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## Optimum Currency Areas in East Asia: A Structural VAR Approach

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### ABSTRACT

This paper assesses the empirical desirability of the East Asian economies to an alternative exchange rate arrangement (a monetary union) that can potentially enhance the exchange rate stability and credibility in the region. Specifically, the symmetry in macroeconomic disturbances of the East Asian economies is examined as satisfying one of the preconditions for forming an Optimum Currency Area (OCA). The Structural Vector Autoregression (VAR) method is employed to assess the nature of macroeconomic disturbances among the East Asian countries, as a preliminary guide in identifying potential candidates for forming an OCA. The preliminary findings of this study suggest that there exists scope among some small sub-regions for potential monetary integration.

*Keywords:* Optimum Currency Area; Monetary Union; Vector autoregression; Exchange rate; East Asia

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## 1. INTRODUCTION

The Asian financial crisis has renewed calls for greater monetary and exchange rate cooperation. Among the remedial and preventive measures that have surfaced during the 1998 ASEAN (Association of South-East Asian Nations) ministerial meeting in Hanoi was the idea of a common currency and exchange rate system. ASEAN is already looking into the feasibility of a common currency and exchange rate system as part of the plan to promote greater economic integration and monetary cooperation in the region. The first East Asia Summit which took place in Kuala Lumpur, Malaysia on 14 December 2005 envisioned an East Asian Community.

In May 2000, at their meeting in Chiang Mai, Thailand, the ASEAN +3 (APT) countries (the members of ASEAN together with China, Japan and Korea) agreed to establish a network of bilateral swaps for countries in financial difficulties. Their Chiang Mai Initiative was regarded as an important first step towards creating a common Asian currency. As a result of its announcement, the idea of a single currency for East Asia was transformed from a “laughable concept” to a “possible policy goal”.<sup>2</sup>

Under what conditions should a region renounce its individual currencies to advance into a currency union? The traditional framework to address this question was created by Mundell (1961), McKinnon (1963), and Kenen (1967) and later formalised by Bayoumi (1994) and Ricci (1997). Much of this literature focuses on three inter-relationships between the members of a potential OCA. They are: (1) the trade intensity; (2) the similarity of the shocks and cycles; and (3) the degree of factor mobility. The greater the linkages between the countries using any of the three criteria, the more suitable a common

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<sup>2</sup> Castellano (2000), p.9.

currency. Given the theoretical consensus in the area, OCA criteria have been applied extensively, especially in judging the suitability of different European countries for the European Monetary Union (EMU). Since the similarity of shocks captures the interaction between several properties, most of the OCA literatures examine only the business cycle correlations as the satisfying condition of OCA.

This study aims to empirically assess the suitability of the East Asian economies for potential monetary integration on the basis of their symmetry in macroeconomic disturbances, as satisfying one of the preconditions for forming an OCA. The greater the symmetry in underlying shocks among the East Asian Economies, the lower the value placed on changes in the exchange rate as an instrument of relative price adjustment and making them better candidates for monetary integration. Since it is not a threshold question in which we know that symmetry is no longer a problem if shock correlation exceeds a certain value, the usual comparative analysis will be done. The Europe is chosen as the benchmark for comparison.

The estimation of the incidences of macroeconomic disturbances is inherently empirical. One of the first empirical papers to have dealt with the issue of macroeconomic disturbances through a statistical approach is by Bayoumi and Eichengreen (1993). Applying a variant of the VAR methodology proposed by Blanchard and Quah (1989), Bayoumi and Eichengreen (1993) assess the nature of macroeconomic disturbances among different groups of countries. The authors measure the importance of asymmetric demand and supply shocks across members of the European Community (EC) and the United States is chosen as a benchmark. Their approach emphasises on the needs to distinguish between cross-country correlations of *observed economic variables* (like output and prices) and those of *underlying structural shocks* (demand and supply disturbances originating from shifts in technology,

preferences, policy changes, etc.). The underlying structural shocks transmit their influence to the observed economic variables through a complex chain of links, both domestic and international (through trade flows and the transmission via the financial markets). Observed economic variables can display strong international correlations even if the underlying shocks are not interrelated, if the international transmission mechanism is sufficiently strong.<sup>3</sup> Their results indicate that the EC was divided into a “core” group of countries (Germany, France, Netherlands, Belgium and Denmark, with stronger “structural” correlations than the “peripheral” ones (UK, Italy, Spain, Ireland, Portugal, Greece). Their results also indicate that the supply and demand shocks to the core EC countries were on average smaller and more correlated with each other.

