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What should be weights on the three major currencies for a common currency basket in East Asia?[†]

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1. Introduction

The Governments of East Asian countries have come to take a positive stance for a regional financial cooperation since they experienced the Asian currency crisis in 1997. They are establishing a network of bilateral currency swap arrangements among ASEAN+3 (China, Japan, and Korea) according to the Chiang Mai Initiatives. Moreover, a study on a regional common currency was started among the ASEAN countries. We should consider what type of regional common currency it is desirable to introduce into East Asia in the future because East Asian countries experienced the currency crisis to learn a lesson that the monetary authorities should not adopt the *de facto* dollar peg system in order to prevent another currency crisis in the future. It follows that it should not be desirable to establish a regional common currency that is based on the US dollar as an anchor currency.

Some empirical researches found that a currency basket system would contribute to stabilizing trade balances and capital flows in East Asian countries. Ito, Ogawa, and Sasaki (1998) estimated optimal weights on the US dollar and the Japanese yen in a currency basket, which would have stabilized trade balances in East Asian countries before the Asian currency crisis. Results of the estimation showed that the optimal weights on the US dollar were smaller than their actual weights that were estimated by Frankel and Wei (1994) and Kawai and Akiyama (1998). It implies that it was not a *de facto* dollar peg system but a currency basket peg system that would have stabilized their trade balances. Ogawa and Sun (2001) simulated capital inflows to the three crisis-hit countries, which include Thailand, Indonesia, and Korea, under a currency basket peg system where weights on the US dollar and the Japanese yen were assumed to have 50%: 50% in a currency basket. Results of the simulation concluded that the *de facto* dollar peg system stimulated capital inflows to the crisis-hit countries before the Asian currency crisis.

Ogawa and Ito (2002) and Ogawa (2002b) pointed out that the monetary authorities in East Asian countries have been unwilling to adopt the *de facto* dollar peg system due to a kind of "coordination failure" in choosing exchange rate system. Accordingly, any form of international policy coordination for their choosing desirable exchange rate system is necessary. For example, all of the monetary authorities in East Asian countries might agree on an arrangement that they create a common currency unit as an anchor currency for their exchange rate system or a reference for their exchange rate policy. They might make references to the common currency unit in choosing exchange rate system or conducting their exchange rate policy. A rigid arrangement is that all of the monetary authorities peg their home currencies to the common currency unit. On one hand, one of more flexible arrangements is that they target the home currencies in a wider band around a central exchange rate of the home currencies vis-à-vis the common currency unit.

Given that a currency basket system would contribute to stabilizing trade balances and capital flows in East Asian countries, we consider that the common currency unit should be denominated in terms of a currency basket in order to solve the "coordination failure" in choosing exchange rate system. Thus, this paper investigates what type of common currency basket should be adopted in East Asian countries from a viewpoint of a long run sustainability of adopting the common currency basket in East Asia while taking into account stabilization of trade balances at the same time. We use a Generalized Purchasing Power Parity (G-PPP) model to analyze the issue[1]. We investigate which part of East Asian countries will be able to create a common currency basket and what weights should be on the three major currencies, which include the US dollar, the euro (the ECU), and the Japanese yen.

We further extend an earlier work of Ogawa and Kawasaki (2003) in order to analyze empirically a common currency basket area for East Asia while taking into account the stability of trade balances. In the earlier work, we defined the common currency basket as the one that was consisted of the same weights of the three major currencies (the US dollar, the ECU, and the Japanese yen) in the common currency basket. We investigated the possibilities to form a common currency area in East Asia by using the Generalized Purchasing Power Parity (G-PPP) approach. We found that the common currency basket was more applicable to create a common currency area than the US dollar. At the same, we found two divided groups whose countries included all of the East Asian countries but were not overlapped each other for the currency basket as an anchor currency.

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[1] Bayoumi, Eichengreen, and Mauro (2000) used a structural VAR model to make an empirical analysis on an optimum currency area in East Asia. However, they cannot show what type of regional common currency is optimal for East Asian countries.

The common currency basket, which we assumed in the earlier work, might not be optimal for East Asia although a common currency basket is, in itself, more desirable as an anchor currency. Rather, we should define a trade weighted currency basket as a common currency basket for the stabilization of trade balances. Therefore, we use it as a common currency basket to investigate a long run sustainability of adopting the common currency basket in East Asia in this paper.

East Asian countries (here we investigate the issues for ASEAN5 countries, China, and Korea) may not have the same long run stationary relationship when we define the trade weighted common currency basket as an anchor currency. This has two implications. One is that the East Asian countries are divided into two or more groups due to the differences in technology growth or other factors among the groups. For the reason, we attempt to find some groups that show a long run stationary relationship.

The other is that the trade-based weights or alternative weights on the three major currencies in the common currency basket may not stabilize the system in the long run because the *de facto* dollar peg system had been in fact adopted in most of East Asian countries especially before the Asian currency crisis. Therefore, our interests turn into the estimation for the basket weights on the three major currencies which would be able to make the system of a common currency basket area stable in the long run. We attempt to develop the method of estimation for endogenous weights in the common currency basket. It is important to compare the endogenous weights with the trade-based weights.

This paper consists of five sections. In the following section we extend our G-PPP model in order to investigate long run equilibrium of the system in using the common currency basket as an anchor currency. In section 3, we analyze the long run sustainability of the common currency basket area that includes more than five East Asian countries when a common currency basket is created by placing trade weights on the three major currencies. In section 4, we show our methodology of estimating the endogenous weights and analyze the possibilities of creating a common currency basket with endogenous weights on the three major currencies. In section 5, we make concluding remarks including summary of our analytical results and their policy implications for introducing a common currency basket into East Asia.

