RIETI Discussion Paper Series 06-E-028

Adopting a Common Currency Basket Arrangement into the "ASEAN Plus Three"

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June, 2006

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Abstract

East Asian countries, for example "ASEAN plus three countries" (China, Korea, and Japan), have been well cognizant of importance of the regional financial cooperation since the Asian currency crisis in 1997. They have established the Chiang Mai Initiative (CMI) to manage currency crises. However, the CMI is not designed for "crisis prevention" because it includes no more than soft surveillance process as well as a network of currency swap arrangements. The surveillance process should be conducted over intra-regional exchange rates and exchange rate policies of the regional countries in order to stabilize intra-regional exchange rates in a situation of a strong economic relationship among the regional countries. On one hand, the regional exchange rate stability is related with an optimum currency area.

Based on a Generalized PPP model, which detects a cointegration relationship among real effective exchanges rates, we investigate whether the region composed of "ASEAN plus three countries" is an optimum currency area. In the investigation, our interest is focused on an issue whether the Japanese yen could be regarded as an "insider" currency as well as other East Asian currencies. Or, is the Japanese yen still an "outsider" which is used as a target currency of foreign exchange rate policy for other East Asian countries. We employ a Dynamic OLS to estimate the long-term relationship among the East Asian currencies in a currency basket. Our empirical results indicate that the Japanese yen works as an exogenous variable in the cointegration system during a pre-crisis period while it works as an endogenous one during a post-crisis period. It implies that the Japanese yen could be regarded as an insider currency as well as other East Asian currencies after the crisis although it is regarded as an outsider currency as well as the US dollar and the euro before the Asian crisis.

JEL classifications: F31, F33, F36
Keywords: Real effective exchange rates, Optimum currency area theory, PPP, Exchange rate policy, Policy Coordination, Cointegration.

1. Introduction

It has been much more recognized in East Asia that monetary and financial cooperation should be necessary for preventing and managing future currency crises. The monetary authorities of ASEAN plus three (Japan, China, and Korea) established a network of swap agreements among them under the Chiang Mai Initiative. They decided to develop the Chiang Mai Initiative at the ASEAN plus three Ministry of Finance Meeting in Istanbul in May of 2005. It is clear that surveillance over economic situation of the ASEAN plus three countries is necessary for prevention of currency crises. In fact, the monetary authorities have been making surveillance under the Chiang Mai Initiative.

It is known that there exist still a variety of exchange rate regimes in East Asia although the monetary authorities have been discussing about the monetary and financial cooperation. For example, Japan and Korea are adopting a free-floating exchange rate system while China and Malaysia had adopted a dollar-peg system before July in 2005. Although the two latter countries announced that they changed their exchange rate regime into a managed floating exchange rate system, they have kept a *de facto* dollar peg system (Ogawa and Sakane (2006), Ito (2005)). The variety of exchange rate systems in East Asia shows a possibility of coordination failure in choosing exchange rate regimes (Ogawa and Ito (2002)). The monetary authorities should make coordination in exchange rate policies if they face the coordination failure. One of the measures to solve the coordination failure is for the monetary authorities of the ASEAN plus three countries to adopt a common exchange rate policy. The exchange rate policy coordination of the ASEAN plus three countries should contribute to stability of intra-regional exchange rates among the ASEAN plus three currencies.

On the other hand, the ASEAN plus three countries should be an Optimum Currency Area (OCA) in order to succeed in adopting a common exchange rate policy. In this paper, we investigate whether the ASEAN plus three countries is an OCA while we take into account a fact that a currency basket system should be desirable for these economies who have strong economic relationships with not only one specific country such as the United States. It is shown in the fact that both the Chinese and Malaysian monetary authorities have adopted a currency basket system. We use the

Generalized-Purchasing Power Parity (G-PPP) model to specify a currency basket as an anchor currency for a common currency exchange rate policy.

This paper has the following contents. We explain a theoretical background of the G-PPP model and relationship between the G-PPP model and the OCA model. Next, we use the G-PPP model to define a common currency area for the ASEAN plus three countries. We explain adoption of a common currency basket arrangement into the ASEAN plus three countries. In the fourth section, we conduct an empirical analysis of possibilities of adopting a common currency basket arrangement into the ASEAN plus three countries. In conclusion, we summarize analytical results.

