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# Is East Asia An Optimum Currency Area?

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**Abstract:** This paper assesses the empirical suitability of the East Asian economies for potential monetary integration. The structural vector autoregression (VAR) method is employed to identify the underlying shocks using a three-variable VAR model across the East Asian economies. We use the estimates of the EEC as a benchmark to compare the size of the underlying shocks and the speed of adjustment to shocks in both regions to determine the feasibility of forming an optimum currency area (OCA) in East Asia. The empirical results do not display strong support for forming an OCA in the East Asian region. The results do imply, however, that some small sub-regions are potential candidates for OCAs, since their disturbances are correlated and small and these economies adjust rapidly to shocks.

**Keywords:** Optimum currency area; Vector autoregression; Exchange rate; East Asia

## 1. INTRODUCTION

The recent regional financial crisis has renewed calls among politicians for greater monetary integration and regional exchange rate stability in East Asia.<sup>1</sup> Although there seems to be a lack of a formal institutional framework in driving monetary integration, and the economic and financial conditions also differ among the countries, East Asia has experienced rapid and spontaneous regional integration during the past decades as a result of unilateral liberalization of goods and capital markets [Zhang, 2001]. Moreover, for the purpose of establishing a well-coordinated economic and financial monitoring system in the region, it is not uncommon to find evidence of monetary co-operation and foreign exchange arrangements among the East Asian economies. History of monetary co-operation in the region can be traced back to the establishment of an ASEAN Swap Arrangement among ASEAN member countries in 1977. More recently, the monetary authority of Hong Kong and the central banks of Malaysia, Indonesia and Thailand announced repurchase agreements of each other's currency in need in late 1995. Japan, the Philippines and Singapore participated in the Repurchase Agreements in March 1996. In 2000

ASEAN plus China, Japan and Korea agreed to establish a currency-swap network and to help avert future crisis.

According to the seminal work of Mundell [1961] and McKinnon [1963], the incentive for two economies to peg their bilateral exchange rates rises with the bilateral intensity of trade, flexibility of factor markets, and symmetry of underlying shocks.<sup>2</sup> By doing so, both will be able to forsake nominal exchange rate changes as an instrument of adjustment and to reap the reduction in transactions costs associated with a common currency. This paper intends to investigate and assess the empirical suitability of the East Asian economies for potential monetary integration in light of the theory of optimum currency area (OCA). In particular, we focus on the symmetrical nature of underlying shocks across the East Asian economies as one of the preconditions for forming an OCA.

The remainder of the paper is organized as follows. Section 2 discusses the theoretical framework and methodology for this study. In section 3, we first assess the characteristics of the variables concerned, and then turn to the estimation of the underlying structural shocks as well as their sizes and the adjustment speed to shocks by applying an impulse response analysis. We also make a comparison of

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<sup>1</sup> East Asia is defined as the following 10 economies: China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand.

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<sup>2</sup> For a survey of OCA, see Tavlas [1993] and De Grauwe [2000].

the estimated shocks and the speed of adjustment between the East Asian and the European regions, and check the robustness of the estimations in this section. The final section concludes this study.

## 2. ANALYTICAL FRAMEWORK

Early studies in OCA focused on how the various observable macroeconomic variables are correlated across the economies or the region. Bayoumi and Eichengreen [1994] employed the Blanchard-Quah [1989] structural VAR method to identify the underlying structural shocks. In this paper, we employ a three-variable VAR open economy model to examine the shock aspect of the OCA literature.<sup>3</sup> The three variables are home output ( $y_t$ ), real effective exchange rate ( $q_t$ ) and home price level ( $p_t$ ) to identify the fundamental supply, demand and monetary shocks.<sup>4</sup> Let  $\Delta x_t \equiv [\Delta y_t, \Delta q_t, \Delta p_t]'$  and  $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$ , where  $\Delta$  represents the first-difference operator, and  $\varepsilon_{st}$ ,  $\varepsilon_{dt}$  and  $\varepsilon_{mt}$  denote supply, demand and monetary shocks, respectively. The structural model can be written as:

$$\Delta x_t = A_0 \varepsilon_t + A_1 \varepsilon_{t-1} + A_2 \varepsilon_{t-2} + \dots = A(L) \varepsilon_t \quad (1)$$

