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On the Desirability of a Regional Basket Currency Arrangement*

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Abstract

This paper constructs a theoretical model of international trade in order to examine an optimal exchange rate regime for (Asian) emerging market economies that export goods to the United States, Japan, and neighboring countries. The optimality of the exchange rate regime is defined as minimizing the fluctuation of trade balances, in the environment where the yen-dollar exchange rate fluctuates exogenously. Since the *de facto* dollar peg regime is blamed as one of the factors that caused the Asian currency crisis, the question of the optimal exchange rate regime is quite relevant in Asia. The novelty of this paper is to show how an emerging market economy's choice of the exchange rate regime (or weights in the basket) is dependent on the neighboring country's. The dollar weights in the currency baskets of the two countries are determined as a Nash equilibrium. We show that they may be stuck at the dollar peg system in both stable and unstable equilibrium cases. Even in a stable equilibrium case, there are multiple equilibria and a "coordination failure" may occur.

Key words: exchange rate regime; trade balance; multiple equilibria; coordination failure

JEL Classification: F31, F33, O11

1. Introduction

One of the lessons from the Asian Currency Crises is the danger of the *de facto* dollar peg adopted by the Asian economies that had extensive trade and investment relationship with countries other than the United States.[1] When the yen appreciated vis-à-vis the US dollar, the Asian economies enjoyed the boom, or a bubble in some cases, due to increased exports. But, when the yen depreciated, the Asian economies tended to experience a recession, or a burst bubble. The experience of the Asian boom and bust in the 1990s, along with the yen-dollar exchange rate fluctuation, is a stark reminder of risk of the fixed exchange rate regime.

An obvious solution for this problem is to increase flexibility of the exchange rate. If the baht had appreciated during the yen appreciation phase of the 1993-95, the extent of overheating in Thailand might have been limited; and if the baht had depreciated along with the yen in 1996-97, then the decline in exports could have been mitigated. This kind of exchange rate flexibility can be achieved by a flexible exchange rate regime which keeps the real effective exchange rate relatively stable.

An obvious insight here is that an emerging market economy, which exports to the United States and Japan, is well advised to consider managed exchange rate regimes, in order to avoid excessive volatility of the real effective exchange rate.[2] The questions to be considered include how to determine a reference rate as an appropriate real effective exchange rate and how much fluctuation is excessive.

The optimality of the exchange rate regime is defined as the one that minimizes the fluctuation of the trade balances,[3] when the yen-dollar exchange rate fluctuates. Ito, Ogawa, and Sasaki (1998) proposed how to calculate the optimal weights when the emerging market economy exports to Japan and the United States only. The optimal weights were calibrated with some assumptions on the demand elasticities and export shares. Ogawa and Ito (2000) extend the Ito, Ogawa, and Sasaki model to include a neighboring emerging market as well as Japan and the United States. A typical Asian economy exports about one-third to the United States and one-third to Japan, and the rest to countries in the Asian region (and EU). Therefore, to simplify, we consider the case that country A (B, respectively) exports to the United States, Japan, and country B (A, respectively). Therefore, the real effective exchange rate calculation includes the currency of neighboring country.

This paper considers how the optimal weights may depend on what the neighboring country is adopting as weights. In the extreme case, if country A is adopting the dollar peg, country B should adopt the dollar peg; and if country B is adopting the dollar peg, then country A should adopt the dollar peg. Namely, the dollar peg is a Nash equilibrium. However, if country A is using a currency basket which mirrors the export shares, adjusted for demand elasticities, then country B should adopt a (similar) currency basket; and if country B is using a currency basket, then country A should adopt a currency basket. This trade-weighted currency basket is also a Nash equilibrium.

Although the paper is motivated by the recent Asian experiences, the application is not limited to Asia. Results obtained in this paper are relevant to any developing countries with a trading structure with export destinations including different currency areas.

Which of the Nash equilibria is chosen depends on the inertia as well as rational calculation. If countries can coordinate, then they should choose the best among Nash equilibria. This process of choosing the optimal Nash equilibrium can be regarded as a regional currency arrangement. Coordination failure could occur if a country has some obstacles for coordination from political or social obstacles against breaking inertia. What this paper shows is that coordinate managed float by the two countries would increase the stability in the trade balance fluctuations.

The rest of the paper is organized as follows. Section 2 explains our two county model where the monetary authorities of country A (hereafter, country A) and the monetary authorities of country B (hereafter, country B) conduct their exchange rate policy in order to stabilize fluctuations of trade balances in a situation of their mutual interdependence. We assume that the Marshall-Lerner condition, which means that depreciation of the local currency will increase the net trade surpluses, is satisfied throughout the paper. We derive reaction functions of the countries for their optimal exchange rate policies. We use the model to analyze interdependence between their exchange rate policies. In section 3, we show cases of stable equilibrium and of unstable equilibrium. In section 4, we show possibilities of multiple equilibra and coordination failure in the stable equilibrium case. We point out that it is difficult for the two countries to conduct optimal exchange rate regime without coordination if they try to shift directly from the current dollar peg system to an optimal exchange rate regime. In section 5, we conclude our analysis.

2. Exchange rate policies in a two-country model

In this section, we develop a two-country model to analyze how the exchange rate policy of one country can be affected by that of the other country. Interactions of the exchange rate policies conducted emerge in the two country model, because the competitiveness of home goods depend on the exchange rate vis-à-vis the neighbor's. At first, we suppose that the two countries have the same objective to stabilize fluctuations in trade balances. The policy reaction function of country *i* is derived in terms of the currency basket in order to stabilize fluctuations in trade balances, given the exchange rate policy of the neighbor country. As a result, it is theoretically possible that a coordination failure may occur.[4]

The coordination failure is a situation where both countries adopt the dollar peg at the same time and either country has no incentive to adopt the currency peg given the other country remains at the dollar peg, while both countries would be better off if both countries simultaneously adopt the currency basket peg. Coordination failure is used in the sense that one Nash equilibrium is inferior to another without a simultaneous movement by the other player. This is the same as the prisoners' dilemma.

