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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 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.

JEL Classification: F31, F33, F36, F41.

Keywords: optimum currency area, vector autoregressions, exchange rates, 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.[1] This is because the crisis has eroded the credibility of unilateral fixed exchange rates and correspondingly increased interest in "harder" pegs. One of the proposals raised during the 1998 ASEAN Ministerial Meeting in Hanoi was the idea of having a common currency and exchange rate system in the region. 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 precondition of forming an OCA.

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.[2] 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. Many studies have so far applied the OCA theory to assessing the feasibility of monetary and financial integration largely in the European region, but few for the East Asian economies.

The OCA criteria generally fall into following groups: (i) the symmetry of shocks across economies, (ii) high intra-regional trade, (iii) factor mobility and labor market flexibility, (iv) financial market integration, and (v) coordination of

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

[2] For a good survey of OCA, see Kawai (1987), Tavlas (1993) and De Grauwe (2000).

macroeconomic policy. This paper studies the shocking aspects of output fluctuations as a measurement of feasibility in forming a currency area.

Most existing studies on OCA in East Asia adopt a straightforward approach to examine the observable macroeconomic variables, such as GDP growth rates, inflation rates, exchange rates, interest rates and stock prices, of the economies in question, and to explore the degree of correlation in these variables (see Ito, 1994, Taguchi, 1994, Tavlas, 1997, and Kwan 1998). Bayoumi and Eichengreen (1993, 1994) are among the first few to estimate the underlying structural shocks by using the Blanchard-Quah (1989) style vector autoregressions (VAR) method. In this paper we extend their work by employing a three-variable VAR model *a la* Blanchard and Quah (1989) to identify various types of shocks over two decades of data from East Asia. In particular, with an open macroeconomic setting, we employ real output, real effective exchange rates and prices variables in the VAR to identify the fundamental supply, demand and monetary shocks. For comparison purpose, we also apply this model to the European countries and compare the correlation results of underlying shocks between the East Asian region and the European region.[3] The associated impulse response function analysis is also conducted to measure the size of the underlying shocks and the speed of adjustment to disturbances. We then attempt to remove the effect of global (US) shocks from the estimated underlying shocks of the East Asian economies and examine correlation of re-estimated shocks for comparison.

The remainder of the paper is organized as follows. Section 2 discusses the theoretical framework and methodology for this study. In section 3, we assess the variability and correlation of output, exchange rates and the price level. This is

[3] We include 14 EU countries in this study only. Owing to data availability, Greece, Ireland and Luxembourg that are member states of the European Union are not included in our analysis.

followed by the examination of the correlations of the identified shocks as well as the size of shocks and the adjustment speed to shocks based on an impulse response analysis. The robustness of the estimations is also checked. The final section concludes this study.

2. ANALYTICAL FRAMEWORK

(1) Model

The simplest approach of the literature on the OCA question is to investigate various observable macroeconomic variables (such as real GDP growth rate, inflation rate and exchange rate) of the economies or regions concerned and to explore to what extent the variables are correlated across the economies or the regions

The influential works of Bayoumi and Eichengreen (1993, 1994) go beyond the analysis of simple cross-country correlations of observable macroeconomic variables, and examine the underlying structural shocks that affect the economies or regions in question by using the structural VAR method developed by Blanchard and Quah (1989). The basic idea is that fluctuations of observable macroeconomic variables are subject to underlying shocks. Bayoumi and Eichengreen decompose shocks affecting GDP growth and inflation into underlying supply and demand shocks, and examine the cross-country correlation of each shock among the economies concerned. Recently, several studies, such as Kawai and Okumura (1996), and Bayoumi, Eichengreen and Mauro (2000), have also applied the OCA theory to the East Asian economies, using a structural VAR method. However, most existing studies employ a two-variable VAR model and their results are also mixed.[4] In study, we set up an open economy macroeconomic model with three variables of output, exchange rate and the price level to examine the underlying shocks that affect the region.[5]

We use three macroeconomic variables, 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.[6] 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 Δ denotes the first-difference operator and ε_{st}, ε_{dt}, and ε_{mt} denote supply, demand and monetary shocks, respectively. The structural model can be compactly written,

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

or

$$\begin{pmatrix} \Delta y_t \\ \Delta q_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{pmatrix} \begin{pmatrix} \varepsilon_{st} \\ \varepsilon_{dt} \\ \varepsilon_{mt} \end{pmatrix} \quad , \tag{2}$$

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[4] Chow and Kim's (2000) study is different from the previous literature: they use a three-variable VAR model, assuming that domestic output is subject to 3 types of shocks (global, regional and country-specific shocks).

[5] Our model draws on Clarida and Gali (1994) that attempt to identify the source of real exchange rate fluctuations using a three-variable VAR model a la Obstfeld (1985). Obstfeld developed a stochastic version of the two-country open macro model under rational expectations. See also Rogers (1998) and Demertzis, Hallet and Rummel (2000) for similar studies on the European countries.

[6] Lowercase variables are natural logarithms so that the first-difference of variables can be interpreted as a growth rate.

where $A_{ij}(L) = a_{ij}^{o} + a_{ij}^{1}L + a_{ij}^{2}L^{2} + \cdots$, and we assume that the structural shocks $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$ are serially uncorrelated and have a variance-covariance matrix normalized to the identity matrix. The model implies that the macroeconomic variables are subject to the three structural shocks, i.e., the supply, demand and monetary shocks.

To identify the structural A_i matrices, we follow the Blanchard-Quah approach and impose the following long-run restrictions: (i) that only supply shocks (ε_{st}) are expected to affect output in the long-run, (ii) that both supply and demand shocks (ε_{st} and ε_{dt}) influence real effective exchange rates in the long-run, and (iii) that monetary shocks (ε_{mt}) have no long-run effect on either output or real effective exchange rates. Thus, the restriction (i) requires $A_{12}(1) = A_{13}(1) = 0$, and the restrictions (ii) and (iii) require $A_{23}(1) = 0$. These long-run restrictions are sufficient to identify the structural A_i matrices and the time series of structural shocks $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$.