2. G-PPP model

2.1 The real effective exchange rates and Generalized PPP

Now we suppose that there are m countries which are expected to adopt a common currency basket as an anchor currency. Country j has n trade partners. It has strong trade relationships with m countries which adopt the same currency basket with country j while it has also trade relationships with the other countries. Therefore, we can define a real effective exchange rate of country j, (countries $1, 2, \ldots, j, \ldots, m+1$ have the common currency basket while countries $m+2, \ldots, n$ are one who do not share the common currency basket) denoted with currency of country j,

$$\begin{aligned} ree_j &= \xi_j \cdot (\omega_{j,1} re_{j,1} + \omega_{j,2} re_{j,2} + \cdots + \omega_{j,m+1} re_{j,m+1}) \\ &+ (1-\xi_j) \cdot (\omega_{j,m+2} re_{j,m+2} + \cdots + \omega_{j,n} re_{j,n}) \end{aligned} \quad (2\text{-}1)$$

where $\omega_{j,i}$ $(\sum_{i=1}^{m+1} \omega_{j,i} = 1, \sum_{i=m+2}^{n} \omega_{j,i} = 1)$ is the country j's trade weights on country i and ξ is the trade weights on a group of countries who share the common currency basket. Here, we assumed that the shocks on the second term in the right hand side of equation (2-1) affects the real effective rate of country j temporally, or even if these shocks are permanent, these shocks affect $m+1$ real effective rates symmetry. In the case where only country j is permanently affected by the countries who do not adopt the common currency basket as an anchor currency, it is difficult to keep adopting a common currency in the region. There are no reasons for country j to stay in the common currency area. Here, we define the real effective exchange rate in terms of a currency of country $m+1$, which excludes temporal shocks in the country j.

$$\begin{aligned} ree^{\xi}_{j,t} &= \omega_{j,1}(re_{j,1,t} - re_{j,m+1,t}) + \cdots + \omega_{j,m-1}(re_{j,m-1,t} - re_{j,m+1,t}) + re_{j,m+1,t} \\ &= \omega_{j,1} re_{m+1,1,t} + \cdots + \omega_{j,1} re_{m+1,m,t} - re_{m+1,j,t} \end{aligned} \quad (2\text{-}2)$$

where $re_{j,k} = re_{j,n} - re_{k,n} = -re_{n,j} + re_{n,k}$. We can write $m+1$ real effective rates in terms of the currency of country $m+1$ in the same ways,

$$
\begin{aligned}
ree^{\xi}_{1,t} &= -re_{m+1,j,t} + \omega_{1,2} re_{m+1,2,t} + \cdots + \omega_{1,m} re_{m+1,m,t} \\
ree^{\xi}_{2,t} &= \omega_{2,1} re_{m+1,1,t} - re_{m+1,2,t} \cdots + \omega_{2,m} re_{m+1,m,t} \\
&\vdots \\
ree^{\xi}_{m,t} &= \omega_{m,1} re_{m+1,1,t} + \cdots + \omega_{m,m-1} re_{m+1,m-1,t} - re_{m+1,m,t} \\
ree^{\xi}_{m+1,t} &= \omega_{m+1,1} re_{m+1,1,t} + \cdots + \omega_{m+1,m-1} re_{m+1,m-1,t} + \omega_{m+1,m} re_{m+1,m,t}
\end{aligned}
.
$$

These $m+1$ real effective rates can be shown as the matrix Ω which defines the trade weights, and the vector $\mathbf{re}$ which includes m elements of the real exchange rate $re_{m+1,j}$ as below,

$$
\mathbf{ree}_t = \Omega \cdot \mathbf{re}_t \tag{2-3}
$$

where

$$
\underset{(m+1)\times m}{\Omega} = \begin{bmatrix} -1 & \omega_{1,2} & \cdots & \omega_{1,m-1} & \omega_{1,m} \\ \omega_{2,1} & -1 & \cdots & \omega_{2,m-1} & \omega_{2,m} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ \omega_{m,1} & \omega_{m,2} & \cdots & \omega_{m,m-1} & -1 \\ \omega_{m+1,1} & \omega_{m+1,2} & \cdots & \omega_{m+1,m-1} & \omega_{m+1,m} \end{bmatrix}
$$

and the vector $\mathbf{ree}$ includes the $m+1$ real effective rates.

Each of the real effective exchange rates is expected to include a common stochastic trend because the countries have strong trade relationships with each other and they seem to share common technologies.[2] We assume that the $m+1$ real effective exchange rates share a common stochastic trend. Using Stock and Watson's (1988) common trend representation for any cointegrated system, we can show that the vector $\mathbf{ree}$ which is characterized by m cointegrating relations, can be described as the sum of a stationary component and a non-starionary component.

$$
\mathbf{ree}_t = \mathbf{r\bar{e}e}_t + \mathbf{r\tilde{e}e}_t \tag{2-4}
$$

[2] Enders and Hurn (1994) developed the G-PPP model based on the real fundamental macroeconomic variables. They assumed these variables shared common trends within a currency area.

The stationary component $\bar{\mathbf{ree}}_t$ is $E(\bar{\mathbf{ree}}_t) = 0$ in this model since the logarithm of the real effective exchange rate can be expected to converge toward zero-mean in the long run. Therefore, the vector $\mathbf{ree}$ can be only described as the non-stationary component $\tilde{\mathbf{ree}}$. By the definition of common trend in Stock and Watson (1988), we obtain the following equation:

$$\mathbf{ree}_t = \Phi \cdot \mathbf{w}_t \tag{2-5}$$

where Φ is the $(m+1)\times(m+1)$ matrix. The vector $\mathbf{w}_t$ is the non-stationary stochastic trend which is characterized by a random walk. We substitute equation (2-5) into equation (2-3), then we obtain the following equation:

$$\Phi \cdot \mathbf{w}_t = \Omega \cdot \mathbf{re}_t . \tag{2-6}$$

Here, we define the non-null matrix Ψ which is composed of $(m+1)\times(m+1)$ and rewrite equation (2-6) to obtain the following equation:

$$\Psi \cdot \Phi \cdot \mathbf{w}_t = \Psi \cdot \Omega \cdot \mathbf{re}_t \tag{2-7}$$