2. OCA theory and G-PPP model

2.1 Real effective exchange rates and Generalized PPP

Ogawa and Kawasaki (2003), Kawasaki (2005), and Kawasaki and Ogawa (2006) modified the Enders and Hurn (1994)'s G-PPP model using a concept of stochastic trend among the real effective exchange rates of countries in the common currency area. We use the "extended G-PPP model" as well.[i]

Suppose there are m countries that are expected to adopt a common currency as an anchor currency. Country j has n trade partners. It has strong trade relationships with $m-1$ countries which adopt the same exchange rate policy as country j, while it has also trade relationships with the other countries. Therefore, we can define the real effective exchange rates of country $j : ree_j$, (countries $1, 2, \cdots, j, \cdots, m$ have the common currency while countries $m+1, \cdots, n$ do

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[i] The G-PPP model is extended from a simple PPP model by taking into account difficulties in holding PPP because frequently occurred nominal and real shocks continuously have effects on macro fundamentals. Even in the long run, changes in a bilateral exchange rate depend not only on changes in the relative prices between the related two countries but also on those in relative prices among the two countries and other countries. Price levels in other countries may have effects on domestic price levels in the two countries because prices of intermediate goods imported from abroad may have effects on prices of domestic products. Therefore, it is assumed in the G-PPP model that there are common factors among some bilateral real exchange rates of the home currency vis-à-vis currencies of foreign countries with which the home country has strong economic relationships. Thus, the real exchange rates have a stable equilibrium in the long run if they have strong economic relationships with each other. The G-PPP model explains that a PPP holds if a linear combination of some bilateral real exchange rate series has equilibrium in the long run, even though each of the bilateral rate series is non-stationary. We assume that this linear combination defines the optimum currency area in the sense of Mundell (1961).

not share the common currency) denoted with currency of country j,

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

where $re_{j,i}$ is the logarithm of the real exchange rate between country i and country j. The coefficients: $\rho_{j,i}$ ($\sum_{i=1,i\neq j}^{m} \rho_{j,i} = 1$, $\sum_{i=m+1}^{n} \rho_{j,i} = 1$) denote that country j's trade weights on country i and ξ are the trade weights of a group of countries that share the common currency.

Here we assume that the shocks from the outside of common currency area affect the real effective rate of country j temporarily. In the case where only country j is permanently affected by the countries that do not adopt the common currency basket as an anchor currency, it is difficult to maintain a common currency in the region.

Here, we focus on the part of real effective exchange rates, which is defined by $m-1$ trade partners who share the common currency with the country j and country $m+1$ who dose not share the common currency with country j. Equation (1) is rewritten as follows,

$$ree_j^{\xi} = \omega_{j,1} re_{j,1} + \omega_{j,2} re_{j,2} + \cdots + \omega_{j,m} re_{j,m} + \omega_{j,m+1} re_{j,m+1} \tag{2}$$

where the coefficients: $\omega_{j,i}$ ($\sum_{i=1,i\neq j}^{m+1} \omega_{j,i} = 1$) denote the country j's trade weights on country i and the country $m+1$.

Again, evaluating the real effective exchange rate of Equation (2) in terms of a currency of the country $m+1$, real effective exchange rate of country j is re-written as follows:

$$\begin{aligned} ree_{j,t}^{\omega} &= \omega_{j,1}(re_{j,1,t} - re_{j,m+1,t}) + \cdots + \omega_{j,m-1}(re_{j,m-1,t} - re_{j,m+1,t}) + re_{j,m+1,t} \\ &= \omega_{j,1} re_{m+1,1,t} + \cdots + \omega_{j,1} re_{m+1,m,t} - re_{m+1,j,t} \end{aligned}$$

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

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

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 $re_{m+1,i}$ as below,

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

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 $\mathbf{ree}$ include 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.[ii] 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 cointegration system, we can show that the vector $\mathbf{ree}$ which is characterized by m cointegration relationships, can be described as the sum of a stationary component and a non-stationary component.

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

[ii] 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 $\mathbf{r\bar{e}e}_t$ is $E(\mathbf{r\bar{e}e}_t) = 0$ in this model since the logarithm of the real effective exchange rate can be expected to converge toward the zero-mean in the long run. Therefore, the vector $\mathbf{ree}$ can be only described as the non-stationary component $\mathbf{r\tilde{e}e}$. If we could find a cointegration relationship in $\mathbf{r\tilde{e}e}$, we can have a long term equilibrium defined by the following linear combination:

$$\zeta_1 \cdot re_{m+1,1} + \zeta_2 \cdot re_{m+1,2} + \cdots + \zeta_m \cdot re_{m+1,m} = 0\,, \tag{5}$$

where ζ_i is an element of cointegrating vector.

