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

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Abstract

Since Asian currency crisis in 1997, East Asian countries have been well cognizant of importance of the international policy coordination. In the outlines of Chiang Mai Initiative (CMI) and Asian Bond Market Initiative (ABMI), pragmatically policy dialogues now progress among ASEAN plus three countries: ASEAN countries, China, Korea and Japan. While CMI is expected to work as “crisis management” once crisis happens, it is not designed for “crisis prevention” and dose not have deterrent effect.

For the possible financial and/or currency crisis, we suppose that introducing a common currency basket peg system can be a solution for the coordination failure of choosing country’s exchange rate system and its policy, the inter-group or intra-regional policy coordination will be still essential even in a possible East Asian common currency area. We examine whether the region composed of “ASEAN plus three countries” is Optimum Currency are or not by using the G-PPP approach.

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 (2005), 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

Kawasaki (2003) and Ogawa and Kawasaki (2003a, b) 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 not share the common currency) denoted with currency of country j,

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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).

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

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

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

[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 $\bar{\mathbf{ree}}_t$ 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 **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 cointegration 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, Korea, and China

To define the common currency area by using the G-PPP approach, it is important to consider which countries are conducive to conducting a common exchange rate policy and which external currency should be adopted as a numéraire. Ogawa and Kawasaki (2003a) supposed that the seven East Asian countries: ASEAN 5 (Singapore, Malaysia, Thailand, the Philippines, and Indonesia), Korea, and China create a common currency union with the US dollar or the basket currency composed of the three major currencies; the US dollar, the Deutsche mark, and the Japanese yen as an anchor currency. The paper concluded that a common currency basket is more

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[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.

applicable as an anchor currency than the US dollar, in forming a common currency area in the region.

Here, an exchange rate of an East Asian country i in terms of the common currency basket is defined as follows:

$$RE_{CB,i}^{DM,JP,US} = (RE_{DM,i})^{\alpha} \cdot (RE_{JP,i})^{\beta} \cdot (RE_{US,i})^{\gamma}\ , \quad \alpha + \beta + \gamma = 1\ . \tag{6a}$$

where $RE_{CB,i}^{DM,JP,US}$ is the real exchange rate and (α, β, γ) are non-negative values of the weights on the three major currencies. Equation (6a) is rewritten in terms of the logarithm:

$$re_{CB,i}^{DM,JP,US} = \alpha \cdot re_{DM,i} + \beta \cdot re_{JP,i} + \gamma \cdot re_{US,i}\ , \quad \alpha + \beta + \gamma = 1 \tag{6b}$$

where re is the logarithm of bilateral real exchange rate.

Again, if m countries are included in the currency area evaluated by the common currency basket, we rewrite equation (5) to obtain the following equation:

$$\zeta_1 \cdot re_{CB,1}^{DM,JP,US} + \zeta_2 \cdot re_{CB,2}^{DM,JP,US} + \cdots + \zeta_m \cdot re_{CB,m}^{DM,JP,US} = 0\ . \tag{7}$$

Then, a usual cointegration framework can estimate the cointegration vector in equation (7) like equation (5).

Table 1 shows the results of empirical work in Ogawa and Kawasaki (2003). Cointegrated relationships were found in 12 combinations in which all elements in a linear combination showed significant results on the three tests. 7 of the 12 combinations include three East Asian countries in a currency area; Korea, Singapore, and Indonesia, Singapore, Malaysia, and the Philippines, Korea, Singapore, and Thailand, Singapore, Malaysia, and Thailand, Indonesia, Malaysia, and Thailand, Singapore, Thailand, and China, and Korea, Singapore, and China. The other 5 combinations include four East Asian countries in a currency area; Korea, Malaysia, the Philippines, and Indonesia, Korea, Singapore, Thailand, and Indonesia, Korea, Malaysia, Indonesia, and China, Korea, Singapore, Thailand, and China, and Singapore, Thailand, Indonesia, and China.