If there exists a nonzero $\mathbf{w}$ for which $\Psi \cdot \Phi \cdot \mathbf{w}_t = 0$, $\Psi \cdot \Phi$ does not have a full rank. The rank condition will be expected as follows:

$$\mathrm{rank}(\Psi \cdot \Phi) = \mathrm{rank}(\Phi) < m$$

As long as the rank condition holds, there exists a non-null matrix Ψ which satisfies the following equation:

$$\Psi \cdot \Phi = 0 \tag{2-8}$$

When we set $\mathrm{Z} = \Psi \cdot \Omega$ and substitute it into equation (2-7), we obtain the following equation:

$$\mathrm{Z} \cdot \mathbf{re} = 0 \tag{2-9}$$

If we could find a matrix Z, which satisfies $\mathrm{rank(Z)} < m$ and equation (2-9), it means that there exists nonzero **re** for $Z \cdot \mathbf{re} = 0$ and that the matrix Ψ is not a null matrix. Accordingly, the number of rank Ω must be smaller than m. Here, we assume that $\text{rank}(Z) = 1$. We can rewrite equation (2-9) to obtain the following linear combination:

$$\zeta_1 \cdot re_{m+1,1} + \zeta_2 \cdot re_{m+1,2} + \cdots + \zeta_m \cdot re_{m+1,m} = 0 \tag{2-10}$$

This linear combination is the same as that of Enders and Hurn (1994). Therefore, we can use Johansen and Juselius (1990)'s method to estimate the cointegrating vector.

2.2 G-PPP model evaluated by the currency basket in seven Asian countries

In the previous section, we introduced the G-PPP model based on the real effective exchange rates. The important feature of our G-PPP model is that a common currency is denominated in terms of an anchor currency. This feature is very useful to investigate what types of common currency in terms of an anchor currency have the long run stationary relationship when some countries form an optimum currency area with an anchor currency. Kawasaki (2000) and Ogawa and Kawasaki (2001) investigated the optimum currency area for ASEAN5 and Korea evaluated by a single currency: the US dollar, the Japanese yen, the Deutche Mark, and the Singapore dollar. In this paper, we extend this feature into the investigating a common currency basket as an anchor currency in any group of East Asian countries.

Here, we suppose that seven East Asian countries (ASEAN5 + Korea + China) create a common currency basket as an anchor currency where a common currency basket is composed of the three major currencies: the US dollar, the ECU (the euro), and the Japanese yen. We define an exchange rate of country i in terms of the common currency basket as follows:

$$RE_{CB,i} = (RE_{EU,i})^{\alpha} \cdot (RE_{JP,i})^{\beta} \cdot (RE_{US,i})^{\gamma}, \ \ \alpha + \beta + \gamma = 1. \tag{2-11}$$

where RE is the real exchange rate and (α, β, γ) are the weights on the three major currencies. Equation (2-11) is rewritten in terms of the logarithm:

$$re_{CB,i} = \alpha \cdot re_{EU,i} + \beta \cdot re_{JP,i} + \gamma \cdot re_{US,i} \,. \tag{2-12}$$

where re is the logarithm of bilateral real exchange rate.

Again, if all of the seven East Asian countries are included in an optimum currency area, we rewrite equation (2-10) to obtain the following equation:[3]

$$\zeta_1 \cdot re_{CB,1} + \zeta_2 \cdot re_{CB,2} + \cdots + \zeta_m \cdot re_{CB,m} = 0 . \tag{2-13}$$

Then they can establish a common currency basket area. A usual cointegration framework can estimate the cointegration vector in equation (2-13) like equation (2-10).

When we use the Johansen and Juselius (1990)'s method to estimate the cointegrating vector, given the weights on the three major currencies in the common currency basket, endogenous variables in the m-dimensional vector autoregressive model are defined by

$$X' = [re_{CB,1}, re_{CB,2}, \cdots, re_{CB,m}]' .$$

In the case where there is at least one cointegration relationship between endogenous variables, the m-dimensional vector autoregressive model can be written according to an Error Correction Model (ECM) as follows:

$$\Delta X_t = \sum_{i=1}^{k-1} \Lambda_i \Delta X_{t-1} + \Pi \cdot X_{t-1} + \varepsilon_t , \tag{2-14}$$

We test a hypothesis that the reduced rank of the Π matrix is

$$H_1(r) : \Pi = \upsilon \cdot \zeta' .$$

where υ is the loading matrix. The reduced rank r is the number of cointegration relationships. Hence, there is a long run equilibrium among m bilateral exchange rates if we obtain the stability of Π matrix or, in other words, a fact that the rank is at least none zero.

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[3] We still assume $m+1$ countries create common currency area as same as in our G-PPP model of section 2. The host currency needs to be included in the currency area in the sense of Mundell (1964). Here, we just convert the host currency into the currency basket.

3. Empirical analysis on a common currency basket with exogenous weights

3.1 Empirical methodology

In this section, we further extended the earlier work of Ogawa and Kawasaki (2003) in order to analyze empirically a common currency basket area for East Asia. Although we still define that a common currency basket is composed of the three major currencies (the US dollar, the ECU, and the Japanese yen), we suppose that weights in the common currency basket are given by trade weights (exports and imports) on the United States, Japan, and the euro area. We investigate a common currency basket area with more than five East Asian countries: ASEAN 5, ASEAN 5 + Korea, ASEAN 5 + China, and ASEAN 5 + Korea + China. We conduct the Johansen test for each of the combinations. Our empirical analysis using the Johansen cointegrating frameworks follows the arbitrary strategy in Ogawa and Kawasaki (2003) to improve robustness.[4]

3.2 Data

The sample for our empirical tests covers from the period between January 1981 and June 1997.[5] Seven East Asian countries were included Korea, Singapore, Malaysia, Thailand, the Philippines, Indonesia, and China. Real exchange rates were based on monthly data of nominal exchange rates and consumer price indices of the related countries.[6] These data are from the IMF, *International Financial Statistics* (CD-ROM).[7] The exports and imports data are from the IMF, *Direction of Trade Statistics* (CD-ROM). The value of trade weights on the three major currencies shows in the Table 1. Table 1.1 shows the each of the East Asian countries' trade weights on trade

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4 To improve the robustness for the Johansen cointegration framework is that we should choose a lag length by taking into account whether the equilibrium of that model is adequate for the cointegration relationship or not. See details of our strategy to define the unique model in the Appendix of Ogawa and Kawasaki (2003).