In our extended G-PPP approach, this linear combination define that m countries form a common currency area in terms of the currency of the country $m+1$. It means that this area exhibits optimal currency area in the sense of Mundell (1961). [iii]

3. G-PPP and a common currency basket

3.1 Adopting the "common" currency basket arrangement into "ASEAN plus three"

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 the three major currencies such as the US dollar, the Euro, and the Japanese yen but also other East Asian currencies.

In the case that a country adopts the neighborhood's currencies in the group of ASEAN plus three into its basket currency as their target policy, country i's reference rate can be rewritten as follows;

[iii] This linear combination is the same formation as that of Enders and Hurn (1994), however, in our extended G-PPP model, the country $m+1$ dose not belong the common currency area unlike that of them. As Mundell (1961) pointed out, the idea of the optimum currency area works best if each currency share internal factor mobility and external factor immobility. Although possible countries exhibit the external factor immobility commonly, but may not exhibit enough internal factor mobility because of trade protections or labor policy among these countries. Domestic policies would be changed and obstacles would be omitted after lunching their economic union. Therefore, to investigate the candidates of the future monetary union, we should consider not only the internal mobility but also external "common" immobility and investigate how external shocks affect the each economy in the region. Again, to capture the effect from external economies, common currency area should be evaluated in terms of macro fundamental variables of external countries.

$$re_{CB,i} = \varphi_{US,i} \cdot re_{US,i} + \varphi_{EU,i} \cdot re_{EU,i} + \varphi_{JP,i} \cdot re_{JP,i} + \varphi_{1,i} \cdot re_{1,i} + \cdots + \varphi_{m,i} \cdot re_{m,i} \,,$$

$$\sum_{i=1, j \neq i}^{m,US,EU,JP} \varphi_{j,i} = 1 \tag{6}$$

Equation (6) can be written in terms of the US dollar as follows:

$$\begin{aligned} re_{CB,i} &= (\varphi_{US,i} re_{US,i} + \varphi_{EU,i} re_{EU,i} + \varphi_{JP,i} re_{JP,i} + \varphi_{1,i} re_{1,i} + \varphi_{2,i} re_{2,i} + \cdots + \varphi_{m,i} re_{m,i}) - re_{US,i} + re_{US,i} \\ &= \varphi_{US,i}\left(re_{US,i} - re_{US,i}\right) + \varphi_{EU,i}\left(re_{EU,i} - re_{US,i}\right) + \varphi_{JP,i}\left(re_{JP,i} - re_{US,i}\right) \\ &\quad + \varphi_{1,i}\left(re_{1,i} - re_{US,i}\right) + \cdots + \varphi_{m,i}\left(re_{m,i} - re_{US,i}\right)\} + re_{US,i} \\ &= \varphi_{EU,i} re_{EU,US} + \varphi_{JP,i} re_{JP,US} + \varphi_{1,i} re_{1,US} + \varphi_{2,i} re_{2,US} + \cdots + \varphi_{m,i} re_{m,US} + re_{US,i} \end{aligned} \tag{7}$$

Then, we can write the real exchange rates between the basket currency and country i $i = 1, 2, \ldots, 7$ for seven East Asian countries as a vector form.

$$\underset{(7\times1)}{\mathbf{re}_{CB,i}} = \underset{(7\times9)}{\mathbf{F}} \bullet \underset{(9\times1)}{\mathbf{re}_{(i,EU,JP),US}} = \begin{pmatrix} -1 & \varphi_{1,2} & \varphi_{1,3} & \varphi_{1,4} & \varphi_{1,5} & \varphi_{1,6} & \varphi_{1,7} & \varphi_{1,EU} & \varphi_{1,JP} \\ \varphi_{2,1} & -1 & \varphi_{2,3} & \varphi_{2,4} & \varphi_{2,5} & \varphi_{2,6} & \varphi_{2,7} & \varphi_{2,EU} & \varphi_{2,JP} \\ \varphi_{3,i} & \varphi_{3,2} & -1 & \varphi_{3,4} & \varphi_{3,5} & \varphi_{3,6} & \varphi_{3,7} & \varphi_{3,EU} & \varphi_{3,JP} \\ \varphi_{4,1} & \varphi_{4,2} & \varphi_{4,3} & -1 & \varphi_{4,5} & \varphi_{4,6} & \varphi_{4,7} & \varphi_{4,EU} & \varphi_{4,JP} \\ \varphi_{5,1} & \varphi_{5,2} & \varphi_{5,3} & \varphi_{5,4} & -1 & \varphi_{5,6} & \varphi_{5,7} & \varphi_{5,EU} & \varphi_{5,JP} \\ \varphi_{6,1} & \varphi_{6,2} & \varphi_{6,3} & \varphi_{6,4} & \varphi_{6,5} & -1 & \varphi_{6,7} & \varphi_{6,EU} & \varphi_{6,JP} \\ \varphi_{7,1} & \varphi_{7,2} & \varphi_{7,3} & \varphi_{7,4} & \varphi_{7,5} & \varphi_{7,6} & -1 & \varphi_{7,EU} & \varphi_{7,JP} \end{pmatrix} \begin{pmatrix} re_{1,US} \\ re_{2,US} \\ re_{3,US} \\ re_{4,US} \\ re_{5,US} \\ re_{6,US} \\ re_{7,US} \\ re_{EU,US} \\ re_{JP,US} \end{pmatrix} \tag{8}$$

