East Asian Currency Cooperation

Eiji Ogawa[a] and Kentaro Kawasaki[b]

First version: November 2, 2007

Revised version: November 30, 2007

[a]. Professor, Graduate School of Commerce and Management, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo 186-8601 Japan, e-mail: ogawa.eiji@srv.cc.hit-u.ac.jp.

[b]. Associate Professor, Faculty of Business Administration, Toyo University, 5-28-20 Hakusan, Bunkyo-ku, Tokyo 112-8606 Japan, e-mail: kawasaki-k@toyonet.toyo.ac.jp.

1. Introduction

Through the experience of the Asian Currency Crisis in 1997, we learned the lesson that the monetary authorities of East Asian countries should undertake regional currency cooperation in East Asia. In fact, the monetary authorities of East Asian countries, especially those of the Association of Southeast Asian Nations (ASEAN) plus 3 (Japan, China, and Korea), have been strengthening their regional monetary cooperation since 2000 under the Chiang Mai Initiative, by which they established a network of bilateral swap arrangements for managing a currency crisis that might occur in a member country. The monetary authorities focus only on domestic macroeconomic variables in a surveillance process under the Chiang Mai Initiative to prevent a future currency crisis.

The ASEAN plus 3 Financial Ministers Meeting has established a research group to study the use of a Regional Monetary Unit (RMU) as a regional common currency unit for coordinated exchange rate policy as well as private use such as a denominating currency for use with Asian bonds. Deviation indicators of respective East Asian currencies based on the RMU should be useful for surveillance of misalignments of intra-regional exchange rates among East Asian currencies. The RMU might be a first step toward a single common currency in East Asia in the distant future, although we must take a gradual and multi-step process toward achieving it. For that reason, this paper is intended to present consideration of a multi-step process toward a common currency in East Asia as well as a regional common currency unit as the first step.

East Asia should be an Optimum Currency Area (OCA)[1] to succeed in introducing a common currency into East Asian countries. At the same time, some obstacles to adopting a common currency in East Asia are already apparent: East Asian countries have different stages of economic development. For that reason, a structural Vector Autoregressive (VAR) model is useful to investigate whether economic shocks, especially aggregate supply shocks, are symmetrical among East Asian countries, given that symmetry of shocks is one condition for OCA[2]. The symmetry of shocks that are investigated using the structural VAR is no more than a sufficient condition for OCA. A region is regarded as an OCA if one of the other conditions is satisfied, although the shocks are asymmetric among its countries. Therefore, asymmetry of shocks should not always show that the relevant region is not an OCA.

Alternatively, a Generalized Purchasing Power Parity (G-PPP) model developed by Enders and Hurn (1994) might be useful to investigate whether the ASEAN plus

1. See Mundell (1960) and McKinnon (1964).
2. See Bayoumi, Eichengreen, and Mauro (2000).

three countries is an OCA, although we can consider the fact that a currency basket system should be desirable for these economies which have strong economic relationships with not only one specific countries such as the United States[3]. The G-PPP model is used to estimate cointegrating vectors for ASEAN plus three currencies with the currency basket of the US dollar and the euro as the anchor currency according to the modified G-PPP model. In addition, the G-PPP model is useful for specifying a common currency basket as an anchor currency that the monetary authorities are targeting in conducting their exchange rate policies.

An analytical result put forward by Ogawa and Kawasaki (2007) suggested combinations allowing three or four countries to conduct a common exchange rate policy related to a common currency basket including three major currencies in the pre-crisis period. In the post-crisis period (January 1999 – November 2005), various groupings such as ASEAN 5 + Japan, ASEAN 5 + Korea + Japan, ASEAN 5 + China + Japan suggest possible combinations for which the monetary authorities can conduct a common exchange rate policy related to the common currency basket. Therefore, we might regard that the Japanese yen should be included as an endogenous variable in a long-run relationship along with other East Asian currencies. The Japanese yen functions exogenously similarly to the US dollar and the euro in a system comprising East Asian currencies, which implies that it increases the possibilities of success in adopting a common currency basket arrangement into the ASEAN plus three countries that include Japan. The ASEAN plus three countries are forming an OCA in terms of the G-PPP model under development of economic integration. That integration has been exemplified in recent years by production networks in East Asia leading to gradual convergence of economic development. It is more possible for the ASEAN plus three countries to succeed in adopting a common exchange rate policy in the post-crisis period than in the pre-crisis period.

This paper consists of the following sections. Section 2 explains current regional currency cooperation in East Asia. Section 3 proposes a multi-step process toward East Asian Currency Cooperation which includes a common currency in East Asia. Section 4 uses updated data to extend sample period of the analysis in Ogawa and Kawasaki (2007) for an empirical study on OCA of East Asia. Also here, the G-PPP model is used to analyze whether East Asia is an OCA to investigate the possibility of introducing a common currency into East Asia. Section 5 suggests the RMU for coordinated exchange rate policy as the first step toward a common currency. Section 6 presents concluding remarks.

[3]. See Kawasaki (2005), Kawasaki and Ogawa (2006), Ogawa and Kawasaki (2006, 2007).

2. Current Regional Currency Cooperation in East Asia

Monetary authorities of East Asian countries, especially those of ASEAN plus 3, have strengthened their mutual monetary cooperation since the Asian Currency Crisis in 1997 through the Chiang Mai Initiative. The monetary authorities of ASEAN plus 3 established a network of bilateral swap arrangements for managing a currency crisis in a member country. Under the Chiang Mai Initiative, the monetary authorities should conduct a surveillance process for preventing a currency crisis in the future. However, the monetary authorities have no standing institution for carrying out any surveillance process in East Asia. Instead, they regularly meet for Economic Review and Policy Dialogue in the ASEAN plus 3 Finance Deputy Ministers Meeting for surveillance of their macroeconomic performance, although they focus only on domestic macroeconomic variables, e.g., GDP, inflation, and financial sector soundness.

The monetary authorities of East Asian countries should prevent biased changes in relative prices caused by US dollar depreciation under different exchange rate systems in East Asian countries. To do so, they have been coordinated in the choice of their exchange rate systems and exchange rate policies. Kawai, Ogawa, and Ito (2004) provide the following advice related to the exchange rate policy in East Asia. First, the monetary authorities of the ASEAN plus 3 should discuss the exchange rate issue as a part of the surveillance process. They should specifically address the exchange rate issue as well as the domestic macroeconomic policies and the soundness of financial sector: the exchange rates of home currencies against those of neighboring countries are indeed linked by the terms of trade and competitive prices. Each country in eastern Asia retains strong economic relationships with other intra-regional countries as well as with the United States and European countries.

Exchange rates among the intra-regional currencies should affect economic activities in each country of East Asia through intra-regional trade, investments, and finance. The monetary authorities should not only hold under account movements of the exchange rates but also their deviations from the regional averages and, in turn, their exchange rate policies *per se*.

The surveillance process, in itself, might not be sufficiently solid to preserve regional policy coordination in the long run because the monetary authorities from each country are not committed to policy coordination. They might make a limited contribution to policy coordination. It is necessary to build a mechanism that can preserve regional coordination in the long run by compelling the monetary authorities to be committed to regional policy coordination.

Regarding regional policy coordination, it is necessary that all monetary

authorities in the region agree on an arrangement to create a regional common unit of account that consists of a basket of regional currencies. They might make a commitment to follow the regional common unit of account in carrying out their exchange rate policy. It is desirable to create a regional common unit of account that monetary authorities of East Asian countries should target in conducting their exchange rate policies so that they should practice mutual regional policy coordination for their exchange rate policies. To do so, an RMU should be introduced into East Asia as a regional common unit of account. For this purpose, a common currency basket that includes regional currencies of the ASEAN plus 3 countries is created. The ASEAN plus 3 Financial Ministers Meeting was launched to create a research group to study a RMU for coordinated exchange rate policy; furthermore, the Asian Development Bank has been studying a regional common unit of account called an Asian Currency Unit (ACU).

3. A Multi-step Process toward East Asian Currency Cooperation

Ogawa and Shimizu (2007) suggest that a common currency basket system in the region be gradually developed by adopting an individual currency basket in each East Asian country as the East Asia becomes an OCA. One issue is whether the Japanese yen is an insider or outsider of the common currency basket in East Asia. It is expected that the Japanese yen would play a different role as a key currency at each stage toward regional monetary coordination in East Asia.