5 We can get the Chinese trade data after January 1981 from DOT.

6 For the ECU real exchange rates, we calculated a GDP-weighted average of CPI.

7 The Chinese consumer price index is provided by Yu Yongding, the Chinese Academy of Social Sciences (CASS).

partners; the United States, Japan, the euro area, intra-regional trade in East Asia, and rest of the world. Table 1.2 shows the aggregate trade weights on the trade partners and trade-based weights on the three major currencies in the common currency basket.

3.3 Empirical Results

Table 2 shows the result of Johansen test; λ-trace and λ-max tests after selecting the correct lag-order of all of the ECM. The combination of ASEAN5 was not passed the pre-test for the Johansen test which could not reject the null of auto correlation of the residuals in each VAR model. We excluded this case from our analysis in this section. While we could not find any cointegration relationships in the combination of ASEAN5 + Korea, We could find the several cointegrating vectors in the combination of ASEAN5 + China and the combination of ASEAN5 + Korea + China.

Table 3 shows the result of the three chi-square-based test identified as the optimal model. The first row for each vector shows the test statistics for the null hypothesis of $\zeta_{ij} = 0 \quad (1 \le j \le r)$. The second row shows test statistics for the stationarity. This test is to check whether the individual series can be stationary by themselves. The null is $\zeta = (H_i, \varphi)$. The third low shows test statistics for the weak exogeneity for the long run equilibrium. The null hypothesis is $\upsilon_{ij} = 0 \quad (1 \le j \le r)$. Here, we should only focus on the combinations in which all countries in a linear combination have significant results on those three tests, because we need to specify the minimal combination for the common currency basket area.

From the result of Table 3, we could find that ASEAN5 + China could form an optimum currency area by using the common currency basket with the aggregated trade weights on the three major currencies at same time. On the other hand, the combination of ASEAN + Korea + China include the country whose statistics for the chi-square tests were insignificant, e.g. the variable Singapore might be excluded from the cointegration relationship and the variable of Indonesia might indicate exogenous. It means that it is difficult for the combination of ASEAN5 + Korea + China to form an optimum currency area by using the common currency basket with the aggregated trade weights on the three major currencies at same time.

4. Empirical analysis on a common currency basket with endogenous weights

4.1 Estimation of endogenous weights

We show the methodology of estimating endogenous weights on the three major currencies in the common currency basket. We still assume that $m+1$ East Asian countries form a common currency basket area and their real exchange rates have at least one cointegration relationship. Hence, equation (2-13) will hold in the long run. Here, we rewrite equation (2-12) as follows:

$$re_{CB,i} = \alpha \cdot re_{EU,i} + \beta \cdot re_{JP,i} + (1-\alpha-\beta) \cdot re_{US,i}\,. \tag{4-1}$$

By substituting equation (4-1) into equation (2-13), we obtain the following equation:

$$\begin{aligned}&\zeta_1 \cdot \{\alpha \cdot re_{EU,1} + \beta \cdot re_{JP,1} + (1-\alpha-\beta) \cdot re_{US,1}\}\\ &+ \zeta_2 \cdot \{\alpha \cdot re_{EU,2} + \beta \cdot re_{JP,2} + (1-\alpha-\beta) \cdot re_{US,2}\}\\ &+ \cdots + \zeta_m \cdot \{\alpha \cdot re_{EU,m} + \beta \cdot re_{JP,m} + (1-\alpha-\beta) \cdot re_{US,m}\} = 0\end{aligned}$$

Then,

$$\begin{aligned}&\zeta_1 \cdot \{\alpha \cdot (re_{EU,1} - re_{US,1}) + \beta \cdot (re_{JP,1} - re_{US,1}) + re_{US,1}\}\\ &+ \zeta_2 \cdot \{\alpha \cdot (re_{EU,2} - re_{US,2}) + \beta \cdot (re_{JP,2} - re_{US,2}) + re_{US,2}\}\\ &+ \cdots + \zeta_m \cdot \{\alpha \cdot (re_{EU,m} - re_{US,m}) + \beta \cdot (re_{JP,m} - re_{US,m}) + \cdot re_{US,m}\} = 0\end{aligned}$$

Hence,

$$\begin{aligned}&\zeta_1 \cdot \{\alpha \cdot re_{EU,US} + \beta \cdot re_{JP,US} + re_{US,1}\}\\ &+ \zeta_2 \cdot \{\alpha \cdot re_{EU,US} + \beta \cdot re_{JP,US} + re_{US,2}\}\\ &+ \cdots + \zeta_m \cdot \{\alpha \cdot re_{EU,US} + \beta \cdot re_{JP,US} + \cdot re_{US,m}\} = 0\end{aligned}$$

$$\begin{aligned}\alpha \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m) \cdot re_{EU,US} + \beta \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m) \cdot re_{JP,US}\\ + \zeta_1 \cdot re_{US,1} + \zeta_2 \cdot re_{US,2} + \cdots + \zeta_m \cdot re_{US,m} = 0\end{aligned} \tag{4-2}$$

where the $m+2$ dimensional vector autoregressive model are defined by

$$X' = [re_{US,1}, re_{US,2}, \cdots, re_{US,m}, re_{EU,US}, re_{JP,US}]',$$

We conduct the Johansen test to obtain estimated values for the $m+2$ elements of the cointegrating vector $Z'^{*} = [\zeta_1^*, \zeta_2^*, \cdots, \zeta_m^*, \zeta_{m+1}^*, \zeta_{m+2}^*]'$ if $\mathrm{rank}(Z) = 1$, we can get the only one linear combination written in the form of the equation (4-2) from the Johansen framework, where $\xi_{m+1}^* = \alpha^*(\zeta_1^* + \zeta_2^* + \cdots + \zeta_m^*)$, $\xi_{m+2}^* = \beta^*(\zeta_1^* + \zeta_2^* + \cdots + \zeta_m^*)$. We use the estimated value to calculate the estimated optimal weights as follows:

$$\alpha^* = \frac{\zeta_{m+1}^*}{\zeta_1^* + \zeta_2^* + \cdots + \zeta_m^*}, \quad \beta^* = \frac{\zeta_{m+2}^*}{\zeta_1^* + \zeta_2^* + \cdots + \zeta_m^*}. \qquad (4\text{-}3)$$

4.2 Empirical methodology

We attempt to estimate the endogenous weights in the common currency basket directly. Especially, we conduct the Johansen test for the long run stationary relationship among more than five East Asian countries. We set the four combinations to test: ASEAN5, ASEAN5 + Korea, ASEAN5 + China, and ASEAN 5 + Korea + China. Here, we test for the null hypothesis of coefficients in the Johansen framework.