where, $\mathbf{re}_{CB,i} = \left[re_{CB,1}, re_{CB,2}, re_{CB,3}, re_{CB,4}, re_{CB,5}, re_{CB,6}, re_{CB,7}\right]'$. Here, Equation (8) can rewrite as follows:

$$\begin{aligned} \underset{(7\times1)}{\mathbf{re}_{CB,i}} &= \underset{(7\times9)}{\mathbf{F}} \cdot \underset{(9\times1)}{\mathbf{re}_{(i,EU,JP),US}} = \underset{(7\times7)}{\mathbf{F}_1} \cdot \underset{(7\times1)}{\mathbf{re}_1} + \underset{(7\times2)}{\mathbf{F}_2} \cdot \underset{(2\times1)}{\mathbf{re}_2} \\ &= \begin{pmatrix} -1 & \varphi_{1,2} & \varphi_{1,3} & \varphi_{1,4} & \varphi_{1,5} & \varphi_{1,6} & \varphi_{1,7} \\ \varphi_{2,1} & -1 & \varphi_{2,3} & \varphi_{2,4} & \varphi_{2,5} & \varphi_{2,6} & \varphi_{2,7} \\ \varphi_{3,i} & \varphi_{3,2} & -1 & \varphi_{3,4} & \varphi_{3,5} & \varphi_{3,6} & \varphi_{3,7} \\ \varphi_{4,1} & \varphi_{4,2} & \varphi_{4,3} & -1 & \varphi_{4,5} & \varphi_{4,6} & \varphi_{4,7} \\ \varphi_{5,1} & \varphi_{5,2} & \varphi_{5,3} & \varphi_{5,4} & -1 & \varphi_{5,6} & \varphi_{5,7} \\ \varphi_{6,1} & \varphi_{6,2} & \varphi_{6,3} & \varphi_{6,4} & \varphi_{6,5} & -1 & \varphi_{6,7} \\ \varphi_{7,1} & \varphi_{7,2} & \varphi_{7,3} & \varphi_{7,4} & \varphi_{7,5} & \varphi_{7,6} & -1 \end{pmatrix} \begin{pmatrix} re_{1,US} \\ re_{2,US} \\ re_{3,US} \\ re_{4,US} \\ re_{5,US} \\ re_{6,US} \\ re_{7,US} \end{pmatrix} + \begin{pmatrix} \varphi_{EU,1} & \varphi_{JP,1} \\ \varphi_{EU,2} & \varphi_{JP,2} \\ \varphi_{EU,3} & \varphi_{JP,3} \\ \varphi_{EU,4} & \varphi_{JP,4} \\ \varphi_{EU,5} & \varphi_{JP,5} \\ \varphi_{EU,6} & \varphi_{JP,6} \\ \varphi_{EU,7} & \varphi_{JP,7} \end{pmatrix} \begin{pmatrix} re_{EU,US} \\ re_{JP,US} \end{pmatrix} \end{aligned} \tag{9}$$

where,

$$\underset{(7\times1)}{\mathbf{re}_{CB,i}} = \underset{(7\times7)}{\mathbf{F}_1} \cdot \underset{(7\times1)}{\mathbf{re}_1} + \underset{(7\times2)}{\mathbf{F}_2} \cdot \underset{(2\times1)}{\mathbf{re}_2}$$
$$\because \mathbf{F} = \begin{pmatrix}\mathbf{F}_1 & \mathbf{F}_2\end{pmatrix}, \mathbf{re}_{(i,EU,JP),US} = \begin{pmatrix}\mathbf{re}_1 & \mathbf{re}_2\end{pmatrix}' \tag{10}$$