Bayoumi and Eichengreen (1994) carried out an empirical study on East Asian countries to estimate the correlations of underlying shocks among these countries.<sup>4</sup> They conclude that East Asian can be grouped into two OCAs, namely the Northern Asian bloc (Japan, Korea and Taiwan) and the Southeast Asian bloc (Hong Kong, Indonesia, Malaysia and Singapore) as they find supply shocks symmetrical among these two groups of countries. Demand shocks are found to be highly symmetrical for the latter group of countries. Their results on the correlation, size and speed of adjustment to underlying disturbances for Asia are updated in Bayoumi, and Mauro (1999).<sup>5</sup> They find that macroeconomic disturbances appear relatively similar across some ASEAN members, a pattern also seen in Europe in the 1980s. It is concluded that aggregate supply disturbances affecting Indonesia, Malaysia and Singapore are reasonably correlated, while the Philippines and Thailand experience more idiosyncratic

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<sup>3</sup> Canova and Dellas (1993) build a real business cycle model in which trade intensity induces international correlation of business cycles, and test it on a panel of 10 countries. Their estimates confirm the existence of such link.

<sup>4</sup> Their sample covers the years 1972-1989.

<sup>5</sup> The updated Asian results use data from 1968 to 1998, compared to a sample period of 1969-1989 used in the European results reported. The results are reported in Table 3 and 4.

shocks.<sup>6</sup> Their study also reports that, (1) size of the disturbances experienced by the Asian economies is considerably larger than that of the equivalent shocks for Europe<sup>7</sup>; (2) the speed of adjustment in Asia (and ASEAN in particular) is much more rapid than in Europe. Based on economic criteria, the authors conclude that ASEAN is less suitable for a currency union than the continental European countries were in 1987 (a few years before the Maastricht treaty providing a road map for EMU was signed), although the difference is not very large.<sup>8</sup>

This study extends the Bayoumi and Eichengreen (1994, 1999) study by considering longer time period. In addition, we separate the data into two periods, before and after 1997 to study the impacts of Asian financial crisis. We have also included China, a country absent in Bayoumi and Eichengreen's studies, in our study.

The remainder of this article is organised as follows. Section 2 discusses the methodology used in this study. Section 3 discusses the data. In section 4, we provide the empirical findings on the estimation of the underlying structural shocks as well as their sizes and the adjustment speed to shocks. The results are compared with the one prevails in the Europe. Finally, section 5 concludes the article.

## **2. METHODOLOGY**

This study applies Bayoumi and Eichengreen (1993, 1994, 1999) approach to isolate the permanent and transitory effects of macroeconomic shocks. Their model is based on the Aggregate Demand-

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<sup>6</sup> The authors claim that there are parallels with Europe, where the shocks experienced by France and Germany are relatively highly correlated, while those affecting Italy and Spain were more idiosyncratic (p.8).

<sup>7</sup> This also occurs when the sample period excludes the Asian crisis (1997 and 1998).

<sup>8</sup> The authors view firm political commitment as vital in forming a regional currency arrangement.

Aggregate Supply framework. They argue that a positive demand shock will increase both price and output in the short run but only price in the long run, whilst positive supply shocks will increase output and lower price both in the short run and long run. In other words, while supply shocks have long run permanent effects on the level of output, demand shocks only have temporary effects (both have permanent effects on the level of prices). The procedure used is a modification of Blanchard and Quah (1989), developed by Bayoumi (1992).

