are judged to be reasonable from one period to another"[11]. For the purposes of this study the value of Q was set at a relatively small level (0.1), as large variations of the unobserved variable from one year to the next seem unlikely. Furthermore, the size of the variance of the residuals of the measurement equation was set at a larger value (1) so that the Q/H is fixed at about 0.1, which allows for some dynamics to emerge but avoids sharp period-to-period zigzags[12].

3. Data and Results

The data on both real Gross Domestic Product (GDP) and Consumer Price Index (CPI) comes from IMF's International Financial Statistics and consists of annual real GDP and

[11] Boone (2000), p. 6. Most studies do not indicate their choice for this ratio which makes it virtually impossible to compare results.
[12] This is within the range (0.1 to 0.4) of typical values for the signal-to-noise ratio suggested by Boone (2000).

annual CPI series for all countries which have 1995 as the base year[13]. Data on the Real Effective Exchange Rates (REER) had to be generated, as the IFS database does not provide data for all countries under analysis[14]. The source of the data and methodology used in generating the REER time series are presented in Appendix B.

To identify supply, monetary (or LM) and demand (or IS) disturbances using the model described in Appendix A, trivariate VARs were estimated for each of the five countries under analysis plus the USA which is included as a proxy for the global economy[15]. The period of analysis is 1968-1996 and 1999-2004, leaving out the data on the three variables for the 1997-1998 Asian Financial crisis period as it was likely to distort the results[16]. Since this method requires all variables to be stationary, the first difference of the log functions of real GDP, REER and CPI were used. The results for both the Augmented Dickey-Fuller test and the Phillips-Peron test on the first difference of the log of all three variables are presented in Table C-1 of Appendix C and show all time series to be stationary in at least one of the tests at the 5% level of confidence[17]. As all individual VARs proved to be stable we can reasonably assume all time series to be stationary[18]. A lag of one was chosen for all VARs as the Likelihood Ratio test clearly indicated that this was the ideal lag length in all of the five models.

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[13] The original purpose of this study was to include all ten ASEAN members. A closer look at the available data, however, indicated that such a task was extremely difficult as the data available for some of the smaller members of the ASEAN countries proved to be quite limited. Therefore, the analysis shall be reduced to the five founding members (ASEAN5): Philippines, Malaysia, Indonesia, Singapore and Thailand.

[14] The REER time series were not available for all countries in the analysis. In fact, and perhaps surprisingly, the IMF's International Financial Statistics do not provide data for Indonesia and Thailand.

[15] As the main objective of the estimation of this model is to generate the structural shocks, a cointegration analysis of the VARs was not conducted here.

[16] Even though this strategy can be seen as questionable, the inclusion of this period is known to inflate the results (see for example Zhang, Sato and McAleer, 2004). When the Structural VAR was estimated for the whole sample period (1968-2004), the Jarque-Bera normality tests on the residuals clearly suggested the presence of a structural break in the data.

[17] The exception was the data on the USA consumer price index which was only found to be stationary at the 10% level. However, even in this case the VAR system proved to be stable.

[18] The VARs proved to be stable as the inverse roots of the characteristic AR polynomial test showed that all roots had modulus less than one and thus lay inside the unit circle.

3.1. Correlation of Shocks

The trivariate Structural VAR model allows for the determination of the correlation of the three separate types of shocks. The correlation coefficients of Monetary (or LM), Demand (or IS) and Supply shocks among ASEAN5 members and the USA, used as a proxy for global shocks, are presented in Table 1.

Table 1: Correlation of Structural Shocks in ASEAN – 1968-2004 (excluding 1997 and 1998)

	Ind.	Mal.	Phil.	Sing.	Thail.	USA
Monetary Shocks (LM)						
Indonesia	1.00					
Malaysia	0.09	1.00				
Philippines	-0.04	0.39*	1.00			
Singapore	0.09	0.61*	0.34	1.00		
Thailand	0.16	0.54*	0.18	0.62*	1.00	
USA	0.05	-0.10	0.23	0.16	0.21	1.00
Demand Shocks (IS)						
Indonesia	1.00					
Malaysia	0.34*	1.00				
Philippines	0.57*	0.26	1.00			
Singapore	0.42*	0.39*	0.44*	1.00		
Thailand	0.53*	0.31	0.63*	0.50*	1.00	
USA	0.46*	0.53*	0.52*	0.36*	0.56*	1.00
Supply Shocks (S)						
Indonesia	1.00					
Malaysia	0.47*	1.00				
Philippines	0.20	0.22	1.00			
Singapore	0.36*	0.44*	0.35*	1.00		
Thailand	0.31	0.18	0.14	0.39*	1.00	
USA	0.22	0.34*	0.11	0.24	0.22	1.00

Notes: Significance levels are assessed using Fisher's variance stabilizing transformation. For an explanation see for example Zhang, Sato and McAleer (2004).
* = Positive correlation coefficient at the 5% level.

An analysis of Table 1 allows for several conclusions. First, with two exceptions, all coefficients yield a positive sign which can be seen as an encouraging sign for the existence of preconditions for a common currency area in the region. Also, all pairs that include Malaysia, and the pair Singapore-Thailand yield significant monetary shocks coefficients. Demand shocks are highly correlated among ASEAN members (and the USA) with two exceptions, Malaysia and the Philippines, and Malaysia and Thailand. These results might suggest a high degree of macroeconomic policy coordination not only among ASEAN countries but between the ASEAN countries and the USA[19]. Also, among ASEAN countries, all four pairs that include Singapore, and the pair Malaysia and Indonesia yielded significant supply shock correlation coefficients. Finally, only Malaysia presents a significant correlation coefficient of supply shocks with the USA.

Using a similar methodology, Zhang, Sato and McAleer (2004) found only three significant supply shock correlation coefficients for the period 1980-1997: only two pairs that include Singapore; Singapore-Malaysia and Singapore-Philippines, and the pair Malaysia-Indonesia. When extending the data range to include the financial crisis (1980-2000), they found that two more coefficients became significant: Malaysia-Thailand and Malaysia-Philippines, suggesting that the 1997-1998 Asian financial crisis has increased the degree of shock correlation in ASEAN. Similarly, in this study, Table C-2 of Appendix C presents the correlation of structural shocks in ASEAN for the period 1968-2004 and shows that when including the period of the financial crisis, the number of significant coefficients of the correlation of supply shocks does indeed increase.

The difference in the results presented here with those of Zhang, Sato and McAleer (2004) is likely to be due to the different frequency and range of the data (they use quarterly data from 1980 to 2000).