To identify the structural A_i matrices, we estimate the following reduced-form VAR model instead of the structural MA model of equation (1):

$$\Delta x_t = B(L)\Delta x_{t-1} + u_t, \qquad (3)$$

where u_t is a vector reduced-form disturbance. A MA representation of equation (3) is:

$$\Delta x_t = C(L)u_t \qquad (4)$$

where $C(L) = (1 - B(L)L)^{-1}$ and the lead matrix of $C(L)$ is by construction $C_0 = I$. By comparing equations (1) and (4), we obtain the relationship between the structural and reduced-form disturbances: $u_t = A_0\varepsilon_t$. Hence, it is necessary to obtain estimates of A_0 to recover the time series of structural shocks ε_t. Since the structural shocks are mutually orthogonal and each shock has unit variance, the following relationship between the variance-covariance matrices is obtained: $C(1)\Sigma C(1)' = A(1)A(1)'$ where $\Sigma = Eu_t u_t' = EA_0\varepsilon_t\varepsilon_t' A_0' = A_0 A_0'$. Letting H denote the lower triangular Choleski decomposition of $C(1)\Sigma C(1)'$, we obtain $A(1) = H$ since our 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, $\varepsilon_t \equiv [\varepsilon_{st}, \varepsilon_{dt}, \varepsilon_{mt}]'$.

(2) Discussions

Before moving on to our empirical results, we must note the following critiques to our empirical methodology. First, the structural decomposition using the Blanchard-Quah technique does not necessarily identify purely stochastic disturbances. The estimated demand and monetary disturbances tend to include the effect of macroeconomic policies, whereas supply disturbances are assumed to be less likely to include the impact of policies implemented.[7] This implies that supply

[7] One possible way to overcome this problem is to include extra policy variables in the VAR system. However, the more variables in the VAR system, the more difficult to identify structural shocks, unless we can get obvious identifying restrictions from economic theory. Demertzis, Hallett and Rummel (2000) investigate whether the symmetry of structural shocks for European countries is policy-induced by investigating correlations between identified

disturbances are more informative for evaluating the symmetry of shocks, and hence the feasibility of OCAs, than other disturbances. In other words, the more (less) symmetric shocks the economies encounter, the higher (lower) the correlation in supply shocks is, the more (less) feasible for these economies to set up an OCA. This is the standard approach in the OCA literature.

Second, in the open-economy framework, estimated structural shocks tend to include the effect of foreign shocks.[8] For example, even though we obtain the high correlation of demand shocks across the economies, our technique cannot distinguish whether the result simply reflects the correlation of local shocks or the correlation is affected by global shocks. In the later section, we attempt to remove such effects of global shocks and to calculate correlation of re-estimated local shocks across the East Asian economies.

Third, asymmetric shocks would not cause a great deal of trouble to countries if the size of shocks were much smaller and if an economy responded more quickly to disturbances. In the later section, we will investigate and compare the size of shocks and the speed of adjustment between the East Asian economies and the European countries. In addition, asymmetric shocks would not generate large costs of adjustment for the economies concerned, if country-specific policies can stabilize national output by mitigating real-side shocks, and if factor mobility mitigates the impact of shocks. These issues call for the analysis of other OCA criteria: for example, in light of factor mobility and labor market flexibility. These issues are not

shocks and policy variables.

[8] Kawai and Okumura (1996) focus on this issue and attempt to remove the effect of global shocks in calculating correlation of underlying shocks, while Chow and Kim (2000) attempt to identify three types of shocks: global, regional and country-specific shocks.

taken up in this paper, since we confine our analysis to the shocking aspects of the OCA criteria.

Finally, Frankel and Rose (1998) argue that more international trade will produce more highly correlated business cycles, which implies that the correlation of underlying (supply) shocks is likely to increase as trade integration progresses. This critique in light of the so-called endogeneity issue is also applicable to our study, since we are using time-invariant VARs and our analysis focuses on just one condition of the OCA criteria. Further investigation into the effect of regime changes on correlation of shocks should be necessary.

3. EMPIRICAL RESULTS

(1) Data

We use real GDP as a proxy for real output variable and consumer price index (CPI) as a measure of changes in prices. 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. All data are quarterly, in natural logarithm and seasonally unadjusted except for real GDP series.[9] Data for the East Asian economies and the United States span 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).

[9] We use *EViews 4* for our empirical examination below. Seasonal adjustment is conducted using Census X-11 (multiplicative).

The major data sources used in this study 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[10] , and the ICSEAD database (see Data Appendix for details).

(2) Variability and Correlation of the Variables

The variability of nominal bilateral exchange rates for the 10 East Asian economies and the United States is shown in Tables 1 through 4 for different periods with a reference to the effect of the two regional crises in the 1980s and 1990s and China's unification of its dual exchange rates in the early 1994. In the view of the whole sample period from 1983 to 2000, exchange rates of the East Asian economies are relatively stable against each other. 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.

The 1997 financial crisis started in Thailand and became a regional crisis shortly. Indonesia and Korea were hit mostly by this financial crisis, which caused high volatility of their exchange rates against their neighbors'. The Indonesia Rupiah became the most volatile currency in the region after the crisis, followed by the Korea Won and Thai Baht. However, the rest of the East Asian economies continue to display very low levels of variability vis-à-vis one another even after the East Asian financial crisis. In comparison, the first economic recession happened in ASEAN and China's unification of its dual exchange rates have not contributed much to the exchange rate volatility in the region.

[10] We are most grateful to Tilak Abeysinghe for providing us with the real GDP series for

The low variability of bilateral exchange rates in East Asia reflects the progress of its financial market integration. It also reflects to a certain extent the symmetric effects of shocks originated from the region and the rest of the world. To this end, it may imply the possibility of further regional monetary integration.

We turn to the examination of correlations in growth and inflation of the East Asian economies for specified periods (Tables 5 and 6)[11]. Overall, the East Asian economies display a less coherent pattern in GDP growth compared to inflation movements, though the former has become more correlated after the financial crisis. It is interesting to note that the recent financial crisis has changed the correlation patterns of economic growth and inflation among the economies concerned. 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 East Asian region.