In the case of $\zeta_{m+1}^* = 0$ or $\zeta_{m+2}^* = 0$, the weights on the Japanese yen or the ECU in the common currency basket equal to zero. When $\zeta_{m+1}^* = 0$ and $\zeta_{m+2}^* \neq 0$, the common currency basket will be composed of the US dollar and the ECU. When $\zeta_{m+1}^* \neq 0$ and $\zeta_{m+2}^* = 0$, the common currency basket will be composed of the US dollar and the Japanese yen. If both of the cointegrating parameters are zero ($\zeta_{m+1}^* = \zeta_{m+2}^* = 0$), all of the currencies peg to the US dollar. Under the null hypothesis that the Japanese yen or the ECU is excluded from the currency basket, the test statistic is asymptotically distributed as χ^2 with r degrees of freedom in the cointegration analysis.

4.3 Data

The sample for our empirical tests covers the period between January 1981 and June 1997.

Seven East Asian countries are included Korea, Singapore, Malaysia, Thailand, the Philippines, Indonesia, and China. The real exchange rates were based on the monthly data of nominal exchange rates and consumer price indices of the related countries.[8] These data are from the IMF, *International Financial Statistics* (CD-ROM).[9]

4.4 Analytical results

Table 4 shows the result of the Johansen test; λ-trace and λ-max tests after selecting the correct lag-order of all of the ECM. The combination of ASEAN5 + China could not reject the null hypothesis of the auto correlation in the residuals of any VAR models which have 2 to 12 lag-length. Therefore, we excluded this combination from our analysis. We could find several cointegration relationships in the any combinations when we conducted the Johansen test.

Table 5 shows the result of the three chi-square-based tests that includes the result of test for the null hypothesis of coefficients of the Japanese yen and the ECU. The first row for each vector shows the test statistics for the null hypothesis of $\zeta_{ij} = 0$ ($i = 1, 2, \ldots, 7, \text{US/JP}, \text{US/DM}$, $1 \le j \le r$). Here, we carefully focus on the case that shows significant results on the long run exclusion test and the stationary test for all of the East Asian countries at least. For the combination of ASEAN5, since the test statistics of Indonesia in the first cointegrating vector is insignificant, we should focus on the second-, the third-, and the forth-cointegrating vector. For the combination of ASEAN5 + Korea, we should focus on the second-, the third-, the forth-, and the fifth-cointegrating vector. For the combination of ASEAN5 + Korea + China, we should focus on the fifth-cointegrating vector.

Table 6 shows each value in the cointegrating vectors. Table 7 shows calculated weights on the three major currencies in the common currency basket. For the combination of ASEAN5, the coefficient of the Japanese yen in the third cointegrating vector is 7.325. On the other hand, that of the ECU is 5.909 and the test statistics is significant. Therefore, we can calculate the weight on the

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[8] For the ECU real exchange rates, we calculated a GDP-weighted average of CPI.

[9] The Chinese consumer price index is provided by Yu Yongding, the Chinese Academy of Social Sciences (CASS).

Japanese yen as 16.4%, the weight on the ECU as 13.2%, and the weight on the US dollar as 70.4%. For the second and forth vector, we obtained the unexpected signs and values of the weights so that this cointegrating vector may not be proper for the equilibrium of the common currency basket area.

For the combination of ASEAN5 + Korea, the coefficient of the Japanese yen in the second-cointegrating vector is –9.946 and that of the ECU is –5.054. Both of test statistics are significant. Therefore, the weight on the Japanese yen is 16.1%, the weight on the ECU is 8.2%, and the weight on the US dollar is 75.8 %. For the fifth-vector, the weight on the Japanese yen is 12.6%, the weight on the ECU is 10.3%, and the weight on the US dollar is 77.1%. For Korea and/or Indonesia, however, the test statistics for the exogenous test were insignificant in both cases. The weights calculated from the third and the forth-cointegrating vector showed the unexpected signs.

For the combination of ASEAN5 + Korea + China, only the fifth cointegrating vector indicates significant results on the long run exclusion test and the stationary test on seven East Asian countries. But the weights calculated from fifth-cointegrating vector showed the unexpected signs.

Our analytical results showed that there are no significant results when China was included in the common currency basket area. On the other hand, for the combination of ASEAN5 or ASEAN5 + Korea, we could find the non-zero weights on the Japanese yen or the ECU in the common currency basket. Some countries in the cointegrating vector showed the exogeneity for the long run relationship. It means that these countries affect the long run relationship among other countries but do not converge toward the equilibrium by themselves. Although a long run relationship is not stable for the East Asian common currency area, the calculated weights on the US dollar, the Japanese yen and the ECU are at least useful to discuss.

5. Conclusion

This paper investigated what type of common currency basket is desirable for East Asian countries from a viewpoint of a long run sustainability of adopting the common currency basket in East Asia, given that the common currency unit should be denominated in terms of a currency basket in order to solve the “coordination failure” in choosing exchange rate system and that a currency basket system would contribute to stabilizing trade balances and capital flows in East Asian countries.

When we investigated the common currency basket area which included more than five East Asian countries using the trade weighted common currency basket of the three major currencies, we found the combination of ASEAN5 + China could form the common currency basket area with the three major currencies. It means that the trade weights on the three major currencies are optimized for the common currency basket area in ASEAN5 + China.

When we directly estimate the endogenous weights on the three major currencies in the common currency basket, the weight on the US dollar in the common currency basket are lager than that of the weights based on the trade volumes of seven East Asian countries with the United States. The larger weight (but not 100%) on the US dollar in the common currency basket tends to make the bilateral exchange rates among East Asian countries stationary in the long run. This seems the reason why we cannot find the long run relationship among more than five East Asian countries in our earlier works.