3.2. Size and Speed of Adjustment of Shocks

Countries are better candidates for a currency union if their disturbances are correlated and small, and adjustment to them is rapid. This is especially true concerning aggregate supply shocks as they are more relevant than both demand and monetary shocks when assessing the feasibility of a monetary union. As pointed out by Bayoumi and Mauro (2001), supply shocks are closely linked to underlying private sector behaviour and therefore are not likely to be related to macroeconomic policies. Conversely, Monetary and Demand shocks are

[19] This is a probable outcome. Demertzis, Hallet and Rummel (2000) show that for the case of the EU, policy actions were responsible for about one-half to one-third of the structural shocks correlations reported for the period 1970-1995. Even though the same degree of policy coordination is not expected to exist in ASEAN, a large number of initiatives have been implemented recently in the region to further policy coordination. See footnote 1 for further details.

easier to tame through the implementation of common demand policies which are likely to be implemented if further monetary cooperation in ASEAN is attempted.

Since the estimated structural shocks are assumed to have unit variances, their size and adjustment speed cannot be inferred by analysing the identified disturbances recovered from the VAR estimation. They can, however, be determined by analysing the associated impulse response functions. Since supply shocks are the only ones with permanent effects on output, the size of supply shocks is measured as the long-run effect (12-year horizon) of a unit shock on changes in real GDP. The size of demand shocks is measured as the sum of its 1-year impact on the changes of real GDP and price level (Bayoumi and Eichengreen, 1994), and the size of monetary shocks is measured as its 1-year impact on the changes of the real effective exchange rates (Brito, 2004).

The speed of adjustment to shocks is defined in this study as the proportion of the long run adjustment accomplished in the first two years after the occurrence of a structural shock[20]. Both the size and the speed of adjustment to disturbances are crucial to the assessment of the feasibility of a currency union. The smaller the size of underlying shocks the easier it will be to maintain a fixed exchange rate, and therefore the stronger the case for a monetary union. Also, as pointed out by Brito (2004), if the deviations that follow a shock are quickly eliminated, the costs of forsaking policy independence are bound to be smaller even in situations where countries experience asymmetric shocks and divergent responses to those shocks. Table 2 presents the size of shocks and the speed of adjustment to disturbances.

Table 2: Size and Speed of Adjustment of Structural Shocks

	Monetary Shocks		Demand Shocks		Supply Shocks	
	Size	Speed	Size	Speed	Size	Speed
Indonesia	0.0355	0.935	0.0151	0.872	0.0285	0.955
Malaysia	-0.0120	0.966	0.0091	0.985	0.0335	0.731
Philippines	0.0117	0.999	0.0188	0.938	0.0508	0.700
Singapore	0.0195	0.969	0.0097	0.843	0.0558	0.736
Thailand	-0.0283	0.877	0.0168	0.912	0.0323	0.869
USA	-0.0268	0.787	0.0049	0.964	0.0153	0.659

[20] Following Brito (2004), the speed of adjustment is measured as the average across the endogeneous variables of one minus the adjustment remaining. The adjustment remaining is calculated as the absolute value of one minus the ratio of the response after two years to the long run effect of any particular shock. For the responses to which the theoretical identifying restrictions impose convergence toward zero, the measure of the speed of adjustment is computed as one minus the impulse-response after two years.

Brito (2004) using the same method, estimated the Euro-zone average speed of adjustment to Monetary, Demand and Supply shocks to be 0.919, 0.669 and 0.502 and the average size to be 0.0078, 0.0059 and 0.0213, respectively for the period 1979-1998[21]. Thus, the average size of the three underlying shocks is much larger in ASEAN than in both the Euro-zone countries and the USA. In contrast, the speed of adjustment to shocks is much faster in ASEAN than both the EU and the USA. The explanation seems to point to the fact that the labour market and wage rates are more flexible in ASEAN which makes it easier for these countries to adjust internally to shocks (Bayoumi and Mauro, 2001).

The combination of the results from Tables 1 and 2 allows for the clear distinction of a core (formed by Indonesia, Malaysia and Singapore) as they experience smaller and more correlated supply disturbances, and a periphery (formed by Thailand and the Philippines) in ASEAN. These results are in line with most of the previous studies.

3.3. Constant Parameter Estimation Results

As mentioned above, the initial values of the state equations are provided by OLS estimation of (1). The results for the full sample period (1968-2004) are presented in Table C-3 of Appendix C and Table C-4 presents the results for the period 1968-1996 and 1999-2004. One immediate conclusion we can make from these two tables is that, in the great majority of cases, the Asian Financial Crisis seems to have increased convergence among ASEAN members, as the β estimates in Table C-3 are lower than those in Table C-4. Furthermore, it is clear in both cases, that the degree of convergence of supply shocks among the ASEAN5 is much higher that the convergence achieved for both monetary and demand shocks. Finally, all the estimated β coefficients measuring the convergence of Singapore with its ASEAN partners (fourth column in Tables C-3 and C-4) are somewhat atypical. In fact, only one out of twelve of the OLS estimated coefficients were found to be significant at the 1% level in Table C-3 with one of them (Singapore-Malaysia) found to be negative. Nevertheless, the

[21] Bayoumi and Mauro (2001) found the average size of supply shocks in the Euro-zone for the period 1969-1989 to be 0.031. Since they apply a bivariate analysis, the other results are not comparable.

overall pattern found in both those tables is broadly consistent with the pattern found for shock correlation in the previous section.

3.4. Time-Varying Parameter Estimation Results

In this section, the state-space model described in (1) and (2) is estimated by the use of the Kalman filtering procedure. This model allows for the estimation of the time-varying parameters α_t and β_t. All estimates presented in this section are smoothed estimates (which use the full information set) rather than filtered estimates (which only use the information available at the time that the forecast was made)[22]. The estimated time-varying β coefficients showing the monetary (or LM), demand (or IS), and supply shock convergence path of Indonesia, Malaysia, the Philippines, Singapore and Thailand with each of its ASEAN5 partners against the rest of the world, here proxied by the U.S., for the period 1968-2004, excluding the years 1997 and 1998, are presented in Figures C-1 to C-5, respectively, of Appendix C[23]. As expected, the shape over the whole sample period of the estimated β coefficients paths is broadly similar both for the convergence path from country i to country j and from country j to country i, as opposed to the rest of the world. In some cases, however, the trend in some periods is quite different in each case, with the β coefficients attaining values well out of the expected range. The likely reason for this outcome is that the model might not be well specified in some cases and therefore the time-varying constant α is capturing the fact that the difference between country i's shocks and those of the USA vary greatly from the difference between those of country j and the USA[24]. This would suggest that

[22] As pointed out by Boone (2000), the Kalman filtering procedure comprises two stages: first a filtering procedure, second a smoothing procedure. The smoothing procedure allows for the smoothing of the first stage estimate, taking the information available from the whole sample of observation which provides more robust estimates. It should be noted, however, that the use of smooth estimates makes it less likely for the estimates of α_t to be stationary as should be expected in a well constructed model.

[23] Estimations of the time-varying model for the whole sample period 1968-2004 were also conducted and the results were found to be very similar to the reported ones but much more volatile.