These results showed that several countries among East Asian countries can conduct a common exchange rate policy and that these countries can adopt a common currency basket arrangement.

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

In the previous section, ASEAN 5, Korea, and China were supposed to conduct a common exchange rate policy using a common basket currency and Japan and its economy were supposed to be exogenous to the East Asian countries. Here, we supposed the Japanese government make the regional exchange rate policy arrangement together with other seven East Asian countries. In this case, the long-term equilibrium among the countries is defined as follows:

$$\zeta_1 \cdot re_{CB,1} + \zeta_2 \cdot re_{CB,2} + \cdots + \zeta_m \cdot re_{CB,m} + \zeta_{JP} \cdot re_{CB,JP} = 0 \quad (8)$$

where the linear combination also includes the real exchange rates between the Japanese yen and the basket currency.

A common currency basket is composed of the US dollar and the ECU (the euro) and it excludes the Japanese yen. The exchange rate of country i in terms of the common currency basket is defined as follows:

$$RE_{CB,i}^{EU,US} = (RE_{EU,i})^{\kappa} \cdot (RE_{US,i})^{\tau}, \quad \kappa + \tau = 1 . \quad (9a)$$

where $RE_{CB,i}^{EU,US}$ is the real exchange rate and (κ, τ) are non-negative values of weights on the ECU (the euro) and the US dollar. Equation (9a) is rewritten in terms of the logarithm:

$$re_{CB,i}^{EU,US} = \kappa \cdot re_{EU,i} + \tau \cdot re_{US,i}, \quad \kappa + \tau = 1 . \quad (9b)$$

Hence,

$$re_{CB,1}^{EU,US} = \kappa \cdot re_{EU,i} + (1-\kappa) \cdot re_{US,i} . \quad (9c)$$

Here, we substitute equation (9c) into the definition of the long term equilibrium of a common currency: equation (8), we obtain the following equation:

$$\zeta_1 \cdot \{\kappa \cdot re_{EU,1} + (1-\kappa) \cdot re_{US,1}\} + \zeta_2 \cdot \{\kappa \cdot re_{EU,2} + (1-\kappa) \cdot re_{US,2}\} + \cdots + \zeta_m \cdot \{\kappa \cdot re_{EU,m} + (1-\kappa) \cdot re_{US,m}\} + \zeta_{JP} \cdot \{\kappa \cdot re_{EU,JP} + (1-\kappa) \cdot re_{US,JP}\} = 0$$

Then,

$$\kappa \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m) \cdot re_{EU,US} + \zeta_1 \cdot re_{US,1} + \zeta_2 \cdot re_{US,2} + \cdots + \zeta_m \cdot re_{US,m} + \zeta_{JP} \cdot re_{US,JP} = 0 \tag{10}$$

Equation (10) is the long term equilibrium of the common currency area evaluated by the common currency basket composed of the euro and the US dollar. Using the cointegration approach, the estimated values of the cointegration vector: $\zeta^*_{EU,US}$, ζ^*_i, and ζ^*_{JP}, the weight on the US dollar and the euro in the common currency basket: κ^* can be calculated as follows,

$$\kappa^* = \frac{\zeta^*_{EU,US}}{\zeta^*_1 + \zeta^*_2 + \cdots + \zeta^*_m + \zeta^*_{JP}}. \tag{11}$$

3.3 The case of including regional currencies in the basket

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 each country adopts the other currencies in the group of ASEAN plus three into its basket currency as their target policy, we can rewrite the definition of the currency basket; equation (9) as follows;

$$re^{EU,US,region}_{CB,i} = \lambda(\kappa \cdot re_{EU,i} + \tau \cdot re_{US,i}) + (1-\lambda)(\varphi_1 \cdot re_{1,i} + \cdots + \varphi_m \cdot re_{m,i}),$$

$$\kappa + \tau = 1, \quad \sum_{i=1, j\neq i}^{m} \varphi_j = 1 \tag{12}$$

where λ is a total share of the US dollar and the euro in the currency basket.