For the sake of simplicity, the dollar weight of the other country is assumed to be instantly observable in deriving a Nash equilibrium in the model. This is plausible assumption, because a simple regression (a la Frankel and Wei (1994)) using the dollar/yen exchange rate movements and the exchange rate movements of the other countries would reveal the dollar weight quickly. Of course, an interaction of county A guessing country B's dollar weight and country B's guessing country A's dollar weight would make the convergence a little more complicated. The iteration of such mutual guessing can be simulated by the convergence process using the reaction function. On day two, country A decides its dollar weight based on its observation of country B's revealed dollar weight of day one, and then, on day three, country B decides its dollar weight based on its observation of country A's revealed dollar weight of day two, and so on. This process is illustrated in Figure 1 (See arrows).

We focus on exchange rates of home currency vis-à-vis both the US dollar and the Japanese yen by assuming that the two countries trade with not only the neighboring country but also the United States and Japan. Asian countries export their goods and services mainly to Japan, the

United States, and neighboring Asian countries. For example, Thailand exports one-fourth to Japan, one-fifth to NIES (Korea, Singapore, Hong Kong, and Taiwan) and ASEAN-4 countries (Thailand, Philippines, Indonesia, and Malaysia), one-seventh to the United States. These three categories account for more than 60 percent. Similarly, Malaysia exports to 22 percent, 34 percent and 17 percent to Japan, to the United States, and to Asian countries, respectively. The sum of these three categories reaches 72 percent. The structure is similar in Indonesia and the Philippines. Table 1 shows the export shares by destination to Japan, the United States, Asian countries, and four European countries (Germany, France, UK, and Italy). Therefore, the assumptions of the model, Country A exports to Japan, the United States, and neighboring country B, are realistic.

We express effects of exchange rates on the trade balances of countries A and B in terms of rates of changes as follows:

$$\hat{T}_A = A^{A/Y}\hat{E}^{A/Y} + A^{A/\$}\hat{E}^{A/\$} + A^{B/Y}\hat{E}^{B/Y} + A^{B/\$}\hat{E}^{B/\$} \quad (2.1)$$

$$\hat{T}_B = B^{B/Y}\hat{E}^{B/Y} + B^{B/\$}\hat{E}^{B/\$} + B^{A/Y}\hat{E}^{A/Y} + B^{A/\$}\hat{E}^{A/\$} \quad (2.2)$$

where T_i: trade balances of country i, $E^{i/Y}$: exchange rate of currency i vis-à-vis the Japanese yen, $E^{i/\$}$: exchange rate of currency i vis-à-vis the US dollar, $A^{i/j}$: elasticity of trade balances of country A in terms of the exchange rate of currency i vis-à-vis j, $B^{i/j}$: elasticity of trade balances of country B in terms of the exchange rate of currency i vis-à-vis j. Variables with a hut represent a rate of change in the relevant variable ($\hat{x} = \Delta x / x$).

We can obtain the above equations from a micro-foundation framework where domestic firms import parts from the United States and Japan and compete with neighboring country firms in US and Japanese product markets as shown in Ogawa and Ito (2000). Equations (2.1) and (2.2) include the following three effects of exchange rates on trade balances. The first effect is a direct price effect of exchange rates on trade balances. The second effect is an indirect effect of exchange rates via PTM (pricing to market) behaviors of country *A* and *B* firms. The third effect is indirect effects of exchange rates on trade balances via export and import volumes. It is usual to assume that the Marshall-Lerner condition is satisfied in theoretical analysis. Accordingly, it is necessary that the volume effect should dominate the *sum* of the direct price effect and the PTM effect.

Thus, The volume effects of exchange rates should dominate in equations (2.1) and (2.2) by the assumption of the Marshall-Lerner condition, . For the qualitative analysis, we regard signs of *A* and *B* coefficients in equations (2.1) and (2.2) as the signs of coefficients in the volume effects of exchange rates.

Coefficients ($A^{A/Y}$, $A^{A/\$}$, $B^{B/Y}$, and $B^{B/\$}$) on the exchange rates of the home currency vis-à-vis the yen and the dollar should be positive under the Marshall-Lerner condition. The exchange rates have negative effects on export volumes into the US or Japanese market through increases in cost of imported parts in terms of the home currency while they have direct positive effects on export volumes through relative prices and decrease import volume of parts. Thus, the effects of the exchange rates on the trade volumes are ambiguous because parts are imported in our model. The dominance of the volume effect is necessary but is not sufficient for the Marshall-Lerner condition to hold in our model. In addition, it has to be supposed that the direct effect of the exchange rates on export volume is larger than the effect via imported part costs on export volume for the Marshall-Lerner condition to hold. Hence, the Marshall-Lerner condition is satisfied in the model when the latter condition as well as the dominance of the volume effect is satisfied.

Coefficients ($A^{B/Y}$, $A^{B/\$}$, $B^{A/Y}$, and $B^{A/\$}$) on the exchange rates of the neighboring country's currency vis-à-vis the yen and the dollar are unambiguously negative in our model. The appreciation of the neighboring country's currency has positive effects on the trade volume, as the competitiveness of home products would increase compared with the neighboring country's products.

However, the Marshall-Lerner condition cannot make it clear whether coefficients on the exchange rates of the home currency vis-à-vis the yen and the dollar is larger or smaller than absolute values of neighboring country's currency vis-à-vis the yen and the dollar. Especially in a general case where firms import parts from both Japan and the United States, it is not always satisfied that coefficients on the exchange rates of the home currency are larger than those on the exchange rate of the neighboring country's currency ($A^{A/Y} > -A^{B/Y}$, $A^{A/\$} > -A^{B/\$}$, $B^{B/Y} > -B^{A/Y}$, and $B^{B/\$} > -B^{A/\$}$). As explained above, coefficients ($A^{A/Y}$, $A^{A/\$}$, $B^{B/Y}$, and $B^{B/\$}$) on the exchange rates of the home currency include an offsetting factor through imported part costs in terms of home currency. Accordingly, if the offsetting factor is relatively large, the coefficients may be smaller than the coefficients on the exchange rates of the neighboring country's currency though they are positive under the Marshall-Lerner condition.

We can have more definite relationships among the coefficients if we assume limited situations where firms imports parts from either of Japan and the United States. In a case where firms imports parts from only Japan, $A^{A/\$} > -A^{B/\$}$ for country *A* and $B^{B/\$} > -B^{A/\$}$ for country *B*. In contrast, in a case where firm imports parts from only the United States, $A^{A/Y} > -A^{B/Y}$ for country *A* and $B^{B/Y} > -B^{A/Y}$ for country *B*.