[24] This is quite clear, for example, in terms of the monetary shocks convergence path of Indonesia-Malaysia and Malaysia-Indonesia (blue line in left-hand graphs in figures C-1 and C-2, respectively). In both cases, the highest values are reached in 1979. But whilst in the first case the period of convergence after that ends in 1986, in the second case it continues until 2004, with is final value being around an unexpected -0.5. An analysis of the data on the difference of Indonesian and Malaysian monetary shocks with those of the USA shows that the mean value for the years 1986-2004 is close to zero in the first case (0.000419) but far from zero in the second (0.104576) which might explain the different results. At the same time, the α estimates (not reported) tend towards zero in the case of Indonesia-Malaysia but not in the case of Malaysia-Indonesia.

the signal-to-noise ratio should not be set at the same level for all cases, or that the data should be normalised between 0 and 1. That would, however, make comparisons very difficult and therefore, the same constraints are applied in all cases. For the purposes of this paper, the existence of a clear trend is defined only when the same trend can be identified both ways, that is, when the same trend can be found in the convergence (divergence) of country i with country j and simultaneously from country j to country i.

Following this definition of convergence, a visual analysis of Figures C-1 to C-5 shows very few clear trends over the whole sample period. The only exceptions are a clear diverging trend in the cases of the β estimates of Monetary shocks of the Philippines with Malaysia and the Philippines with Singapore.

In order to facilitate the analysis, the mean values and standard deviations of the β estimates of monetary, demand and supply shocks for five alternative time spans are presented in Tables C-5 to C-7 respectively, of Appendix C. The first three columns show the mean values and standard deviations of three similar spaced sub-periods, 1968-1979, 1980-1991 and 1992-2004, the fourth column shows the results for the whole sample period excluding the 1997-1998 Asian Financial Crisis data, and the last column shows the results for the whole sample (1968-2004), and thus including the data for 1997 and 1998. In addition, information on whether the α time-varying estimates were found to be stationary was included in the last two columns.

One immediate conclusion that can be made is that unit root tests on the α time-varying coefficient estimates showed that the hypothesis of a unit root could not be rejected at the 5% level in a large number of cases, especially in the case of monetary shocks. As discussed above, the choice for smooth estimates makes this outcome more likely. Furthermore, an analysis of Tables C-5 to C-7 of Appendix C, shows that in terms of Monetary Shocks, convergence over the whole sample period was found in the pair Indonesia-Malaysia and in Indonesia-Thailand whilst divergence occurred in the pairs Philippines-Indonesia and Philippines-Singapore. In terms of demand shocks, the only case of convergence was found in the pair Indonesia-Philippines whilst in the case of supply shocks, no clear trend was found.

When concentrating on the last period (1992-2004), however, a clearer picture emerges. The evolution of the time-varying estimates of β for this period in comparison with the one that precedes it (1980-1991), for the three types of shocks is presented in Table 3 below.

Table 3: Convergence of ASEAN5 countries with their partners as opposed to the USA (assembled from Tables C-5 to C-7 from Appendix C)[Ж].

	Ind.	Mal.	Phil.	Sing.	Thail.
Monetary Shocks (LM)					
Indonesia	-				
Malaysia	▼▼	-			
Philippines	▲▲	▲▼	-		
Singapore	▼▲	▲▼	▲▲	-	
Thailand	▼▼	▲▼	▲▼	▲▼	-
Demand Shocks (IS)					
Indonesia	-				
Malaysia	▼▼	-			
Philippines	▼▼	▼▼	-		
Singapore	▼▼	▼▲	▼▼	-	
Thailand	▼▼	▼▼	▼▼	▲▼	-
Supply Shocks (S)					
Indonesia	-				
Malaysia	▼▲	-			
Philippines	▼▲	▲▲	-		
Singapore	▲▲	▼▲	▲▲	-	
Thailand	▼▲	▲▲	▲▲	▲▲	-

Notes: ▲ = increase from previous period (divergence).
▼ = decrease from previous period (convergence).
First symbol indicates the increase or decrease in the convergence of country i to country j while the second indicates the convergence of country j to county i as opposed to the USA. According to the definitions set in this paper, convergence or divergence only occurs in the cases where the symbols are black.
Ж = excluding the years 1997 and 1998.

An analysis of Table 3 allows for some important conclusions[25]. First, the only clear trends in terms of monetary shocks are the same trends that were found for the whole sample period analysis, that is, convergence for the pairs Indonesia-Malaysia and Indonesia-Thailand, and divergence for the pairs Philippines-Indonesia and Philippines-Singapore. Next, in terms of demand shocks, with two exceptions (Singapore-Malaysia, and Singapore-Thailand), all country pairs present a clear converging trend. Finally, in terms of supply shocks, the majority of cases yield a clear diverging trend. This being particularly true for the case of Thailand

[25] When including the critical years of the Asian Financial Crisis, the results were found to be exactly the same with the exception of the trend in convergence of Monetary Shocks. In this case, four diverging relationships were found: Philippines-Indonesia, Philippines-Malaysia, Philippines-Singapore and Singapore-Malaysia. And no convergence was found.

(Thailand-Malaysia, Thailand-Philippines and Thailand-Singapore) and the Philippines (Philippines-Malaysia, Philippines-Singapore and Philippines-Thailand). Considering that supply shocks are more relevant than both demand and monetary shocks when assessing the feasibility of a monetary union, these results imply that the countries forming the periphery are increasingly less prepared to embark on further monetary cooperation with their ASEAN partners.

4. Concluding Remarks

The present study expands the existing literature by applying a dynamic analysis of the symmetry of shocks in ASEAN. The results yielded a number of important results that complement the Structural VAR analysis of previous studies. First, it showed that in the majority of cases there has been an increase in the degree of convergence of demand shocks in recent years. More importantly, it also showed an increase in divergence in supply shocks for most cases since the beginning of the 90's even when taking into account the Asian Financial Crisis. This is especially true for the periphery countries suggesting that the Philippines and Thailand are not only not converging but actually diverging from the core group comprising Indonesia, Malaysia and Indonesia. Considering that supply shocks are more relevant than both monetary and demand shocks when assessing the feasibility of a monetary union, these results imply that an ASEAN5 wide monetary union should not be attempted without further economic integration. Nevertheless, the evidence also suggests the existence of a core that is in a better position to move faster towards the constitution of a monetary union in the future than the periphery, in what can be perceived as a 'two-speed' monetary integration process[26].