As the first step, the monetary authorities of ASEAN plus 3 will be responsible for undertaking policy dialogue related to exchange rates and exchange rate policies for coordinated exchange rate policies among them. At such a time, the RMU and the RMU-based Deviation Indicators of regional currencies should be used to conduct surveillance over the exchange rates and exchange rate policies as well as domestic macroeconomic situation at the Economic Review and Policy Dialogue of ASEAN plus 3 Finance Deputy Ministers Meeting. The surveillance process based on the RMU should include all the ASEAN plus 3 countries. Accordingly, all the ASEAN plus 3 currencies should be included in the RMU because the RMU is used as a deviation indicator in the surveillance process of the Economic Review and Policy Dialogue.

As the second step, the monetary authorities of ASEAN plus 2 (China and Korea) will adopt a managed floating exchange rate system related to its own individual G3 currency (US dollar, euro, and Japanese yen) basket for managed-float countries. It is not difficult, especially for the Chinese monetary authority, to adopt a managed-float exchange rate system in relation to its own individual G3 currency basket: the Chinese government announced its adoption of the exchange rate system on July 21, 2005. The monetary authorities of ASEAN plus 3, which includes Japan, should continue

surveillance using the RMU and the RMU-based Deviation Indicators of regional currencies.

As the third step, the monetary authorities of ASEAN plus 2 shifted to a managed-float exchange rate system related to a common G3 currency basket for managed-float countries. Simultaneously, the monetary authorities of ASEAN plus 3 should continue conducting the surveillance process using the RMU and the RMU-based Deviation Indicators of regional currencies. At the second and third steps, the Japanese yen should be one of the G3 currencies that the monetary authorities of ASEAN plus 2 targets in conducting their exchange rate policies.

As the fourth step, some countries of ASEAN+3 (which might be designated as "core countries") would peg to a common regional currency basket, the RMU, to stabilize intra-regional exchange rates among the core countries of ASEAN plus 3. They should conduct coordinated monetary policies to stabilize intra-regional exchange rates. The core countries should be required to adopt the RMU peg system.

As the fifth step, some ASEAN plus 3 countries would introduce a bilateral grid method based on the RMU to conduct some intervention in foreign exchange markets of the relevant intra-regional exchange rates. An Asian Exchange Rate Mechanism should be established for their coordinated intervention. It would resemble the Exchange Rate Mechanism established under the European Monetary System (EMS) before introducing the euro.

At the time of execution of the fourth and fifth steps, the core countries should include Japan as an anchor country. In this case, the Japanese yen should be a regional key currency in terms of keeping its value appreciating against the US dollar and the euro and conducting a disinflationary stance of monetary policy. East Asian currencies should be linked with such a regional anchor and key currency as the Japanese yen so that values of the RMU and the regional currencies that are linked to the RMU should remain stable in terms of intra-regional exchange rates. It might, in turn, contribute to prevention of a currency crisis.

4. Possibility of a Common Currency in East Asia

(1) Adopting the "common" currency basket arrangement into "ASEAN plus three"

Kawasaki (2005), Kawasaki and Ogawa (2006), and Ogawa and Kawasaki (2006, 2007) modified the Enders and Hurn (1994) G-PPP model using the concept of a stochastic trend among the real effective exchange rates of countries in the common currency policy area. We also use the "extended G-PPP model".

After the Asian Currency Crisis in 1997, it is said that some East Asian countries changed their exchange rate policy from the *de facto* dollar peg system to a currency

basket system for a while. Each country makes reference to a currency basket that includes not only three major currencies, e.g. the US dollar, euro, and Japanese yen, but also other East Asian currencies. Here, we assume that a country adopts a basket currency as their target policy as did Ogawa and Kawasaki (2007).

In the case where an East Asian country adopts $m-1$; ($m>1$), neighboring countries' currencies and $h-m$; ($h>m$), major trading partners' currencies (such as the US dollar or other major currencies) into the basket currency as its target policy, Country i's reference rate can be expressed as

$$re_{CB,i} = \varphi_{1,i} \cdot re_{1,i} + \cdots + \varphi_{j,i} \cdot re_{j,i}, \sum_{i,j=1,i\neq j}^{h+1} \varphi_{j,i} = 1, \quad (1)$$

where h is the number of exchange rates which are included in the currency basket and m is the number of countries in the possible region of currency union.

Because $re_{i,k} = re_{i,j} - re_{k,j} = -re_{j,i} + re_{j,k}$, Eq. (1) can be expressed in terms of the currency of the other country in the basket. We rewrite it in terms of the US dollar as

$$re_{CB,i} = \varphi_{1,i} re_{1,US} + \cdots + \varphi_{h,i} re_{h,US} + re_{US,i}. \quad (2)$$

Here, we presume that the monetary authorities in the seven East Asian countries adopt the currency basket as their exchange rate policy and use the same composition of the basket currency. The real exchange rates of each East Asian currency against the basket currency can be rewritten as a general vector form.

$$\underset{(m\times 1)}{\mathbf{re}_{CB}} = \underset{(m\times h)}{\mathbf{F}} \cdot \underset{(h\times 1)}{\mathbf{re}_{US}} \quad (3)$$

Therein, $\mathbf{re}_{CB} = \left[re_{CB,1}, \cdots, re_{CB,m} \right]'$; vector $\mathbf{re}_{US}$ includes h number of exchange rates of each of the related currencies against the US dollar, $\mathbf{re}_{US} = \left[re_{1,US}, \cdots, re_{h,US} \right]'$, and

$$\underset{(m\times h)}{\mathbf{F}} = \begin{pmatrix} -1 & \varphi_{1,2} & \cdots & \varphi_{1,m} & \cdots & \varphi_{1,h} \\ \varphi_{2,1} & -1 & \cdots & \varphi_{2,m} & \cdots & \varphi_{2,h} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ \varphi_{m,1} & \varphi_{m,2} & \cdots & -1 & \cdots & \varphi_{m,h} \end{pmatrix}.$$

If the monetary authorities in the region agree to peg their own currencies to the regional currency basket and intervene in foreign exchange markets to maintain their exchange rate stability, a long-term property of those real exchange rates should be stationary: $\mathbf{re}_{CB} = 0$.[4] Here, we define the non-null matrix, $\mathbf{Z}$, which is composed of $m \times m$; Eq. (6) can be written to obtain the following equation.

$$\underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times h)}{\mathbf{F}} \cdot \underset{(h\times 1)}{\mathbf{re}_{US}} = 0 \tag{4}$$

If there exists a nonzero matrix, $\mathbf{Z}$, for which $\mathbf{Z}\cdot\mathbf{F}\cdot\mathbf{re}_{US} = 0$, then $\mathbf{Z}$ does not have a full rank. If we could find a matrix $\mathbf{Z}$ which satisfies $\text{rank}(\mathbf{Z}) < m$, there exists a nonzero $\mathbf{re}_{US}$ for $\mathbf{Z}\cdot\mathbf{F}\cdot\mathbf{re}_{US} = 0$ and matrix $\mathbf{Z}$ is not a null matrix. Accordingly, the number of rank $\mathbf{Z}$ must be smaller than m, which is a same logic of the rank condition of G-PPP theory in Kawasaki and Ogawa (2006). In the case of $\text{rank}(\mathbf{Z}) = 1$, there must exist only one cointegration relationship among real exchange rates, $\mathbf{re}_{US}$; then, the long-term equilibrium among the regional real exchange rates against the US dollar is defined as

$$\zeta_1 \cdot re_{US,1} + \zeta_2 \cdot re_{US,2} + \cdots + \zeta_h \cdot re_{US,h} = 0, \tag{5}$$

where ζ_i indicates the cointegrating vectors.