We will analyze interactions of exchange rate policies conducted by countries *A* and *B* in the following two cases: one is a case where coefficients on the exchange rates of the home currency are larger than those on the exchange rate of the neighboring country's currency ($A^{A/Y} > -A^{B/Y}$, $A^{A/\$} > -A^{B/\$}$, $B^{B/Y} > -B^{A/Y}$, and $B^{B/\$} > -B^{A/\$}$) and the other is a case where that coefficients on the exchange rates of the home currency are smaller than those on the exchange rate of the neighboring country's currency ($A^{A/Y} < -A^{B/Y}$, $A^{A/\$} < -A^{B/\$}$, $B^{B/Y} < -B^{A/Y}$, and $B^{B/\$} < -B^{A/\$}$).

A currency basket is defined as weighted averages of exchange rates of a home currency vis-à-vis the dollar and the yen. Thus, a currency basket peg means that a currency basket of nominal exchange rates is fixed at a level.[5] In other words, rates of changes in a currency basket, which is a weighted average of rates-of-changes in the exchange rates, is equal to zero:

$$w_A \hat{E}^{A/\$} + (1 - w_A)\hat{E}^{A/Y} = 0 \qquad (2.3)$$

$$w_B \hat{E}^{B/\$} + (1 - w_B)\hat{E}^{B/Y} = 0 \qquad (2.4)$$

where w_i (for $i = A, B$): a weight on the dollar in a currency basket for country *i*. We suppose a realistic case where $0 \le w_i \le 1$.[6]

When the country pegs the home currency to a currency basket, relationships between the exchange rates of the home currency vis-à-vis the dollar or the yen and those of the yen vis-à-vis the dollar are shown as follows:

$$\begin{cases} \hat{E}^{A/\$} = (1 - w_A)\hat{E}^{Y/\$} \\ \hat{E}^{A/Y} = -w_A \hat{E}^{Y/\$} \end{cases} \qquad (2.5)$$

$$\begin{cases} \hat{E}^{B/\$} = (1 - w_B)\hat{E}^{Y/\$} \\ \hat{E}^{B/Y} = -w_B \hat{E}^{Y/\$} \end{cases} \qquad (2.6)$$

If the monetary authorities adopt a dollar peg system and a weight on the dollar in a currency basket is equal to unity, the exchange rate of the home currency vis-à-vis the dollar is fixed at a level while the exchange rate of the home currency vis-à-vis the yen co-moves with that of the yen vis-à-vis the dollar. The home currency appreciates against the yen when the dollar appreciates against the dollar.

Both countries are assumed to choose weights on the dollar and the yen in a currency basket in order to stabilize the fluctuation of their own trade balances that is caused by changes in the exchange rates. [7] Our optimality of the exchange rate policy is to stabilize fluctuations in trade balances in terms of the dollar under a currency basket peg system. We assume that each country minimizes the squared rate of change its trade balances in terms of the dollar. That is, the countries have the following policy objective functions to minimize:

$$\hat{T}_A^{\;2} = \left(A^{A/Y}\hat{E}^{A/Y} + A^{A/\$}\hat{E}^{A/\$} + A^{B/Y}\hat{E}^{B/Y} + A^{B/\$}\hat{E}^{B/\$} \right)^2 \tag{2.7}$$

$$\hat{T}_B^{\;2} = \left(B^{B/Y}\hat{E}^{B/Y} + B^{B/\$}\hat{E}^{B/\$} + B^{A/Y}\hat{E}^{A/Y} + B^{A/\$}\hat{E}^{A/\$} \right)^2 \tag{2.8}$$

By substituting equations (2.5) and (2.6) into equations (2.7) and (2.8), respectively, the objective functions are shown in terms of weights on the exchange rates, w_A and w_B.

$$\hat{T}_A^{\;2} = \left\{ A^{A/\$} + A^{B/\$} - (A^{A/Y} + A^{A/\$})w_A - (A^{B/Y} + A^{B/\$})w_B \right\}^2 \hat{E}^{Y/\$2} \tag{2.9}$$

$$\hat{T}_B^{\;2} = \left\{ B^{B/\$} + B^{A/\$} - (B^{A/Y} + B^{A/\$})w_A - (B^{B/Y} + B^{B/\$})w_B \right\}^2 \hat{E}^{Y/\$2} \tag{2.10}$$

From equations (2.9) and (2.10), we can derive first order conditions for minimizing their objective functions to obtain the following linear reaction functions: [8]

$$(A^{A/Y} + A^{A/\$})w_A + (A^{B/Y} + A^{B/\$})w_B = A^{A/\$} + A^{B/\$} \tag{2.11}$$

$$(B^{B/Y} + B^{B/\$})w_B + (B^{A/Y} + B^{A/\$})w_A = B^{B/\$} + B^{A/\$} \tag{2.12}$$

Equation (2.11) is a policy reaction function for country *A*, which means that the monetary authority of country *A* chooses an optimal weight for minimizing its objective function given a weight w_B chosen by country *B*. Also, equation (2.12) is a policy reaction function for f country *B*.

It chooses an optimal weight for minimizing its policy objective function given a weight w_A chosen by country *A*. Thus, each country has to determine its optimal weight in a currency basket while they are affected by behavior of the other country.

There is a unique equilibrium pair of optimal weights for countries *A* and *B* because both of the policy reaction functions are linear functions. From equations (2.11) and (2.12), we derive a pair of optimal weights on the dollar in a currency basket to stabilize their trade balances for both of the countries *A* and *B* at the same time:

$$w_A^* = \frac{(A^{A/\$} + A^{B/\$})(B^{B/Y} + B^{B/\$}) - (A^{B/Y} + A^{B/\$})(B^{B/\$} + B^{A/\$})}{(A^{A/Y} + A^{A/\$})(B^{B/Y} + B^{B/\$}) - (A^{B/Y} + A^{B/\$})(B^{A/Y} + B^{A/\$})} \quad (2.13)$$

$$w_B^* = \frac{(A^{A/Y} + A^{A/\$})(B^{B/\$} + B^{A/\$}) - (A^{A/\$} + A^{B/\$})(B^{A/Y} + B^{A/\$})}{(A^{A/Y} + A^{A/\$})(B^{B/Y} + B^{B/\$}) - (A^{B/Y} + A^{B/\$})(B^{A/Y} + B^{A/\$})} \quad (2.14)$$

If both of the countries adopt their optimal weights at the same time, fluctuations of trade balances are zero for both of the countries.