In this way, several areas of further research can be identified. First, the inclusion of a larger number of ASEAN economies in the analysis would certainly allow us to refine the

[26] A two-speed integration process has already been considered in ASEAN but in terms of economic integration. In fact, the October 2003 Bali summit clearly considered the possibility of adopting a so-called "2+x" approach to ASEAN economic integration, in which two countries which are ready to cooperate on specific sectors could work together first, instead of waiting for a consensus to be reached on the global level (or the so-called "ASEAN-x" formula).

conclusions on the desirability (and extent) of ASEAN becoming a currency union. Second, the state-space model and the Kalman filtering method applied in the dynamic analysis require several key assumptions which can significantly alter the results and for which there seems to be no consensus in the current literature about the right procedures. Finally, the study of the causes of the degree of convergence in structural shocks such as the degree of factor mobility across countries or the effect of trade or macroeconomic policy coordination, would almost certainly help explain the reasons behind the fact that some countries appear to have more synchronised business cycles than others and thus complement the results presented in this study.

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APPENDIX A: Description of the Clarida and Gali (1994) Methodology as Applied in this Paper

Clarida and Gali (1994)'s methodology can be explained briefly as follows. Consider a system where the true model can be represented by an infinite moving average of a (vector) of variables X_t and an equal number of shocks ε_t. Using the lag operator L, this can be written as:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + A_3\varepsilon_{t-3} + ... \quad (1)$$

$$= \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t,} \quad (2)$$

where the matrices A_i represent the impulse response functions to the shocks of the elements of X. Let vector X be made up of the change in output, Δy, changes in the real effective exchange rate, Δq and changes in the price level, Δp. The reduced form, moving average representation is given by

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix} \begin{bmatrix} \varepsilon_{lmt} \\ \varepsilon_{ISt} \\ \varepsilon_{St} \end{bmatrix}, \quad (3)$$

where y_t, p_t and q_t represent the logarithm of output, real effective exchange rates and prices, ε_{LMt} , ε_{ISt} and εst independent (LM) monetary, (IS) demand and (S) supply disturbances, and a_{11i} represents element a_{11} in matrix A_i.

Since the vector of structural disturbances ε_t is unobservable, the system of equations in (3) cannot be estimated directly. Following the Blanchard and Quah (1989) decomposition method, we assume that the estimated residuals of a VAR on the elements of X, e_t , are linear representations of the unobservable structural shocks, ε_t, so that $e_t = C\varepsilon_t$.

Estimating this model using a Vector Autoregression (VAR), and letting B represent these estimated coefficients, the estimating equation becomes

$$X_t = B_1 X_{t-1} + B_2 X_{t-2} + ... + B_n X_{t-n} + e_t \quad (4)$$

$$= \left[(I - B(L))\right]^{-1} e_t$$

$$= \left[I + B(L) + B(L)^2 + B(L)^{3..} + ...\right] e_t$$

$$= e_t + D_1 e_{t-1} + D_2 e_{t-2} + D_3 e_{t-3} + \dots \ ,$$

or alternatively:

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta p_t \end{bmatrix} = \sum_{i=1}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} & d_{13i} \\ d_{21i} & d_{22i} & d_{23i} \\ d_{31i} & d_{32i} & d_{33i} \end{bmatrix} . \begin{bmatrix} e_{yt} \\ e_{qt} \\ e_{pt} \end{bmatrix}, \tag{5}$$

where e_t represents the residuals of a regression of lagged values of Δy_t, Δq_t and Δp_t on current values of each in turn, that is, the residuals of the output, exchange rates and price equations, e_{yt} , e_{qt} and e_{pt}, respectively.

To convert this reduced form equation into the structural model, the residuals from the VAR, e_t, must be transformed into monetary, demand and supply shocks, ε_t. Following the Blanchard and Quah (1989) decomposition method, it is assumed that the estimated residuals of a VAR on the elements of X, e_t, are linear representations of the unobservable structural shocks, ε_t, so that (3) and (5) can be combined as

$$\begin{bmatrix} e_{yt} \\ e_{qt} \\ e_{pt} \end{bmatrix} = \left[\sum_{i=1}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} & d_{13i} \\ d_{21i} & d_{22i} & d_{23i} \\ d_{31i} & d_{32i} & d_{33i} \end{bmatrix}^{-1} . \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix} \right] . \begin{bmatrix} \varepsilon_{lLMt} \\ \varepsilon_{ISt} \\ \varepsilon_{St} \end{bmatrix} = C . \begin{bmatrix} \varepsilon_{LMt} \\ \varepsilon_{ISt} \\ \varepsilon_{St} \end{bmatrix} \tag{6}$$

To uniquely identify matrix C in the three by three case described above, nine restrictions have to be imposed to reduce the number of unknown structural parameters to be less than or equal to the number of estimated parameters of the variance-covariance matrix Σ of the innovations e_y e_q, and e_p. It is assumed that the three structural shocks are serially uncorrelated and have a variance-covariance matrix normalized to the identity matrix. In this manner, the orthogonality condition CC'=Σ imposes six non-linear restrictions on the elements of C.

The remaining three (theoretical) necessary restrictions stem from the condition that only supply shocks have permanent effects on output (and therefore the cumulative effect of both ε_{IS} and ε_{LM} shocks on output growth is zero) and that monetary shocks (ε_{LM}) do not have long-run effects on real effective exchange rates. These conditions, given the ordering of the variables, imply the restrictions:

$$\sum_{i=0}^{\infty} a_{11i} = \sum_{i=0}^{\infty} a_{12i} = \sum_{i=0}^{\infty} a_{21i} = 0\,, \tag{7}$$

which in terms of the SVAR model implies:

$$\sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} & d_{13i} \\ d_{21i} & d_{22i} & d_{23i} \\ d_{31i} & d_{32i} & d_{33i} \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{bmatrix} = \begin{bmatrix} 0 & 0 & . \\ 0 & . & . \\ . & . & . \end{bmatrix}, \tag{8}$$

and allows the matrix C to be uniquely defined, and the monetary, demand and supply shocks to be (just) identified.

APPENDIX B: Description of the Real Effective Exchange Rate Methodology

The Real Effective Exchange Rate time series (REER) were calculated for the five countries under analysis for the period 1968-2001. According to the IMF's definition, the REER is computed as the weighted geometric average of the price of the domestic country relative to the prices of its trade partners. Following Zanello and Desruelle (1997), the REER (based on consumer price indices) can be expressed as[27]:

$$REER = \prod_{j \neq i} \left[\frac{P_i R_i}{P_j R_j} \right]^{Wij},$$

where *j* is an index that runs over country *i*'s partners, W_{ij} is the competitiveness weight of country *i* on country *j*, P*i* and P*j* are consumer price indices in countries *i* and *j*, and R*i* and R*j* represent the nominal exchange rates of countries *i* and *j*'s currencies in US dollars. An increase in the index denotes an appreciation of country *i*'s currency.