On the other hand, from our empirical analysis using the pre-crisis data, we could find that the larger weight on the US dollar in the common currency basket also can make the bilateral exchange rates among East Asian countries stable in the long run. If the monetary authorities employ the dollar peg system for their exchange rates policy, they do not need a policy coordination among East Asian countries any more.

Because of the pre-crisis data, we might obtain the analytical result that the larger weights on the US dollar than the trade weights in the common currency basket are so suitable that East Asian currencies should be stabilized the cointegration system for this sample period. The *de facto* dollar peg system in most of East Asian countries before the Asian currency crisis seems to reflect in the analytical results. Recently the monetary authorities in some East Asian countries have decreased the linkage of their home currency to the US dollar. Moreover, they would decrease further the linkage to the US dollar if they made regional monetary coordination to adopt a common currency basket that is desirable in terms of the stability of the trade balances.

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Table1.1:Trade Weights of East Asian Countries

1981:1-1998:12 Trade Partner	China	Indonesia	Korea	Malaysia
United States	12.38%	15.00%	25.07%	16.84%
Japan	20.41%	31.66%	20.12%	20.51%
EU Area	10.20%	11.08%	8.85%	10.41%
East Asia (Common Area)	7.31%	19.42%	9.07%	28.16%
Rest of the World	49.70%	22.84%	36.90%	24.08%

1981:1-1998:12 Trade Partner	The Philippines	Singapore	Thailand
United States	27.26%	17.53%	15.39%
Japan	18.87%	14.41%	22.17%
EU Area	10.38%	9.14%	13.22%
East Asia (Common Area)	13.51%	25.78%	18.18%
Rest of the World	29.98%	33.15%	31.04%

Table1.2:Trade Weights of the Common Currency Area

1981:1-1998:12 Trade Partner	Common Area	Outside Area	Basket Weight
United States	18.09%	21.56%	37.18%
Japan	20.59%	24.48%	42.22%
EU Area	10.00%	11.94%	20.60%
East Asia (Common Area)	16.07%		
Rest of the World	35.24%	42.02%	

Table 2: Johansen tests

Combination	k	H_0	Eigen Vector	Exogenous Weights L-Max	L-Trace
ASEAN5 +Korea	2	0	0.376	38.240 ***	81.720
		1	0.212	19.300	43.480
		2	0.134	11.640	24.190
		3	0.116	9.980	12.540
		4	0.031	2.540	2.560
		5	0.000	0.020	0.020
ASEAN5 +China	3	0	0.368	39.960 ***	115.730 ***
		1	0.304	31.530 ***	75.770 ***
		2	0.268	27.100 ***	44.230 **
		3	0.125	11.590	17.140
		4	0.059	5.250	5.550
		5	0.003	0.300	0.300
ASEAN5 + Korea + China	2	0	0.476	45.920 ***	133.740 ***
		1	0.416	38.150 ***	87.820 **
		2	0.261	21.520 ***	49.670
		3	0.203	16.100 *	28.150
		4	0.109	8.210	12.050
		5	0.050	3.600	3.840
		6	0.003	0.240	0.240

k: lag lengths, upper is for the currency basket, lower is for the US dollar
*95%, **97.5%, ***99.0%

Table 3: Chi-square based Tests

Combination	k	r	DGF	CHISQ 10%	5%	2.5%	1%	Korea (Won)	Singapore ($SG)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines	Thailand (Baht)	China (Yuan)
ASEAN5 + China	3	3	3	6.25	7.81	9.35	11.34		17.09 ****	23.39 ****	23.67 ****	18.63 ****	18.06 ****	20.56 ****
		3	3	6.25	7.81	9.35	13.28		19.72 ****	25.79 ****	19.55 ****	25.42 ****	21.72 ****	17.05 ****
		3	3	6.25	7.81	9.35	11.34		8.33 **	6.68 *	10.8 ***	7.84 **	10.54 ***	20.36 ****
ASEAN5 + China + Korea	2	2	2	4.61	5.99	7.38	9.21	14.4 ****	0.92	5.38 *	11.32 ****	16.85 ****	17.77 ****	6.52 **
		2	5	9.24	11.07	12.83	16.81	19.01 ****	34.03 ****	35.29 ****	32.7 ****	32.58 ****	28.18 ****	28.97 ****
		2	2	4.61	5.99	7.38	9.21	18.04 ****	14.17 ****	4.34	11.18 ****	8.55 ***	12.34 ****	8.22 ***

Test statistics indicate for "long-run exclusion"(upper), "stationarity"(middle), and "weak exogeneity"(lower) respectively.

Table 4: Johansen tests

Combination	k	H_0	Eigen Vector (Endogenous Weights)	L-Max (Endogenous Weights)	L-Trace (Endogenous Weights)
Singapore + Indonesia + Malaysia + The Philippines + Thailand	4	0	0.390	50.350 ***	156.430 ***
		1	0.314	38.450 ***	106.090 ***
		2	0.248	29.080 ***	67.630 ***
		3	0.206	23.500 ***	38.550 *
		4	0.075	7.930	15.050
		5	0.058	6.110	7.120
		6	0.010	1.010	1.010
Korea + Singapore + Indonesia + Malaysia + The Philippines + Thailand	4	0	0.402	62.700 ***	219.020 ***
		1	0.359	54.340 ***	156.320 ***
		2	0.254	35.800 ***	101.980 *
		3	0.200	27.240 ***	66.190 *
		4	0.158	20.950 ***	38.950 *
		5	0.084	10.670 ***	18.000
		6	0.058	7.320 ***	7.330
		7	0.000	0.000	0.000
Korea + Singapore + Indonesia + Malaysia + The Philippines + Thailand + China	3	0	0.442	54.280 ***	248.470 ***
		1	0.405	48.280 ***	194.190 ***
		2	0.340	38.600 ***	145.910 ***
		3	0.331	37.340 ***	107.310 ***
		4	0.262	28.300 ***	69.970 ***
		5	0.187	19.210 ***	41.680 *
		6	0.146	14.710 ***	22.470
		7	0.078	7.570	7.760
		8	0.002	0.190	0.190