$$\hat{T}_A{}^2{}_{(w_A = w_A^*,\, w_B = w_B^*)} = \hat{T}_B{}^2{}_{(w_A = w_A^*,\, w_B = w_B^*)} = 0 \quad (2.15)$$

From equations (2.13) and (2.14), we can obtain a result that the optimal weights w_A^* and w_B^* are always between 0 and 1 ($0 \le w_A^* \le 1$, $0 \le w_B^* \le 1$) in both the case where coefficients on the exchange rates of the home currency are larger than those on the exchange rate of the neighboring country's currency ($A^{A/Y} > -A^{B/Y}$, $A^{A/\$} > -A^{B/\$}$, $B^{B/Y} > -B^{A/Y}$, and $B^{B/\$} > -B^{A/\$}$) and the case where coefficients on the exchange rates of the home currency are smaller than those on the exchange rates of the neighboring country's currency ($A^{A/Y} < -A^{B/Y}$, $A^{A/\$} < -A^{B/\$}$, $B^{B/Y} < -B^{A/Y}$, and $B^{B/\$} < -B^{A/\$}$).

3. Unstable equilibrium of optimal currency baskets

If both countries A and B could, at the same time, set w_A^* and w_B^*, respectively, trade balances would be stabilized in both of the countries. However, it is not always guaranteed that the optimal weights for the both countries are a stable equilibrium.

The condition for a stable equilibrium is

$$-\frac{A^{A/Y} + A^{A/\$}}{A^{B/Y} + A^{B/\$}} > -\frac{B^{A/Y} + B^{A/\$}}{B^{B/Y} + B^{B/\$}} \quad (3.1)$$

This condition is satisfied in the case where coefficients on the exchange rates of the home currency are larger than those on the exchange rate of the neighboring country's currency ($A^{A/Y} > -A^{B/Y}$, $A^{A/\$} > -A^{B/\$}$, $B^{B/Y} > -B^{A/Y}$, and $B^{B/\$} > -B^{A/\$}$).

In this case, a pair of the weights shall change along a converging process toward an equilibrium point implied by the optimal weights (w_A^*, w_B^*). The weights for both of the countries should converge to their optimal equilibrium ones.

Figure 1 shows a case where inequality (3.1) is satisfied. An equilibrium point with the optimal weights (w_A^*, w_B^*) is a stable one on a plain where policy reaction functions of countries A and B are depicted as lines AA and BB, respectively. In this case, each of countries A and B gradually changes its own weight on the dollar in a currency basket in order to stabilize its own trade balances, given the weight chosen by the other country. As the result, the weights for both the countries can eventually reach to an equilibrium point with the optimal weights (w_A^*, w_B^*).

On the other hand, if

$$-\frac{A^{A/Y}+A^{A/\$}}{A^{B/Y}+A^{B/\$}}<-\frac{B^{A/Y}+B^{A/\$}}{B^{B/Y}+B^{B/\$}}, \tag{3.2}$$

a pair of the optimal weights (w_A^*, w_B^*) is an unstable equilibrium. This condition is satisfied in the case where coefficients on the exchange rates of the home currency are smaller than those on the exchange rates of the neighboring country's currency ($A^{A/Y}<-A^{B/Y}$, $A^{A/\$}<-A^{B/\$}$, $B^{B/Y}<-B^{A/Y}$, and $B^{B/\$}<-B^{A/\$}$). In this case, weights diverge out of the optimal weights once they are off the equilibrium point (w_A^*, w_B^*).

Figure 2 illustrates policy reaction functions of both the countries in a case where inequality (3.2) is satisfied. In this case, an equilibrium point with the optimal weights (w_A^*,w_B^*) is unstable. Suppose that each of countries *A* and *B* chooses its own weight in order to stabilize its own trade balances, given the weights chosen by the other country. The weights chosen by the country should diverge out of the optimal weights (w_A^*, w_B^*). Thus, the weights on the dollar increase and reach to a unity for both the countries, provided that the weight is realistically constrained between 0 and 1. Both of the two countries eventually adopt a full dollar peg system rather than the optimal currency basket peg system although they have been choosing their weights in order to stabilize their own trade balances.

Thus, if inequality (3.2) is satisfied, an optimal weight point is unstable. Then, it is difficult for the country to sequentially change its their exchange rate policy to an optimal exchange rate policy. Accordingly, it is natural that he monetary authorities should choose the dollar peg system rather than an optimal exchange rate regime in this case.

4. Multiple equilibrium and coordination failure

Next, we consider situation where the monetary authorities try to shift their exchange rate regime from the current exchange rate regime to an optimal exchange rate regime. We analyze whether countries *A* and *B* can make a direct shift from the current *de facto* dollar peg system to an optimal currency basket peg system in a case of the stable equilibrium, which was analyzed in the previous section. Possibilities of the direct shift to an optimal currency basket peg system depends on whether each of the country can decrease fluctuations in trade balances under an optimal currency basket peg system in comparison with those under the current dollar peg system. Especially, the monetary authorities of each country should care about fluctuations in trade balances in a case where it shifts to the optimal currency basket peg system while the other country keeps the dollar peg system.

We should compare fluctuations in trade balance in a case where only one country adopt an optimal currency basket system with those in a case where both of the countries keep to adopt the currency dollar peg system. If both countries adopt the dollar peg ($w_A = w_B = 1$) at the same time, fluctuations in trade balances are calculated as follows:

$$\hat{T}_{A\,(w_A=w_B=1)}^{\,2} = \left(A^{A/Y} + A^{B/Y}\right)^2 \hat{E}^{Y/\$2} \tag{4.1}$$

$$\hat{T}_{B\,(w_A=w_B=1)}^{\,2} = \left(B^{B/Y} + B^{A/Y}\right)^2 \hat{E}^{Y/\$2} \tag{4.2}$$

It is clear that the fluctuations in trade balances in the case where both of the countries adopt the dollar peg system are larger than those in the case where they adopt the optimal currency basket system because the fluctuations are zero in the latter case. Equations (4.1) and (4.2) are zero under a condition of $A^{A/Y} = -A^{B/Y}$ and $B^{B/Y} = -B^{A/Y}$. The optimal exchange rate regime corresponds to the dollar peg system if $A^{A/Y} = -A^{B/Y}$ and $B^{B/Y} = -B^{A/Y}$.