In this computation, the IMF weights were calculated by using trade flows from 1988-1990 and were based on (a weighted average of) trade in manufactures, primary commodities and tourism services. The CPI based REER index uses the IMF weights for 23 countries including Australia, Belgium, Brazil, Canada, China, Hong Kong, Germany, Indonesia, Italy, Japan, Korea, Malaysia, the Netherlands, the Philippines, Singapore, Spain, Sweden, Switzerland, Thailand, the United Kingdom, the United States and Taiwan.

Data for the competitiveness weights W_{ij}, was kindly provided by IMF's Dominique Desruelle. Both price index and nominal exchange rates source of data was mostly IMF's International Financial Statistics. Exceptions are the CPI data for China and Taiwan with the first taken from the World Bank's World Development Indicators and the latter provided by the Directorate -General of Budget, Accounting and Statistics of the Republic of China.

The indices were calculated at a yearly frequency for the period 1968-2004 and have 1995 as the base year.

[27] Zanello and Desruelle (1997) also present a method of computation of REER based on unit labour costs. However, in this paper the CPI based REER was chosen since as a rule it should provide the same information and its data is more readily available.

APPENDIX C: Additional Data and Results

Table C-1: Unit Root Test Results for the first difference of the log of real GDP, CPI and REER time series. Data Range: 1968-2004

	ADF Test Statistic			PP Test Statistic		
Country	CPI	Real GDP	REER	CPI	Real GDP	REER
Indonesia	-8.7813*	-3.5306**	-5.4242*	-5.0262*	-4.4092*	-8.9110*
Malaysia	-3.8090*	-3.3468**	-3.8206*	-3.3011**	-4.3349*	-4.8976*
Philippines	-4.9005*	-4.2440*	-5.0077*	-4.6151*	-4.2422*	-7.0707*
Singapore	-4.6896*	-3.2948**	-4.4119*	-3.2806**	-3.5562**	-3.4025**
Thailand	-3.6084**	-3.2823**	-4.2688*	-3.1065**	-3.3801**	-4.9591*
USA	-2.8490***	-5.4467*	-3.5783**	-2.0458	-4.8806*	-3.5240**

Where: *, ** and *** = rejection of hypothesis of unit root at 1%, 5% and 10% level, respectively.
ADF= Augmented Dickey-Fuller
PP = Phillips-Peron

Table C-2: Correlation of Structural Shocks in ASEAN – 1968-2004

	Ind.	Mal.	Phil.	Sing.	Thail.	USA
Monetary Shocks (LM)						
Indonesia	1.00					
Malaysia	0.37*	1.00				
Philippines	0.06	0.25	1.00			
Singapore	0.25	0.68*	0.28	1.00		
Thailand	0.43*	0.64*	0.12	0.61*	1.00	
USA	0.24	-0.12	0.15	0.08	0.18	1.00
Demand Shocks (IS)						
Indonesia	1.00					
Malaysia	0.42*	1.00				
Philippines	0.53*	0.21	1.00			
Singapore	0.44*	0.36*	0.45*	1.00		
Thailand	0.54*	0.39*	0.63*	0.49*	1.00	
USA	0.32	0.37*	0.44*	0.33*	0.51*	1.00
Supply Shocks (S)						
Indonesia	1.00					
Malaysia	0.56*	1.00				
Philippines	0.57*	0.42*	1.00			
Singapore	0.51*	0.53*	0.50*	1.00		
Thailand	0.69*	0.34*	0.49*	0.48*	1.00	
USA	0.16	0.31	0.08	0.21	0.11	1.00

Notes:
Significance levels are assessed using Fisher's variance stabilizing transformation. For an explanation see for example Zhang, Sato and McAleer (2004).
* = Positive correlation coefficient at the 5% level.

Table C-3: Convergence of ASEAN5 countries with their partners as opposed to the USA
Constant Parameter Estimation of β (OLS) – Period: 1968-2004

Convergence of: / With:	Ind.	Mal.	Phil.	Sing.	Thail.
Monetary Shocks (LM)					
Indonesia	-	0.468*	0.780*	0.443**	0.361***
Malaysia	0.476*	-	0.447*	-0.119	0.016
Philippines	0.810*	0.516*	-	0.342***	0.581*
Singapore	0.686*	0.360*	0.570*	-	0.286*
Thailand	0.585*	0.351*	0.684*	0.177	-
Demand Shocks (IS)					
Indonesia	-	0.398**	0.482*	0.235	0.145
Malaysia	0.508*	-	0.808*	0.329**	0.366*
Philippines	0.439*	0.746*	-	0.410**	0.185
Singapore	0.502*	0.467*	0.646*	-	0.247***
Thailand	0.521*	0.566*	0.578*	0.351*	-
Supply Shocks (S)					
Indonesia	-	0.150	0.195**	0.119	0.057
Malaysia	0.242**	-	0.321*	0.201***	0.259**
Philippines	0.120	0.168	-	0.072	0.067
Singapore	0.225**	0.212**	0.253*	-	0.149***
Thailand	0.151**	0.253**	0.232*	0.129	-

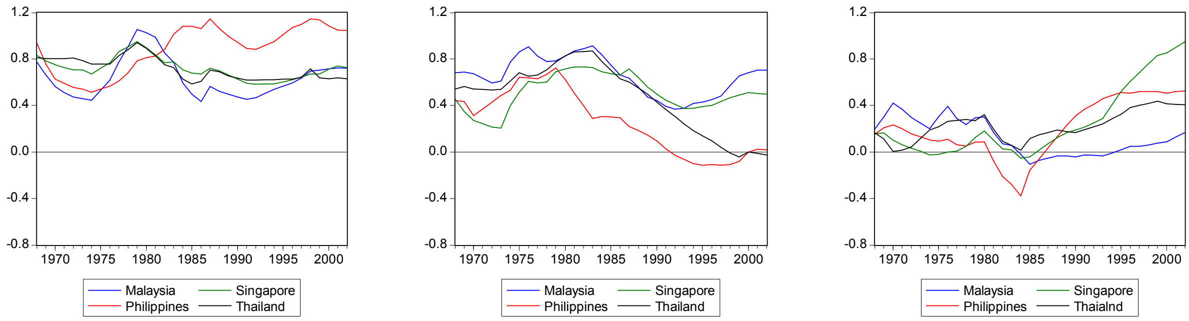
Notes: Regressions also included a constant (not reported)
* = Significant at the 1% level.
** = Significant at the 5% level.
*** = Significant at the 10% level.