Here, partitioning vector $\mathbf{re}_{US}$ into the two groups of insider currencies and outsider currencies, and of both trade weights, matrix $\mathbf{F}$ can also be partitioned: the trade weights into the two matrixes for insider and outsider currencies, respectively. Consequently, Eq. (3) can be rewritten in a general form as

$$\underset{(m\times 1)}{\mathbf{re}_{CB}} = \underset{(m\times m)}{\mathbf{F}_1} \cdot \underset{(m\times 1)}{\mathbf{re}_1} + \underset{[m\times(h-m)]}{\mathbf{F}_2} \cdot \underset{[(h-m)\times 1]}{\mathbf{re}_2}, \tag{6}$$

where $\mathbf{F} = \begin{pmatrix} \mathbf{F}_1 & \mathbf{F}_2 \end{pmatrix}$ and $\mathbf{re}_{US} = \begin{pmatrix} \mathbf{re}_1 & \mathbf{re}_2 \end{pmatrix}'$.

Because matrix $\mathbf{F}_1$ has an inverse matrix, vector $\mathbf{re}_1$ would be solved using matrix $\mathbf{F}$ as follows.

$$\mathbf{re}_1 = \mathbf{F}_1^{-1} \cdot \mathbf{re}_{CB} - \mathbf{F}_1^{-1}\mathbf{F}_2 \cdot \mathbf{re}_2 \tag{7}$$

In Eq. (7), $\mathbf{re}_1$ would be defined by $\mathbf{re}_2$, which means that real exchange rates among East Asian countries in the region would be defined by the currencies outside the region. Therefore, Eq. (4) can also be rewritten as

$$\underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times h)}{\mathbf{F}} \cdot \underset{(h\times 1)}{\mathbf{re}_{US}} = \underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times m)}{\mathbf{F}_1} \cdot \underset{(m\times 1)}{\mathbf{re}_1} + \underset{(m\times m)}{\mathbf{Z}} \cdot \underset{[m\times(h-m)]}{\mathbf{F}_2} \cdot \underset{[(h-m)\times 1]}{\mathbf{re}_2} = 0 . \tag{8}$$

If there exist several major currencies which dominate the exchange rates of regional currencies against the US dollar, such as the Japanese yen and the euro, these exchange rates against the US dollar are not included in vector $\mathbf{re}_1$ but in vector $\mathbf{re}_2$ in Eq. (7). Although three major currencies dominate all regional currencies exogenously, the major currencies are not mutually cointegrated. For that reason, the minimum number of $\text{rank}(\mathbf{Z})$ for which $\mathbf{Z}\cdot\mathbf{F}\cdot\mathbf{re}_{US} = 0$ would be $h - m = 2$. There should exist at least two cointegration relationships that are not overlapped between the yen-dollar and the euro-dollar exchange rates.

If Japan is included as a neighboring country and its exchange rate against the US dollar is included in vector $\mathbf{re_1}$, the minimum number of the rank condition would be $h - m = 1$. The Japanese yen would serve as an endogenous variable in the cointegrating system as well as other Asian currencies and only the euro-dollar exchange rates would dominate all of regional currencies exogenously.

(2) Empirical analysis

For this study, a dynamic OLS (DOLS) is used to estimate the cointegrating vector. We rewrite Eq. (5) as follows.

$$re_{US,EU} = \beta_1 \cdot re_{US,1} + \beta_2 \cdot re_{US,2} + \cdots + \beta_m \cdot re_{US,m} + \beta_{JP} \cdot re_{US,JP} \tag{9}$$

Equation (9) represents the long run relationship whose coefficient can be estimated using the OLS. To estimate it, we add the leads and lags, deterministic trend, and constant term into Eq. (9) as shown below.

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4. Suppose that an $h\times 1$ vector: $\mathbf{re}_{US}$ is characterized by m cointegrating relations.

$$re_{US,EU} = \beta_0 + \beta_1 \cdot re_{US,1,t} + \beta_2 \cdot re_{US,2,t} + \cdots + \beta_m \cdot re_{US,m,t} + \beta_{JP} \cdot re_{US,JP,t} + \sum_{i=1}^{m} \sum_{j=-k}^{k} \gamma_{i,j} \Delta re_{US,i,t+j} + \beta \cdot t + u_t \quad (10)$$

Then, the property of the residuals by the DOLS estimates is

$$\hat{u}_t = \phi_1 \cdot \hat{u}_{t-1} + \phi_2 \cdot \hat{u}_{t-2} + \phi_3 \cdot \hat{u}_{t-3} + \cdots + \phi_p \cdot \hat{u}_{t-p} + e_t \,, \quad (11)$$

where the sample distribution will be adjusted as

$$\hat{\sigma}'_u = \hat{\sigma}_u / (1 - \phi_1 - \phi_2 - \phi_3 - \cdots - \phi_p) \,. \quad (12)$$

We attempt to estimate the cointegrating vector with endogenous weights in the common currency basket. We assume that the serial correlation of residuals is captured by $AR(4)$, and that leads and lags are $k = 2$ as in Eq. (10).

The sample period for our empirical tests covers the period between January 1987 and March 2007. Our sample includes data for the period of the Asian currency crisis. We divide the sample period into two sub-sample periods which can be characterized as a "pre-crisis" period from January 1987 to June 1997 and a "post-crisis" period from January 1998 to March 2007. Eight East Asian countries are included: Korea, Singapore, Malaysia, Thailand, the Philippines, Indonesia, China, and Japan. Their major trading partners include the EU and the US. The real exchange rates were based on monthly data of nominal exchange rates and consumer price indices of the related countries.[5] We calculated the prior euro for estimation before the 1997 crisis.[6] These data were referred from the IMF *International Financial Statistics* (CD-ROM).[7]

Before estimating coefficients in Eq. (10), the existence of at least one cointegrating relationship among the exchange rates of related currencies against the US dollar should be verified.[8] We conducted the Johansen test to detect the cointegrating relationship for the combination of regional countries: ASEAN 5 + Japan,

5. For the prior euro real exchange rates, we calculated a GDP-weighted average of the CPI.
6. The method of calculation of the prior euro is provided by the PACIFIC Exchange rate service of The University of British Colombia (http://fx.sauder.ubc.ca/).
7. Before the 1994 exchange rate unification, there existed a dual foreign exchange rate market in China. As described in Fernald, Edison, and Loungani (1999), 80% of transactions related to the Chinese exports were referred to the non-official, floating exchange rates; therefore, the effective nominal depreciation against to the US dollar was estimated as less than 7% while the official rate depreciated 35% at the 1994 reform. However, the swap date used in their paper was not available to us. We use the official RMB exchange rate in IFS.
8. We conducted the unit root test as well and confirmed that all variables had a unit root.

ASEAN 5 + Japan + Korea, ASEAN 5 + Japan + China, and ASEAN 5 + Japan + Korea + China. The EU and the US were assumed to be their major trade partners.[9]

Table 1 shows the results of the trace test. Assuming a maximum of lags in VAR models as six lags in the effective sample period, we chose an adequate model for each of the VAR models.[10] We had a small finite sample in conducting the Johansen's ML approach; therefore, the critical value for the trace test was corrected following Johansen (2002). For the pre-crisis period of January 1987 to June 1997, we detected no cointegrating relationship for either of the combinations of ASEAN 5 + Japan or ASEAN 5 + Japan + Korea; the small sample corrected statistics in the trace test indicated the existence of two cointegrating relationships at most for the least of the combinations. For the post-crisis period of January 1998 to March 2007, the corrected test statistics indicated that there exists one cointegrating relationship at most among the related exchange rates for all combinations.

Table 2 presents the results of the DOLS for the pre-crisis period. We found no combinations for which all coefficients indicated a significant result among the variables for both rank conditions. Despite the significant test statistics for each of the second cointegrating vectors for the combination of ASEAN 5 + Japan + Korea, the existence of cointegrating vectors had already been rejected using the Johansen test. On the other hand, although there exist, at most, two cointegrating vectors among them for the combination of ASEAN 5 + Japan + Korea + China in Table 1, test statistics for some countries were not significant for any rank condition.

In most cases, for the pre-crisis period, the Japanese yen was excluded not only from a possible currency area but also from the reference of currency baskets as in the rank conditions $r = 1$ and $r = 2$. In addition, the euro was excluded as in $r = 2$. Consequently, the *de facto* dollar peg exchange rate system in East Asian countries might be synonymous with enormous fluctuations in their exchange rates against the Japanese yen and the euro.