k: lag lengths

*:95%, **:97.5%, ***:99%

Table 5: Chi-square based Tests for Estimation of Endogenous Weights

	r	DGF	CHISQ 10%	5%	2.5%	1%	Korea (Won)	Singapore ($SG)	Malaysia (Ringgit)	The Philippines	Thailand (Baht)	Indonesia (Rupiah)	China (Yuan)	US-JP	US-ECU
ASEAN 5	1	1	2.71	3.84	5.02	6.63		8.38 ****	5.66 ***	5.76 ***	6.72 ****	1.98		1.38	0.09
	1	6	10.64	12.59	14.45	16.81		31.37 ****	25.87 ****	30.31 ****	31.86 ****	33.87 ****		32.25 ****	29.82 ****
	1	1	2.71	3.84	5.02	6.63		5.31 ***	11.41 ****	0.76	10.72 ****	1.93		11.83 ****	10.46 ****
	2	2	4.61	5.99	7.38	9.21		15.95 ****	12 ****	7.77 ***	15.78 ****	9.02 ***		7.91 ***	6.97 **
	2	5	9.24	11.07	12.83	15.09		19.97 ****	15.66 ****	18.69 ****	20.89 ****	22.41 ****		21.45 ****	19.01 ****
	2	2	4.61	5.99	7.38	9.21		11.65 ****	19.64 ****	4.74 *	13.36 ****	4.08		12.24 ****	12.69 ****
	3	3	6.25	7.81	9.35	11.34		17.43 ****	15.82 ****	12.93 ****	19.9 ****	14.07 ****		13.41 ****	8.59 **
	3	4	7.78	9.49	11.14	13.28		11.76 ***	8.89 *	10.78 **	12.71 ***	15.03 ****		12.93 ***	11.97 ***
	3	3	6.25	7.81	9.35	11.34		17.04 ****	22.95 ****	5.83	17.46 ****	5.94		15.09 ****	12.85 ****
	4	4	7.78	9.49	11.14	13.28		32.84 ****	31.06 ****	26.73 ****	35.43 ****	27.83 ****		23.77 ****	19.27 ****
	4	3	6.25	7.81	9.35	11.34		10.56 ***	8.16 **	10.69 ***	12.16 ****	15 ****		12.06 ****	11.76 ****
	4	4	7.78	9.49	11.14	13.28		27.29 ****	28.99 ****	13.91 ****	30.45 ****	18.71 ****		25.3 ****	13.21 ***
ASEAN 5 + Korea	1	1	2.71	3.84	5.02	6.63	0.1	7.44 ****	0.41	1.02	7.65 ****	8.19 ****		2.29	5.62 ***
	1	7	12.02	14.07	16.01	18.48	43.78 ****	40.6 ****	35.24 ****	39.5 ****	40.53 ****	42.4 ****		43.33 ****	33.07 ****
	1	1	2.71	3.84	5.02	6.63	0.82	0.21	4.7 **	6.71 ****	8.09 ****	0.57		6.53 ***	4.65 **
	2	2	4.61	5.99	7.38	9.21	13.95 ****	17.61 ****	14.61 ****	8.63 ***	23.64 ****	25.53 ****		9.36 ****	7.75 ***
	2	6	10.64	12.59	14.45	16.81	36.21 ****	32.66 ****	26.88 ****	31.64 ****	32.34 ****	34.66 ****		35.17 ****	25.07 ****
	2	2	4.61	5.99	7.38	9.21	3.86	6.08 **	20.64 ****	9.38 ****	9.21 ***	0.64		8.72 ***	6.27 **
	3	3	6.25	7.81	9.35	11.34	19.38 ****	26.15 ****	22.28 ****	14.31 ****	31.4 ****	28.69 ****		17.7 ****	15.61 ****
	3	5	9.24	11.07	12.83	15.09	20.19 ****	19.06 ****	19.93 ****	19.92 ****	19.13 ****	22.47 ****		21.93 ****	11.44 **
	3	3	6.25	7.81	9.35	11.34	4.25	12.25 ****	21.5 ****	15.94 ****	17.42 ****	2.5		17.26 ****	10.13 ***
	4	4	7.78	9.49	11.14	13.28	21.68 ****	31.33 ****	28.52 ****	20.23 ****	36.62 ****	34.85 ****		20.85 ****	21.08 ****
	4	4	7.78	9.49	11.14	13.28	12.24 ***	11.22 ***	16.76 ****	13.69 ****	12.02 ***	18.44 ****		16.45 ****	6.08
	4	4	7.78	9.49	11.14	13.28	6.8	16.95 ****	26.75 ****	16.03 ****	23.69 ****	3.73		21.73 ****	13.67 ****
	5	5	9.24	11.07	12.83	15.09	31.85 ****	41.36 ****	38.8 ****	23.17 ****	46.58 ****	41.13 ****		27.41 ****	30.04 ****
	5	3	6.25	7.81	9.35	11.34	8.18 **	10.69 ***	13.44 ****	12.4 ****	10.91 ***	13.64 ****		13.4 ****	6
	5	5	9.24	11.07	12.83	15.09	16.77 ****	20.59 ****	31.5 ****	16.99 ****	33.1 ****	8.7		27.51 ****	15.24 ****
ASEAN 5 + Korea + China	1	1	2.71	3.84	5.02	6.63	0.66	0.19	3.56 *	4.81 **	0.39	0.02	5.99 ***	0.68	0.72
	1	8	13.36	15.51	17.54	20.09	23.62 ****	30.81 ****	31.37 ****	34.04 ****	32.77 ****	37.2 ****	36.86 ****	32.32 ****	17.9 ***
	1	1	2.71	3.84	5.02	6.63	5.22 ***	2.01	1.48	2.48	4.49 **	0.51	0.41	4.84 **	0.49
	2	2	4.61	5.99	7.38	9.21	2.05	2.81	8.78 ***	10.24 ****	6.07 **	3.63	12.15 ****	5.15 *	1.31
	2	7	12.02	14.07	16.01	18.48	20.09 ****	25.82 ****	26.26 ****	30.43 ****	28.32 ****	32.59 ****	31.24 ****	26.92 ****	13.38 *
	2	2	4.61	5.99	7.38	9.21	7.67 ***	5.78 *	2.07	4.96 *	6.74 **	1.29	0.7	4.84 *	1.08
	3	3	6.25	7.81	9.35	11.34	2.34	3.37	10.03 ***	11.37 ****	7.18 *	4.13	13.38 ****	5.28	1.31
	3	6	10.64	12.59	14.45	16.81	15.63 ***	20.24 ****	21.40 ****	25.36 ****	22.04 ****	28.31 ****	24.14 ****	22.45 ****	8.97
	3	3	6.25	7.81	9.35	11.34	8.9 **	6.97 *	2.93	5.37	7.91 **	1.43	1.31	5.76	2.33
	4	4	7.78	9.49	11.14	13.28	3.93	12.4 ***	16.82 ****	20.31 ****	15.76 ****	12.35 ***	17.68 ****	9.02 *	3.91
	4	5	9.24	11.07	12.83	15.09	15.47 ****	19.61 ****	21.19 ****	24.79 ****	21.65 ****	28.08 ****	23.32 ****	22.07 ****	8.79
	4	4	7.78	9.49	11.14	13.28	13.24 ***	12.27 ***	11.3 ***	11.84 ***	14.23 ****	8.23 *	9.14 *	14.8 ****	3.53
	5	5	9.24	11.07	12.83	15.09	12.71 **	15.61 ****	24.53 ****	26.32 ****	24.35 ****	21.07 ****	18.71 ****	9.35 *	9.4 *
	5	4	7.78	9.49	11.14	13.28	10.49 **	18.5 ****	21.17 ****	23.97 ****	20.91 ****	23.52 ****	20.81 ****	16.2 ****	6.16
	5	5	9.24	11.07	12.83	15.09	18.01 ****	21.09 ****	16.45 ****	12.06 **	17.95 ****	17.09 ****	9.53 *	16.36 ****	12.6 **
	6	6	10.64	12.59	14.45	16.81	17.19 ****	19.22 ****	28.81 ****	30 ****	28.27 ****	24.1 ****	20.97 ****	12.63 **	12.14 *
	6	3	6.25	7.81	9.35	11.34	4.53	11.23 ***	16.03 ****	16.11 ****	12.8 ****	14.49 ****	12.05 ****	7.14 *	1.82
	6	6	10.64	12.59	14.45	16.81	21.83 ****	23.61 ****	18.04 ****	12.34 *	19.76 ****	19.75 ****	11.94 *	18.2 ****	17.1 ****

