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The basket-peg, dollar-peg and floating
--- A comparative analysis of exchange rate regimes

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Nontechnical summary

In this paper we compare the relative superiority of floating exchange rates, the dollar-peg and the basket-peg, in a small open economy. We measure relative superiority in terms of economic welfare under several different policy objective functions. We have in mind a country such as Thailand, one of the nations hit hard by the Asian currency and economic crisis of 1997-98. The policy objectives we consider are GDP stability, current account stability and bahts-dollar exchange rate stability. All objectives are defined in terms of the policy authority's loss function. The exogenous change that raises the loss initially is a change in the dollar-yen rate. Our theoretical analysis clarifies the direct and indirect effects of this exogenous change on the variables which the authorities are trying to stabilize. This is followed by our empirical analysis using Thai data, which sheds light on the relative superiority of the different regimes under the different objectives.

The following is a summary of results.

(i) The relative superiority of the different exchange rate regimes depends on the policy objective.

(ii) Because exchange risk is explicit in our model, the floating exchange rate regime is shown to be more costly than in models without exchange risk.

(iii) An exogenous change in the yen-dollar exchange rate has all or some of the following effects on the policy objective variables: ①direct effect of the original change in the yen-dollar rate; ②indirect effect of increased risk due to the induced change in the bahts-dollar rate; ③ indirect effect of increased risk due to the induced change in the bahts-yen rate; ④indirect effect via increased expectation of bahts devaluation.

(iv) When the objective is GDP stability or current account stability,

effects ①, ② and ③ exist under floating exchange rates as well as the basket-peg, and effects ①, ③ and ④ exist under the dollar-peg.

(v) When the objective is GDP stability or current account stability, the direct effect (effect ①) is definitely smaller (and the indirect effects are possibly smaller) under the basket-peg compared to the dollar-peg regime. This is because the effects of changes in the bahts-yen and the bahts-dollar exchange rates cancel each other out in this model with three currencies. However, this conclusion presupposes that trade with Japan is yen-denominated and trade with the USA is dollar-denominated.

(vi) When the objective is stability of the bahts-dollar exchange rate, the optimal regime is the dollar-peg where none of the four effects exist. Effect ② exists under floating and effect ① under the dollar-peg. On the other hand, this is the only case where the dollar-peg is the optimal choice.

(vii) Under floating exchange rates, the policy variable available to authorities is the money supply. Under the dollar-peg and the basket-peg, money supply is no longer available to stabilize GDP or the current account. Thus if monetary policy is effective in minimizing the loss, floating is an optimal choice whatever the policy goal.

(viii) Under the basket-peg, money supply is not available as a policy variable to minimize the loss. Money supply becomes instead a tool to stabilize the exchange rate(s). However, it is possible to use the weights on currency exchange rates in the basket as a policy variable. If these weights can be set to optimal values (i.e. values that minimize the loss function), the basket-peg is an optimal choice whatever the policy goal.

(ix) The dollar-peg can attain optimality only when the policy goal is to stabilize the bahts-dollar exchange rate (and other objectives not independent from the bahts-dollar rate objective), unless some other policy tool (such as fiscal policy) becomes available. The dollar-peg is the worst choice among the three, if the respective policy variables are used optimally under the other two exchange rate regimes.

(x) The use of trade weights (exports plus imports with a particular trade-partner country divided by overall exports plus imports) as weights in a currency basket is optimal only in special cases. An example of this special case is when the following sufficient conditions are met: (i) the policy objective is that the country's total trade (exports plus imports) with the rest of the world does not diverge from the desired equilibrium level, (ii) exports and imports depend only on nominal exchange rates, (iii) the elasticity of total trade with respect to the nominal exchange rate is the same for the two trading partners, (iv) there are only two trading partners whose currencies are the only two currencies in the basket and (v) the shock to the economy takes the form of a change in the exchange rate between the two currencies in the basket.