Table 3 shows the DOLS result for the post-crisis period. For the combination of ASEAN 5 + Japan, all test statistics for the rank condition of $r = 1$ were significant. On the other hand, once the Korean won and/or the Chinese yuan were included in the region, test statistics for these two currencies were indicated as not significant. For the combinations of ASEAN 5 + Japan + Korea, ASEAN 5 + Japan + China, and ASEAN 5 + Japan + Korea + China, most test statistics for ASEAN 5 and Japan were indicated as

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9. See Johansen and Juselius (1990).
10. Following reduction of the number of lags, an adequate model of VAR is selected. The test of $H_{i,j} : VAR(i) < VAR(j)$ in lags is asymptotically distributed as χ^2 with $(j-i)p^2$ degrees of

significant. [11]

Table 3 shows mixed results for the possibilities of introduction of a common currency policy into East Asia. However, East Asian countries including Japan seem to satisfy the conditions of optimum currency area in recent years. Although test statistics reported in Table 3 were changed dramatically from those of the post crisis period shown in Table 2, these changes might be consistent with recent developments of integration in the region because East Asian countries have been deepening their mutual relationships in terms of international trade, foreign direct investment, and international finance during 1998–2007.[12]

5. RMU for Coordinated Exchange Rate Policy as the First Step toward a common currency

It is most important for East Asian countries to take a first step toward regional monetary coordination in East Asia by introducing a Regional Monetary Unit (RMU) into the region. The ASEAN plus 3 Financial Ministers Meeting established a research group to study an RMU for coordinated exchange rate policy. The research group is studying the RMU now while accepting an Asian Monetary Unit (AMU), as proposed by Ogawa and Shimizu (2005). As a criterion of the new surveillance system, the monetary authorities of ASEAN plus 3 should advance the creation of an AMU and AMU Deviation Indicators for East Asian currencies. These should contribute to the coordination of exchange rate policies in East Asia, thereby enhancing the monetary authorities' surveillance capabilities.

The AMU is calculated as a weighted average of East Asian currencies. The AMU Deviation Indicators for each East Asian currency are measured to show the degree of deviation from the Benchmark Rate for each of the East Asian currencies in terms of the AMU. Moreover, Ogawa and Shimizu (2005) provide Real AMU Deviation Indicators, which are adjusted on a monthly basis to differences in inflation, as well as the Nominal AMU Deviation Indicators, which are adjusted on a daily basis. The Real AMU

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freedom.

11. When we extended the sample period from Ogawa and Kawasaki (2007), we obtained different results from those of our earlier work for the combinations including the Korean won and the Chinese yuan. Especially, in 2006.1–2006.12, the Japanese yen was depreciating dramatically against the other Asian currencies. It was still depreciating even in early 2007. Therefore, possible structural breaks or misalignments in the yen-dollar exchange rates might be suspected after 2005. If policymakers in the region seek to capture collective movements of exchange rates against the outside major currencies for monitoring purposes, a regional monetary unit, such as the AMU from RIETI or ACU from ADB, and its divergence indicator could be helpful for them to plan coordination of macro economic policies. It would be able to detect such misalignments easily.

12. Ogawa (2004) found that the linkages of the East Asian currencies with the US dollar have decreased since the Asian currency crisis.

Deviation Indicators are more appropriate for conducting surveillance of the effects of changes in exchange rates on the real economy, whereas the Nominal AMU Deviation Indicators are more useful for monitoring their day-to-day deviations from the AMU.

The weight of each currency in the currency basket is based on the arithmetic averages of both countries' respective shares of GDP measured at PPP, and trade volumes (the sum of exports and imports) in the total of sampled countries for the relevant country. We calculate the countries' shares of GDP measured at PPP and their trade volumes for 2001–2003 as the currency shares of the AMU. The average for the past three years, based on available data, is used to calculate the currency shares to reflect the most recent trade relationships and economic conditions of the 13 East Asian countries for calculation of the AMU. Table 4 shows the AMU weights as well as the trade volume share, the share of GDP measured at PPP, the arithmetic shares of both the shares, and the Benchmark Exchange Rates.

A benchmark period is chosen to calculate AMU Deviation Indicators. The benchmark period is defined as the following: the total trade balance of member countries, the total trade balance of member countries (excluding Japan) with Japan, and the total trade balance of member countries with the remainder of world should be close to zero. Data on trade accounts of the 13 East Asian countries from 1990–2003 indicate that the trade accounts were closest to being balanced in 2001. If we assume a one-year time lag before changes in exchange rates affect trade volumes, we should choose 2000 and 2001 as a benchmark period.

Figure 1 shows a recent trend of nominal exchange rate of the AMU in terms of a currency basket of the US dollar and the euro as well as in terms of the US dollar and the euro. The currency basket of the US dollar and the euro includes a 65% US dollar share and a 35% euro share based on trade shares of the East Asian economy with the United States and the euro area during 2002–2004 to reflect the value of the AMU in terms of the major trading partners' currencies. Figure 1 shows that the AMU has been depreciating gradually against the currency basket of the US dollar and the euro. It had depreciated against the currency basket by about 5% by May 2007 compared to the benchmark years of 2000 and 2001. The AMU has been gradually appreciating against the US dollar, while it has been gradually depreciating against the euro.

Figure 2 shows deviations of East Asian currencies against the AMU. The AMU Deviation Indicators of East Asian currencies had been limited to within plus/minus 10% during the period from 2001 to the end of 2004, except for the Philippine peso. The Korean won has been appreciating against the AMU or a weighted average of East Asian currencies since the end of 2004. It is overvalued by more than 20% compared with the

benchmark years. The Thai baht has been appreciating very quickly since the end of 2005. It is overvalued by more than 20% compared to the benchmark years. On the other hand, the Philippine peso was undervalued by more than 10% during 2003–2006. The Laos kip was devalued by 25% in April 2004, although it has been stable since its devaluation. The Vietnamese don has been gradually depreciating and is undervalued by 15% compared to benchmark years.

In summary, the AMU or a weighted average of East Asian currencies has been appreciating against the US dollar in recent years while it has been depreciating against the currency basket of the US dollar and the euro. Deviations among the East Asian currencies have been widening, as shown by the AMU Deviation Indicators of East Asian currencies, and as shown by a kind of standard deviation of East Asian currencies based on the AMU, described in Ogawa and Yoshimi (2007).

Regarding currencies with higher inflation rates, inflation rate differentials should be taken into account to calculate an AMU Deviation Indicator in real terms. Real AMU Deviation Indicators are calculated according to the following equation:

$$real\ \ deviation\ \ indicator_i = nominal\ \ deviation\ \ indicator_i - \left(\dot{P}_{AMU} - \dot{P}_i\right). \qquad (13)$$

Therein, $\dot{P}_{AMU}$ is the inflation rate in the AMU area and $\dot{P}_i$ is that in country *i*.

Consumer Price Index (CPI) data are used as the price index for calculating the Real AMU Deviation Indicator because there are data constraints for some sampled countries for which no alternative data are available: CPI data are used as a price index. Because the CPI data are only available on a monthly basis, we calculate the Real AMU Deviation Indicator per month. For the inflation rates in the AMU area, we calculate a weighted average of the CPI for the AMU area using the AMU shares, which is the combination of shares in terms of trade volumes and GDP measured at PPP.

Figure 4 depicts movements in the Real AMU Deviation Indicators on a monthly basis for each of the East Asian currencies; Figure 3 portrays movements in the Real AMU Deviation Indicators on a monthly basis for comparison. Some differences between the Nominal and Real AMU Deviation Indicators are readily apparent through comparison of Figures 3 and 4. In the case of the Indonesian rupiah, the Real AMU Deviation Indicator has been appreciating since July 2003 while the Nominal AMU Deviation Indicator has been depreciating from July 2003. That discrepancy reflects a higher inflation rate in Indonesia. Higher inflation tends to engender appreciation of the

home currency, even though it is depreciating. The Lao kip has been appreciating in terms of the Real AMU Deviation Indicator, but it has been depreciating in terms of Nominal AMU Deviation Indicator. In contrast, both the Korean won and the Thai baht have been appreciating in terms of Real AMU Deviation Indicators by reflecting appreciation in terms of Nominal AMU Deviation Indicators. Moreover, the Japanese yen has depreciated greatly in terms of real exchange rates, but it has not depreciated so much in terms of nominal exchange rates.