Next, if the Japanese yen would be included in the region, Equation (8) should be rewritten as follows:

$$\underset{(8\times1)}{\mathbf{re}_{CB,i}} = \underset{(8\times9)}{\mathbf{F}} \bullet \underset{(9\times1)}{\mathbf{re}_{(i,JP,EU),US}}$$
$$= \begin{pmatrix} -1 & \varphi_{1,2} & \varphi_{1,3} & \varphi_{1,4} & \varphi_{1,5} & \varphi_{1,6} & \varphi_{1,7} & \varphi_{1,JP} & \varphi_{1,EU} \\ \varphi_{2,1} & -1 & \varphi_{2,3} & \varphi_{2,4} & \varphi_{2,5} & \varphi_{2,6} & \varphi_{2,7} & \varphi_{2,JP} & \varphi_{2,EU} \\ \varphi_{3,1} & \varphi_{3,2} & -1 & \varphi_{3,4} & \varphi_{3,5} & \varphi_{3,6} & \varphi_{3,7} & \varphi_{3,JP} & \varphi_{3,EU} \\ \varphi_{4,1} & \varphi_{4,2} & \varphi_{4,3} & -1 & \varphi_{4,5} & \varphi_{4,6} & \varphi_{4,7} & \varphi_{4,JP} & \varphi_{4,EU} \\ \varphi_{5,1} & \varphi_{5,2} & \varphi_{5,3} & \varphi_{5,4} & -1 & \varphi_{5,6} & \varphi_{5,7} & \varphi_{5,JP} & \varphi_{5,EU} \\ \varphi_{6,1} & \varphi_{6,2} & \varphi_{6,3} & \varphi_{6,4} & \varphi_{6,5} & -1 & \varphi_{6,7} & \varphi_{6,JP} & \varphi_{6,EU} \\ \varphi_{7,1} & \varphi_{7,2} & \varphi_{7,3} & \varphi_{7,4} & \varphi_{7,5} & \varphi_{7,6} & -1 & \varphi_{7,JP} & \varphi_{7,EU} \\ \varphi_{JP,1} & \varphi_{JP,2} & \varphi_{JP,3} & \varphi_{JP,4} & \varphi_{JP,5} & \varphi_{JP,6} & \varphi_{JP,7} & -1 & \varphi_{JP,EU} \end{pmatrix} \begin{pmatrix} re_{1,US} \\ re_{2,US} \\ re_{3,US} \\ re_{4,US} \\ re_{5,US} \\ re_{6,US} \\ re_{7,US} \\ re_{JP,US} \\ re_{EU,US} \end{pmatrix} \tag{11}$$

Here, Equation (8) and (11) rewritten as general form as follows:

$$\underset{(m\times1)}{\mathbf{re}_{CB,i}} = \underset{(m\times m)}{\mathbf{F}_1} \cdot \underset{(m\times1)}{\mathbf{re}_1} + \underset{(m\times(n-m))}{\mathbf{F}_2} \cdot \underset{((n-m)\times1)}{\mathbf{re}_2} \tag{12}$$

Where n is the number of currencies which include in the currency basket with the US dollar and m is the number of countries in the possible region of currency union.

Since the matrix $\mathbf{F}_1$ has an inverse matrix, vector $\mathbf{re}_1$ would be solved by matrix $\mathbf{F}$ as follows:

$$\mathbf{re}_1 = \mathbf{F}_1^{-1} \cdot \mathbf{re}_{CB,i} - \mathbf{F}_1^{-1}\mathbf{F}_2 \cdot \mathbf{re}_2 \tag{13}$$

In Equation (13), $\mathbf{re}_1$ would be defined by $\mathbf{re}_2$. It means that real exchange rates among East Asian countries in the region would be defined by the currencies outside the region.