$$\text{where } A(L) = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{pmatrix},$$

and  $A_{ij}(L) = a_{ij}^0 + a_{ij}^1 L + a_{ij}^2 L^2 + \dots$ . We assume that the structural shocks  $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$  are serially uncorrelated and have a covariance matrix normalized to the identity matrix. To identify structural shocks, we impose the following long run restrictions: (i) only supply shocks affect relative output in the long run; (ii) both supply and demand shocks affect real effective exchange rates in the long run; and (iii) monetary shocks have no long run effect on either relative output or real effective exchange rates. These long run restrictions amount to  $A_{12}(1) = A_{13}(1) = A_{23}(1) = 0$ , which are sufficient to identify the  $A_i$  matrices and, hence, the series of structural shocks.

<sup>3</sup> Our model draws on Clarida and Gali [1994] that attempt to identify the sources of real exchange rate fluctuations using a three-variable VAR model as in Obstfeld [1985].

<sup>4</sup> Lowercase variables are natural logarithms so that the first-difference of variables can be interpreted as the growth rate.

We estimate the following reduced-form VAR model instead of the structural MA model of equation (1):

$$\Delta x_t = B(L) \Delta x_{t-1} + u_t, \quad (2)$$

where  $u_t$  is a vector reduced-form disturbance. An MA representation of equation (2) is:

$$\Delta x_t = C(L) u_t, \quad (3)$$

where  $C(L) = (1 - B(L))^{-1}$  and the lead matrix of  $C(L)$  is, by construction,  $C_0 = I$ . By comparing equations (1) and (3), we obtain the relationship between the structural and reduced-form disturbances as  $u_t = A_0 \varepsilon_t$ . Hence, it is necessary to obtain estimates of  $A_0$  to recover the time series of structural shocks  $\varepsilon_t$ . As the structural shocks are mutually orthogonal and each shock has a unit variance, the following relationship between the covariance matrices is obtained:

$$C(1) \Sigma C(1)' = A(1) A(1)' \quad (4)$$

where  $\Sigma = E u_t u_t' = E A_0 \varepsilon_t \varepsilon_t' A_0' = A_0 A_0'$ . Letting  $H$  denote the lower triangular Choleski decomposition of  $C(1) \Sigma C(1)'$ , we obtain  $A(1) = H$  since the long run restrictions imply that  $A(1)$  is also lower triangular. Consequently, we obtain  $A_0 = C(1)^{-1} A(1) = C(1)^{-1} H$ . Given an estimate of  $A_0$ , we can recover the time series of structural shocks,  $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$ .

## 3. EMPIRICAL RESULTS

### 3.1 Data

The major data sources used in this paper are IMF: *International Financial Statistics*, CD-ROM, *China Monthly Statistics*, *Hong Kong Monthly Digest of Statistics*, the websites of the Japan and Taiwan statistics authorities, and NUS ESU databank and the ICSEAD database. Real GDP is used as a proxy for real output variables, consumer price index (CPI) as a measure of changes in prices, and real effective exchange rates are calculated as a trade weighted geometric average of real exchange rates with 29 major trading partners of each individual economy.