Table C-4: Convergence of ASEAN5 countries with their partners as opposed to the USA
Constant Parameter Estimation of β (OLS) – Period: 1968-2004 (excluding 1997-1998)

Convergence of: / With:	Ind.	Mal.	Phil.	Sing.	Thail.
Monetary Shocks (LM)					
Indonesia	-	0.649*	0.893*	0.509***	0.505**
Malaysia	0.739*	-	0.427**	-0.087	0.061
Philippines	0.933*	0.516*	-	0.423**	0.647*
Singapore	0.820*	0.462*	0.662*	-	0.320*
Thailand	0.796*	0.478*	0.767*	0.235**	-
Demand Shocks (IS)					
Indonesia	-	0.665*	0.640*	0.401**	0.390**
Malaysia	0.693*	-	0.962*	0.503*	0.724*
Philippines	0.430**	0.935*	-	0.570**	0.303
Singapore	0.479*	0.528*	0.764*	-	0.353**
Thailand	0.537*	0.771*	0.665*	0.434*	-
Supply Shocks (S)					
Indonesia	-	0.261**	0.324*	0.232**	0.289*
Malaysia	0.182	-	0.318*	0.201***	0.327**
Philippines	0.135	0.211	-	0.091	0.193
Singapore	0.154	0.204**	0.212**	-	0.187**
Thailand	0.165	0.288**	0.261**	0.136	-

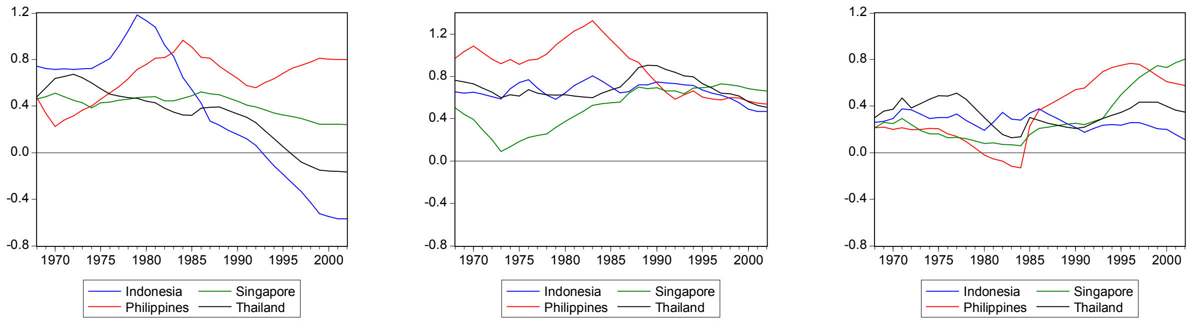
Notes: Regressions also included a constant (not reported)
* = Significant at the 1% level.
** = Significant at the 5% level.
*** = Significant at the 10% level.

Figure C-1: Convergence of Indonesia to ASEAN as opposed to the USA: β coefficients: (1968-2004, excluding 1997-1998)



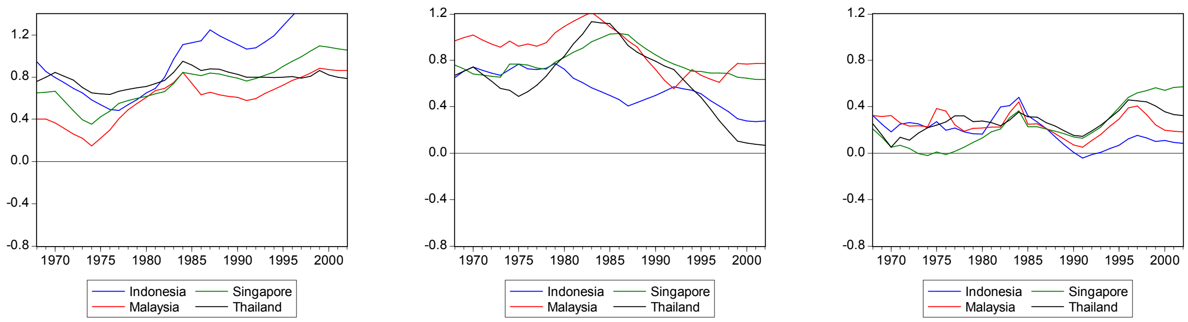
Monetary Shocks Demand Shocks Supply Shocks

Figure C-2: Convergence of Malaysia to ASEAN4 as opposed to the USA: β coefficients (1968-2004, excluding 1997-1998)



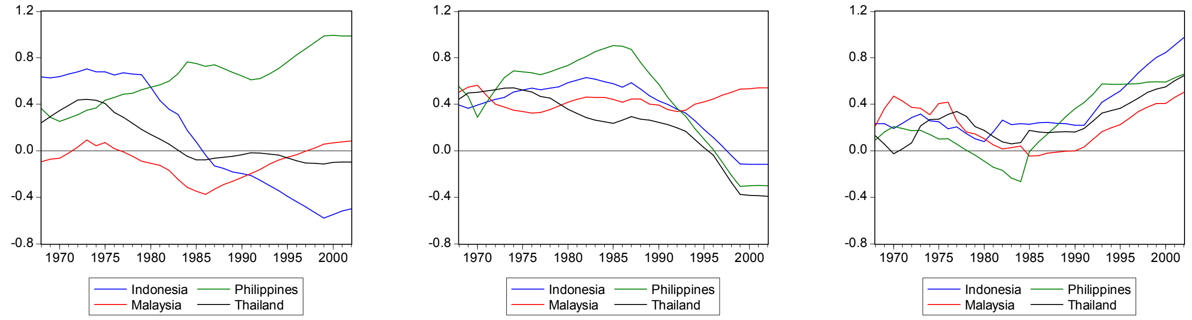
Monetary Shocks Demand Shocks Supply Shocks

Figure C-3: Convergence of Philippines to ASEAN4 as opposed to the USA: β coefficients (1968-2004, excluding 1997-1998)



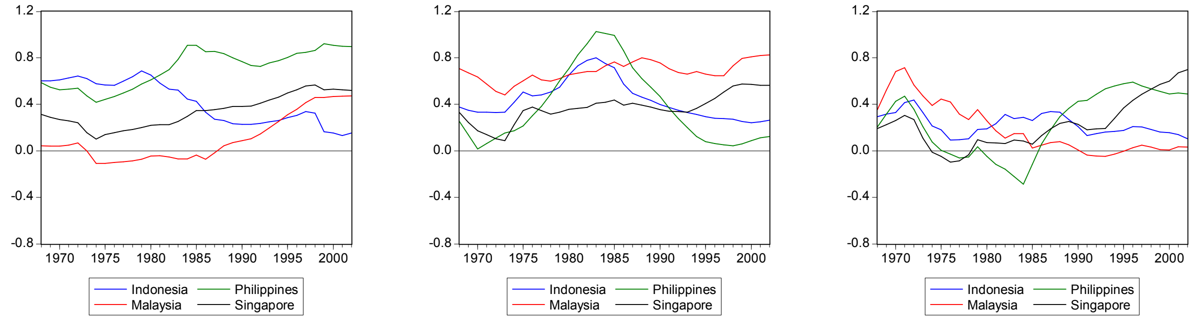
Monetary Shocks Demand Shocks Supply Shocks

Figure C-4: Convergence of Singapore to ASEAN4 as opposed to the USA: β coefficients (1968-2004, excluding 1997-1998)