If monetary authorities in the region agree to peg their currencies to the regional currency basket and intervene into foreign exchange market to maintain their exchange rate stability, a long-term property of those real exchange rates should be zero; $\mathbf{re}_{CB,i} = 0$. Here, we define the non-null matrix $\mathbf{Z}$ which is composed of $m \times m$, Equation(12) would be written to obtain the following equation:

$$\underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times n)}{\mathbf{F}} \cdot \underset{(n\times 1)}{\mathbf{re}_{(i,EU,JP),US}} = \underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times m)}{\mathbf{F}_1} \cdot \underset{(m\times 1)}{\mathbf{re}_1} + \underset{(m\times m)}{\mathbf{Z}} \cdot \underset{(m\times(n-m))}{\mathbf{F}_2} \cdot \underset{((n-m)\times 1)}{\mathbf{re}_2} = 0 \tag{14}$$

If there exists a nonzero $\mathbf{Z}$ for which $\mathbf{Z} \cdot \mathbf{re}_{(i,EU,JP),US} = 0$, $\mathbf{Z}$ does not have a full rank. If we could find a matrix Z, which satisfies $\mathrm{rank}(\mathbf{Z}) < m$, it means that there exists a nonzero $\mathbf{re}$ for $\mathrm{Z} \cdot \mathbf{re} = 0$ and that the 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 in G-PPP theory. It means that if the exchange rate between Japanese yen and US dollar is included in the vector: $\mathbf{re}_2$, the number of rank $\mathbf{Z}$ for which $\mathbf{Z} \cdot \mathbf{re}_{CB,i} = 0$ would be $n - m = 2$, and if it is included in the vector: $\mathbf{re}_1$, the number of rank would be $n - m = 1$. There must be a cointegration relationship among real exchange rates: $\mathbf{re}_{(i,JP,EU),US}$.

4. Empirical analysis

4.1 Methodology

In our earlier works, we could find several linear combinations which had cointegration relationships while we set the basket weight on three major currencies in advance. In this paper, basket weights on the anchor currencies: the US dollar and the Euro, will be set by the estimation. The more countries adopt the common currency basket exchange rate policy, the less robust result we had with small sample by using the Johansen approach.

In this paper we use the dynamic OLS (DOLS) to estimates the cointegrating vector. We rewrite Equation (5) as follows;

$$re_{US,EU} = \beta_1 \cdot re_{US,1} + \beta_2 \cdot re_{US,2} + \cdots + \beta_m \cdot re_{US,m} + \beta_{JP} \cdot re_{US,JP} \tag{15}$$

Equation (15) is the long term relationship to estimate by the OLS. To estimate it, we add the leads and lags, deterministic trend, and constant term into Equation (15) as follows:

$$re_{US,EU} = \beta_0 + \beta_1 \cdot re_{US,1,t} + \beta_2 \cdot re_{US,2,t} + \cdots + \beta_m \cdot re_{US,m,t} + \beta_{JP} \cdot re_{US,JP,t} + \sum_{i=1}^{m}\sum_{j=-k}^{k} \gamma_{i,j} \Delta re_{US,i,t+j} + \beta \cdot t + u_t \tag{16}$$

Then, the property of the residuals by the DOLS estimates is show as follows:

$$\hat{u}_t = \phi_1 \cdot \hat{u}_{t-1} + \phi_2 \cdot \hat{u}_{t-2} + \phi_3 \cdot \hat{u}_{t-3} + \cdots + \phi_p \cdot \hat{u}_{t-p} + e_t \tag{17}$$

Where the sample distribution will be adjusted as follows:

$$\hat{\sigma}'_u = \hat{\sigma}_u / (1 - \phi_1 - \phi_2 - \phi_3 - \cdots - \phi_p) \tag{18}$$

We attempt to estimate the cointegrating vector with endogenous weights in the common currency basket. In this paper, we test combinations: ASEAN 5, ASEAN 5 + Korea, ASEAN 5 + China, and ASEAN 5 + Korea + China for $r = 2$, and : ASEAN 5 + Japan, ASEAN 5 + Korea + Japan, ASEAN 5 + China + Japan, and ASEAN 5 + Korea + China + Japan for $r = 1$.[iv] We assumed serial correlation of residuals was captured by an $AR(4)$, and leads and lags was $k = 2$ in Equation (16).

4.2 Data

The sample for our empirical tests covers the period between January 1987 and June 2004. Apparently, our sample includes the data in the period of the Asian currency crisis. We divide the sample periods into "pre-crisis" period from January 1987 to June 1997 and "post-crisis" period from

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[iv] As using the OLS approach to estimate the coefficients of variables, the researchers assume that related variables are cointegrated and have only one cointegration relationship. To assure this assumption, we should examine whether the related variables are cointegrated or not before we estimate the coefficients by the dynamic OLS. However, if we examine the combination of ASEAN5, Korea, China, and Japan, we need to include 9 variables in the error correction model. Small sample property and many endogenous variables in the error correction model in the Johansen approach will cause less robust results by the low degree of freedom. For combinations tested here, the existence of the cointegration relationship among the variables have not confirmed by the Johansen methods.