**Table 1.** Correlation of Structural Shocks between the United States and the East Asian Economies

	US	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch	US	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch	
	<i>Panel A: Supply Shocks (1980Q3-1997Q1)</i>											<i>Panel D: Supply Shocks (1980Q3-2000Q3)</i>											
US	1.00											1.00											
Japan	0.07	1.00										-0.07	1.00										
Korea	-0.02	-0.03	1.00									-0.17	0.22	1.00									
Taiwan	0.11	-0.06	0.31	1.00								0.05	0.00	0.28	1.00								
Hong Kong	0.03	0.09	0.10	0.49	1.00							0.03	0.16	0.22	0.44	1.00							
Singapore	-0.03	-0.08	-0.08	0.14	0.07	1.00						-0.10	-0.03	0.11	0.23	0.16	1.00						
Malaysia	-0.09	-0.03	-0.03	0.00	-0.03	0.30	1.00					-0.19	0.22	0.37	0.18	0.16	0.32	1.00					
Indonesia	0.12	-0.20	0.01	0.03	-0.16	0.06	0.32	1.00				-0.04	0.05	0.45	0.20	0.03	0.18	0.44	1.00				
Thailand	0.08	-0.18	0.15	0.01	-0.11	0.05	0.06	0.16	1.00			0.05	0.09	0.30	-0.05	0.09	0.06	0.17	0.31	1.00			
Philippines	-0.01	0.16	0.01	0.07	0.24	0.12	0.02	-0.05	-0.03	1.00		-0.05	0.12	0.13	0.07	0.21	0.12	0.08	0.16	0.04	1.00		
China	-0.05	-0.20	-0.18	0.00	0.12	0.17	-0.02	-0.04	-0.16	0.05	1.00	-0.06	-0.03	-0.04	-0.01	0.20	0.17	0.04	0.06	0.02	0.04	1.00	
	<i>Panel B: Demand Shocks (1980Q3-1997Q1)</i>											<i>Panel E: Demand Shocks (1980Q3-2000Q3)</i>											
US	1.00											1.00											
Japan	-0.63	1.00										-0.53	1.00										
Korea	0.66	-0.49	1.00									0.30	-0.07	1.00									
Taiwan	0.58	-0.33	0.62	1.00								0.23	0.24	0.63	1.00								
Hong Kong	0.50	-0.22	0.39	0.36	1.00							0.28	-0.09	0.31	0.27	1.00							
Singapore	0.31	-0.23	0.21	0.18	0.31	1.00						0.15	0.24	0.42	0.64	0.28	1.00						
Malaysia	0.46	-0.44	0.21	0.31	0.16	0.18	1.00					0.20	0.03	0.54	0.59	0.14	0.51	1.00					
Indonesia	0.28	-0.21	0.23	0.08	0.12	-0.08	0.10	1.00				0.09	0.04	0.52	0.39	0.05	0.33	0.45	1.00				
Thailand	0.49	-0.39	0.31	0.32	0.40	0.09	0.24	0.13	1.00			0.18	0.01	0.49	0.48	0.23	0.41	0.54	0.29	1.00			
Philippines	0.46	-0.49	0.45	0.40	0.16	0.26	0.44	0.29	0.31	1.00		0.32	-0.26	0.45	0.40	-0.03	0.28	0.55	0.41	0.27	1.00		
China	0.36	-0.29	0.30	0.21	-0.38	-0.27	0.33	0.32	0.22	0.24	1.00	0.33	0.06	0.37	0.40	-0.05	0.35	0.39	0.17	0.33	0.20	1.00	
	<i>Panel C: Monetary Shocks (1980Q3-1997Q1)</i>											<i>Panel F: Monetary Shocks (1980Q3-2000Q3)</i>											
US	1.00											1.00											
Japan	0.16	1.00										-0.03	1.00										
Korea	0.24	0.08	1.00									0.20	-0.03	1.00									
Taiwan	0.33	0.24	0.12	1.00								0.23	0.18	0.11	1.00								
Hong Kong	0.14	0.33	0.08	0.18	1.00							0.08	0.10	-0.01	0.30	1.00							
Singapore	-0.09	0.19	0.17	0.06	0.18	1.00						-0.07	0.15	0.15	0.11	0.26	1.00						
Malaysia	0.05	0.14	0.19	0.10	-0.05	0.46	1.00					-0.02	-0.02	0.33	0.26	0.16	0.47	1.00					
Indonesia	0.05	-0.03	0.27	0.19	-0.11	0.22	0.29	1.00				-0.01	-0.10	0.15	0.23	0.04	0.06	0.35	1.00				
Thailand	0.21	0.45	0.13	0.14	0.22	0.05	0.13	-0.14	1.00			0.06	0.24	0.13	0.07	0.19	0.11	0.24	0.06	1.00			
Philippines	0.04	-0.08	0.02	0.24	0.13	0.25	0.17	0.20	-0.18	1.00		-0.01	0.02	0.05	0.23	0.19	0.28	0.30	0.08	-0.16	1.00		
China	0.15	-0.19	0.37	-0.06	-0.15	-0.12	0.48	0.17	0.08	-0.04	1.00	0.14	-0.18	0.36	0.03	0.12	0.15	0.35	0.16	0.27	0.11	1.00	

Notes: The sample period starts from 1983Q3 for Hong Kong and from 1986Q3 for China. Painted figures denote positive and significant at the 5 percent level. Significance levels are assessed using the Fisher's variance-stabilizing transformation, and the null hypothesis is that correlation coefficient is zero.