### 3. DATA

This study examines eight East Asian countries, namely ASEAN 5 – Indonesia, Malaysia, the Philippines, Singapore and Thailand – and China, Japan and Korea.<sup>9</sup> The data used in this paper are drawn from the World Bank's World Development Indicators CD-ROM, except for Austria, France and Germany, for which data are obtained from the International Financial Statistics. In analysing the macroeconomic shocks, two different sample periods will be examined in East Asia. It is our interest to find out how the inclusion of the periods after Asian financial crisis in mid-1997 affects the results. The first sample period covers 1960-1997 and the second sample period covers 1960-2006. For the European countries, annual data on real GDP and GDP deflator were collected for 1960-1998, periods before the European Monetary Union in 1999.<sup>10</sup> For each country growth and inflation were calculated as the first difference of the logarithm of real GDP and the GDP deflator.<sup>11</sup>

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<sup>9</sup> The new ASEAN members include Cambodia, Laos, Myanmar and Vietnam are excluded in the study as the stages of development in these countries are very much different from the rest of the APT members. Williamson (1999), for example, omits the new members of ASEAN, limiting the heterogeneity of the countries adopting a common basket peg. We lack data on Brunei.

<sup>10</sup> The sample periods covered in this study include a potential change in regime due to the break-up of the Bretton Woods in the early 1970s. However, Bayoumi and Eichengreen (1993) report that their tests of structural stability produced no evidence of a shift in the early 1970s.

<sup>11</sup> Bayoumi and Eichengreen (1993) state that GDP deflator should be chosen over CPI since it reflects the price of output rather than the price of consumption.

## 4. ESTIMATION AND RESULTS

We estimated bivariate VARs for each country and region in the sample to identify supply and demand shocks. The standard Schwarz information criterion was used in determining the optimal lag length. Since most of the models had an optimal lag length of one, the number of lags was set at 1 for all countries to preserve the symmetry of the specification across countries.

### *4.1 Correlation of Supply and Demand Shocks*

The structural VAR approach mentioned earlier is used to estimate the underlying macroeconomic disturbances. It is assumed that if the correlation of structural shocks is positive, the shocks are considered to be symmetric, and if negative, they are asymmetric. Results of the two identified shocks among the East Asian economies are reported in Table 1.

Examining the sample period 1960-1997, this study finds relatively symmetric supply shocks for the following groups of countries: Japan, Korea and Thailand; Malaysia and Indonesia; Malaysia and Singapore; Malaysia and Thailand; and the Philippines and Singapore. The Asian regional crisis was sparked in mid-1997 by the devaluation of the Thai baht. This can be seen by the significant increase in supply shocks correlations between Thailand and the rest of the East Asian economies (except China) after the financial crisis. The results have shown that, after the financial crisis, the supply shock correlations among all the East Asian economies concerned have increased rather significantly, especially for the most-hit economies by the crisis (compare Panel A and C in Table 1).

This study finds three overlapping subgroups when the periods after the financial crisis are included: (1) Japan, Korea and Thailand; (2) Indonesia, Korea, Malaysia and Thailand; (3) Korea, the Philippines, Malaysia, Singapore and Thailand. The only ASEAN country that shows highly symmetrical supply shocks with Japan is Thailand. This result is not surprising as Thailand is one of Japan's closest friends in Southeast Asia. Due to the appreciation of the Yen, many Japanese companies have moved into Thailand in the 1980s. Japan is one of the most important trading partners and the largest investor in Thailand. China has experienced mainly asymmetric shocks or insignificant correlations with the rest of the East Asian economies. Based on our empirical results in both sample periods, China should be excluded for any regional monetary arrangement. Overall, the demand shocks tend to be less symmetric than the supply shocks in the East Asian economies in both sample periods. However, Japan tends to have more highly correlated demand shocks with the ASEAN countries (except Indonesia).

We conducted a similar study of the structural shocks for the European countries; the results are reported in Table 2. German supply shocks are found to be highly correlated with those experienced by the following countries: Austria, Belgium, Denmark, France, Greece, Italy, Netherlands, Portugal and Spain. Its supply shocks correlations with other European countries are either asymmetric or low. The empirical results show that only sub-grouped European countries experienced symmetric supply shocks. For instance, Ireland's supply shocks with the other European countries are mostly asymmetric. Supply and demand shocks in Norway are only highly correlated with Denmark and not with any other European countries. These results suggest that supply shocks are less symmetric in the European countries than one expects. Similarly, symmetric demand shocks prevail only in sub-grouped European countries. Demand shocks in Greece and Portugal are not



positively correlated with any of the European countries. Ireland is found to be positively and significantly correlated in demand shocks only with Netherlands. Overall, the results show that the underlying structural shocks are less symmetric in the East Asian economies than in the European countries.