January 1999 to November 2005. Eight East Asian countries are included Korea, Singapore, Malaysia, Thailand, the Philippines, Indonesia, China, and Japan. The real exchange rates were based on the monthly data of nominal exchange rates and consumer price indices of the related countries.[v] We calculated the prior Euro to estimate before 1997 crisis.[vi] These data are from the IMF, *International Financial Statistics* (CD-ROM).[vii]

4.3 Analytical results

Table 1 shows the result of the DOLS for pre-crisis period (from January 1987 to June 1997). In the pre-crisis period, We could not find any combinations which all the coefficients indicated the significant result among the variables for both of rank conditions. While we could find the combinations which 3 or 4 countries could form a common currency union with common currency basket composed of three major currencies, we could not assure the existence of cointegrating vectors in the combinations which included more than 5 countries in our earlier works. Results here seem to be consistent with our earlier findings.

Table 2 shows the result of the DOLS for post-crisis period (from January 1999 to November 2005). All test statistics for the rank condition: $r = 1$ indicated significant for the combination: ASEAN 5 + Japan, ASEAN 5 + Korea + Japan, ASEAN 5 + China + Japan. On the other hand, test statistics for $r = 2$ indicated insignificant in most cases. It means that the Japanese yen should be included in the region as the currency which leads the other East Asian currency stable in the long run. East Asian countries including Japan seem to satisfy the conditions of optimum currency area in resent years. While test statistics reported here were dramatically changed from that of post crisis period, these results is consistent with the recent developments of integration in the region because East Asian countries have been deepening the inter-relationship in any economic sense, (e.g. FTA, ABMI, ABF, APEC, etc….) for 1999-2005.

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[v] For the prior Euro real exchange rates, we calculated a GDP-weighted average of CPI.

[vi] 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/)

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

5. Conclusion

In this paper, we investigate possibilities of adopting a common currency basket peg arrangement into the ASEAN plus three. We used the DOLS to estimate the cointegrating vector 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. We obtained the analytical results that the Japanese yen should be included as an endogenous variable in the long-term relationship as well as other East Asian currencies while the Japanese yen worked exogenously as well as the Euro and the US dollar in the system composed of the East Asian currencies. It implies that it is increasing the possibilities of success in adopting the common currency basket arrangement into the ASEAN plus three countries that include Japan.

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

Dependent variables	Explanetories							
	Japan (Yen)	**Indonesia (Rupiah)**	**Malaysia (Ringgit)**	**The Philippines (Peso)**	**Singapore ($SG)**	**Thailand (Baht)**	**Korea (Won)**	**China (Yuan)**
EU/US	0.0162	-0.9948	0.7092	-0.3870	0.0467	1.1397		
(rank=1)	(0.32122)	(2.02308)	(0.62715)	(0.42195)	(1.45216)	(3.63366)		
EU/US	-	-0.9583	0.6652	-0.3676	0.0227	1.2014		
(rank=2)		(1.15805)	(0.50424)	(0.35774)	(0.80176)	(2.23868)		
JP/US	-	5.0534 ****	0.1892	-0.3717	3.3679 ****	-7.8083 ****		
(rank=2)		(0.98000)	(0.42671)	(0.30274)	(0.67849)	(1.89449)		
EU/US	-0.3104	-1.2086	2.2608 ***	-0.8616	0.0862	1.2311	1.0006 **	
(rank=1)	(0.20239)	(1.14389)	(0.78621)	(0.35177)	(0.78188)	(1.98842)	(0.44839)	
EU/US		-2.2605 **	1.7601 **	-0.6484 *	-0.7436	3.0897	0.7342	
(rank=2)		(1.13705)	(0.86317)	(0.39031)	(0.70763)	(2.00540)	(0.44838)	
JP/US		3.2282 ****	1.6373 **	-0.7135 **	2.4474 **	-5.4477 **	0.9098 *	
(rank=2)		(1.19814)	(0.90955)	(0.41129)	(0.74565)	(2.11316)	(0.47248)	
EU/US	-0.0825	-0.6479	0.4326	-0.3605	1.0343	0.6338		0.1931
(rank=1)	(0.30153)	(1.84107)	(0.62267)	(0.37673)	(1.59292)	(3.35042)		(0.22566)
EU/US		-1.0497	0.3748	-0.3139	0.5836	1.4740		0.1710
(rank=2)		(1.17591)	(0.55881)	(0.34406)	(0.92062)	(2.33383)		(0.19899)
JP/US		4.4661 ****	-0.1835	-0.3040	4.0813 ****	-6.4481 ****		0.3130 *
(rank=2)		(0.97102)	(0.46144)	(0.28411)	(0.76021)	(1.92718)		(0.16432)
EU/US	-0.3919 **	-1.2604	1.7446 *	-0.7352	0.8780	1.4663	0.8249 *	0.1989
(rank=1)	(0.19390)	(1.08749)	(0.91614)	(0.37657)	(0.91154)	(1.92056)	(0.48731)	(0.13505)
EU/US		-2.2878 *	1.4196	-0.5665	-0.3763	3.2852	0.6266	0.1074
(rank=2)		(1.22817)	(1.06306)	(0.43579)	(0.90096)	(2.23441)	(0.50100)	(0.16949)
JP/US		2.6400 **	1.2918	-0.6293	2.7869 ***	-4.0726 *	0.8312 *	0.2112
(rank=2)		(1.14911)	(0.99463)	(0.40774)	(0.84296)	(2.09059)	(0.46876)	(0.15858)