Here, we assumed that the East Asian countries also include the other East Asian currencies in their currency basket. We substitute equation (12) into the definition of the long term equilibrium of a common currency: equation (8), we obtain the following equation:

$$
\begin{aligned}
&\zeta_1 \cdot \{\lambda(\kappa \cdot re_{EU,1} + (1-\kappa)\cdot re_{US,1}) + (1-\lambda)(\varphi_2 \cdot re_{2,1} + \cdots + \varphi_m \cdot re_{m,1} + \varphi_{JP} \cdot re_{JP,1})\} \\
&+\zeta_2 \cdot \{\lambda(\kappa \cdot re_{EU,2} + (1-\kappa)\cdot re_{US,2}) + (1-\lambda)(\varphi_1 \cdot re_{1,2} + \cdots + \varphi_m \cdot re_{m,2} + \varphi_{JP} \cdot re_{JP,2})\} + \cdots \\
&+\zeta_m \cdot \{\lambda(\kappa \cdot re_{EU,m} + (1-\kappa)\cdot re_{US,m}) + (1-\lambda)(\varphi_1 \cdot re_{1,m} + \cdots + \varphi_{m-1} \cdot re_{m-1,m} + \varphi_{JP} \cdot re_{JP,m})\} \\
&+\zeta_{JP} \cdot \{\lambda(\kappa \cdot re_{EU,JP} + (1-\kappa)\cdot re_{US,JP}) + (1-\lambda)(\varphi_1 \cdot re_{1,JP} + \cdots + \varphi_m \cdot re_{m,JP})\} = 0
\end{aligned}
$$

Here, we assume that countries adopt same basket weights on any currencies in the currency basket. We rewrite all exchange rates using the US dollar as follows;

$$
\begin{aligned}
&\lambda\kappa \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m + \zeta_{JP}) \cdot re_{EU,US} \\
&+\zeta_1 \cdot [\lambda re_{US,1} + (1-\lambda)\cdot\{\varphi_2 \cdot (re_{2,1} - re_{US,1}) + \cdots \\
&\quad + \varphi_m \cdot (re_{m,1} - re_{US,1}) + \varphi_{JP} \cdot (re_{JP,1} - re_{US,1}) + re_{US,1}\}] \\
&+\zeta_2 \cdot [\lambda re_{US,2} + (1-\lambda)\cdot\{\varphi_1 \cdot (re_{1,2} - re_{US,2}) + \cdots \\
&\quad + \varphi_2 \cdot (re_{m,2} - re_{US,2}) + \varphi_{JP} \cdot (re_{JP,2} - re_{US,2}) + re_{US,2}\}] + \cdots \\
&+\zeta_m \cdot [\lambda re_{US,m} + (1-\lambda)\cdot\{\varphi_1 \cdot (re_{1,m} - re_{US,m}) + \cdots \\
&\quad + \varphi_{m-1} \cdot (re_{m-1,m} - re_{US,m}) + \varphi_{JP} \cdot (re_{JP,m} - re_{US,m}) + re_{US,m}\}] \\
&+\zeta_{JP} \cdot [\lambda re_{US,JP} + (1-\lambda)\cdot\{\varphi_1 \cdot (re_{1,JP} - re_{US,JP}) + \cdots + \varphi_{JP} \cdot (re_{m,JP} - re_{US,JP}) + re_{US,JP}\}] = 0
\end{aligned}
$$