(xi) In general, the optimal weights in the basket are functions of all or some of the following partial derivatives: ①response of bond demand to interest rate; ②response of bond demand to rate of return on foreign investment; ③wealth effect on bond demand; ④response of bond demand to exchange risk; ⑤response of bond demand to GDP; ⑥ response of investment to interest rate; ⑦response of goods and services demand to exchange rate; ⑧response of goods and services demand to exchange risk; ⑨response of goods and services demand to GDP; ⑩response of foreign bond demand to interest rate; ⑪response of foreign bond demand to rate of return on foreign investment; ⑫ response of foreign bond demand to GDP, ⑬wealth effect on foreign bond demand.

(xii) Using Thailand's macroeconomic data, our empirical analysis shows that, as expected, losses are zero under all policy objectives when money supply is set to optimal values under floating exchange rates, as well as when the weights in the basket are set to optimal values under the basket-peg.

(xiii) In pegging to a basket of bahts-dollar and bahts-yen exchange rates, the optimal weight on the bahts-dollar exchange rate is between 0.56 and 1 (depending on the policy goal). Thailand's data shows the trade-weight on the bahts-dollar exchange rate is 0.4, and our empirical analysis confirms our theoretical result that losses are higher using trade-weights as basket-weights.

(xiv) Using trade weights as basket weights under the basket–peg leads to higher losses than not using money supply at all under floating exchange rates, for all types of policy objective.

Introduction

One of the factors often cited as the cause of the recent Asian currency crisis is the virtual peg of the domestic currency against the US dollar. For this reason, there has been much discussion about the desirable exchange rate regime for small open economies such as those hit by the crisis.

Existing analyses on basket-peg regimes include Ito, Ogawa and Sasaki (1998), which concentrate on the market for traded goods. In contrast, ours is a general equilibrium model of five markets as in Yoshino and Fujimaru (1999). Our analysis differs from Yoshino and Fujimaru (1999) in the following ways. We (1) adopt the stock-equilibrium approach to exchange rate determination, (2) explicitly take exchange risk into account and (3) analyze the relationship between the policy objectives and exchange rate regimes. Specifically, we ask which among the basket-peg, dollar-peg and floating exchange rate regimes result in the lowest value of the different loss functions corresponding to the different policy objectives. The policy objectives we analyze are stabilities in domestic GDP, in the current account and in the exchange rate against the dollar. We also (4) calculate the optimal weights in a currency basket. Our theoretical analysis is followed by our empirical analysis using Thai data.

The main results can be summarized as follows. One, the optimal choice of exchange rate regime for a small open economy depends on its policy objective. In other words, it is not productive to discuss which regime should be chosen by such a country, without first specifying the policy goal.

Two, gains from adopting a basket-peg is larger when the county uses the yen in trade with Japan, the dollar in trade with the USA.

Three, when adopting a basket-peg, the values of weights in the basket affect the level of welfare loss. The optimal values of weights are those that minimize the loss, given the policy objective (loss) function. The common practice of choosing trade weights as weights in a currency-basket is optimal only under special conditions. In general, the optimal weights in the basket depend on many partial derivatives (response by the private sector to exogenous changes), and are not equal to trade weights.

Four, in general, the dollar-peg is not a very desirable choice. Unless there are other policy tools available, the dollar-peg can attain optimality only when the goal is stability of the bahts-dollar exchange rate (and other objectives not independent from the bahts-dollar rate objective).

Five, from our empirical analysis using Thai data, we find that in pegging to a basket of bahts-dollar and bahts-yen exchange rates, the optimal weight on the bahts-dollar exchange rate is between 0.56 and 1 (depending on the policy goal).

Finally, we find that using trade weights as basket weights under the basket–peg leads to higher losses than not using money supply at all under floating exchange rates, for all types of policy objective.

1. A macroeconomic model of goods and financial markets

As in Yoshino and Fujimaru（1999）, ours is a general equilibrium model comprising five markets; those for ① domestic money, ② domestic bonds, ③ assets denominated in dollars, ④ assets denominated in yen, and ⑤ goods and services. There are three sectors: ① the public sector (the government and the central bank), ② the private sector, and ③ the foreign sector. There are also three countries: the USA, Japan and Thailand. We assume that Thailand is a small country. Among other things, this means that the yen-dollar exchange rate is exogenous to Thailand. The relationship between the bahts-yen rate, the bahts-dollar rate and the yen-dollar rate is

bahts per yen ＝bahts per dollar × dollar per yen.