All data are quarterly, in natural logarithms and seasonally unadjusted except for real GDP series.<sup>5</sup> Data for East Asia and the United States are from 1980Q1 to 2000Q3 (for China and Hong Kong, from 1986Q1 and 1983Q1, respectively), and for EU countries, the sample period covers 1980Q1-1998Q4 except for Belgium (1985Q1-1998Q4) and Denmark (1988Q1-1998Q4).

We have investigated the time series properties of the variables and found that most variables are I(1) based on the result of the Phillips-Perron and KPSS tests (results are available upon request). Therefore, we take the first difference of all variables to ensure the stationarity of the variables. For estimation of the VAR, we choose one lag based on SBIC.

### 3.2 Variability and Correlation of the Variables

The results (available upon request) show that exchange rates of the East Asian economies are relatively stable against each other for the whole sample period and some sub-periods. In all cases volatility of exchange rates against each other is

below five percent and against the US dollar is below four percent, with the exception of the Indonesian Rupiah. After the 1997 financial crisis, the Indonesia Rupiah became the most volatile currency in the region, followed by the Korea Won and Thai Baht, while the rest of East Asia continue to display a low level of variability. It is found that the first economic recession happened in ASEAN in the middle of the 1980s and China's unification of its dual exchange rates in 1994 have not contributed much to the exchange rate volatility in the region. The low variability of bilateral exchange rates in East Asia reflects the progress of its financial market integration [Phylaktis, 1999], and to a certain extent the symmetric effects of shocks originated from the region and the rest of the world.

The East Asian economies display a less coherent pattern in GDP growth as compared to inflation movements before the financial crisis. After the crisis, the number of significant correlations in GDP growth has increased among the East Asian countries and between the U.S. and the region. However, the financial crisis has turned a number of significant positive correlations in inflation to insignificant and negative. The findings have implications for forming an OCA in the region.

<sup>5</sup> Seasonal adjustment is conducted using Census X-11 (multiplicative).

### 3.3 Correlation of Underlying Structural Shocks

We estimated the underlying shocks by the structural VAR approach for East Asia in 1980Q1-1997Q1 and 1980Q1-2000Q3. It is assumed that if the correlation of structural shocks is positive, the shocks are considered to be symmetric, and if negative and/or insignificant, they are asymmetric. Results of correlations of the three identified shocks among the East Asian economies are reported in Table 1.

#### 3.3.1 East Asian Economies and the United States

It is found that, in 1980Q1-1997Q1 (Panel A of Table 1), supply shocks are correlated significantly among a few ASEAN countries and the Asian NIEs. The regional financial crisis improved the number of significant correlations of supply shocks, especially among the economies that have been hit mostly by the crisis (Panel D).<sup>6</sup> Those ASEAN economies and NIEs that displayed high correlations in their growth patterns are likely to have similar supply shocks which tend to be permanent. For the rest of East Asia, asymmetric shocks seem to prevail. There are no significant correlations of supply shocks between the U.S. and the region as well as between Japan and the rest of East Asia prior to the financial crisis. Although the financial crisis has improved the correlation coefficients of Japan with some economies, Malaysia is the only country showing a significant correlation with Japan at the 5 percent level. This finding seems against our casual observation.

In contrast, demand shocks and monetary shocks are highly correlated among the economies concerned. In particular, the U.S. was significantly and positively correlated in demand shocks with almost all the East Asian economies except Japan prior to the crisis, which reflects the similarity of their macroeconomic policy pursued during the period, and Japan exhibited a high negative correlation of demand shocks with the rest of East Asia (Panels B and E in Table 1). As Japan is the major source of imports for the rest of East Asia, an increase in Japan's price level driven by her demand shocks would spur a negative impact on the demand of the other East Asian economies. Demand shocks are significantly correlated among the Asian NIEs in both sample periods. The financial crisis increased the number of significant correlations in the region, especially for the most-hit economies by the crisis. It is noted that China has increased its correlation with the U.S., the NIEs and ASEAN. The correlation coefficients of Japan with the rest of East Asia have mostly turned to positive, though they remained

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<sup>6</sup> However, one should be cautious of interpreting this result as including the post-crisis period in the sample may cause structural breaks in the series, which would affect estimation.

insignificant except for Taiwan and Singapore.