Next, we consider a possibility that the countries adopt the dollar peg system. One possible reason is that one county cannot adopt an optimal exchange rate policy because its losses increase if the country alone adopts the basket while the other country keeps pegging its home currency to the dollar.

We consider how one country should behave, given that the other country adopts the dollar peg. For example, suppose that country A adopts the above optimal currency basket peg ($w_A = w_A^*$) while country B adopts the dollar peg ($w_B = 1$). Fluctuations in trade balances for country A are obtained in this case as follows:

$$\hat{T}_A{}^2{}_{(w_A=w_A^*, w_B=1)} = \left\{ \frac{(A^{A/Y} + A^{A/\$})(B^{B/Y} - B^{A/\$}) + (A^{A/\$} - A^{B/Y})(B^{A/Y} + B^{A/\$})}{(A^{A/Y} + A^{A/\$})(B^{B/Y} + B^{B/\$}) - (A^{B/Y} + A^{B/\$})(B^{A/Y} + B^{A/\$})} (A^{B/Y} + A^{B/\$}) \right\}^2 \hat{E}^{Y/\$2} \quad (4.3)$$

Here we suppose that the two countries have adopted the dollar peg system but contemplate on two options: one is to keep the dollar peg system and the other is to jump to the optimal currency basket peg system. When country *A* has options to adopt the dollar peg ($w_A = 1$) or the optimal currency basket peg ($w_A = w_A^*$), given that country *B* adopts the dollar peg ($w_B = 1$), country A compares fluctuations in trade balances between the two options. Country *A* compares equation (4.3) with equation (4.1). They prefer the dollar peg to the optimal currency basket peg because fluctuations in trade balance in the case of adopting the dollar peg (equation (4.1)) are less than those in the case of adopting the optimal currency basket peg (equation (4.3)) ($\hat{T}_A{}^2{}_{(w_A=w_A^*, w_B=1)} > \hat{T}_A{}^2{}_{(w_A=1, w_B=1)}$).[9]

If country *B* chose the optimal currency basket peg ($w_B = w_B^*$) while country *A* adopts the dollar peg ($w_A = 1$), country *B* would have fluctuations in trade balances:

$$\hat{T}_A{}^2{}_{(w_A=1, w_B=w_B^*)} = \left\{ \frac{(B^{B/Y} + B^{B/\$})(A^{A/Y} - A^{B/\$}) + (B^{B/\$} - B^{A/Y})(A^{B/Y} + A^{B/\$})}{(A^{A/Y} + A^{A/\$})(B^{B/Y} + B^{B/\$}) - (A^{B/Y} + A^{B/\$})(B^{A/Y} + B^{A/\$})} (B^{A/Y} + B^{A/\$}) \right\}^2 \hat{E}^{Y/\$2} \quad (4.4)$$

The fluctuations in trade balances in this case are larger than those in the case where both of the countries adopt the dollar peg system ($\hat{T}_B{}^2{}_{(w_A=1, w_B=w_B^*)} > \hat{T}_B{}^2{}_{(w_A=1, w_B=1)}$).[10]

We can use Table 2 to explain how each country adopts exchange rate policy. Table 2 shows a typical coordination game framework where there are two Nash equilibria. We are enforced to keep to stay in an inferior Nash equilibrium without coordination once we fall into it in the coordination game framework.

Suppose that we begin with a situation where both countries adopt the dollar peg system, which is represented by the northwest cell in Table 2. We consider whether both of them directly shift from the dollar peg system to their own optimal currency basket systems, which is represented by the southeast cell in Table 2. Each country compares the fluctuations in trade balances in the case of keeping the dollar peg system with those in the case of shifting to its optimal currency basket system, given that the other country keeps the dollar peg system. The latter case corresponds to the Northeast cell for country A and the Southwest cell for country B, respectively.

Country A should choose to keep the dollar peg system by comparing fluctuations in trade balances between the northwest and northeast cells. Country B should choose the same option by comparing fluctuations in trade balances between the southwest and southeast cells. Therefore, both countries should keep the dollar peg system, which is represented by the northwest cell.

It is sure that fluctuations of trade balances in a case where both of the countries adopt their own optimal exchange rate regime are smaller than those in a case where one country adopt non-optimal exchange rate regime while the other country adopt an optimal exchange rate regime. Our model has two equilibria which include an optimal currency basket equilibrium and a dollar peg equilibrium. Once both of the countries choose the dollar peg system, they are enforced to keep the dollar peg system in the dollar peg equilibrium even though they should choose their optimal currency basket system for minimizing fluctuations of trade balances. In this sense, history decided a current exchange rate regime.

Accordingly, it is difficult for both of the monetary authorities to shift directly from the current exchange rate regime to their optimal exchange rate regimes without coordination. The monetary authorities cannot escape from the current dollar peg system when they are faced with coordination failures. It is necessary that they should make coordination in choosing exchange rate regime in order to adopt their optimal exchange rate regime.

5. Conclusion

We examined the question of choosing the exchange rate regime for emerging market economies that export goods to the United States, Japan, and neighbor countries. The optimal exchange rate regime is defined as the one that minimizes the fluctuation of the trade balance, as the yen-dollar exchange rate fluctuates. One might object to this framework, since the Asian currency crises were largely caused by capital movements, and not by the trade account problem. There are two reasons why the trade account stabilization is important. First, one of the important triggers that caused sudden reversal of capital (or an attack by speculators) in

Thailand was the large current account deficit (about 8 percent of GDP in 1996), partly caused by the overvalued baht. The trade balance is important since it affects the confidence of the exchange rate regime. Second, when capital movements are large, that would drive the currency overvalued and/or the current account into deficits. In order to judge whether the exchange rate is misaligned or not, one needs the "benchmark." The exchange rate that is calculated to stabilize the real exchange rate gives such a benchmark. Therefore, having calculated such a basket value, it gives a good reference to answer a question whether capital flows are too much or too little to cause misalignment.

We can draw some policy implications from these conclusions. First, if the Asian region that relies on exports to Japan, the United States, and other regions, wants to avoid a boom and bust cycle due to under- and over-valued exchange rates, the real effective exchange rate must be managed. In particular, the basket currency regime is helpful. Second, the choice of the exchange rate regime (or weights in the basket) may depend on your neighboring country's choice of the regime. There may be coordination failure. Given the dollar peg of the neighboring country, the choice is the dollar peg, and the neighboring country decides the choice in the same manner. However, both countries would be better off to move to a basket currency regime with more weights on the yen, if the decisions are made simultaneously. Third, in order to help the calculation of such a basket tailored to each country, it may be helpful to calculate and publish the typical currency basket unit for the region. Such a currency unit (say, Asian Currency Unit, or ACU) has weights on the US dollar, the yen, and the euro. Each Asian country manages its own currency within the reasonable band around the ACU, then the coordination failure may be avoided. Calculation of such a currency unit and simulations of the trade balances under the basket system is left for future work.