Then,

$$
\begin{aligned}
&\lambda\kappa \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m + \zeta_{JP}) \cdot re_{EU,US} \\
&+\zeta_1 \cdot [\lambda re_{US,1} + (1-\lambda)\cdot\{\varphi_2 \cdot re_{2,US} + \cdots + \varphi_m \cdot re_{m,US} + \varphi_{JP} \cdot re_{JP,US} + re_{US,1}\}] \\
&+\zeta_2 \cdot [\lambda re_{US,2} + (1-\lambda)\cdot\{\varphi_1 \cdot re_{1,US} + \cdots + \varphi_m \cdot re_{m,US} + \varphi_{JP} \cdot re_{JP,US} + re_{US,2}\}] + \cdots \\
&+\zeta_m \cdot [\lambda re_{US,m} + (1-\lambda)\cdot\{\varphi_1 \cdot re_{1,US} + \cdots + \varphi_{m-1} \cdot re_{m-1,US} + \varphi_{JP} \cdot re_{JP,US} + re_{US,m}\}] \\
&+\zeta_{JP} \cdot [\lambda re_{US,JP} + (1-\lambda)\cdot\{\varphi_1 \cdot re_{1,US} + \cdots + \varphi_{m-1} \cdot re_{m-1,US} + \varphi_m \cdot re_{m,US} + re_{US,JP}\}] = 0
\end{aligned}
$$

$$
\begin{aligned}
&\lambda\kappa \cdot (\zeta_1 + \zeta_2 + \cdots + \zeta_m + \zeta_{JP}) \cdot re_{EU,US} \\
&+\zeta_1 \cdot \{re_{US,1} - (1-\lambda)\cdot(\varphi_2 \cdot re_{US,2} + \cdots + \varphi_m \cdot re_{US,m} + \varphi_{JP} \cdot re_{US,JP})\} \\
&+\zeta_2 \cdot \{re_{US,2} - (1-\lambda)\cdot(\varphi_1 \cdot re_{US,1} + \cdots + \varphi_m \cdot re_{US,m} + \varphi_{JP} \cdot re_{US,JP})\} + \cdots \\
&+\zeta_m \cdot \{re_{US,m} - (1-\lambda)\cdot(\varphi_1 \cdot re_{US,1} + \cdots + \varphi_{m-1} \cdot re_{US,m-1} + \varphi_{JP} \cdot re_{US,JP})\} \\
&+\zeta_{JP} \cdot \{re_{US,JP} - (1-\lambda)\cdot(\varphi_1 \cdot re_{US,1} + \cdots + \varphi_{m-1} \cdot re_{US,m-1} + \varphi_m \cdot re_{US,m})\} = 0
\end{aligned}
$$

Therefore,

$$\lambda\kappa\cdot(\zeta_1+\zeta_2+\cdots+\zeta_m+\zeta_{JP})\cdot re_{EU,US}$$
$$+\{\zeta_1-\varphi_1(1-\lambda)\sum_{i=2}^{m,JP}\zeta_i\}\cdot re_{US,1}+\{\zeta_2-\varphi_2(1-\lambda)\sum_{i=1,i\neq 2}^{m,JP}\zeta_i\}\cdot re_{US,2}+\cdots$$
$$+\{\zeta_m-\varphi_m(1-\lambda)\sum_{i=1,i\neq m}^{m-1,JP}\zeta_i\}\cdot re_{US,m}+\{\zeta_{JP}-\varphi_{JP}(1-\lambda)\sum_{i=1,i\neq JP}^{m}\zeta_i\}\cdot re_{US,JP}=0$$

where, $0<\lambda<1$, $0<\kappa<1$, and $\varphi_i\geq 0$. (13)

Equation (13) means that we may have minus signs of coefficients for the cointegration vector of real exchange rates if a country adopts the currency basket system including not only the major currencies but also the other East Asian currencies.

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 cointegration vector. We rewrite the equation (10) as follows;

$$re_{US,EU}=\beta_1\cdot re_{US,1}+\beta_2\cdot re_{US,2}+\cdots+\beta_m\cdot re_{US,m}+\beta_{JP}\cdot re_{US,JP} \tag{10b}$$

Equation (10b) 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 (10b) as follows:

$$\begin{aligned}re_{US,EU}=&\beta_0+\beta_1\cdot re_{US,1,t}+\beta_2\cdot re_{US,2,t}+\cdots+\beta_m\cdot re_{US,m,t}+\beta_{JP}\cdot re_{US,JP,t}\\&+\sum_{i=1}^{m}\sum_{j=-k}^{k}\gamma_{i,j}\Delta re_{US,i,t+j}+\beta\cdot t+u_t\end{aligned} \tag{10c}$$

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

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

Where the sample distribution will be adjusted as follows:

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

We attempt to estimate the cointegration vector with endogenous weights in the common currency basket. In this paper, we test same 12 combinations which we have already known that the related real exchange rates contains a stochastic trend and exhibited a long term equilibrium among the countries from our earlier paper.[iv] We assumed serial correlation of residuals: equation (11) was captured by an $AR(4)$, and leads and lags in equation (10) was $k = 2$.