†Significance level: *90%, **95%, ***97.5%, ****99%,

Table 2: DOLS estimation (post crisis: 1998:1-2005:11)

Dependent variables	Explanetories							
	Japan (Yen)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines (Peso)	Singapore ($SG)	Thailand (Baht)	Korea (Won)	China (Yuan)
EU/US	-0.7691 ****	0.6302 ****	-4.7695 ****	-0.4464 **	2.7001 ****	0.6401 **		
(rank=1)	(0.14485)	(0.08529)	(0.75476)	(0.18897)	(0.43576)	(0.29745)		
EU/US		0.5395 ****	-5.5718 ****	-0.3996	2.0716 **	0.4252		
(rank=2)		(0.18520)	(1.59216)	(0.41760)	(0.93066)	(0.63908)		
JP/US		0.1467	1.4802	-0.1484	0.9202	0.3034		
(rank=2)		(0.21186)	(1.82136)	(0.47772)	(1.06464)	(0.73107)		
EU/US	-0.8305 ****	0.5539 ****	-3.1482 ****	-0.6802 ****	3.0316 ****	0.4374 **	0.3436 ****	
(rank=1)	(0.09914)	(0.06438)	(0.80190)	(0.15433)	(0.30341)	(0.20593)	(0.11760)	
EU/US		0.5784 ****	-6.0095 ***	-0.3315	2.1075 **	0.4323	-0.0637	
(rank=2)		(0.21913)	(2.41719)	(0.50826)	(0.97978)	(0.67306)	(0.33892)	
JP/US		0.0080	3.7160	-0.4835	1.1360	0.1182	0.4190	
(rank=2)		(0.24933)	(2.75032)	(0.57831)	(1.11482)	(0.76582)	(0.38563)	
EU/US	-0.7994 ****	0.3811 ****	-3.6697 ****	-0.3838 ***	3.5278 ****	0.9368 ****		-2.35701 ***
(rank=1)	(0.11328)	(0.12513)	(0.77322)	(0.15093)	(0.48399)	(0.27155)		-0.99384
EU/US		0.39405	-4.9078 ***	-0.3771	2.4352 **	0.6283		-1.2763
(rank=2)		-0.34461	(1.91169)	(0.42660)	(1.23349)	(0.73022)		(2.58917)
JP/US		-0.0762	2.1985	-0.0406	1.5688	0.5425		-2.0129
(rank=2)		(0.42815)	(2.37510)	(0.53001)	(1.53249)	(0.90723)	(3.21681)	
EU/US	-0.8299 ****	0.4574 ****	-3.0462 ****	-0.5830 ****	3.3451 ****	0.6392 *	0.2442	-1.1472
(rank=1)	(0.11102)	(0.12950)	(0.95485)	(0.20947)	(0.49622)	(0.34440)	(0.19039)	(1.34229)
EU/US		0.3025	-5.8279	-0.0949	2.9225	1.0064	-0.2994	-3.1035
(rank=2)		(0.35394)	(2.35729)	(0.56030)	(1.30130)	(0.84758)	(0.42163)	(3.31939)
JP/US		0.0558	3.8811 **	-0.5069	0.9068 **	-0.0168	0.4830	0.6394
(rank=2)		(0.44345)	(2.95346)	(0.70200)	(1.63040)	(1.06194)	(0.52827)	(4.15888)

†Significance level: *90%, **95%, ***97.5%, ****99%,