(3) Correlation of Underlying Structural Shocks

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 (the 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. The structural VAR approach allows us to recognize

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some East Asian economies.

[11] In Tables 5 and 6, GDP growth rates and CPI inflation rates are calculated as a percentage change over corresponding period of previous year.

underlying shocks and how the shocks affect the observed macroeconomic variables. 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.

(3.1) Correlation Analysis: The East Asian Economies and the United States

The results of correlations of the three identified shocks among the East Asian economies for 1980Q1-1997Q1 and 1980Q1-2000Q3 are reported in Tables 7 and 8.[12] In the top panel of Table 7, it is found that supply shocks are correlated significantly only among a few ASEAN countries and the Asian NIEs. It is interesting to note that the regional financial crisis improved the number of significant correlations of supply shocks in these economies, especially among the economies that have been hit mostly by the crisis (the top panel of Table 8). 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.

[12] We assess the significance levels of correlation coefficients using the Fisher's variance-stabilizing transformation of *r*, $z = (1/2)\ln[(1+r)/(1-r)]$, which has a distribution that approaches normality much faster than that of *r*, where *r* denotes estimated correlation coefficient. Asymptotically, the mean of *z* is zero and the standard deviation is approximately $(n-3)^{-1/2}$, under the null hypothesis is that correlation coefficient is zero, where *n* denotes the sample size. A concise explanation is given in Rodriguez (1982).

In contrast, demand shocks and monetary shocks are highly correlated among the economies concerned (Panel B of Tables 7 and 8). 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. Japan exhibited a high negative correlation of demand shocks with the rest of East Asia. As Japan is the major source of imports for the rest of East Asia,[13] 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 the periods both including and excluding the crisis. The financial crisis has increased the number of significant correlations in the region, especially for the most-hit economies by the crisis. In particular, the ASEAN economies have become significantly correlated with Korea and Taiwan as well as among themselves since the crisis. China has also 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 remained insignificant except with 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 (Panel C of Tables 7 and 8). 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 one significant correlation of shocks with Taiwan in the periods

[13] According to ICSEAD (2001), Japan accounted for roughly about 20-30 percent of other

both including and excluding the crisis. However, one should be cautious as including the post-crisis period in the sample may cause structural breaks in the series, which would affect estimation.[14]

According to the OCA literature, 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.

(3.2) Comparison with European Countries

To assess our conclusion, we apply the same method to estimate the three structural shocks in the EU countries for comparison purpose. The results are reported in Table 9.

First, it is noted that symmetric supply shocks prevail only in sub-grouped EU countries and are not uniformly observed across the European countries. This is the

East Asia's total imports in the 1980s and 1990s.

[14] We have estimated the underlying shocks by the structural VAR approach using data from the 1980s and 1990s prior to the financial crisis. The number of significant correlations of the three identified shocks among the East Asian economies in the 1990s do not change as much in the 1980s.

case even in the so-called “core” countries and in the Euro area.[15] For instance, Germany, which is typically considered as the regional lead country, is significantly correlated in supply shocks only with Austria and Italy.[16] These results suggest that supply shocks are far less symmetric in the EU countries than one expects. This contrasts with our earlier conclusion for the East Asian region.

Then, the correlations of demand shocks show a similar pattern to that of supply shocks in the EU countries. They are significantly correlated only within sub-grouped countries. In the core countries, symmetric demand shocks prevail and the significance of correlations is high, reflecting their close macroeconomic policy coordination. In particular, Germany is found to be positively and significantly correlated of demand shocks with the core countries and Switzerland. In contrast, the leading economy of 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, Hallett and Rummel (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.

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[15] Conventionally, the “core” countries include Austria, the Benelux, Denmark, France and Germany, while Luxembourg is not taken up in this paper. Euro area consists of the 12 countries: Austria, Benelux, Finland, France, Germany, Greece, Ireland, Italy, Portugal and Spain, though Greece, Ireland and Luxembourg are not taken up due to the data availability.

[16] With a different setting and data source, Bayoumi and Eichengreen (1994) find that Germany’s supply shocks are significantly correlated with those of France, Netherlands, Belgium, Denmark, Austria and Switzerland. Demertzis, Hallett and Rummel (2000, Table 2) also show that significant correlations of supply shocks with Germany are observed in France, Belgium, Denmark, Luxembourg, Netherlands, United Kingdom, Sweden and Italy.

Overall, it is found 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 regions. These results are consistent with our earlier conclusion that it is less feasible for the entire East Asian region to form an OCA, but very possible in some sub-groups, such as among some NIEs and ASEAN countries where the underlying shocks are positively and significantly correlated.

(4). Size of Disturbances and Speed of Adjustment

In addition to the analysis of correlations in structural shocks, investigations into other two conditions are also necessary to assess the feasibility of an OCA, i.e., (1) the size of shocks and (2) the speed of adjustment to shocks. The larger 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.

Bayoumi and Eichengreen (1994) calculate the size of disturbances and the speed of adjustment based on the impulse response function analysis. Since the estimated structural shocks are assumed to have unit variances in the structural VAR method, their size and adjustment speed can be inferred by analyzing the associated impulse response functions. For supply shocks, we use the long-run (20-quarter horizon) effect of a unit shock on changes in real GDP as a measure of size. For demand and monetary shocks, we choose the 1-quarter impact on changes in real exchange rates and CPI, respectively. The speed of adjustment is measured by the response after 4-quarters as a share of the long-run effect (the response after a 20-quarter horizon).[17]

Table 10 represents the results of the impulse response function analysis. 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, such as Korea, Thailand Indonesia and Malaysia. In comparison with the EU countries, the average size of the three underlying shocks is much larger in East Asia.

However, in comparison, 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 this difference 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.

Thus, the results support 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.

[17] Our choice of the 1-quarter impact in calculating the size of demand and monetary shocks is somewhat arbitrary. However, choosing longer horizons for demand and monetary shocks as a measure will not change the conclusion.