Or, using our notation given in Table 1,

$$e^{¥} = e^{\$} + e^{\$/¥}.$$

Because the yen-dollar rate is exogenously constant, the bahts-dollar rate and bahts-yen rate always change in opposite directions in this analysis[1].

Table 1

r ：rate of interest on domestic assets

$r_{\$}$ ：rate of interest on dollar-denominated assets

$r_{¥}$ ：rate of interest on yen-denominated assets

$e^{\$e}$ ：expected bahts-dollar exchange rate

$e^{\$}$ ：bahts-dollar exchange rate

[1] If we wanted to consider the possibility that the yen and the dollar change in the same direction against the bahts (which in reality is a possibility), we need either a fourth country, or a dynamic model that depicts the process of convergence from one equilibrium to another during which the exogenous variable adjusts along with the endogenous variables.

$e^{¥e}$ **: expected bahts-yen exchange rate**

$e^{¥}$ **: bahts-yen exchange rate**

$e^{\$/¥}$**: yen-dollar exchange rate (dollar per yen)**

$e^{\$/¥e}$**: expected yen-dollar exchange rate**

$\Delta e^{\$}$ **: exchange risk from holding dollar-denominated assets**

$\Delta e^{¥}$ **: exchange risk from holding yen-denominated assets**

w **: domestic stock of assets**

$\$^{f}$ **: private stock of dollar denominated assets**

$¥^{f}$ **: private stock of yen denominated assets**

$\$^{g}$ **: public stock of dollar denominated assets**

$¥^{g}$ **: public stock of yen denominated assets**

b^{g} **: stock of government bonds supplied**

b^{c}**: stock of government bonds held by the central bank**

m **: stock of money supplied**

g **: government spending**

y **: domestic GDP**

$y^{\$}$**: US GDP**

$y^{¥}$**: Japanese GDP**

p **: price of good produced domestically**

$p^{¥}$ **: price of good produced in Japan**

$p^{\$}$ **: price of good produced in USA**

Except for the rates of interest, all variables are natural logarithm values of the originals.

We assume that the yen-denominated assets and dollar-denominated assets are perfect substitutes. Bahts denominated assets are not perfect substitutes with either the dollar-denominated assets or the yen-denominated assets. Because of these assumptions, there are three stock equilibrium conditions in our asset market. All partial derivatives are defined to be positive.

The equilibrium condition for domestic money is

$$m-p=-\varepsilon_1 r-\varepsilon_2(r_\$+e^{\$e}-e^{\$})-\varepsilon_3(r_¥+e^{¥e}-e^{¥})+\varepsilon_4 y+\varepsilon_5(w-p)$$

The left-hand side is the real value of the stock of money supplied. The right-hand side is the real value of money demand. Money demand depends on the domestic rate of interest, rates of interest on dollar and yen denominated assets, GDP and real value of stock of assets.

Using the assumption that the yen- and dollar- denominated assets are perfect substitutes;

$$r_\$=r_¥+e^{\$/¥e}-e^{\$/¥},$$

this can be rewritten as

$$m-p=-\varepsilon_1 r-(\varepsilon_2+\varepsilon_3)(r_\$+e^{\$e}-e^{\$})+\varepsilon_4 y+\varepsilon_5(w-p) \qquad \textbf{(1)}$$

The equilibrium condition for domestic bonds is

$$b^g-p=b^c+\beta_1 r-\beta_2(r_\$+e^{\$e}-e^{\$})-\beta_3(r_¥+e^{¥e}-e^{¥})+\beta_4 y+\beta_5(w-p)+\beta_6\Delta e^{\$}+\beta_7\Delta e^{¥}$$

The left-hand side is the real value of the stock of domestic bonds supplied by the government. The right-hand side is the real value of demand for domestic bonds. Because this is a small country, foreigners do not hold domestic bonds. Domestic demand for domestic bonds depends on its own return, rates of interest on dollar- and yen-denominated assets, GDP and the real value of stock of assets. The last two terms on the right-hand side show that demand for domestic bonds increase with the increase in foreign exchange risk.