Although this paper simplifies many aspects of the real world, the essential points, we believe, are very relevant to the real world. Asian countries will benefit from coordination with each other in choosing the exchange rate regime.

Appendix (Proof of $\hat{T}_A{}^2{}_{(w_A=w_B=1)} < \hat{T}_A{}^2{}_{(w_A=w_A^*, w_B=1)}$)

We prove that $\hat{T}_A{}^2{}_{(w_A=w_B=1)} < \hat{T}_A{}^2{}_{(w_A=w_A^*, w_B=1)}$ in a case of stable equilibrium. We assumed that $A^{A/Y} > -A^{B/Y}$, $A^{A/\$} > -A^{B/\$}$, $B^{B/Y} > -B^{A/Y}$, and $B^{B/\$} > -B^{A/\$}$ to satisfy the following condition of stable equilibrium case:

$$-\frac{A^{A/Y} + A^{A/\$}}{A^{B/Y} + A^{B/\$}} > -\frac{B^{A/Y} + B^{A/\$}}{B^{B/Y} + B^{B/\$}} \tag{3.1}$$

From equations (4.1) and (4.3),

$$\hat{T}_A{}^2_{(w_A=w_A^*,w_B=1)} - \hat{T}_A{}^2_{(w_A=w_B=1)}$$
$$= \left[\left\{ \frac{(A^{A/Y}+A^{A/\$})(B^{B/Y}-B^{A/\$})+(A^{A/\$}-A^{B/Y})(B^{A/Y}+B^{A/\$})}{(A^{A/Y}+A^{A/\$})(B^{B/Y}+B^{B/\$})-(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})}(A^{B/Y}+A^{B/\$}) \right\}^2 - (A^{A/Y}+A^{B/Y})^2 \right] \hat{E}^{Y/\$2}$$

Our assumption of $A^{A/Y} > -A^{B/Y}$ makes $(A^{A/Y}+A^{B/Y})$ in the above equation positive. Therefore, $\hat{T}_A{}^2_{(w_A=w_B=1)} < \hat{T}_A{}^2_{(w_A=w_A^*,w_B=1)}$ if the following inequality holds:

$$\frac{(A^{A/Y}+A^{A/\$})(B^{B/Y}-B^{A/\$})+(A^{A/\$}-A^{B/Y})(B^{A/Y}+B^{A/\$})}{(A^{A/Y}+A^{A/\$})(B^{B/Y}+B^{B/\$})-(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})}(A^{B/Y}+A^{B/\$}) > A^{A/Y}+A^{B/Y}$$

We can arrange a difference between the right-hand side and the left-hand side of the above inequality in the following way:

$$\frac{(A^{A/Y}+A^{A/\$})(B^{B/Y}-B^{A/\$})+(A^{A/\$}-A^{B/Y})(B^{A/Y}+B^{A/\$})}{(A^{A/Y}+A^{A/\$})(B^{B/Y}+B^{B/\$})-(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})}(A^{B/Y}+A^{B/\$}) - (A^{A/Y}+A^{B/Y})$$
$$= \frac{1}{\Delta}\Big[\big\{(A^{A/Y}+A^{A/\$})(B^{B/Y}-B^{A/\$})+(A^{A/\$}-A^{B/Y})(B^{A/Y}+B^{A/\$})\big\}(A^{B/Y}+A^{B/\$})$$
$$-\big\{(A^{A/Y}+A^{A/\$})(B^{B/Y}+B^{B/\$})-(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})\big\}(A^{A/Y}+A^{B/Y})\Big]$$
$$= \frac{1}{\Delta}\Big[(A^{A/Y}+A^{A/\$})\big\{(B^{B/Y}-B^{A/\$})(A^{B/Y}+A^{B/\$})-(B^{B/Y}+B^{B/\$})(A^{A/Y}+A^{B/Y})\big\}$$
$$+(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})(A^{A/Y}+A^{A/\$})\Big]$$
$$= \frac{1}{\Delta}(A^{A/Y}+A^{A/\$})\big\{(B^{B/Y}-B^{A/\$})(A^{B/Y}+A^{B/\$})-(B^{B/Y}+B^{B/\$})(A^{A/Y}+A^{B/Y})+(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$})\big\}$$
$$= \frac{1}{\Delta}(A^{A/Y}+A^{A/\$})\big\{(A^{B/Y}+A^{B/\$})(B^{B/Y}+B^{A/Y})-(B^{B/Y}+B^{B/\$})(A^{A/Y}+A^{B/Y})\big\}$$

where $\Delta \equiv (A^{A/Y}+A^{A/\$})(B^{B/Y}+B^{B/\$})-(A^{B/Y}+A^{B/\$})(B^{A/Y}+B^{A/\$}) < 0$ from inequality (3.1).

In equations (2.1) and (2.2), coefficients ($A^{A/Y}$, $A^{A/\$}$, $B^{B/Y}$, and $B^{B/\$}$) on the exchange rates of the home currency vis-à-vis the yen and the dollar should be positive under the Marshall-Lerner condition. Moreover, Coefficients ($A^{B/Y}$, $A^{B/\$}$, $B^{A/Y}$, and $B^{A/\$}$) on the exchange rates of the neighboring country's currency vis-à-vis the yen and the dollar are unambiguously negative. Accordingly, the difference is positive in the stable equilibrium case.

Therefore, $\hat{T}_{A}{}^{2}{}_{(w_A=w_B=1)} < \hat{T}_{A}{}^{2}{}_{(w_A=w_A^*, w_B=1)}$ in the stable equilibrium case. Fluctuations of trade balances in the case where both of the countries adopt the dollar peg system at the same time are smaller than those in the case where only the home country adopt the optimal currency basket peg system while the other keeps to adopt the dollar peg system.