4.3 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 January 1999 to June 2004. 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

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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. To assure the robustness in our estimation, we only test the 12 combinations which contain 3 or 4 countries in the currency area, and we have already known that these real exchange rates share the common stochastic trend to assure the common currency area defined by linear combination stable in the long run.

[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/)

IMF, *International Financial Statistics* (CD-ROM).[vii]

4.4 Analytical results

Table 2 shows the result of the DOLS for pre-crisis period (from January 1987 to June 1997). In the pre-crisis period, all combinations which include Singapore had the significant coefficients. Coefficients of Japanese yen or Korean won indicated significant results, however, we could not find any combinations which both currencies indicated significant at same time. Comparing with the results from our earlier works, we had no combinations which coefficients of all currencies indicated the significant. In our earlier works, we set the basket weights on the three major currencies in advance to identify the long-term equilibrium. It means that in the pre-crisis period, the Japanese yen worked exogenously as well as the euro and the US dollar in the system composed of East Asian currencies.

Table 3 shows the result of the DOLS for post-crisis period (from January 1999 to June 2004). Comparing with the results from that of the pre-crisis period, all coefficients of the Singapore, dollar, the Thai baht, and the Malaysia ringgit indicated significant among the combinations. In the most combinations excluding the only one case, coefficients of the Japanese yen indicated significant. In the post-crisis period, we had the two cases which all currencies in the region indicated significant: the combination of Singapore, Malaysia, the Philippines, and Japan, and the combination of Singapore, Malaysia, Thailand, and Japan. This means that Japanese yen should be included as an endogenous variable in the long-term relationship as well as other East Asian currencies.

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 cointegration vector for ASEAN plus three currencies with the currency basket of the US dollar and the euro as the anchor

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

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 1.1: Summary of Empirical Analysis : Currency Basket (Ogawa and Kawasaki (2003): 1985:9-1997:6)

Number of Countries in the Currency Area	Korea(Won)	Singapore($SG)	Indonesia(Rupiah)	Malaysia(Ringgit)	The Philippines(Peso)	Thailand(Baht)	China(Yuan)
3	○	○	○				
		○		○	○		
	○	○				○	
		○		○		○	
			○	○		○	
		○				○	○
	○	○					○
4	○		○	○	○		
	○	○	○			○	
	○		○	○			○
	○	○				○	○
		○	○			○	○

Table 1.2: Summary of Empirical Analysis : U.S. dollar

Number of Countries in the Currency Area	Korea(Won)	Singapore($SG)	Indonesia(Rupiah)	Malaysia(Ringgit)	The Philippines(Peso)	Thailand(Baht)	China(Yuan)
4		○	○	○		○	