Monetary shocks reflect internal monetary disturbances, whether policy-induced or purely stochastic. The results show that monetary shocks are less correlated than demand shocks in East Asia in both sample periods (Panels C and F of Table 1). Although the regional financial crisis improved the number of significant correlations of monetary shocks among the NIEs and ASEAN countries, it reduced the number of significant correlations of Japan with the rest of East Asia. The U.S. economy maintained a significant correlation of shocks with Taiwan in both sample periods.

It has been argued that supply shocks are considered to be more informative for evaluating the symmetry of shocks, because estimated demand and monetary shocks using the structural VAR tend to include the effects of macroeconomic policies as well as purely stochastic disturbances [Bayoumi and Eichengreen, 1994; Kawai and Okumura, 1996; and Demertzis et al., 2000]. The more (less) symmetric shocks encountered, the higher (lower) are the correlations in supply shocks, and the more feasible it becomes for these economies to establish an OCA. Therefore, our results do not display strong support for forming an OCA in the entire East Asian region. However, they do suggest that the OCA is feasible in some sub-regions, such as among some Asian NIEs and ASEAN countries.

#### 3.3.2 Comparison with the European Countries

We conducted a similar study of the structural shocks for the EU countries (results are available upon request). The results show that symmetric supply shocks prevail only in sub-grouped EU countries and are not uniformly observed across the European countries. This is the case even in the so-called "core" countries and in the Euro area. For instance, Germany is significantly correlated in supply shocks only with Austria and Italy. These results suggest that supply shocks are far less symmetric in the EU countries than one expects.

Similarly, demand shocks in Europe are significantly correlated only within the sub-grouped countries. In the core countries, symmetric demand shocks prevail and the significance of correlations is high, reflecting their close macroeconomic policy coordination. Germany is found to be positively and significantly correlated for demand shocks with the core countries and Switzerland. This contrasts with our earlier findings that Japan does not exhibit a significant correlation of demand shocks with other East Asian economies. Finally, similar to the case of East Asia, the symmetric pattern of monetary shocks in the EU countries is found less clear and undetermined. This finding is consistent with

Demertzis et al. [2000] that the symmetry in Europe observed from correlation analysis of structural shocks is created by policy interventions rather than some natural symmetry in the underlying shocks.

Overall, the results show that the underlying structural shocks are less symmetric in the East Asian region than in the European region, and the leading economy (Germany versus Japan) also displays very different influence on other economies in the respective region. This finding is consistent with our earlier conclusion that it is less feasible for the entire East Asian region to form an OCA, but possible in some sub-groups, such as among some NIEs and ASEAN countries where the underlying shocks are positively and significantly correlated.

### 3.4 Size of Disturbances and Adjustment Speed

Since the estimated structural shocks are assumed to have unit variances in the structural VAR, their size and adjustment speed can be inferred by analyzing the associated impulse response functions [Bayoumi and Eichengreen, 1994]. For the size of supply shocks, we use the long run (20-quarter horizon) effect of a unit shock on changes in real GDP. For demand and monetary shocks, we choose the 1-quarter impact on changes in real exchange rates and CPI. The speed of adjustment is measured by the share of the response after 4-quarters in its long run effect. The larger is the size of the shocks, the more disruptive the effects an economy will encounter. Similarly, the slower the adjustment to disturbances, the larger will be the cost of maintaining a fixed exchange rate system and renouncing monetary sovereignty and policy autonomy.

**Table 2.** Size of Shocks and Speed of Adjustment

	Supply Shocks		Demand Shocks		Monetary Shocks	
	Size	Speed	Size	Speed	Size	Speed
East Asia						
1980-1997	0.016	0.99	0.035	0.986	0.01	0.961
1980-2000	0.021	0.977	0.046	0.969	0.01	0.913
EU						
1980-1998	0.011	0.931	0.018	0.968	0.006	0.853

Table 2 reports only the average size of shocks and the speed of adjustments in the East Asian and European regions (results for individual economy available upon request). It is found that the size of supply shocks is the largest in the most open economies, such as Hong Kong, Singapore, Malaysia and the Philippines. For demand and monetary shocks, the sizes appear to be the largest in the Philippines, China, Indonesia and Taiwan. The Asian financial crisis increased considerably the sizes of supply and demand shocks for the economies most hit by the crisis. In comparison with the EU countries, the average size of the three underlying shocks is much larger in East Asia.