Consequently, monetary authorities should monitor the Real AMU Deviation Indicators rather than the Nominal AMU Deviation Indicators to discern the effects of exchange rates on real economic variables such as trade volumes and real GDP. On the other hand, Nominal AMU Deviation Indicators are more useful than Real AMU Deviation Indicators when we consider both the frequency and time lags as important for monitoring these measures. Accordingly, we should use the Nominal and Real AMU Deviation Indicators as complementary measures for scrutinizing exchange rate policies and related macroeconomic variables and for devising coordinated exchange rate policies among the East Asian currencies.

6. Conclusion

Since they experienced the Asian currency crisis of 1997, the monetary authorities of East Asian countries became responsible for regional monetary coordination to prevent currency crises and to manage currency crises. Especially, the ASEAN plus 3 Financial Ministers Meeting was established and has been strengthening currency swap arrangements under the Chiang Mai Initiative. Simultaneously, they are supervising domestic macroeconomic variables at the Economic Review and Policy Dialogue under that same initiative. Furthermore, the ASEAN plus 3 Financial Ministers Meeting produced a research group to study an RMU as a regional common currency unit for exchange rate policy coordination as well as for private uses which include Asian Bond denomination. It is necessary for the monetary authorities of ASEAN plus 3 to take the most important first step for their coordinated exchange rate policies and then move toward further regional monetary coordination in East Asia in the future. It is also necessary to introduce an RMU for coordinated exchange rate policies, with introduction of a common currency in the more distant future.

The monetary authorities of East Asian countries have adopted a multi-step process toward forming a common currency in East Asia because East Asian countries present different stages of economic development; moreover, all East Asian countries confront difficulties in forming an OCA right now. As the first step, the monetary authorities of ASEAN plus 3 should launch a have policy dialogue related to exchange

rates and exchange rate policies for coordinated exchange rate policies among them while a regional common currency unit is used for surveillance processes. As the second step, the monetary authorities of East Asian countries should adopt a managed floating exchange rate system related to its own individual G3 currency. As the third step, the monetary authorities should shift to a managed floating exchange rate system concerning a common G3 currency basket. As the fourth step, some limited East Asian countries as a core would peg to a common regional currency basket: the RMU. As the fifth step, some East Asian countries would conduct coordinated intervention in foreign exchange markets of their intra-regional exchange rates under an Asian Exchange Rate Mechanism.

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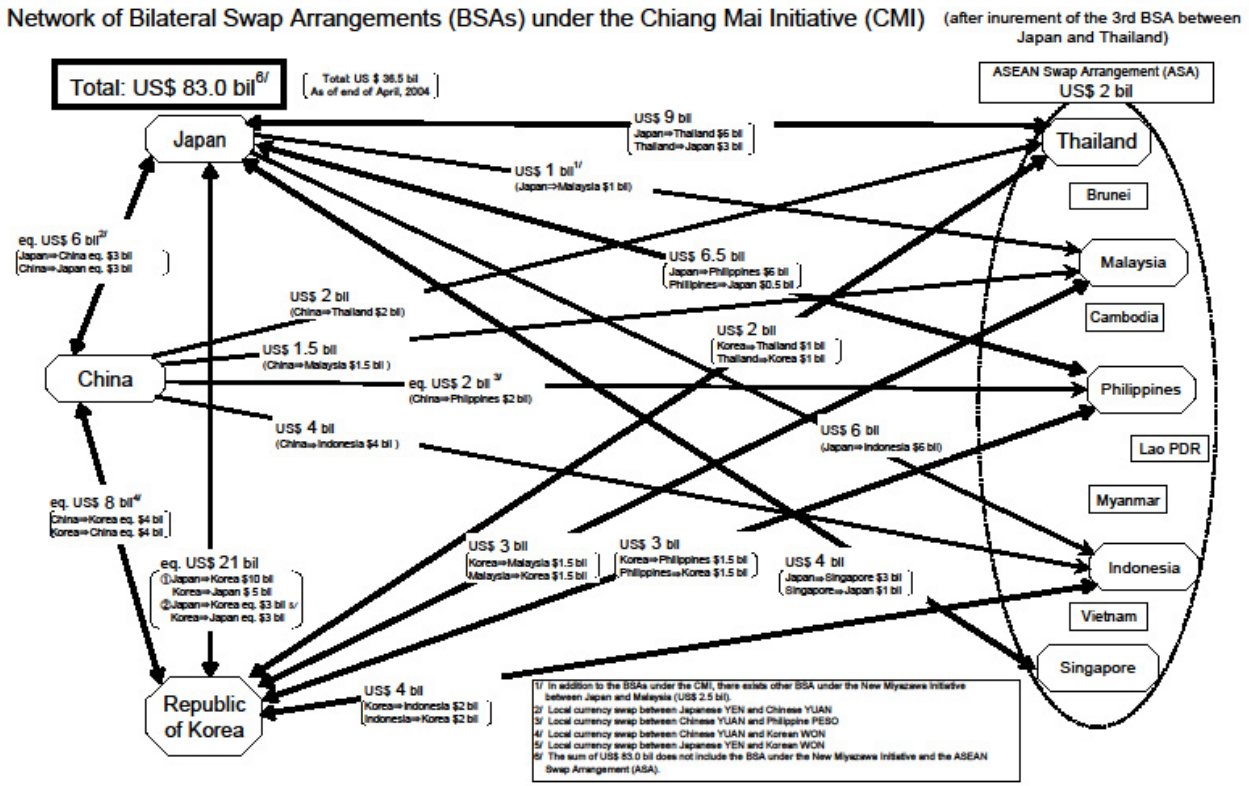
Figure 1: Network of Bilateral Swap Agreements under the Chiang Mai Initiative



Source: http://www.mof.go.jp/english/if/CMI_0707.pdf

Table 1: Johansen tests

Combination			1987:1 - 1997:6				1998:1 - 2007:3		
	k	H_0	*Eigen Vector*	*Trace*	*Small-sample corrected ††*	k	*Eigen Vector*	*Trace*	*Small-sample corrected ††*
ASEAN5 + Japan	4	0	0.379	144.097 ***	119.177	6	0.476	183.733 ***	127.121 *
		1	0.209	85.976	71.853		0.339	116.466 ***	84.680
		2	0.181	57.306	47.162		0.229	73.389 **	53.768
		3	0.126	32.896	26.670		0.178	46.404	34.692
		4	0.073	16.507	14.185		0.135	26.060	14.602
		5	0.047	7.196	5.042		0.090	10.960	7.042
		6	0.011	1.380	1.154		0.011	1.183	1.144
ASEAN5+ Japan + Korea	6†	0	0.417	214.550 ***	153.251	4	0.568	236.877 ***	187.942 ***
		1	0.296	149.733 ***	105.875		0.406	147.836 ***	118.060
		2	0.265	107.638 ***	69.509		0.271	92.545 *	71.876
		3	0.197	70.724 *	41.811		0.160	59.104	45.294
		4	0.161	44.339	25.844		0.151	40.627	15.995
		5	0.113	23.252	19.449		0.108	23.247	12.894
		6	0.070	8.843	5.978		0.082	11.125	5.768
		7	0.001	0.081	0.056		0.019	2.072	1.191
ASEAN5+ Japan + China	6	0	0.376	234.181 ***	164.791 **	4	0.486	225.678 ***	172.497 ***
		1	0.318	177.685 ***	127.578 *		0.400	155.817 ***	114.290
		2	0.286	131.708 ***	86.229		0.278	102.244 **	74.068
		3	0.275	91.281 ***	61.320		0.199	68.034	48.396
		4	0.189	52.767 *	36.399		0.184	44.795	15.446
		5	0.123	27.629	19.796		0.132	23.386	10.809
		6	0.094	11.905	8.716		0.065	8.489	5.572
		7	0.001	0.076	0.065		0.013	1.426	1.349
ASEAN5+ Japan + Korea + China	4	0	0.423	287.505 ***	218.875 ***	4	0.621	312.906 ***	242.013 ***
		1	0.414	220.476 ***	170.768 ***		0.519	209.968 ***	158.892
		2	0.345	155.294 ***	121.739		0.294	132.424 **	102.052
		3	0.266	103.662 ***	82.286		0.275	95.578 *	71.592
		4	0.196	65.948 **	45.028		0.182	61.436	45.562
		5	0.164	39.267 *	24.752		0.144	40.168	18.110
		6	0.091	17.464	15.085		0.106	23.666	10.472
		7	0.042	5.805	3.555		0.083	11.739	4.634
		8	0.005	0.565	0.376		0.024	2.543	1.425

k : lag lengths Significance Level: *: 5%, **: 2.5%, ***: 1%

†: Model includes following lags: (t-1), (t-2), (t-3), (t-4), (t-6)