**Table 1. Correlations of Structural Shocks among the East Asian Countries**

*Panel A: Supply Shocks (1960-1997)*

*Panel C: Supply Shocks (1960-2006)*

	C	I	J	K	M	P	S	T	C	I	J	K	M	P	S	T	
C	1. 0 0								1. 0 0								
I	- 0. 1 9	1. 0 0							- 0. 0 9	1. 0 0							
J	0. 0 9	0. 2 1	1. 0 0						0. 0 9	0. 2 5	1. 0 0						
K	0. 0 3	0. 2 1	0. 3 1	1. 0 0					0. 0 2	0. 5 5	0. 3 8	1. 0 0					
M	- 0. 2 3	0. 3 7	0. 0 3	0. 2 3	1. 0 0				- 0. 1 1	0. 6 8	0. 2 5	0. 0 9	1. 0 0				
P	- 0. 2 1	- 0. 0 1	0. 0 5	0. 2 2	0. 2 4	1. 0 0			- 0. 1 8	0. 2 3	0. 1 2	0. 3 2	0. 4 2	1.0 0			
S	- 0. 0 3	0. 0 2	- 0. 0 2	0. 1 6	0. 5 1	0. 3 6	1. 0 0		- 0. 0 3	0. 2 8	0. 1 2	0. 3 4	0. 6 2	0. 1 2	0.4 1	1. . 0 0	
T	0. 2 3	0. 1 9	0. 3 9	0. 3 1	0. 3 6	0. 2 6	0. 1 5	1. 0 0	0. 1 9	0. 5 9	0. 4 5	0. 6 2	0. 7 2	0. 1 1	0.4 1	0. . 3 8	1. 0 0

Panel B: Demand Shocks (1960-1997)

	C	I	J	K	M	P	S	T	C	I	J	K	M	P	S	T
C	1. 0 0								1. 0 0							
I	- 0. 3 2	1. 0 0							0. 2 4	1. 0 0						
J	0. 1 4	- 0. 0	1. 0 0						0. 1 3	- 0. 0	1. 0 0					
K	0. 0 0	- 0. 0	0. 2 7	1. 0 0					- 0. 0	- 0. 4	0. 2 9	1. 0 0				
M	0. 0 1	- 0. 0	0. 4 7	0. 0 3	1. 0 0				- 0. 0	- 0. 3	0. 4 6	0. 2 4	1. 0 0			
P	0. 0 3	0. 0 0	0. 3 2	0. 1 0	0. 2 6	1. 0 0			0. 0 3	- 0. 1	0. 3 3	0. 1 4	0. 3 2	1.0 0		
S	0. 0 4	0. 1 8	0. 6 1	0. 3 6	0. 5 2	0. 1 6	1. 0 0		0. 0 7	0. 0 1	0. 5 7	0. 3 7	0. 4 8	0.1 4	1 .	0 0
T	0. 0 5	0. 1 4	0. 5 5	0. 0 7	0. 5 1	0. 1 3	0. 6 8	1. 0 0	0. 0 0	- 0. 3	0. 5 3	0. 4 2	0. 6 3	0.2 1	0 .	1. 0 0

Notes: The list of country abbreviations is provided in Appendix 1. The painted figures are those above 0.3.

**Table 2: Correlations of Structural Shocks among the European Countries**

1960-1998  
Supply Shocks  
Correlations

	A u s	B e l	D e n	F i n	F r	C e r	G r e	I r e	I t a	N e t	N o r	F c r	S p a	S v e	S v i t	U k
A u s	1															
B e l	0.59	1														
D e n	0.50	0.65	1													
F i n	0.26	0.44	0.43	1												
F r	0.60	0.70	0.73	0.45	1											
C e r	0.51	0.42	0.44	0.11	0.39	1										
C r e	0.03	0.19	0.43	0.23	0.29	0.36	1									
I r e	0.23	0.33	0.33	0.29	0.20	0.29	0.00	1								
I t a	0.62	0.81	0.63	0.28	0.57	0.41	0.05	0.20	1							
N e t	0.54	0.71	0.62	0.28	0.60	0.47	0.11	0.14	0.06	1						
N o r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1					