Test statistics indicate for "long-run exclusion"(upper), "stationarity"(middle), and "weak exogeneity"(lower) respectively.

Table 6: Estimated cointegration vector (transposed)

	r	Korea	Singapore	Malaysia	The Philippines	Thailand	Indonesia	China	US-JP	US-ECU
ASEAN 5	1		55.774 *	-41.595 *	19.238 *	-136.951 *	44.033		4.620	-1.677
	2		32.312 *	38.611 *	-11.529 *	-119.036 *	91.519 *		11.304 **	-16.215 **
	3		13.917 *	28.112 *	-25.645 *	-25.272 *	53.558 *		7.325 **	5.909 **
	4		-40.017 *	-26.552 *	7.963 *	54.989 *	25.772 *		-1.192 **	-12.409 **
ASEAN 5 + Korea	1	3.770	-61.122 *	16.917	-9.130	184.060 *	-98.624 *		-7.545	13.281 **
	2	-32.291 *	-19.505 *	-71.725 *	20.034 *	55.338 *	-13.727 *		-9.946 **	-5.054 **
	3	-14.894 *	-45.783 *	-40.057 *	20.518 *	62.576 *	-14.362 *		-12.954 **	-20.825 **
	4	11.095 *	1.679 *	19.529 *	-14.290 *	-34.426 *	44.548 *		-1.706 **	6.094 **
	5	20.886 *	-17.626 *	4.341 *	-3.641 *	41.156 *	7.942 *		6.686 **	5.470 **
ASEAN 5 + Korea + China	1	-9.319	10.706	-49.994 *	23.551 *	36.465	-4.412	11.290 *	-3.539	-5.480
	2	-13.574	-40.616	-35.798 *	10.229 *	123.997 *	-62.111	-0.246 *	-7.534 **	5.202
	3	11.724	-44.182	43.129 *	-15.649 *	100.752 *	-52.071	-4.360 *	2.074	-0.356
	4	17.268	49.843 *	-4.461 *	5.930 *	-40.935 *	-65.289 *	-0.706 *	5.811 **	14.463
	5	43.576 *	1.432 *	29.902 *	-2.028 *	-31.027 *	-27.924 *	-2.727 *	2.186 **	19.988 **
	6	-8.727	-47.339 *	-22.253 *	9.582 *	25.569 *	-12.425 *	-8.337 *	-12.194 **	-15.216 **

*:From Table 5, the null hypothesis of the long-run exclusion and the stationarity for the coefficients of seven East Asian coutries are rejected.

**:From Table 5, $\zeta_{US\text{-}JP}$ or $\zeta_{US\text{-}ECU} \neq 0$

Table 7: Endogenous weights (normalized)

	r	alpha (¥)	beta (ECU)	gamma ($)	Results
ASEAN 5	1	0.000	0.000	1.000	
	2	0.355	-0.509	1.154	
	3	0.164	0.132	0.704	**
	4	-0.054	-0.560	1.614	
ASEAN 5 + Korea	1	0.000	0.370	0.630	
	2	0.161	0.082	0.758	**
	3	0.405	0.651	-0.056	
	4	-0.061	0.217	0.844	
	5	0.126	0.103	0.771	**
ASEAN 5 + Korea + China	1	0.000	0.000	1.000	
	2	0.416	0.000	0.584	
	3	0.000	0.000	1.000	
	4	-0.152	0.000	1.152	
	5	0.195	1.784	-0.979	
	6	0.191	0.000	0.809	

*: α, β, $\gamma \geq 0$, $\zeta_i \neq 0$ (i=1,…,7, US-JP, US-ECU)