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

Combination	Korea (Won)	Singapore ($SG)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines (Peso)	Thailand (Baht)	China (Yuan)	Japan (Yen)
CB301	0.16234 (0.12698)	2.42787 *** (0.32249)	0.18396 (0.2818)	-	-	-	-	-0.3224 *** (0.11134)
CB309	-	2.68565 **** (0.27572)	-	-0.003 (0.18531)	-0.02015 (0.12799)	-	-	-0.3006 ** (0.066)
CB311	0.16977 (0.12626)	2.17016 *** (0.3653)	-	-	-	0.49507 (0.55878)	-	-0.3011 ** (0.10734)
CB315	-	2.48701 *** (0.34479)	-	-0.0837 (0.17846)	-	0.18232 (0.62085)	-	-0.3244 *** (0.07274)
CB316	-	-	-2.44732 *** (0.57049)	0.08264 (0.26984)	-	4.76868 *** (0.93489)	-	0.05019 (0.09707)
CB324	-	2.50446 *** (0.53746)	-	-	-	0.14316 (0.55761)	0.06095 (0.09252)	-0.326 ** (0.10041)
CB335	0.12904 (0.12202)	2.6055 *** (0.46403)	-	-	-	-	0.04949 (0.09094)	-0.3287 ** (0.12952)
CB404	1.22281 *** (0.39254)	-	-0.70616 (0.64302)	2.52783 *** (0.72723)	-0.83472 *** (0.35265)	-	-	-0.2296 (0.175)
CB406	0.14807 (0.13593)	1.82892 *** (0.58734)	-0.50414 (0.66676)	-	-	1.33145 (1.27677)	-	-0.2417 (0.13324)
CB418	0.91052 *** (0.19848)	-	-0.76661 (0.40571)	1.41129 *** (0.30762)	-	-	-0.38791 *** (0.0724)	-0.0597 (0.10816)
CB426	0.16109 (0.13877)	2.24536 *** (0.5643)	-	-	-	0.48073 (0.64096)	0.01726 (0.0966)	-0.3099 ** (0.13101)
CB428	-	2.05878 *** (0.667)	-0.72204 (0.70016)	-	-	1.40203 (1.34504)	0.0729 (0.09618)	-0.2401 * (0.12507)

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

Table 3: DOLS estimation (post crisis: 1999:1-2004:6)

Combination	Korea (Won)	Singapore ($SG)	Indonesia (Rupiah)	Malaysia (Ringgit)	The Philippines (Peso)	Thailand (Baht)	China (Yuan)	Japan (Yen)
CB301	0.16066 (0.29624)	-3.56628 *** (0.65097)	-0.28513 ** (0.12580)	-	-	-	-	0.34040 (0.26913)
CB309	-	-5.30949 **** (0.75397)	-	6.59577 *** (2.88378)	-0.84770 ** (0.45023)	-	-	0.92167 *** (0.27395)
CB311	-0.12993 (0.27564)	-3.49468 *** (0.74947)	-	-	-	-0.61804 ** (0.27944)	-	0.77811 *** (0.22162)
CB315	-	-4.65845 **** (0.63294)	-	4.73587 *** (1.73756)	-	-0.90550 *** (0.26948)	-	1.16140 **** (0.20323)
CB316	-	-	-0.62234 ** (0.28968)	9.58553 ** (4.29970)	-	-1.42070 ** (0.56443)	-	0.59238 (0.40214)
CB324	-	-4.41305 **** (0.77697)	-	-	-	-0.65973 ** (0.28599)	0.97919 (0.96730)	0.92362 *** (0.20872)
CB335	-0.68923 * (0.38585)	-3.92372 *** (0.95677)	-	-	-	-	-1.89648 (1.30209)	1.10728 *** (0.28240)
CB404	0.87509 ** (0.34182)	-	-0.93112 **** (0.21832)	7.57570 *** (2.00428)	-0.65830 (0.51553)	-	-	-0.64480 *** (0.18681)
CB406	-0.13271 (0.33934)	-3.23429 **** (0.65688)	-0.02101 (0.16319)	-	-	-0.58408 ** (0.24659)	-	0.58048 ** (0.28957)
CB418	-0.14447 (0.48050)	-	-1.11935 **** (0.16228)	9.69343 *** (2.67444)	-	-	-4.19045 *** (1.10536)	0.71460 * (0.41821)
CB426	0.76614 (0.58387)	-3.89572 **** (0.70913)	-	-	-	-1.44212 *** (0.49045)	3.34463 ** (1.90015)	0.54635 ** (0.27294)
CB428	-	-5.00340 **** (0.68499)	0.24994 (0.16301)	-	-	-1.12734 *** (0.39050)	2.38860 ** (1.09400)	0.98880 **** (0.21249)

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