r	.01	18	33	16	.13	C3	16	11	12	24										
F	06	05	04	C1	05	C3	02	-C1	C6	C5	-09	10								
c																				
r	64	54	49	44	88	99	44	11	44	55	00	00								
S	05	06	06	C4	05	C3	01	C1	C5	C4	01	C1								
F	22	55	00	11	44	99	00	33	11	22	22	34								
a	00	00	00	C0	00	C0	00	C0	C0	C0	00	C0	C1							
S	.15	.46	.44	.67	.44	.14	.21	.12	.41	.38	.16	.19								
v	50	60	00	C7	44	C4	11	C2	C1	C8	06	C6	C1							
e	06	06	03	C3	05	C2	.01	C8	C5	C6	05	C4	C3							
S	70	71	44	99	33	44	11	88	66	22	55	33	33							
v	00	00	00	C0	00	C0	00	C0	C0	C0	-00	C0	C0	C1						
i	.67	.61	.44	.99	.33	.44	.11	.88	.66	.22	.55	.33	.33	.15						
t	00	00	00	C0	00	C0	00	C0	C0	C0	-00	C0	C0	C0	C1					
U	.14	.21	.56	.44	.44	.13	.45	.05	.33	.33	.04	.47	.26	.36						
F	44	41	66	11	33	33	55	55	33	00	04	76	66	66						

*Demand Shocks Correlations*

	Aus	Bel	Den	Fin	Fr	Ger	Gre	Ire	Ita	Net	Nor	Fcr	Spa	Sve	Svit	UK
Aus	1															
Bel	053	1														
Den	052	067	1													
Fin	.28	.31	.38	1												
Fr	065	069	072	C41	1											
Ger	051	055	061	C9	049	1										



## *4.2 Size of Disturbances and Adjustment Speed*

Bayoumi and Eichengreen's (1994) methodology also allows us to estimate the relative size of the disturbances and the countries' adjustment speed to the disturbances. A country becomes a better candidate of OCA if the underlying shocks are small. Similarly, the faster the adjustment to disturbances, the smaller will be the cost of renouncing the monetary sovereignty. The size of demand and supply shocks reported in Table 3 is measured by the standard deviations of the underlying shocks. The size of the supply shocks has reportedly increased for Indonesia, Korea, Malaysia and Thailand (most-hit economies by the Asian financial crisis) when the sample period is extended to include periods after the financial crisis. It is evident that East Asia economies have experienced much larger demand shocks than supply shocks. In comparison with the EU countries, the average size of both demand and supply shocks is much larger in East Asia.

A simple measure of the speed of adjustment to supply shocks is the ratio of the impulse response function in the third year to its long run level.<sup>12</sup> The higher the value, the faster the adjustment. Table 3 reports the results. Table 4 reports the impulse response of GDP to the supply shocks and table 5 reports the impulse response of prices to the demand shocks for the East Asian countries. The speed of adjustment to demand shocks is measured by taking the value of the impulse response function on the sixth year, with a low value now representing speedy adjustment.<sup>13</sup> The Asian financial crisis increased considerably the speed of adjustment to supply shocks for Indonesia, Malaysia, Singapore and Thailand. However, the financial crisis does not change much the speed of adjustment to the demand shocks. It is evident that the speed of adjustment to both shocks in East Asia is much faster than in the EU region.

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<sup>12</sup> Follows the suggestion by Bayoumi and Eichengreen (1993).

<sup>13</sup> Bayoumi and Eichengreen (2003) suggest taking the value of the impulse response function after 5 years.

The difference in adjustment speed can be explained by the higher factor mobility in most East Asian economies. In comparison with the EU at the time of the Maastricht Treaty, ASEAN has relatively high labour mobility as well as capital mobility (Goto and Hamada 1994; Bayoumi and Eichengreen 1999; Moon, Rhee, and Yoon 2000). Goto and Hamada (1994) note the extent of migration between the less- and more-developed East Asian economies and emphasises its responsiveness to changing economic conditions.