However, the speed of adjustment to shocks in East Asia is much faster than in the EU region. Most of the East Asian countries take less than one year to complete the adjustment to shocks. On average, 96 percent or more of adjustment is completed within a 4-quarter horizon before the crisis. The regional financial crisis does not change much the speed of adjustment. A possible explanation to the difference in adjustment speed is that the labor market and wage rates in most East Asian economies are relatively more flexible, and hence, it is easier for these economies to adjust internally in response to shocks. This finding supports the proposal of a common currency arrangement as, according to the OCA literature, countries are better candidates for a currency arrangement if their disturbances are correlated and small, and if these countries adjust rapidly to shocks.

### 3.5 Robust Test

As in the open-economy framework the estimated structural shocks may include the effect of global shocks as well as local shocks, it is possible that the significant correlation of shocks obtained is due to the effect of global shocks (see Kawai and Okumura, 1996). In this section, we conduct a robust test of our empirical findings by investigating the correlations of underlying shocks after removing the effect of global shocks. We assume the US shocks to be the global shocks affecting the East Asian economies. We first regress the respective shocks of the East Asian economies on the three types of US shocks (i.e., supply, demand and monetary shocks) with four lags by OLS:

$$\varepsilon_{i,t}^j = \text{const} + \sum_{k=0}^4 \alpha_k \varepsilon_{s,t-k}^{US} + \sum_{k=0}^4 \beta_k \varepsilon_{d,t-k}^{US} + \sum_{k=0}^4 \gamma_k \varepsilon_{m,t-k}^{US} \quad (5)$$

where  $s$ ,  $d$ , and  $m$  stand for supply, demand and monetary shocks, respectively;  $i = s, d, m$ ; and the superscript  $j$  denotes a country of East Asia. Then, we re-estimate the equations by including the US shocks that are statistically significant at least at the 5 percent level in the first-stage OLS regression. Seemingly unrelated regression (SUR) is used to allow for possible contemporaneous correlation in the residuals across the equations. The residuals obtained by SUR can be regarded as the structural shocks after removing the effect of global (US) shocks. The SUR results for the period of 1980-1997 are not reported due to space constraints.

It is found that the correlation pattern of supply shocks using SUR is almost the same as that reported in Panel A of Table 1, which implies that the underlying supply shocks estimated by the structural VAR method are not affected by the US shocks. As monetary shocks are concerned, both the

SUR and VAR methods have generated very similar results, implying a weak impact of global shocks. However, the SUR method produced a very different result for demand shocks from that of the structural VAR method. After removing the effect of the global shocks, only four significant correlations of demand shocks are identified between Korea, Taiwan, the Philippines and Malaysia. This result indicates that the U.S. economy has a dominant influence on the demand side of the East Asian economies.<sup>7</sup>

#### 4. CONCLUDING REMARKS

In this paper we used a three-variable VAR model to identify various types of shocks using over two decades of quarterly data from East Asia. The results show that 1) the exchange rates are relatively stable, but these economies display a less coherent pattern in GDP growth than that of inflation; 2) supply shocks were correlated significantly only among a few ASEAN countries and the NIEs, but were improved after the financial crisis; and 3) demand and monetary shocks are highly correlated among the East Asian economies and also between the U.S. and the region. These results are affirmed using the SUR method.

In comparison with the EU countries, the underlying structural shocks in East Asia are less symmetric with a larger size on average, but the speed of adjustment is faster, taking less than one year to complete the adjustment. This rapid speed of adjustment is largely due to their relatively more flexible labor market and wage rates, making internal adjustment easier.

Thus, the empirical results do not display strong support for forming an OCA in the East Asian region. However, they do imply that some sub-regions are better candidates for a currency arrangement as their disturbances are correlated and small, and these countries adjust rapidly to shocks.

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<sup>7</sup> To determine the possible impact of the second oil crisis on our results, we re-estimated the correlation of underlying shocks for the period of 1982-1997 to remove the effect of the second oil crisis, and found very similar results to that in Table 1, implying little influence of the oil crisis on our empirical findings.

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