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Table 1: Export shares by destination				
Exports from	to Japan	to US	to NIEs4+ASEAN4	To EU4
Korea	19.5	19.8	10.8	9.0
Singapore	17.6	16.9	32.0	10.5
Indonesia	23.4	11.3	32.8	15.1
Thailand	25.7	13.8	21.5	9.6
Malaysia	22.0	16.8	34.1	10.4
Philippines	20.5	17.5	24.7	10.4
China	20.4	11.5	35.3	9.7

Notes:

All data are from 1997, except Indonesia exports to Taiwan, and Philippine exports to Taiwan, 1996.

EU4=Germany, France, UK, Italy

ASEAN4=Indonesia, Thailand, Malaysia, Philippines

NIEs4=Korea, Taiwan, Hong Kong, Singapore

Source: Economic Planning Agency, Asian Economies 1999.

Table 2

Country A / Country B	Dollar peg	Optimal currency basket
Dollar peg	$\hat{T}_A{}^2{}_{(w_A=1,\, w_B=1)}$ $\hat{T}_B{}^2{}_{(w_A=1,\, w_B=1)}$	$\hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=1)}$ $\hat{T}_B{}^2{}_{(w_A=w_A^*,\, w_B=1)}$
Optimal currency basket	$\hat{T}_A{}^2{}_{(w_A=1,\, w_B=w_B^*)}$ $\hat{T}_B{}^2{}_{(w_A=1,\, w_B=w_B^*)}$	$\hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=w_B^*)}$ $\hat{T}_B{}^2{}_{(w_A=w_A^*,\, w_B=w_B^*)}$

$$\hat{T}_A{}^2{}_{(w_A=1,\, w_B=1)} < \hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=1)},\ \hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=w_B^*)} < \hat{T}_A{}^2{}_{(w_A=1,\, w_B=w_B^*)},$$

$$\hat{T}_B{}^2{}_{(w_A=1,\, w_B=1)} < \hat{T}_B{}^2{}_{(w_A=1,\, w_B=w_B^*)},\ \hat{T}_B{}^2{}_{(w_A=w_A^*,\, w_B=w_B^*)} < \hat{T}_B{}^2{}_{(w_A=w_A^*,\, w_B=1)}$$

Figure 1

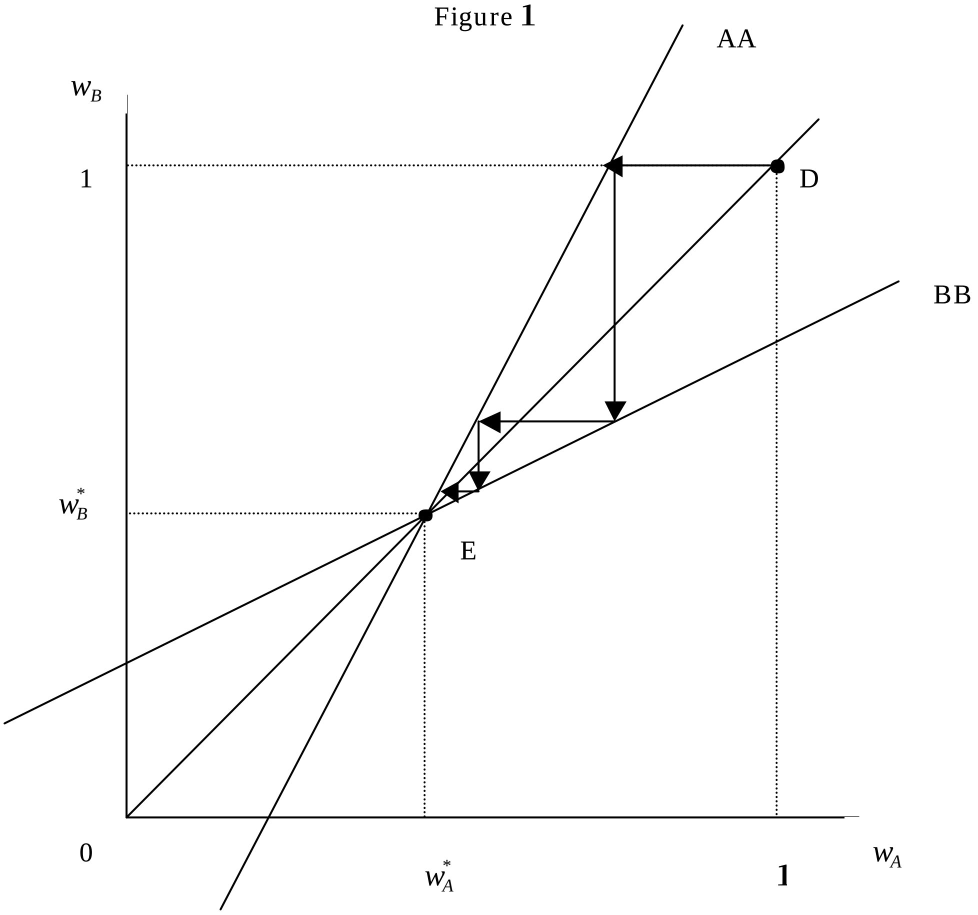
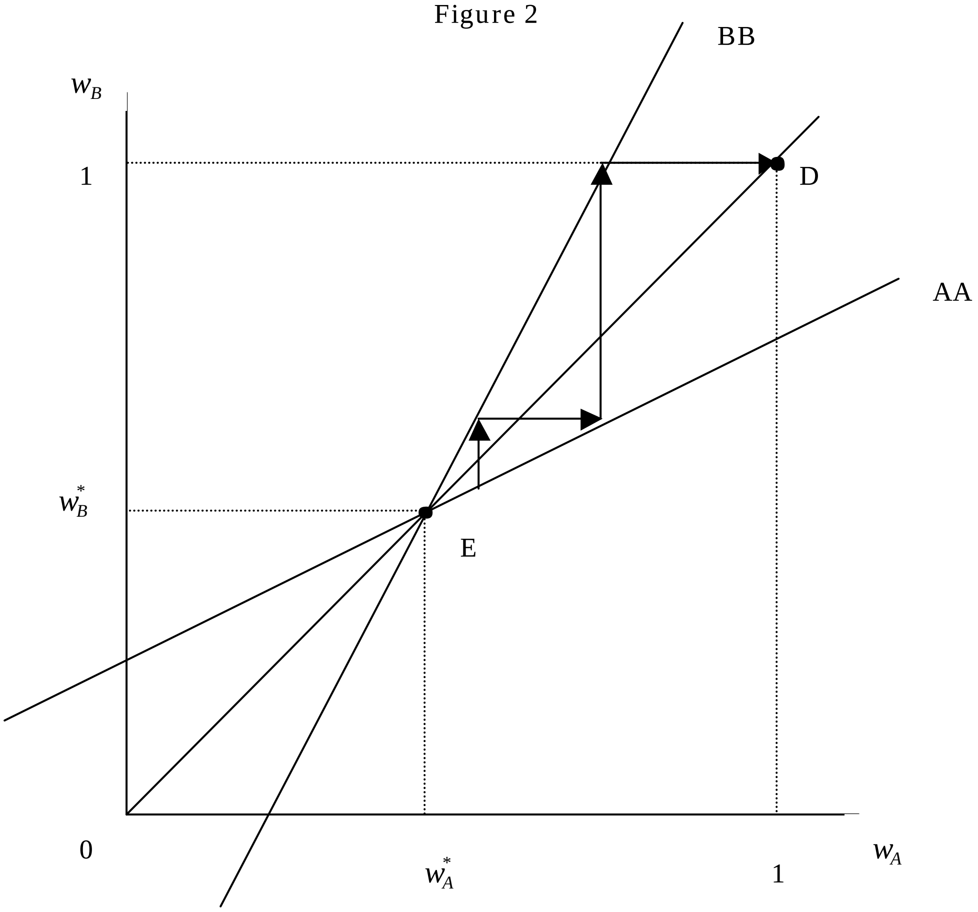