(5). Robustness: Removing the Effects of Global Shocks

As mentioned earlier, in the open-economy framework, estimated structural shocks obtained by the structural VAR method tend to include the effect of global shocks as well as local shocks. In other words, even if underlying shocks are significantly correlated across the economies, it does not necessarily ensure a significant correlation of local shocks. It is possible that such significant correlation of shocks is due to the effect of global shocks (see Kawai and Okumura, 1996). In this section, we conduct a robustness test of our empirical findings by investigating the correlations of underlying shocks after removing the effect of global shocks.

We assume the US shocks as 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:[18]

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

where s, d, and m stand for supply, demand and monetary shocks, respectively; $i = s$, d, m; $k = 0, 1, .., 4$; and the superscript j denotes a country name indicating fundamental shocks of each East Asian economy. Then, we re-estimate the equation by including the US shocks that are statistically significant at least at the 5 percent level in the first-stage OLS regression. In particular, we estimate a system of three

[18] Kawai and Okumura (1996) regard both US and Japanese shocks as global shocks. Since Japan is included in the East Asian economies in this study, we assume only US shocks to be exogenous to the East Asian economies.

equations for each economy, where supply, demand and monetary shocks of the economy are on the left-hand side of the equations and the US shocks that are significant at the first-stage estimation are on the right-hand side. 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 reported in Table 11.

As seen in Panel A of Table 11, the correlation pattern of supply shocks using SUR is almost the same as that reported in Table 7, 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 have been identified (Panel B of Table 11). This result indicates that the U.S. economy has a dominant influence on the demand side of the East Asian economies.[19]

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

[19] It is noted that oil price fluctuations may also affect the underlying shocks. 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 by removing the effect of the second oil crisis, and found very similar results to that in Table 7, implying little influence of the oil crisis on our empirical findings. The results are available upon request.

the exchange rates of the East Asian economies are relatively stable, but these economies display a less coherent pattern in GDP growth than that of inflation, though the former has become more correlated after the financial crisis. Prior to the recent financial crisis, supply shocks were correlated significantly among a few ASEAN countries and the Asian NIEs. It is interesting to note that the regional financial crisis improved the number of significant correlations of supply shocks in these economies, especially among the economies that have been hit mostly by the crisis. For the rest of East Asia, asymmetric shocks seem to prevail. The U.S. economy is not significantly correlated with the region, and so is Japan. In contrast, demand shocks and monetary shocks are highly correlated among the East Asian economies and also between the U. S. and the region. Japan exhibits a high negative correlation of demand shocks with the rest of East Asia. These results are affirmed by our robustness test using the SUR method.

In comparison with the EU countries, it is found that the underlying structural shocks are less symmetric and the average size of the underlying shocks is larger in the East Asian countries. However, the speed of adjustment to shocks in East Asia is much faster than in the EU region, taking less than one year to complete the adjustment to shocks. This is largely due to the fact 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.

Thus, the empirical results do not display strong support for forming an optimum currency area 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.

DATA APPENDIX

Real GDP series for the East Asian economies (other than Japan) are obtained from the NUS ESU databank and the private data sources. Japan's real GDP data is collected from the Economic and Social Research Institute, Cabinet Office, Government of Japan (http://www.esri.cao.go.jp/index.html). Real GDP series for other countries are obtained from IMF, *International Financial Statistics, Monthly*, CD-ROM (IFS, henceforth).

Nominal exchange rate series are obtained from IFS and the Taiwan Economic Data Center. The consumer price index (CPI) series are obtained from IFS, *China Monthly Statistics*, *Hong Kong Monthly Digest of Statistics*, National Statistics of Taiwan (http://www.stat.gov.tw/bs3/index/cpiidx.htm) and the Datastream.

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. Data were collected from Statistics Canada, *World Trade Analyzer*, CD-ROM and the International Centre for the Study of East Asian Development (ICSEAD) database.

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Table 1: The Variability of Nominal Exchange Rates, 1983:10-2000:10

	US	JP	CH	HK	ID	KR	MA	PH	SI	TH	TW
US											
JP	0.030										
CH	0.033	0.044									
HK	0.003	0.030	0.033								
ID	0.073	0.074	0.081	0.073							
KR	0.032	0.040	0.046	0.032	0.064						
MA	0.023	0.032	0.038	0.024	0.062	0.030					
PH	0.027	0.040	0.042	0.027	0.066	0.034	0.026				
SI	0.013	0.025	0.036	0.013	0.067	0.030	0.018	0.026			
TH	0.030	0.037	0.044	0.030	0.061	0.029	0.022	0.028	0.024		
TW	0.013	0.028	0.036	0.013	0.070	0.030	0.022	0.027	0.014	0.027	

Table 2: The Variability of Nominal Exchange Rates, 1983:10-1984:12

	US	JP	CH	HK	ID	KR	MA	PH	SI	TH	TW
US											
JP	0.018										
CH	0.020	0.020									
HK	0.010	0.021	0.020								
ID	0.006	0.017	0.017	0.011							
KR	0.004	0.014	0.019	0.012	0.006						
MA	0.009	0.013	0.019	0.013	0.010	0.006					
PH	0.059	0.059	0.065	0.059	0.060	0.059	0.057				
SI	0.008	0.010	0.017	0.012	0.008	0.005	0.006	0.058			
TH	0.039	0.047	0.039	0.039	0.040	0.040	0.040	0.068	0.041		
TW	0.010	0.022	0.023	0.011	0.013	0.012	0.013	0.059	0.013	0.038	

Table 3: The Variability of Nominal Exchange Rates
(1985:01-1996:12 and 1997:01-2000:10)