Using the assumption that the yen- and dollar- denominated assets are perfect substitutes, this can be rewritten as

$$b^g-p=b^c+\beta_1 r-(\beta_2+\beta_3)(r_\$+e^{\$e}-e^{\$})+\beta_4 y+\beta_5(w-p)+\beta_6\Delta e^{\$}+\beta_7\Delta e^{¥} \qquad \textbf{(2)}$$

The equilibrium condition for foreign (dollar- and yen-denominated) bonds is

$$\$^f + ¥^f = \$^g - \eta_1 r + \eta_2(r_\$ + e^{\$e} - e^\$) - \eta_3(r_¥ + e^{¥e} - e^¥) - \eta_4 \Delta e^\$$$
$$+ ¥^g - j_1 r - j_2(r_\$ + e^{\$e} - e^\$) + j_3(r_¥ + e^{¥e} - e^¥) - j_4 \Delta e^¥ + (\eta_5 + j_5)y + (\eta_6 + j_6)(w - p)$$

The left-hand side is the real value of the stock of dollar- and yen-denominated bonds supplied. The right-hand side is the real value of demand for such bonds. This time, the demand comes from the private and public sectors at home. Domestic demand for dollar- and yen-bonds depends on the returns as well as exchange risk on the respective bonds, domestic rate of interest, GDP and real value of stock of assets. The demand for these bonds decline with the increase in foreign exchange risk.

Using the assumption that the yen- and dollar- denominated assets are perfect substitutes, this can be rewritten as

$$\$^f + ¥^f = \$^g - \eta_1 r + (\eta_2 - \eta_3)(r_\$ + e^{\$e} - e^\$) - \eta_4 \Delta e^\$$$
$$+ ¥^g - j_1 r - (j_2 - j_3)(r_\$ + e^{\$e} - e^\$) - j_4 \Delta e^¥ + (\eta_5 + j_5)y + (\eta_6 + j_6)(w - p) \tag{3}$$

and the balance sheet of the central bank is

$m = b^c + \$^g$.

The equilibrium condition in the goods and services market is as follows.

$$y = \gamma_1 y - \gamma_2 r + \gamma_3 g + \gamma_4(e^\$ + p^\$ - p) + \gamma_5 y^\$ - \gamma_6 y + \gamma_7 \Delta e^\$ + r_\$ + e^\$ + \$^f$$
$$+ \gamma_8(e^¥ + p^¥ - p) + \gamma_9 y^¥ - \gamma_{10} y + \gamma_{11} \Delta e^¥ + r_¥ + e^¥ + ¥^f \tag{4}$$

This is the IS equation. Consumption depends on GDP, investment depends on the rate of interest. Net exports depend on the bahts-dollar rate, bahts-yen rate, US GDP, Japanese GDP, domestic GDP and exchange risk.

The domestic private sector holds domestic money, domestic bonds, dollar-bonds and yen-bonds. Therefore, the nominal value of assets held by the domestic private sector (W) which appeared in equations (1) to (3) is defined by the following equation.

$$w = h^p + b^p + e^\$ + \$^p + e^¥ + ¥^p \tag{5}$$

This equation is an identity that defines the stock of nominal assets, rather than an equilibrium condition. Due to Walras' law in the asset market (or because the stock of assets in any given time is constant), only two out of the three equilibrium conditions (1) to (3) are independent. From these two equations and equation (4), three endogenous variables are determined. In deriving the reduced forms, we eliminate the equilibrium condition for domestic money.

Two of the three endogenous variables are common to all the analyses below. Specifically, the two endogenous variables are y and r (GDP and the domestic rate of interest) [2]. The remaining endogenous variable will differ depending on the type of exchange rate regime we consider. Under floating exchange rates, this endogenous variable is the bahts-dollar rate. Under the dollar-peg regime and the basket-peg regime, it is the stock of dollar denominated assets held publicly (foreign exchange reserves)[3].