Figure 2



Notes:

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[1] Several Asian countries including Thailand and Korea before the currency crisis claimed that they were adopting a basket system, or a managed float system. However, the actual movements of the exchange rates suggest that the weight of the dollar was quite high. See Frankel and Wei (1994). In that sense, we call the pre-crisis regime as the *de facto* dollar peg.

[2] The so-called "two-corner solution" has become a popular view among some researchers and policy makers in the post-crisis discussions. (See Eichengreen (1999), for example.) According to this view, free floating, an ultimate flexibility, and a currency board, ultimate inflexibility, are only stable regime in the long run. Any intermediate regime—managed float or fixed exchange rate regime without adopting the currency board—is unstable. Advocates of the two corner solution cite the fact that Hong Kong and Argentina, both currency board economies, survived the currency crisis of the neighboring economies.

It is not advisable for countries that export substantial volumes to Japan as well as the United States to adopt the exchange rate regime pegged to the U.S. dollar. Hong Kong seems to be an exception, as it is a small open country with lots of reexports and with high labor and price flexibility of domestic markets. The currency board of the Hong Kong type is not suitable for other Asian economies.

Would the free floating exchange rate a recommended exchange rate regime to other Asian economies? If one believes that the market will (most of the time) determine the exchange rate at the level (almost) consistent with fundamentals, then the free floating is advisable. However, if one believes that the market will (too often) drive the exchange rate to the level (clearly) misaligned with the fundamentals, then policy actions to the domestic market and some direct interventions to the exchange rate market may be called for. The latter view is more convincing in the view of the following evidence. First, even advanced countries find it necessary to intervene occasionally. Foreign exchange rates sometimes become misaligned with fundamentals. The U.S. dollar in 1984-85 and the yen in 1995 are the obvious example of overvaluation. Misalignment needs to be corrected by intervention and some policy adjustment. Second, the worst of the Asian crises, say November 1997 to January 1998, came long after the Asian economies moved to flexible exchange rate regime. When contagious crises feed each other among the regional economies, free floating regimes would cause a downward spiral of the region's currencies. Thus, a devaluation of a currency would bring down the currencies of trade- and investment-related countries. Those who praise China to be a barrier to stop a contagious devaluation spiral in the region by maintaining the fixed exchange rate should also be advocating some sort of managed float in times of crisis.

[3] Flanders and Helpman (1979), Lipschitz and Sundararajan (1980), and Flanders and Tishler (1981) emphasized only the real side of the economy in modeling the currency basket peg issue. On the other hand, Turnovsky (1982) and Bhandari (1985) used a general equilibrium macroeconomic model which included capital mobility.

[4] Bénassy-Quéré (1999) and Ohno (1999) analyzed pegging the US dollar as a coordination failure.

[5] A currency basket of nominal exchange rates is fixed at a level because we suppose that economies experience no inflation. The monetary authorities should adopt a crawling currency basket system if the economies experience positive rates of inflation that are different from those in the United States and Japan.

[6] We limit a realistic case though it is theoretically possible to suppose $1 < w_i$.

[7] The assumption was made in Ito, Ogawa, Sasaki (1998). Alternatively, we may assume that the monetary authorities minimize absolute variations of the trade account to GDP ratio. Bénassy-Quéré (1999) assumed that the monetary authorities are to stabilize both their external competitiveness and the real price of their external debt.

[8] We can obtain the linear reaction functions because we assume quadratic functions of rate of change in trade balances. It is usual to consider fluctuations of trade balances as a second order of moment though it is, in general, unnecessary to limit a second order of moment. We can obtain non-linear functions if we assume more general form of objective functions.

[9] See appendix for a proof of inequality $\hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=1)} > \hat{T}_A{}^2{}_{(w_A=1,\, w_B=1)}$.

[10] Equations (4.1) and (4.2) shows that $\hat{T}_A{}^2{}_{(w_A=w_B=1)}$ and $\hat{T}_B{}^2{}_{(w_A=w_B=1)}$ are symmetric. Equations (4.3) and (4.4) shows that $\hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=1)}$ and $\hat{T}_B{}^2{}_{(w_A=1,\, w_B=w_B^*)}$ are symmetric. Accordingly, we can apply the proof of inequality $\hat{T}_A{}^2{}_{(w_A=w_A^*,\, w_B=1)} > \hat{T}_A{}^2{}_{(w_A=1,\, w_B=1)}$ for country A to a proof of inequality $\hat{T}_B{}^2{}_{(w_A=1,\, w_B=w_B^*)} > \hat{T}_B{}^2{}_{(w_A=1,\, w_B=1)}$ for country B.

[11] Ohno (1989) examined pass-through effects of exchange rates on export pricing behavior in manufacturing after taking account of prices of raw materials. Marston (1990) modeled a similar pricing to market model.

[12] In our model, Japanese and US suppliers of parts are not assumed to price to markets because many suppliers exist and they behave competitively. Parts are more difficult to differentiate compared to brand-name products.