## **5. Conclusion**

In this paper we used the Structural VAR approach proposed by Bayoumi and Eichengreen (1993, 1994, 1999) to identify the structural shocks among the East Asian economies, as a preliminary way of examining the desirability of the East Asian economies to an alternative exchange rate arrangement (a monetary union) that can potentially enhance the exchange rate stability and credibility in the region.

In comparison with the European countries, the underlying structural shocks in East Asia are less symmetric with a larger size on average. However, the speed of adjustment to shocks in East Asia is much faster. The correlations of supply shocks suggest that it is less feasible for the entire East Asian region concerned to form a currency union. However, the results do imply that some sub-groups among some East Asian countries with highly symmetrical permanent supply shocks are better candidates for a currency union. The examination of the pre- and post-crisis data reveals that it was the permanent shocks which affected the region during the crisis. As one would expect, the correlations of supply shocks among the East Asian countries are found to have increased rather significantly after the crisis.

In addition, the results indicate that although the financial crisis had increased the size of the supply shocks to the region, the region adjusted to the shocks fairly quickly.

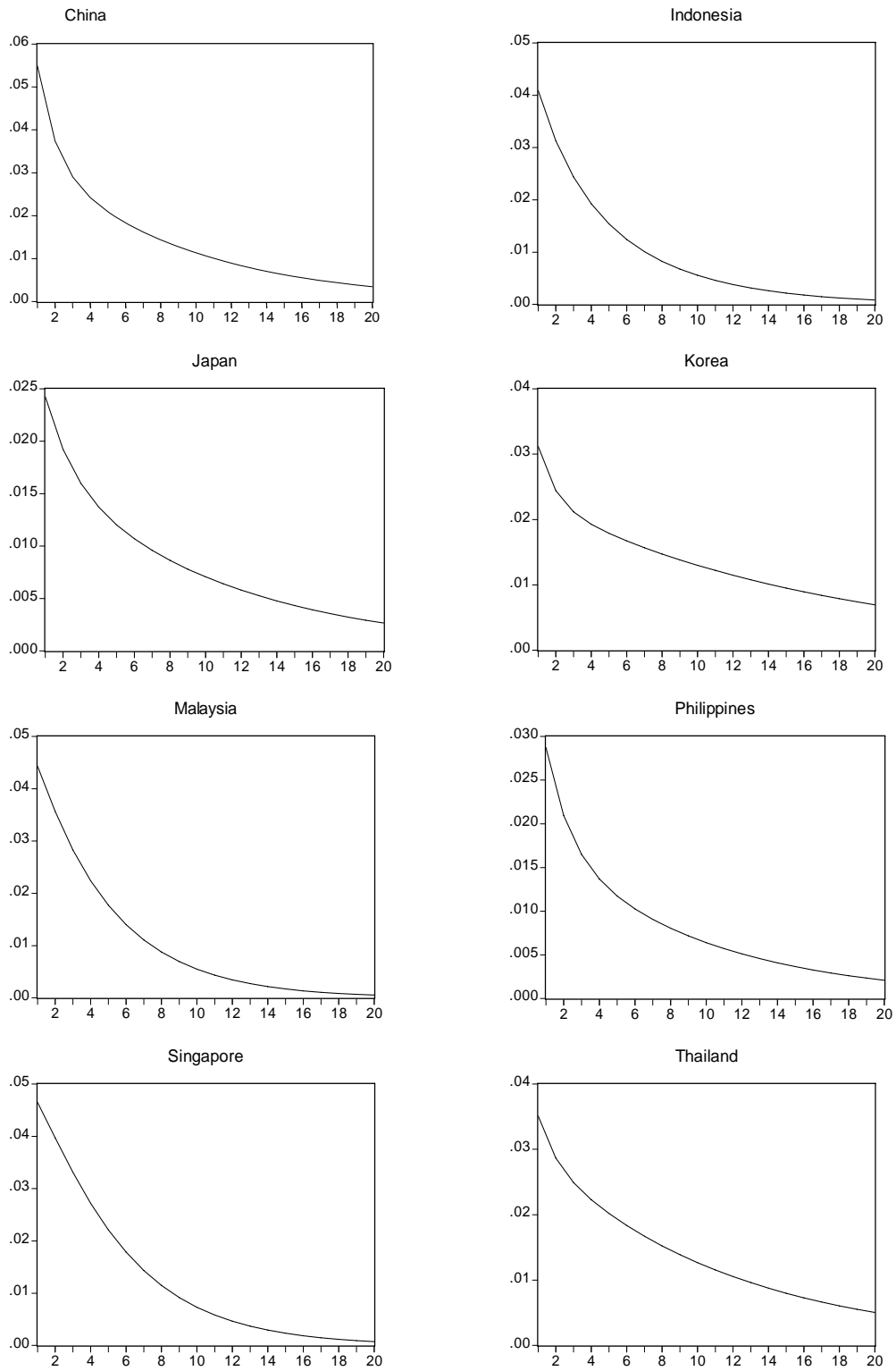
Nevertheless, the drive towards monetary integration will depend on other economic and non-economic factors as well. While political issues are beyond the scope of this paper, it is recognised that East Asian countries lack the political solidarity and cohesion for a monetary union at present (see also Bayoumi and Eichengreen (1999)).