	US	JP	CH	HK	ID	KR	MA	PH	SI	TH	TW
US		0.030	0.038	0.001	0.022	0.008	0.011	0.015	0.010	0.006	0.008
JP	0.032		0.048	0.030	0.036	0.029	0.028	0.037	0.025	0.025	0.029
CH	0.000	0.033		0.038	0.045	0.039	0.036	0.041	0.040	0.039	0.040
HK	0.000	0.032	0.000		0.022	0.008	0.011	0.015	0.010	0.006	0.011
ID	0.148	0.143	0.148	0.148		0.024	0.025	0.027	0.023	0.023	0.026
KR	0.032	0.068	0.067	0.067	0.129		0.014	0.018	0.012	0.009	0.011
MA	0.045	0.046	0.045	0.045	0.123	0.060		0.019	0.011	0.010	0.015
PH	0.036	0.043	0.036	0.036	0.127	0.057	0.029		0.020	0.018	0.019
SI	0.020	0.028	0.020	0.020	0.134	0.059	0.032	0.026		0.007	0.013
TH	0.058	0.058	0.058	0.058	0.120	0.055	0.037	0.035	0.044		0.012
TW	0.018	0.028	0.019	0.019	0.140	0.060	0.037	0.030	0.014	0.049	

Note: Top panel of Table 3 presents the variability of the exchange rates in 1985-1996, and the bottom presents the variability in 1997-2000.

Table 4: The Variability of Nominal Exchange Rates
(1983:10-1993:12 and 1994:01-2000:10)

	US	JP	CH	HK	ID	KR	MA	PH	SI	TH	TW
US		0.028	0.022	0.003	0.024	0.007	0.010	0.026	0.011	0.015	0.011
JP	0.032		0.036	0.028	0.035	0.028	0.026	0.040	0.023	0.027	0.029
CH	0.045	0.053		0.023	0.033	0.022	0.024	0.032	0.026	0.025	0.024
HK	0.000	0.032	0.045		0.025	0.008	0.011	0.026	0.011	0.015	0.011
ID	0.111	0.110	0.120	0.111		0.026	0.026	0.036	0.025	0.028	0.028
KR	0.050	0.054	0.067	0.050	0.097		0.013	0.027	0.012	0.016	0.011
MA	0.035	0.040	0.052	0.035	0.092	0.046		0.027	0.010	0.016	0.014
PH	0.029	0.040	0.054	0.029	0.095	0.044	0.025		0.028	0.029	0.027
SI	0.016	0.027	0.047	0.016	0.101	0.044	0.025	0.022		0.015	0.014
TH	0.044	0.047	0.063	0.044	0.090	0.042	0.029	0.028	0.033		0.018
TW	0.016	0.027	0.049	0.016	0.105	0.045	0.031	0.026	0.013	0.037	

Note: The top panel of Table 4 presents the variability of the exchange rates in 1985-1996, and the bottom presents the variability in 1997-2000.

Table 5: Correlation of GDP Growth across the United States and the East Asian Economies

	US	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch
					Panel A: 1981Q1-2000Q3						
United States	1.00										
Japan	-0.06	1.00									
Korea	-0.03	0.44	1.00								
Taiwan	0.38	0.27	0.45	1.00							
Hong Kong	0.21	0.25	0.63	0.68	1.00						
Singapore	0.00	0.17	0.34	0.22	0.52	1.00					
Malaysia	-0.10	0.28	0.54	0.07	0.45	0.75	1.00				
Indonesia	-0.03	0.43	0.65	0.31	0.58	0.54	0.79	1.00			
Thailand	-0.16	0.57	0.70	0.26	0.45	0.53	0.70	0.77	1.00		
Philippines	-0.20	0.04	0.12	-0.10	0.14	0.40	0.35	0.20	0.22	1.00	
China	0.27	-0.01	0.11	0.25	0.17	-0.11	-0.11	0.10	0.08	-0.54	1.00
					Panel B: 1981Q1-1997Q1						
United States	1.00										
Japan	0.09	1.00									
Korea	0.07	0.20	1.00								
Taiwan	0.50	0.12	0.53	1.00							
Hong Kong	0.31	0.00	0.41	0.73	1.00						
Singapore	0.04	-0.05	0.01	0.11	0.35	1.00					
Malaysia	-0.06	-0.08	-0.13	-0.20	0.02	0.70	1.00				
Indonesia	0.30	-0.10	-0.17	0.09	0.23	0.35	0.50	1.00			
Thailand	-0.04	0.30	0.14	0.07	0.04	0.50	0.47	0.22	1.00		
Philippines	-0.25	0.06	0.00	-0.12	0.05	0.38	0.36	0.23	0.37	1.00	
China	0.41	-0.26	-0.02	0.16	0.11	-0.24	-0.37	-0.36	-0.33	-0.57	1.00
					Panel C: 1997Q2-2000Q3						
United States	1.00										
Japan	0.24	1.00									
Korea	0.46	0.72	1.00								
Taiwan	0.17	0.52	0.48	1.00							
Hong Kong	0.68	0.70	0.84	0.69	1.00						
Singapore	0.47	0.65	0.77	0.80	0.91	1.00					
Malaysia	0.46	0.73	0.91	0.72	0.93	0.93	1.00				
Indonesia	0.44	0.61	0.85	0.74	0.90	0.95	0.97	1.00			
Thailand	0.60	0.60	0.96	0.30	0.81	0.68	0.83	0.77	1.00		
Philippines	0.35	0.55	0.80	0.70	0.84	0.92	0.92	0.97	0.72	1.00	
China	-0.08	-0.08	-0.17	-0.11	-0.01	0.03	-0.15	-0.06	-0.12	0.03	1.00

Notes:
1. Quarterly data of real GDP growth rate is used.
2. GDP growth rates denote the percentage change over corresponding period of previous year.