When the Thai monetary authorities intervene in the foreign exchange market under the dollar-peg regime, they intervene to maintain the bahts-dollar exchange rate at a constant level. The bahts-yen rate is determined residually and endogenously, but is also kept constant as a result, given the triangle relationship between the three exchange rates and the exogenous determination of the yen-dollar rate[4].

Under the basket-peg regime, authorities intervene to change both the

[2] Throughout the paper, the yen-bahts exchange rate also remains an endogenous variable. Changes in the yen-bahts rate can easily be derived from changes in the dollar-bahts rate, using the relationship $e^{¥} = e^{\$} + e^{\$/¥}$, given $e^{\$/¥}$.

[3] Authorities are assumed to hold only the US dollar as foreign exchange reserves, and change the dollar into yen in global financial markets as is necessary for intervention.

[4] This is why it is legitimate to assume that the yen- and dollar-denominated assets are perfect substitutes even under the dollar-peg.

bahts-dollar rate and the bahts-yen rate to maintain the exchange rate of the bahts against a basket comprising the dollar and the yen. Both the bahts-dollar and bahts-yen rates change one-to-one with the initial change in the yen-dollar rate. What the authorities try to do is to cause these two exchange rates to change in such a way that keeps the weighted average of these exchange rates (i.e. the value of the basket) constant, given the change in the yen-dollar rate.

Finally, under floating exchange rates, the authorities do not intervene in either the bahts-dollar or the bahts-yen market, leaving both of these exchange rates endogenous.

3. The reduced forms

(1) Floating exchange rates

Assume that this small country, Thailand, allows the bahts-dollar rate to float freely. The bahts-dollar exchange rate is an endogenous variable, while the stock of dollar holdings by the monetary authority is exogenous[5]. The reduced forms for the three endogenous variables are;

$$
\begin{bmatrix}
(1-\overset{(++)}{\gamma_1+\gamma_6}+\gamma_{10}) & \overset{(+)}{\gamma_2} & \overset{(-)}{-(\gamma_{4+}\gamma_8+2)} \\
\overset{(+)}{\beta_4} & \overset{(++)}{\beta_1} & \overset{(+)}{(\beta_2+\beta_3+2\beta_5)} \\
\overset{(+)}{\eta_5+j_5} & \overset{(-)}{-(\eta_1+j_1)} & \overset{(--)}{(-\eta_2+j_2)+(-j_3+\eta_3)+2(\eta_6+j_6)}
\end{bmatrix}
\begin{bmatrix}
(y-\bar{y}) \\
(r-\bar{r}) \\
(e^{\$}-\bar{e}^{\$})
\end{bmatrix}
$$

$$
=\begin{bmatrix}
1 & \overset{(?)}{\gamma_7} & \overset{(+)}{(1+\gamma_8)} & 0 & 0 & 0 & \gamma_{11} \\
0 & \overset{(-)}{-\beta_6} & \overset{(-)}{(-\beta_3-\beta_5)} & \overset{(+)}{\beta_2} & 1 & 0 & -\beta_7 \\
0 & \overset{(+)}{\eta_4} & \overset{(+)}{(-\eta_3+j_3)}-(\eta_6+j_6) & \overset{(-)}{-\eta_2+j_2} & 0 & -1 & j_4
\end{bmatrix}.
\begin{bmatrix}
(g-\bar{g}) \\
(\Delta e^{\$}-\Delta\bar{e}^{\$}) \\
(e^{\$/¥}-\bar{e}^{\$/¥}) \\
(e^{\$e}-\bar{e}^{\$e}) \\
(b^{g}-\bar{b}^{g}) \\
(\$^{g}-\bar{\$}^{g}) \\
(\Delta e^{¥}-\Delta\bar{e}^{¥})
\end{bmatrix}
$$

---

[5] This is because the monetary authority does not have to intervene in the

(6)

where $\bar{y}$, $\bar{r}$, $\bar{e}^{\$}$ are long-run equilibrium values which are shown in Appendix 1.