††: The trace test statistics are correced. Small sample correction of trace test derived in Johanse (2002)

Table 2: DOLS estimation (pre crisis: 1987:1-1997:6)

Dependent variables	Explanatory variables							
	Japan (Yen)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines (Peso)	Singapore ($SG)	Thailand (Baht)	Korea (Won)	China (Yuan)
EU/US (rank=1)	0.0504	-1.3721	0.8183	-0.4216	-0.0654	1.6692		
	(0.29144)	(1.82888)	(0.56962)	(0.41533)	(1.3852)	(3.32783)		
EU/US (rank=2)		-1.1568	0.7888	-0.4154	0.0645	1.3811		
		(1.08593)	(0.50146)	(0.36426)	(0.768)	(2.13926)		
JP/US (rank=2)		4.9484 ****	0.2897	-0.5560	3.5966 ****	-7.7342 ****		
		(1.02249)	(0.47217)	(0.34297)	(0.72313)	(2.01427)		
EU/US (rank=1)	-0.2682	-1.5716	1.9836 ****	-0.7779 **	0.2405	1.4307	0.7783 *	
	(-0.21068)	(1.16027)	(0.73461)	(0.37422)	(0.86174)	(2.07024)	(0.42252)	
EU/US (rank=2)		-2.4697 **	1.5785 *	-0.5686	-0.6075	3.1595	0.5770	
		(1.1402)	(0.80725)	(0.40823)	(0.73546)	(2.04327)	(0.42189)	
JP/US (rank=2)		3.2139 ****	1.6754 *	-0.8696 **	2.8813 ****	-5.8147 ****	0.9224 **	
		(1.23539)	(0.87465)	(0.44231)	(0.79686)	(2.21386)	(0.45711)	
EU/US (rank=1)	-0.0010	-1.1859	0.7663	-0.3543	0.0304	1.2113		-0.06734
	(-0.3021)	(1.76589)	(0.61289)	(0.49669)	(1.53214)	(3.34682)		(0.23699)
EU/US (rank=2)		-1.21459	0.7264	-0.3592	-0.0206	1.4384		-0.0398
		(1.12852)	(0.59198)	(0.46701)	(0.93581)	(2.1195)		(0.22674)
JP/US (rank=2)		4.5865 ****	0.4826	-0.7135 *	3.9728 ****	-7.8931 ****		0.1396
		(0.98017)	(0.51417)	(0.40562)	(0.81279)	(1.84089)		(0.19694)
EU/US (rank=1)	-0.3889 ***	-0.6212	2.8050 ****	-0.8306 ****	-0.3905	0.7727	1.6558 ****	-0.4308 ****
	(-0.15503)	(0.87749)	(0.56788)	(0.26485)	(0.68503)	(1.55188)	(0.39999)	(0.13656)
EU/US (rank=2)		-2.2022 ***	2.0096 ****	-0.4859	-1.4654 *	3.4504 **	1.1305 ***	-0.3418 *
		(0.96165)	(0.71425)	(0.34991)	(0.80924)	(1.73753)	(0.47553)	(0.20621)
JP/US (rank=2)		3.4246 ****	1.8693 ***	-0.8362 *	2.5550 ***	-5.9043 ***	1.1728 *	-0.1667
		(1.28042)	(0.95101)	(0.46589)	(1.07749)	(2.31349)	(0.63315)	(0.27456)

†Significance level: * 10% ** 5% *** 2.5% **** 1%

Table 3: DOLS estimation (post crisis: 1998:1-2007:3)

Dependent variables	Explanatory variables							
	Japan (Yen)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines (Peso)	Singapore ($SG)	Thailand (Baht)	Korea (Won)	China (Yuan)
EU/US (rank=1)	-0.4870 ****	0.5547 ****	-3.9578 ****	-0.4810 ***	2.5703 ****	0.6959 ***		
	(-0.11463)	(0.09789)	(0.57135)	(0.19682)	(0.53181)	(0.3102)		
EU/US (rank=2)		0.4760 ****	-4.0739 ****	-0.3420	1.5982 ***	0.8585 *		
		(0.14048)	(0.82622)	(0.28478)	(0.67329)	(0.45695)		
JP/US (rank=2)		0.2585	0.3587	-0.4088	2.7218 ***	-0.4801		
		(0.22444)	(1.32002)	(0.45499)	(1.0757)	(0.73005)		
EU/US (rank=1)	-0.4761 ****	0.5524 ****	-4.0564 ****	-0.4788 **	2.5630 ****	0.7277 **	0.0006	
	(-0.12936)	(0.11252)	(0.77148)	(0.21893)	(0.5742)	(0.36598)	(0.16307)	
EU/US (rank=2)		0.4867 ****	-4.1562 ****	-0.3504	1.6712 **	0.8690 *	-0.0023	
		(0.14885)	(1.02341)	(0.31083)	(0.76261)	(0.50949)	(0.1792)	
JP/US (rank=2)		0.3129	-0.3899	-0.2397	1.9950 *	-0.1168	-0.3262	
		(0.2134)	(1.46722)	(0.44562)	(1.09331)	(0.73043)	(0.2569)	
EU/US (rank=1)	-0.4420 ****	0.6132 ****	-3.9973 ****	-0.5036 ***	2.3582 ****	0.6190 *		0.51605
	(-0.12243)	(0.15405)	(0.55968)	(0.21976)	(0.56572)	(0.32075)		(0.93862)
EU/US (rank=2)		0.53401 ****	-4.0487 ****	-0.3490 ***	1.6418	0.6943		0.3555
		(0.18884)	(0.73612)	(0.27394)	(0.7075)	(0.42625)		(1.18235)
JP/US (rank=2)		0.4464	0.0294	-0.6215	1.7910 *	-0.3737		1.9056
		(0.28404)	(1.10721)	(0.41204)	(1.06416)	(0.64114)		(1.7784)
EU/US (rank=1)	-0.4156 ****	0.6515 ****	-3.7729 ****	-0.6253 *	2.3243 ****	0.4893	0.1242	1.0989
	(-0.1453)	(0.18837)	(0.90923)	(0.33186)	(0.63645)	(0.49874)	(0.23921)	(1.49397)
EU/US (rank=2)		0.5471 ***	-4.1246 ****	-0.3678	1.6369 **	0.7293	-0.0030	0.4234
		0.22669	1.01511	0.38812	0.7629	0.57738	0.22904	1.7553
JP/US (rank=2)		0.3136	-0.5261	-0.3158	1.7326	0.0201	-0.2753	0.3677
		0.32854	1.47117	0.56248	1.10566	0.83678	0.33195	2.54391

†Significance level: * 10% ** 5% *** 2.5% **** 1%

Table 4: AMU Shares and Weights of East Asian Currencies

(revised in 9/2007****, benchmark year=2000/2001)

	Trade volume* %	GDP measured at PPP** ,%	Arithmetic average shares % (a)	Benchmark exchange rate*** (b)	AMU weights (a)/(b)
Brunei	0.33	0.33	0.33	0.589114	0.0056
Cambodia	0.19	0.23	0.21	0.000270	7.6219
China	23.99	51.70	37.85	0.125109	3.0251
Indonesia	6.47	5.31	5.89	0.000113	522.9228
Japan	24.79	25.28	25.04	0.009065	27.6235
South Korea	13.01	6.66	9.83	0.000859	114.4362
Laos	0.08	0.08	0.08	0.000136	5.7474
Malaysia	8.10	1.72	4.91	0.272534	0.1801
Myanmar	0.32	0.32	0.32	0.159215	0.0202
Philippines	2.66	2.56	2.61	0.021903	1.1926
Singapore	11.71	0.81	6.26	0.589160	0.1063
Thailand	6.36	3.46	4.91	0.024543	2.0005
Vietnam	1.98	1.55	1.76	0.000072	246.5203

* The trade volume is calculated as the average of total export and import volumes in 2002, 2003, and 2004 taken from DOTS (IMF).