Table 6: Correlation of Inflation across the United States and the East Asian Economies

	US	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch
					Panel A: 1981Q1-2000Q3						
United States	1.00										
Japan	0.76	1.00									
Korea	0.83	0.71	1.00								
Taiwan	0.75	0.61	0.90	1.00							
Hong Kong	0.53	0.61	0.64	0.53	1.00						
Singapore	0.81	0.68	0.77	0.67	0.67	1.00					
Malaysia	0.63	0.54	0.75	0.74	0.40	0.74	1.00				
Indonesia	-0.07	-0.01	0.16	0.08	-0.18	-0.13	0.34	1.00			
Thailand	0.62	0.59	0.86	0.77	0.49	0.68	0.73	0.26	1.00		
Philippines	0.30	0.41	0.07	0.02	0.26	0.24	0.17	0.05	-0.07	1.00	
China	0.27	-0.01	0.18	0.38	0.53	0.31	0.15	-0.30	0.07	0.08	1.00
					Panel B: 1981Q1-1997Q1						
United States	1.00										
Japan	0.80	1.00									
Korea	0.87	0.71	1.00								
Taiwan	0.74	0.61	0.91	1.00							
Hong Kong	0.53	0.50	0.61	0.54	1.00						
Singapore	0.80	0.67	0.79	0.67	0.85	1.00					
Malaysia	0.70	0.57	0.76	0.76	0.71	0.83	1.00				
Indonesia	0.56	0.46	0.53	0.49	0.46	0.46	0.59	1.00			
Thailand	0.76	0.58	0.89	0.85	0.47	0.77	0.75	0.45	1.00		
Philippines	0.25	0.37	0.00	-0.04	0.17	0.20	0.13	0.27	-0.15	1.00	
China	-0.13	-0.34	-0.22	0.01	-0.01	-0.12	0.15	-0.04	-0.20	-0.16	1.00
					Panel C: 1997Q2-2000Q3						
United States	1.00										
Japan	-0.49	1.00									
Korea	-0.59	0.53	1.00								
Taiwan	-0.16	0.14	0.51	1.00							
Hong Kong	-0.56	0.85	0.79	0.24	1.00						
Singapore	0.43	0.49	-0.01	-0.28	0.35	1.00					
Malaysia	-0.86	0.19	0.72	0.43	0.47	-0.63	1.00				
Indonesia	-0.76	-0.01	0.50	0.41	0.24	-0.80	0.93	1.00			
Thailand	-0.63	0.62	0.94	0.40	0.90	0.08	0.70	0.48	1.00		
Philippines	-0.90	0.25	0.59	0.33	0.46	-0.62	0.94	0.94	0.63	1.00	
China	0.27	0.65	0.16	0.10	0.56	0.81	-0.39	-0.54	0.25	-0.39	1.00

Notes:
1. Quarterly data of CPI inflation rate is used.
2. CPI inflation rates denote the percentage change over corresponding period of previous year.
3. The Hong Kong data starts from 1984Q1 and the China data from 1987Q1.

Table 7: Correlation of Structural Shocks between the United States and the East Asian Economies before the Financial Crisis

	US	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch
	Panel A: Supply Shocks (1980Q3-1997Q1)										
United States	1.00										
Japan	0.07	1.00									
Korea	-0.02	-0.03	1.00								
Taiwan	0.11	-0.06	0.31	1.00							
Hong Kong	0.03	0.09	0.10	0.49	1.00						
Singapore	-0.03	-0.08	-0.08	0.14	0.07	1.00					
Malaysia	-0.09	-0.03	-0.03	0.00	-0.03	0.30	1.00				
Indonesia	0.12	-0.20	0.01	0.03	-0.16	0.06	0.32	1.00			
Thailand	0.08	-0.18	0.15	0.01	-0.11	0.05	0.06	0.16	1.00		
Philippines	-0.01	0.16	0.01	0.07	0.24	0.12	0.02	-0.05	-0.03	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
	Panel B: Demand Shocks (1980Q3-1997Q1)										
United States	1.00										
Japan	-0.63	1.00									
Korea	0.66	-0.49	1.00								
Taiwan	0.58	-0.33	0.62	1.00							
Hong Kong	0.50	-0.22	0.39	0.36	1.00						
Singapore	0.31	-0.23	0.21	0.18	0.31	1.00					
Malaysia	0.46	-0.44	0.21	0.31	0.16	0.18	1.00				
Indonesia	0.28	-0.21	0.23	0.08	0.12	-0.08	0.10	1.00			
Thailand	0.49	-0.39	0.31	0.32	0.40	0.09	0.24	0.13	1.00		
Philippines	0.46	-0.49	0.45	0.40	0.16	0.26	0.44	0.29	0.31	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
	Panel C: Monetary Shocks (1980Q3-1997Q1)										
United States	1.00										
Japan	0.16	1.00									
Korea	0.24	0.08	1.00								
Taiwan	0.33	0.24	0.12	1.00							
Hong Kong	0.14	0.33	0.08	0.18	1.00						
Singapore	-0.09	0.19	0.17	0.06	0.18	1.00					
Malaysia	0.05	0.14	0.19	0.10	-0.05	0.46	1.00				
Indonesia	0.05	-0.03	0.27	0.19	-0.11	0.22	0.29	1.00			
Thailand	0.21	0.45	0.13	0.14	0.22	0.05	0.13	-0.14	1.00		
Philippines	0.04	-0.08	0.02	0.24	0.13	0.25	0.17	0.20	-0.18	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

Notes:
1. Sample period is from 1980Q3 to 1997Q1 for all economies except China (from 1986Q3 to 1997Q1) and Hong Kong (from 1983Q3 to 1997Q1).
2. Significance levels are assessed using the Fisher's variance-stabilizing transformation. See the text for more details.
3. The sample size is 67 for all economies except Hong Kong (55) and China (43), and the critical value at the 5 percent significance level (two-tailed test) is +/-0.240, +/-0.265 and +/-0.300, respectively. Painted figures denote positive correlation coefficients at the 5 percent level.

Table 8: Correlation of Structural Shocks between the United States and the East Asian Economies Including the Post-Financial Crisis Period

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

Notes:
1. Sample period is from 1980Q3 to 2000Q3 for all economies except Japan (from 1980Q4 to 2000Q3), China (from 1986Q3 to 2000Q3) and Hong Kong (from 1983Q4 to 2000Q3).
2. Significance levels are assessed using the Fisher's variance-stabilizing transformation. See the text for more details.
3. The sample size is 81 for all economies except Japan (80), Hong Kong (69) and China (57), and the critical value at the 5 percent significance level (two-tailed test) is +/-0.218, +/-0.220, +/-0.237 and +/-0.261, respectively. Painted figures denote positive correlation coefficients at the 5 percent level.