By simplifying the expression, we have

$$\begin{bmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & \overset{(-)}{Y_{e\$}} \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & \overset{(+)}{B_{e\$}} \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & \overset{(-)}{F_{e\$}} \end{bmatrix} \begin{bmatrix} (y-\bar{y}) \\ (r-\bar{r}) \\ (e^{\$}-\bar{e}^{\$}) \end{bmatrix} = \begin{bmatrix} \overset{(+)}{Y_g} & \overset{(?)}{Y_{\Delta e\$}} & \overset{(+)}{Y_{e\$/¥}} & 0 & 0 & 0 & \overset{(?)}{Y_{\Delta e¥}} \\ 0 & \overset{(-)}{B_{\Delta e\$}} & \overset{(-)}{B_{e\$/¥}} & \overset{(+)}{B_{e\$e}} & 1 & 0 & \overset{(-)}{B_{\Delta e¥}} \\ 0 & \overset{(+)}{F_{\Delta e\$}} & \overset{(+)}{F_{e\$/¥}} & \overset{(-)}{F_{e\$e}} & 0 & -1 & \overset{(+)}{F_{\Delta e¥}} \end{bmatrix} \begin{bmatrix} (g-\bar{g}) \\ (\Delta e^{\$}-\Delta\bar{e}^{\$}) \\ (e^{\$/¥}-\bar{e}^{\$/¥}) \\ (e^{\$e}-\bar{e}^{\$e}) \\ (b^{g}-\bar{b}^{g}) \\ (\$^{g}-\bar{\$}^{g}) \\ (\Delta e^{¥}-\Delta\bar{e}^{¥}) \end{bmatrix}$$

(7)

Denoting the determinant of the coefficient matrix on the left-hand side as $|M_e|$ and assuming dominant diagonals, we have $|M_e| < 0$.

(2) The dollar-peg

In this case the central bank of Thailand intervenes in the foreign exchange market to maintain the bahts-dollar exchange rate constant. Its stock of foreign exchange is now an endogenous variable, and changes according to how much intervention is necessary. In its place, the bahts-dollar exchange rate is now an exogenous variable. The reduced forms are;

---

foreign exchange market.

$$\begin{bmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & 0 \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & 0 \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & 1 \end{bmatrix} \begin{bmatrix} (y-\bar{y}) \\ (r-\bar{r}) \\ (\$^g - \$^g) \end{bmatrix} = \begin{bmatrix} \overset{(+)}{Y_g} & \overset{(?)}{Y_{\Delta e\$}} & \overset{(+)}{Y_{e\$/¥}} & 0 & 0 & \overset{(+)}{Y_{e\$}} & \overset{(?)}{Y_{\Delta e¥}} \\ 0 & \overset{(-)}{B_{\Delta e\$}} & \overset{(-)}{B_{e\$/¥}} & \overset{(+)}{B_{e\$e}} & 1 & \overset{(-)}{B_{e\$}} & \overset{(-)}{B_{\Delta e¥}} \\ 0 & \overset{(+)}{F_{\Delta e\$}} & \overset{(+)}{F_{e\$/¥}} & \overset{(-)}{F_{e\$e}} & 0 & \overset{(++)}{F_{e\$}} & \overset{(+)}{F_{\Delta e¥}} \end{bmatrix} \begin{bmatrix} (g-\bar{g}) \\ (\Delta e^{\$} - \Delta\bar{e}^{\$}) \\ (e^{\$/¥} - \bar{e}^{\$/¥}) \\ (e^{\$e} - \bar{e}^{\$e}) \\ (b^g - \bar{b}^g) \\ (e^{\$} - \bar{e}^{\$}) \\ (\Delta e^{¥} - \Delta\bar{e}^{¥}) \end{bmatrix} \quad (8)$$

Assuming dominant diagonals in calculating the determinant of the coefficient matrix on the left-hand side $|M_{\$}|$, we can see that $|M_{\$}| > 0$.

(3) The basket peg

The basket we consider is a weighted average of the bahts-dollar rate and the bahts-yen rate. Specifically,

$$ve^{\$} + (1-v)e^{¥} = \alpha \quad \textbf{(9)}$$

where v and 1-v are the weights, and α is the value of the basket[6]. Because $e^{¥} = e^{\$} + e^{\$/¥}$, we have

$$e^{\$} = \alpha - (1-v)e^{\$/¥} \quad \text{and} \quad \textbf{(10)}$$

$$e^{¥} = \alpha + ve^{\$/¥} \quad \textbf{(11)}$$

where $0 \le v \le 1$.