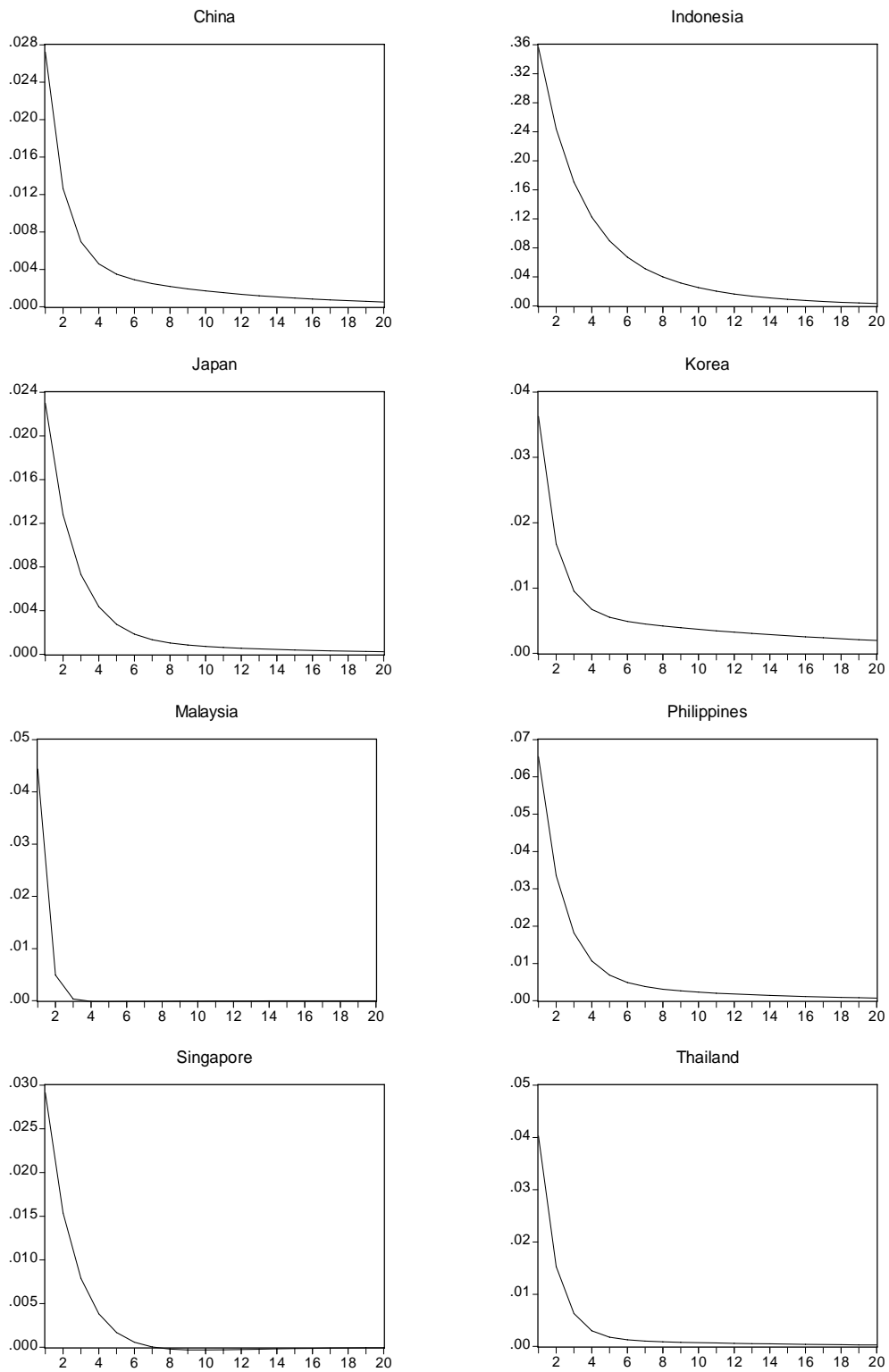
***Table 3: Size and Speed of Adjustment***