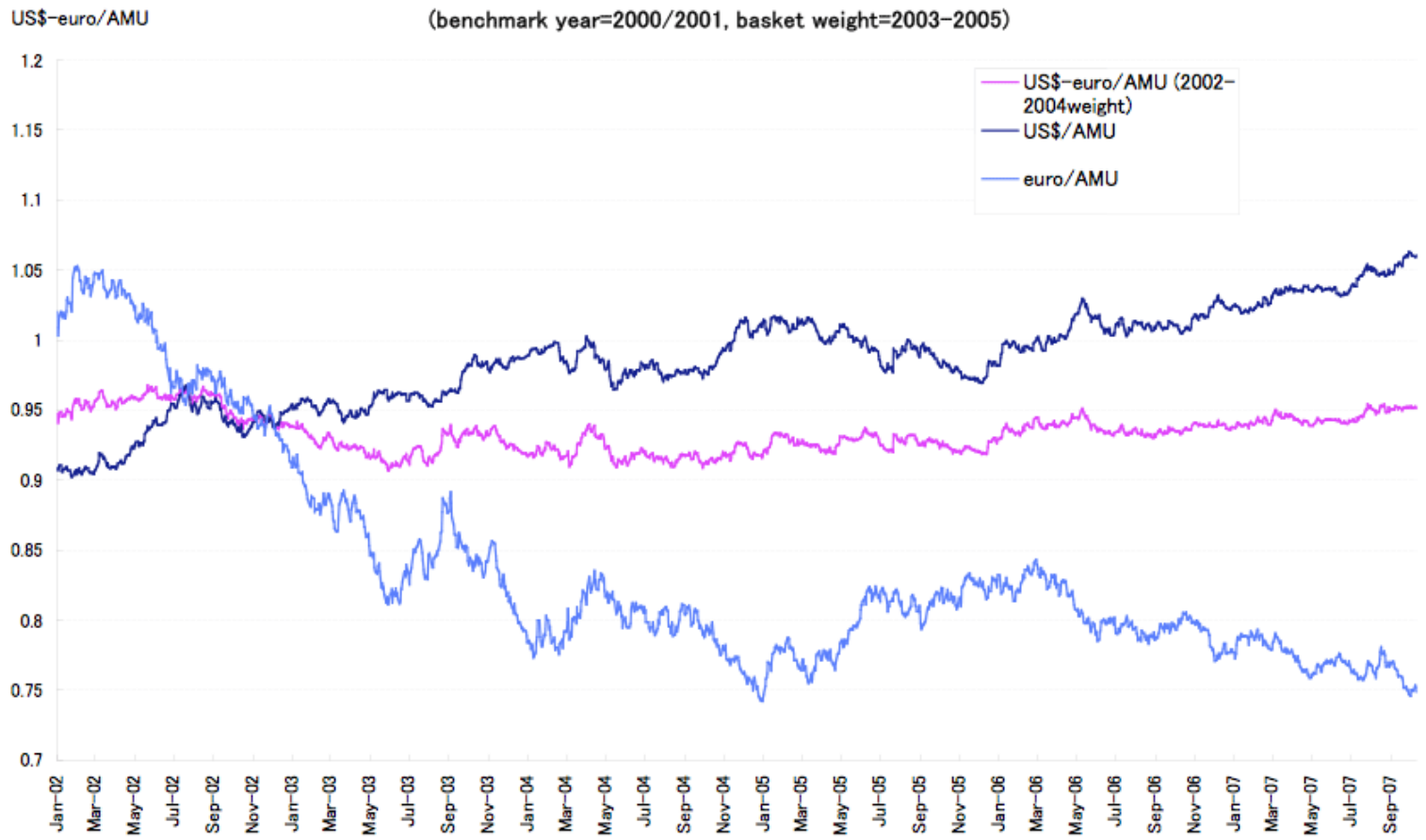
** GDP measured at PPP reflects the average of that data from 2003, 2004, and 2005 taken from the *World Development Report* (The World Bank). For Brunei and Myanmar, we again use the same share of trade volume since no GDP data are available for these countries.

*** The benchmark exchange rate ($-euro/Currency) is the average of the daily exchange rate in terms of US$-euro in 2000 and 2001.

**** AMU shares and weights were revised in Sept. 2007. This is the third version.

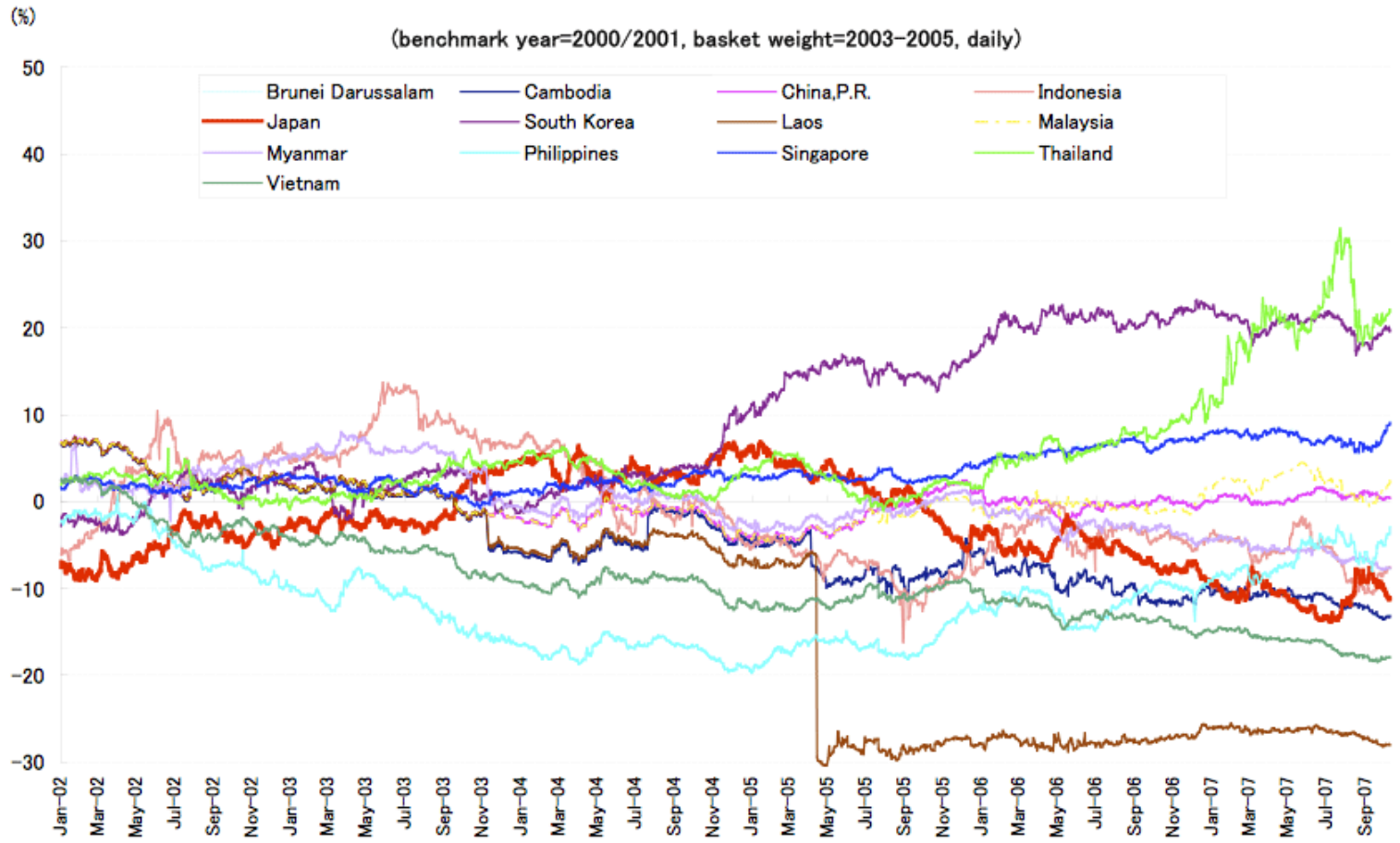
Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 2: Movements of AMU