Equations (7) and (8) show that, if α is to be kept constant, the bahts-dollar and bahts-yen exchange rates each have a one-to-one relationship with the yen-dollar rate. These equations also show that the bahts-dollar rate and the bahts-yen rate always change in opposite directions, if α is kept constant. They are both endogenous, but

[6] This type of basket is called a geometric average≤. There are other types of currency-baskets, such as the arithmetic average and the harmonic average. See Takagi (1992).

determined solely by what happens to the yen-dollar rate[7].

The goal of the Thai authority is to keep α constant while the yen-dollar rate is determined in the international financial markets. If the yen-dollar rate is constant, then the bahts-dollar and bahts-yen rates must also be kept constant. If, on the other hand, the yen-dollar rate changes exogenously, the Thai authority must intervene in the foreign exchange market to move the bahts-dollar and bahts-yen rates in such a way that α, or the value of the basket, remains constant. Either way, they must intervene to influence both the bahts-dollar and the bahts-yen rates in just such a way that α remains constant. Clearly, adopting a basket-peg does not free the authorities from the burden of intervention. As in the case of the dollar-peg, the stock of foreign exchange reserves is an endogenous variable.

The reduced forms are;

$$\begin{bmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & 0 \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & 0 \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & 1 \end{bmatrix} \begin{bmatrix} (y-\bar{y}) \\ (r-\bar{r}) \\ (\$^g - \bar{\$}^g) \end{bmatrix} = \begin{bmatrix} \overset{(+)}{Y_g} & Y_{\Delta e\$} & \overset{(+)}{Y_{e\$/¥}} - (1-\nu)\overset{(+)}{Y_{e\$}} & 0 & 0 & Y_{\Delta e ¥} \\ 0 & \overset{(-)}{B_{\Delta e\$}} & \overset{(-)}{B_{e\$/¥}} - (1-\nu)\overset{(-)}{B_{e\$}} & \overset{(+)}{B_{e\$e}} & 1 & \overset{(-)}{B_{\Delta e ¥}} \\ 0 & \overset{(+)}{F_{\Delta e\$}} & \overset{(+)}{F_{e\$/¥}} - (1-\nu)\overset{(+)}{F_{e\$}} & \overset{(-)}{F_{e\$e}} & 0 & \overset{(+)}{F_{\Delta e}} \end{bmatrix} \begin{bmatrix} (g-\bar{g}) \\ (\Delta e^{\$} - \Delta\bar{e}^{\$}) \\ (e^{\$/¥} - \bar{e}^{\$/¥}) \\ (e^{\$e} - \bar{e}^{\$e}) \\ (b^g - \bar{b}^g) \\ (\Delta e^{¥} - \Delta\bar{e}^{¥}) \end{bmatrix}$$

(12)

Assuming dominant diagonals in deriving the determinant of the coefficient matrix on the left-hand side $|M_{\$}|$, we have $|M_{\$}| > 0$.

4. Exchange rate regimes and monetary policy autonomy

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[7] Recall that the yen-dollar exchange rate is exogenous to this small country. We have also assumed that the bahts-yen rate is always endogenous. In this particular case of a basket-peg, the bahts-dollar rate is also endogenous.

Before moving on to analyzing the relationship between policy objectives and the optimal exchange rate regime, it would be worth emphasizing the following. Adoption of a basket-peg per se does not return monetary policy autonomy to a small country[8].

Monetary policy autonomy is critical in maintaining the health of an economy, especially one whose currency comes under attack. In the currency crises that started in July 1997 in Asia, countries such as Thailand, South Korea and Indonesia lost their foreign exchange reserves, as a result of their vain attempt to defend their virtual peg to the dollar. They also had to maintain high levels of interest rates. Needless to say, this meant huge contractions in their money supply, which had devastating consequences to their domestic economies. The loss in monetary policy autonomy turned a currency crisis into an economic crisis.