Monetary Shocks | Demand Shocks | Supply Shocks

Figure C-5: Convergence of Thailand to ASEAN4 as opposed to the USA: β coefficients (1968-2004, excluding 1997-1998)



Monetary Shocks | Demand Shocks | Supply Shocks

Table C-5: Convergence of ASEAN5 countries with their partners as opposed to the USA
Time Varying Parameter estimation of β (OLS) – Period: 1968-2004

Monetary Shocks (LM)

		1968-1979	1980-1991	1992-2004$^{\varphi}$	1968-2004$^{\varphi}$ β	α$^{\theta}$	full sample^{Ж} β	α$^{\theta}$
Convergence of Indonesia on:								
	Malaysia	0.647	0.639▼	0.624▼	0.637	y	0.387	n
		(0.194)	(0.213)	(0.095)	(0.172)		(0.126)	
	Philippines	0.643	0.983▲	1.035▲	0.883	n	0.668	n
		(0.126)	(0.110)	(0.086)	(0.207)		(0.250)	
	Singapore	0.782	0.718▼	0.650▲	0.719	n	0.535	n
		(0.087)	(0.087)	(0.059)	(0.094)		(0.133)	
	Thailand	0.811	0.694▼	0.638▼	0.716	y	0.518	n
		(0.055)	(0.093)	(0.027)	(0.097)		(0.084)	
Convergence of Malaysia on:								
	Indonesia	0.815	0.546▼	-0.318▼	0.367	n	0.241	n
		(0.154)	(0.370)	(0.229)	(0.549)		(0.442)	
	Philippines	0.440	0.784▲	0.723▼	0.647	n	0.620	n
		(0.148)	(0.110)	(0.091)	(0.192)		(0.257)	
	Singapore	0.454	0.470▲	0.298▼	0.410	n	0.367	y
		(0.032)	(0.032)	(0.054)	(0.087)		(0.095)	
	Thailand	0.561	0.367▼	-0.022▼	0.312	y	0.298	n
		(0.079)	(0.043)	(0.154)	(0.262)		(0.139)	
Convergence of Philippines on:								
	Indonesia	0.660	1.022▲	1.395▲	1.015	n	0.842	n
		(0.149)	(0.200)	(0.193)	(0.350)		(0.275)	
	Malaysia	0.340	0.670▲	0.776▲	0.590	y	0.591	y
		(0.118)	(0.075)	(0.100)	(0.216)		(0.325)	
	Singapore	0.535	0.766▲	0.969▲	0.750	y	0.575	n
		(0.107)	(0.081)	(0.114)	(0.204)		(0.119)	
	Thailand	0.722	0.835▲	0.807▼	0.788	y	0.650	y
		(0.071)	(0.070)	(0.020)	(0.076)		(0.099)	
Convergence of Singapore on:								
	Indonesia	0.661	0.082▼	-0.445▼	0.115	n	0.167	n
		(0.022)	(0.274)	(0.108)	(0.485)		(0.380)	
	Malaysia	-0.013	-0.250▼	-0.014▲	-0.095	n	-0.087	y
		(0.191)	(0.087)	(0.084)	(0.137)		(0.053)	
	Philippines	0.383	0.665▲	0.849▲	0.627	n	0.455	n
		(0.094)	(0.074)	(0.142)	(0.219)		(0.183)	
	Thailand	0.336	-0.011▼	-0.079▼	0.087	n	0.101	n
		(0.088)	(0.072)	(0.035)	(0.197)		(0.125)	
Convergence of Thailand on:								
	Indonesia	0.612	0.392▼	0.235▼	0.418	n	0.327	n
		(0.035)	(0.154)	(0.075)	(0.184)		(0.170)	
	Malaysia	-0.028	-0.009▲	0.363▲	0.101	y	0.051	n
		(0.068)	(0.066)	(0.121)	(0.200)		(0.180)	
	Philippines	0.510	0.785▲	0.840▲	0.708	n	0.593	n
		(0.052)	(0.097)	(0.067)	(0.163)		(0.205)	
	Singapore	0.206	0.314▲	0.505▲	0.337	n	0.284	n
		(0.066)	(0.067)	(0.050)	(0.138)		(0.206)	
no. of obs:		12	12	11	35		37	

Notes: Figures in the table represent mean values for five alternative time spans. Values in parenthesis represent standard deviations.
φ = excluding the years of 1997 and 1998.
Ж = including the years of 1997 and 1998.
θ = Result of Dickey-Fuller Unit Root tests on the α time-varying coefficient estimates, where y = rejection of hypothesis of a unit root at 5% critical level and n = failure to reject the presence of a unit root at the 5% critical level. The estimations included a trend when a trend was found to be significant at the 5% level.
▲ = increase from previous period (divergence).
▼ = decrease from previous period (convergence).

Table C-6: Convergence of ASEAN5 countries with their partners as opposed to the USA
Time Varying Parameter estimation of β (OLS) – Period: 1968-2004

Demand Shocks (IS)