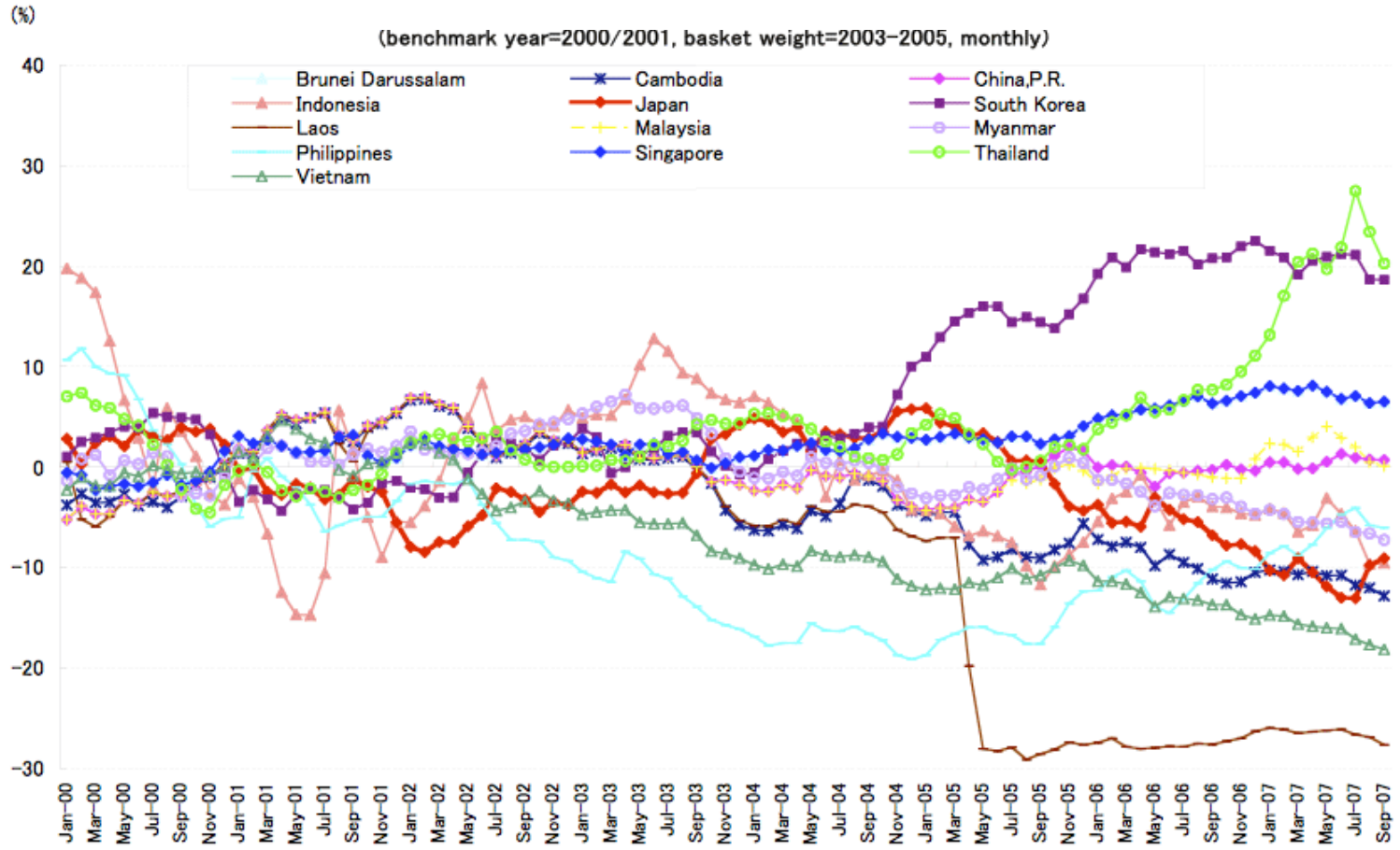
Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 3: Nominal AMU Deviation Indicators



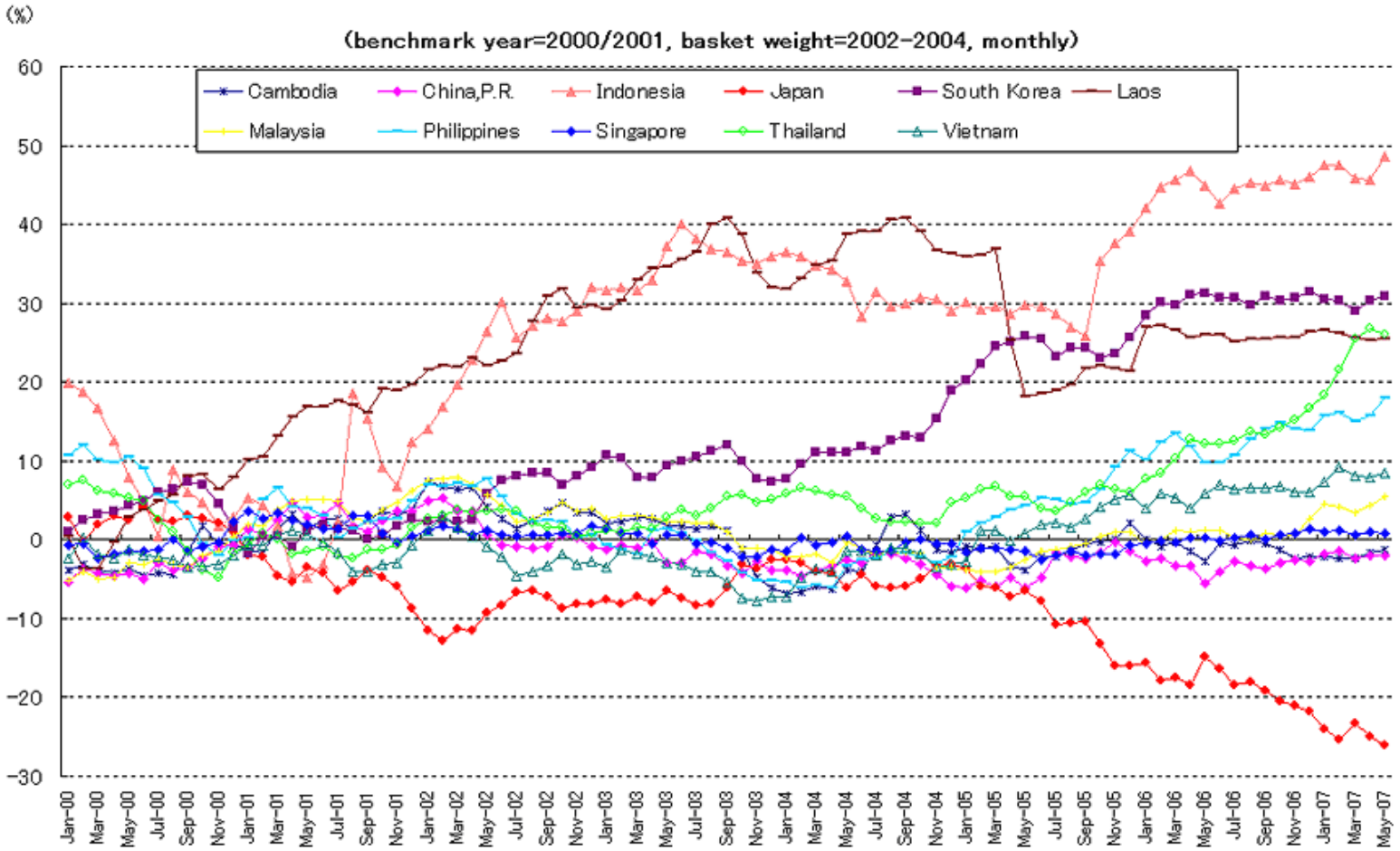
Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 4: Nominal AMU Deviation Indicators (monthly)



Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 5: Real AMU Deviation Indicators (monthly)



Source: http://www.rieti.go.jp/users/amu/en/index.html