	Aggregate Supply Disturbances		Aggregate Demand Disturbances	
	Size	Speed of Adjustment	Size	Speed of Adjustment
East Asia (1960-1997)				
China	0.057	0.430	0.027	0.0028
Indonesia	0.030	0.385	0.366	0.0792
Japan	0.025	0.361	0.024	0.0018
Korea	0.029	0.209	0.039	0.0050
Malaysia	0.029	0.365	0.046	0.0005
Philippines	0.029	0.428	0.068	0.0049
Singapore	0.043	0.626	0.027	0.0011
Thailand	0.028	0.231	0.040	0.0019
<b>Average</b>	<b>0.034</b>	<b>0.379</b>	<b>0.079</b>	<b>0.0122</b>
East Asia (1960-2006)				
China	0.055	0.463	0.027	0.0029
Indonesia	0.041	1.074	0.356	0.0673
Japan	0.024	0.372	0.023	0.0019
Korea	0.031	0.226	0.036	0.0049
Malaysia	0.044	1.505	0.044	0.0001
Philippines	0.029	0.453	0.065	0.0049
Singapore	0.046	1.294	0.029	0.0006
Thailand	0.035	0.315	0.040	0.0013
<b>Average</b>	<b>0.038</b>	<b>0.713</b>	<b>0.078</b>	<b>0.0105</b>
Europe (1960-1998)				
Austria	0.019	0.192	0.009	0.0010
Belgium	0.020	0.222	0.012	0.0262
Denmark	0.008	0.146	0.010	0.0241
Finland	0.023	0.332	0.024	0.0636
France	0.013	0.256	0.013	0.0051
Germany	0.027	0.404	0.008	0.0015
Greece	0.035	0.535	0.032	0.1146
Ireland	0.024	0.204	0.032	0.0823
Italy	0.021	0.387	0.018	0.0638
Netherlands	0.017	0.194	0.013	0.0292
Norway	0.012	0.210	0.024	0.0016
Portugal	0.026	0.277	0.029	0.0074
Spain	0.018	0.344	0.018	0.0741
Sweden	0.018	0.388	0.017	0.0546
Switzerland	0.022	0.957	0.017	0.0413
UK	0.015	0.244	0.028	0.0753
<b>Average</b>	<b>0.020</b>	<b>0.331</b>	<b>0.019</b>	<b>0.0416</b>

**Table 4: Impulse Response of GDP to Supply Shocks**  
*Response to Structural One S.D. Innovations*



**Table 5: Impulse Response of Prices to Demand Shocks**  
*Response to Structural One S.D. Innovations*



## APPENDIX 1

### Country Abbreviations

C : China  
 : Indonesia  
I : Japan  
J : Korea  
K : Malaysia  
 : Philippines  
M : Singapore  
 : Thailand  
P : Austria  
S : Belgium  
T : Denmark  
A : Finland  
u : France  
s : Germany  
B : Greece  
e : Ireland  
l : Italy  
D : Netherlands  
e : Norway  
n : Portugal  
F : Spain  
i : Sweden  
n : Switzerland  
F : United Kingdom  
r  
G  
e  
r  
G  
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