	1968-1979	1980-1991	1992-2004$^{\varphi}$	1968-2004$^{\varphi}$		full sample$^{\text{Ж}}$	
				β	α^{θ}	β	α^{θ}
Convergence of Indonesia on:							
Malaysia	0.734	0.686▼	0.531▼	0.654	y	0.508	y
	(0.100)	(0.186)	(0.135)	(0.165)		(0.191)	
Philippines	0.525	0.282▼	-0.062▼	0.257	y	0.310	y
	(0.133)	(0.167)	(0.055)	(0.273)		(0.155)	
Singapore	0.429	0.649▲	0.440▼	0.508	n	0.508	n
	(0.173)	(0.097)	(0.053)	(0.156)		(0.167)	
Thailand	0.612	0.665▲	0.083▼	0.464	y	0.535	n
	(0.081)	(0.179)	(0.118)	(0.292)		(0.195)	
Convergence of Malaysia on:							
Indonesia	0.656	0.718▲	0.607▼	0.662	y	0.446	y
	(0.057)	(0.049)	(0.101)	(0.085)		(0.265)	
Philippines	0.992	1.047▲	0.590▼	0.885	y	0.707	y
	(0.059)	(0.221)	(0.035)	(0.242)		(0.247)	
Singapore	0.274	0.569▲	0.688▲	0.505	y	0.461	y
	(0.123)	(0.109)	(0.028)	(0.200)		(0.184)	
Thailand	0.666	0.734▲	0.668▼	0.690	y	0.570	n
	(0.056)	(0.126)	(0.114)	(0.105)		(0.158)	
Convergence of Philippines on:							
Indonesia	0.718	0.530▼	0.410▼	0.557	y	0.386	y
	(0.036)	(0.092)	(0.121)	(0.154)		(0.259)	
Malaysia	0.962	0.995▲	0.693▼	0.889	y	0.685	y
	(0.039)	(0.191)	(0.076)	(0.180)		(0.325)	
Singapore	0.725	0.927▲	0.687▼	0.782	y	0.660	n
	(0.046)	(0.082)	(0.043)	(0.122)		(0.122)	
Thailand	0.629	0.948▲	0.325▼	0.643	y	0.568	n
	(0.088)	(0.136)	(0.243)	(0.302)		(0.276)	
Convergence of Singapore on:							
Indonesia	0.471	0.548▲	0.070▼	0.371	y	0.116	y
	(0.067)	(0.076)	(0.187)	(0.240)		(0.462)	
Malaysia	0.471	0.548▲	0.070▼	0.371	y	0.139	y
	(0.067)	(0.076)	(0.187)	(0.240)		(0.210)	
Philippines	0.579	0.765▲	-0.051▼	0.445	y	0.241	y
	(0.133)	(0.140)	(0.026)	(0.392)		(0.449)	
Thailand	0.493	0.273▼	-0.138▼	0.219	n	0.144	n
	(0.042)	(0.037)	(0.237)	(0.294)		(0.327)	
Convergence of Thailand on:							
Indonesia	0.415	0.597▲	0.283▼	0.436	y	0.265	n
	(0.083)	(0.159)	(0.035)	(0.166)		(0.286)	
Malaysia	0.601	0.727▲	0.722▼	0.683	y	0.377	y
	(0.065)	(0.048)	(0.075)	(0.085)		(0.201)	
Philippines	0.239	0.755▲	0.111▼	0.376	y	0.256	y
	(0.176)	(0.221)	(0.071)	(0.327)		(0.291)	
Singapore	0.251	0.385▲	0.475▲	0.368	y	0.299	n
	(0.104)	(0.030)	(0.099)	(0.124)		(0.229)	
no. of obs:	12	12	11	35		37	

Notes: Figures in the table represent mean values for five alternative time spans. Values in parenthesis represent standard deviations.
φ = excluding the years of 1997 and 1998.
Ж = including the years of 1997 and 1998.
θ = Result of Dickey-Fuller Unit Root tests on the α time-varying coefficient estimates, where y = rejection of hypothesis of a unit root at 5% critical level and n = failure to reject the presence of a unit root at the 5% critical level. The estimations included a trend when a trend was found to be significant at the 5% level.
▲ = increase from previous period (divergence).
▼ = decrease from previous period (convergence).

Table C-7: Convergence of ASEAN5 countries with their partners as opposed to the USA
Time Varying Parameter estimation of β (OLS) – Period: 1968-2004

Supply Shocks

	1968-1979	1980-1991	1992-2004$^{\varphi}$	1968-2004$^{\varphi}$ β	1968-2004$^{\varphi}$ α^{θ}	full sample^{Ж} β	full sample^{Ж} α^{θ}
Convergence of Indonesia on:							
Malaysia	0.276	0.215▼	0.248▲	0.246	y	0.178	y
	(0.063)	(0.109)	(0.096)	(0.092)		(0.147)	
Philippines	0.072	-0.001▼	0.497▲	0.201	n	0.084	n
	(0.132)	(0.235)	(0.035)	(0.253)		(0.238)	
Singapore	0.054	0.085▲	0.640▲	0.249	y	0.198	n
	(0.067)	(0.092)	(0.247)	(0.307)		(0.309)	
Thailand	0.162	0.153▼	0.357▲	0.220	n	0.130	y
	(0.103)	(0.079)	(0.078)	(0.127)		(0.096)	
Convergence of Malaysia on:							
Indonesia	0.303	0.280▼	0.213▼	0.267	n	0.118	y
	(0.043)	(0.063)	(0.045)	(0.063)		(0.232)	
Philippines	0.174	0.220▲	0.680▲	0.347	n	0.210	n
	(0.037)	(0.279)	(0.070)	(0.282)		(0.141)	
Singapore	0.188	0.160▼	0.589▲	0.303	y	0.260	n
	(0.063)	(0.082)	(0.193)	(0.228)		(0.168)	
Thailand	0.424	0.222▼	0.364▲	0.336	n	0.237	n
	(0.065)	(0.058)	(0.059)	(0.105)		(0.122)	
Convergence of Philippines on:							
Indonesia	0.231	0.226▼	0.081▼	0.182	n	0.067	n
	(0.045)	(0.164)	(0.052)	(0.123)		(0.207)	
Malaysia	0.325	0.012▼	0.313▲	0.214	y	0.246	y
	(0.108)	(0.042)	(0.098)	(0.177)		(0.086)	
Singapore	0.053	0.207▲	0.443▲	0.228	y	0.226	y
	(0.067)	(0.070)	(0.145)	(0.188)		(0.149)	
Thailand	0.210	0.251▲	0.353▲	0.269	y	0.171	y
	(0.051)	(0.064)	(0.085)	(0.097)		(0.090)	
Convergence of Singapore on:							
Indonesia	0.221	0.215▼	0.659▲	0.356	y	0.098	y
	(0.057)	(0.049)	(0.215)	(0.242)		(0.146)	
Malaysia	0.459	0.089▼	0.005▼	0.190	y	0.182	y
	(0.140)	(0.081)	(0.033)	(0.221)		(0.168)	
Philippines	0.113	0.048▼	0.583▲	0.239	y	0.083	y
	(0.076)	(0.236)	(0.041)	(0.278)		(0.144)	
Thailand	0.176	0.139▼	0.453▲	0.251	n	0.157	y
	(0.126)	(0.046)	(0.123)	(0.173)		(0.034)	
Convergence of Thailand on:							
Indonesia	0.249	0.263▲	0.164▼	0.227	n	0.037	n
	(0.121)	(0.064)	(0.030)	(0.091)		(0.139)	
Malaysia	0.296	0.017▼	0.363▲	0.123	n	0.194	y
	(0.070)	(0.116)	(0.063)	(0.153)		(0.179)	
Philippines	0.162	0.066▼	0.529▲	0.245	n	0.064	y
	(0.193)	(0.262)	(0.037)	(0.273)		(0.190)	
Singapore	0.098	0.137▲	0.456▲	0.224	n	0.177	n
	(0.026)	(0.075)	(0.180)	(0.211)		(0.229)	
no. of obs:	12	12	11	35		37	

Notes: Figures in the table represent mean values for five alternative time spans. Values in parenthesis represent standard deviations.
φ = excluding the years of 1997 and 1998.
Ж = including the years of 1997 and 1998.
θ = Result of Dickey-Fuller Unit Root tests on the α time-varying coefficient estimates, where y = rejection of hypothesis of a unit root at 5% critical level and n = failure to reject the presence of a unit root at the 5% critical level. The estimations included a trend when a trend was found to be significant at the 5% level.
▲ = increase from previous period (divergence).
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