Table 9: Correlation of Structural Shocks between the European Countries

	Aus	Bel	Fin	Fra	Ger	Ita	Net	Por	Spa	Den	Nor	Swe	Swi	UK
	Panel A: Supply Shocks (1980Q3-1998Q4)													
Austria	1.00													
Belgium	0.22	1.00												
Finland	0.01	0.26	1.00											
France	0.31	0.50	0.34	1.00										
Germany	0.31	0.22	-0.06	0.23	1.00									
Italy	0.16	0.27	0.32	0.40	0.29	1.00								
Netherlands	0.15	0.29	0.10	0.20	0.03	0.09	1.00							
Portugal	0.06	0.39	-0.08	0.38	-0.04	0.13	-0.04	1.00						
Spain	0.30	0.13	0.13	0.14	-0.04	0.27	-0.01	0.14	1.00					
Denmark	-0.09	0.29	0.32	0.28	-0.03	0.17	0.23	0.18	0.41	1.00				
Norway	-0.08	0.20	0.10	0.34	0.11	0.33	0.15	0.01	0.09	0.18	1.00			
Sweden	0.20	0.38	0.44	0.50	0.03	0.39	0.01	0.07	0.15	0.16	0.27	1.00		
Switzerland	0.18	0.30	0.00	0.15	-0.12	0.16	0.26	0.24	0.14	0.08	0.21	0.02	1.00	
United Kingdom	0.10	0.14	0.19	0.11	0.05	0.12	-0.05	0.03	0.04	0.10	-0.07	0.31	0.11	1.00
	Panel B: Demand Shocks (1980Q3-1998Q4)													
Austria	1.00													
Belgium	0.66	1.00												
Finland	0.00	0.29	1.00											
France	0.53	0.46	-0.07	1.00										
Germany	0.82	0.71	-0.02	0.43	1.00									
Italy	-0.13	0.12	0.18	0.12	-0.05	1.00								
Netherlands	0.85	0.64	-0.04	0.53	0.82	0.07	1.00							
Portugal	0.20	0.20	0.21	0.12	0.12	-0.02	0.01	1.00						
Spain	0.15	0.21	0.14	0.15	0.12	0.18	0.06	0.25	1.00					
Denmark	0.72	0.73	0.22	0.70	0.67	-0.10	0.69	0.34	0.35	1.00				
Norway	0.15	0.33	0.41	0.12	0.10	0.09	0.04	0.18	0.05	0.28	1.00			
Sweden	-0.23	0.23	0.51	-0.04	-0.27	0.31	-0.23	0.02	0.18	0.05	0.26	1.00		
Switzerland	0.43	0.49	-0.05	0.39	0.47	-0.07	0.51	0.00	-0.04	0.55	-0.05	-0.26	1.00	
United Kingdom	-0.39	-0.26	0.15	-0.32	-0.32	0.22	-0.29	-0.13	-0.04	-0.31	0.21	0.21	-0.27	1.00
	Panel C: Monetary Shocks (1980Q3-1998Q4)													
Austria	1.00													
Belgium	0.59	1.00												
Finland	0.19	0.16	1.00											
France	0.03	-0.06	0.35	1.00										
Germany	0.38	0.53	0.29	0.00	1.00									
Italy	-0.13	-0.18	0.20	-0.03	0.24	1.00								
Netherlands	0.22	0.09	-0.02	0.03	0.17	0.16	1.00							
Portugal	0.19	-0.16	0.33	0.18	0.24	0.10	-0.18	1.00						
Spain	0.41	0.26	0.17	0.14	0.21	0.09	-0.25	0.52	1.00					
Denmark	-0.14	0.04	0.15	0.36	0.03	0.31	0.03	0.24	-0.03	1.00				
Norway	0.13	-0.35	0.19	0.05	0.13	0.06	-0.05	0.43	0.29	0.37	1.00			
Sweden	0.18	0.07	0.50	0.25	0.20	0.42	-0.01	0.39	0.17	0.08	0.27	1.00		
Switzerland	0.14	0.19	0.20	0.16	0.46	0.37	0.06	0.26	0.14	0.38	0.22	0.38	1.00	
United Kingdom	0.11	-0.03	0.30	0.45	-0.03	0.11	0.23	0.14	-0.02	0.61	0.04	0.11	0.20	1.00

Notes:
1. Sample period is from 1980Q3 to 1998Q4 for all countries except Belgium (from 1985Q3 to 1998Q4) and Denmark (from 1988Q3 to 1998Q4).
2. Significance levels are assessed using the Fisher's variance-stabilizing transformation. See the text for more details.
3. The sample size is 74 for all countries except Belgium (54) and Denmark (42), and the critical value at the 5 percent significance level (two-tailed test) is +/-0.229, +/-0.268 and +/-0.304, respectively. Painted figures denote positive correlation coefficients at the 5 percent level.

Table 10: The Size of Shocks and the Speed of Adjustment to Shocks across Different Economies

	Supply Shocks		Demand Shocks		Monetary Shocks	
	Size	Speed	Size	Speed	Size	Speed
Panel A: United States and the East Asian Economies (1980Q3-1997Q1)						
United States	0.009	0.981	0.030	0.987	0.004	0.922
Japan	0.009	0.990	0.042	0.984	0.006	0.996
Korea	0.013	0.975	0.026	0.984	0.009	0.889
Taiwan	0.012	1.015	0.027	1.002	0.010	0.959
Hong Kong	0.022	0.994	0.030	0.967	0.006	0.951
Singapore	0.018	0.997	0.016	0.963	0.005	0.962
Malaysia	0.018	0.972	0.022	0.951	0.006	0.980
Indonesia	0.010	0.999	0.052	0.995	0.013	1.000
Thailand	0.014	1.000	0.026	0.998	0.007	0.997
Philippines	0.023	0.952	0.044	1.023	0.015	0.884
China	0.015	1.002	0.061	0.997	0.021	0.991
Average	0.016	0.990	0.035	0.986	0.010	0.961
Panel B: United States and the East Asian Economies (1980Q3-2000Q3)						
United States	0.009	0.972	0.029	0.994	0.004	0.899
Japan	0.011	0.871	0.056	0.980	0.005	0.716
Korea	0.020	1.000	0.044	1.000	0.010	0.946
Taiwan	0.011	1.012	0.041	0.993	0.010	0.971
Hong Kong	0.025	1.004	0.024	0.695	0.005	0.640
Singapore	0.019	1.001	0.027	0.981	0.005	0.948
Malaysia	0.027	0.956	0.035	0.987	0.007	0.997
Indonesia	0.030	0.995	0.072	1.044	0.018	1.045
Thailand	0.027	0.979	0.048	0.998	0.008	0.990
Philippines	0.021	0.962	0.044	1.017	0.015	0.901
China	0.015	0.986	0.070	0.992	0.021	0.973
Average	0.021	0.977	0.046	0.969	0.010	0.913
Panel C: European Countries (1980Q3-1998Q4)						
Austria	0.008	1.000	0.010	0.995	0.007	0.997
Belgium	0.008	0.998	0.011	0.990	0.004	1.000
Finland	0.016	0.963	0.018	0.938	0.005	0.785
France	0.008	0.904	0.012	0.745	0.003	0.433
Germany	0.015	1.002	0.016	0.992	0.006	0.986
Italy	0.008	0.914	0.022	0.949	0.005	0.457
Netherlands	0.008	0.997	0.014	1.012	0.004	1.000
Portugal	0.019	0.931	0.021	0.987	0.013	0.678
Spain	0.017	0.445	0.019	1.011	0.008	0.917
Denmark	0.011	1.006	0.015	0.994	0.004	1.005
Norway	0.011	0.952	0.014	0.948	0.005	0.801
Sweden	0.010	0.985	0.030	1.003	0.009	0.920
Switzerland	0.009	0.985	0.021	1.000	0.007	0.968
United Kingdom	0.010	0.953	0.033	0.987	0.009	0.997
Average	0.011	0.931	0.018	0.968	0.006	0.853

Notes:
1. The size of supply, demand and monetary shocks is inferred from the associated impulse response functions that trace out the effect of a unit shock on changes in real GDP, real effective exchange rates and CPI, respectively. See the text for details.
2. The speed of adjustment is summarized by the response after 4-quarter horizon as a share of the long-run effect (20-quarter horizon).
3. In Panels A and B, the average of 10 East Asian economies is reported.

Table 11: Correlation of Structural Shocks between the East Asian Economies after Removing the US Shocks

	Jp	Kr	Tw	HK	Si	Ml	Id	Th	Ph	Ch
	Panel A: Supply Shocks (1980Q3-1997Q1)									
Japan	1.00									
Korea	-0.09	1.00								
Taiwan	-0.08	0.33	1.00							
Hong Kong	0.06	0.02	0.52	1.00						
Singapore	-0.13	-0.03	0.07	0.00	1.00					
Malaysia	-0.06	-0.10	-0.08	-0.05	0.28	1.00				
Indonesia	-0.38	-0.13	-0.08	-0.17	0.10	0.29	1.00			
Thailand	-0.18	0.06	-0.07	-0.16	0.05	0.06	0.17	1.00		
Philippines	0.16	0.04	0.11	0.24	0.10	0.06	0.07	-0.04	1.00	
China	-0.25	-0.10	-0.03	0.13	0.18	0.13	0.07	-0.13	0.12	1.00
	Panel B: Demand Shocks (1980Q3-1997Q1)									
Japan	1.00									
Korea	-0.06	1.00								
Taiwan	-0.03	0.45	1.00							
Hong Kong	0.15	0.04	0.10	1.00						
Singapore	-0.10	0.02	0.10	0.14	1.00					
Malaysia	-0.17	-0.07	-0.04	-0.12	-0.02	1.00				
Indonesia	-0.05	0.04	-0.15	-0.13	-0.18	-0.06	1.00			
Thailand	-0.14	-0.09	0.04	0.22	-0.02	0.08	-0.04	1.00		
Philippines	-0.27	0.30	0.27	-0.13	0.22	0.29	0.17	0.12	1.00	
China	-0.07	0.07	0.01	-0.68	-0.37	0.16	0.18	-0.11	-0.10	1.00
	Panel C: Monetary Shocks (1980Q3-1997Q1)									
Japan	1.00									
Korea	0.01	1.00								
Taiwan	0.28	0.07	1.00							
Hong Kong	0.29	0.10	0.12	1.00						
Singapore	0.08	0.18	0.18	0.18	1.00					
Malaysia	-0.03	0.16	-0.08	-0.08	0.37	1.00				
Indonesia	-0.06	0.19	0.10	0.01	0.17	0.27	1.00			
Thailand	0.33	-0.13	0.01	0.34	-0.07	-0.10	-0.26	1.00		
Philippines	-0.08	0.02	0.11	0.02	0.16	0.10	-0.01	-0.26	1.00	
China	-0.20	0.35	-0.09	-0.10	-0.15	0.48	0.15	-0.01	-0.05	1.00

Notes:
1. The sample period starts from 1981Q2 for Japan and Malaysia; from 1981Q3 for Korea, Taiwan, Singapore, Indonesia, Thailand and the Philippines; from 1983Q3 for Hong Kong; and from 1986Q3 for China.
2. The sample size is 64 for Japan and Malaysia, 63 for Korea, Taiwan, Singapore, Indonesia, Thailand and the Philippines, 55 for Hong Kong, and 43 for China, and the critical value at the 5 percent significance level (two-tailed test) is +/-0.246, +/-0.248, +/-0.265 and +/-0.300, respectively. Painted figures denote positive correlation coefficients at the 5 percent level.