The only regime that assures monetary policy autonomy to a small open economy is a floating exchange rate regime[9]. The cleaner the float, the more complete the monetary policy autonomy.

But this does not mean that the degree of loss in monetary policy

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[8] Every monetary authority faces a policy dilemma. Some express this dilemma in the form of the “inconsistent triangle”. This triangle has the three policy goals; (1) exchange rate stability, (2) monetary policy autonomy and (3) free movement of capital and goods, at the three points. In general, all three of the goals cannot be attained simultaneously. In the case of the Asian countries that came under duress, they had chosen goal (3). So they had to choose between (1) exchange rate stability and (2) monetary policy autonomy. In trying to keep (1) they lost (2) and had to conduct a severe contractionary monetary policy despite the negative effects on the domestic economy.

[9] If a country enjoys the benefit of other countries intervening to maintain the fixed exchange rate between other currencies and its own currency, then it can have an autonomous monetary policy even under fixed exchange rates. This was mostly the case for the USA under the Bretton Woods System, and Germany in the ERM, but is much less likely to apply to small countries.

autonomy is the same under the dollar-peg and the basket-peg. Even though a basket-peg does not free a country from foreign exchange market intervention, the amount of intervention is not the same as under the dollar-peg. In fact, if the currency-rates in the basket move in opposite directions (as they necessarily do in this model), countries do not have to intervene as heavily as they would under the peg to one currency. If instead of the peg to the dollar, the Asian countries had adopted the peg to a basket, <u>and</u> if the currencies in the basket (say the dollar and the yen) had moved in opposite directions against the domestic currency (say the bahts), they would not have had to intervene as heavily. In the special case where the changes in the currency rates in the basket are such that their weighted average <u>turns out</u> automatically to be zero, the country with the basket-peg does not have to intervene in the foreign exchange market. In this case, the county fully recovers monetary policy autonomy even as it pegs its currency to a basket. Such a state may not last very long. But if only by a fluke, at least temporarily, monetary policy autonomy returns to a small open economy without adopting flexible exchange rates[10].

There is another possibility under a basket-peg regime to recover monetary policy autonomy. This possibility arises by adjusting the weights on the different exchange rates in the currency basket. Even if the weighted average of changes in the rates in the basket does not turn out to be zero under one set of weights, it may do so under another set of weights. This suggests that by adjusting the weights in the basket after each change in the currency exchange rates, to values such that the value of the basket remains constant, the authorities do not have to intervene until the next change in the currency rates. This is not a very

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realistic option, however, because the authorities may have to constantly change the weights. In the next section we consider adjusting the weights, not to maintain the value of the basket but to minimize the loss function itself.

5. Policy objectives and optimal exchange rate regimes

In as much as policy decisions are made with the objective in mind, the choice of an exchange rate regime should depend on the policy authority's objective function. In this section we scrutinize this dependence. Specifically, we clarify the difference in the way the policy objective variables are affected by an exogenous shock under floating, dollar-peg and basket-peg regimes. The policy objectives we consider are the stability in GDP, current account and the bahts-dollar exchange rate.

One purpose of this theoretical exercise is to emphasize that the relative desirability of different exchange rate regimes depends on the country's policy goal. It is not productive to try to determine whether a small open economy such as Thailand should adopt a basket-peg without first specifying its policy goal.

Another novelty of the analysis in this chapter is the optimization with respect to the weights in the currency basket. Conventionally, the weights on exchange rates in the basket were treated as some fixed value. But whether this is optimal depends on the policy objective. If instead policy authorities set these weights at values that minimize the objective function, a basket-peg regime can be even more desirable.

Tables 1 and 2 below provide the summary of our results[1]. We discuss the relative superiority of the different regimes in our empirical analysis in section 6. Throughout the analysis, the exogenous shock to the economy is the change in the yen-dollar exchange rate, which was, is and will remain a serious exogenous event for small open economies in Asia.

[1] In this paper we do not consider the case where the policy authority wants to stabilize more than one macroeconomic variable at a time. This is because there is at most one policy variable under all of the exchange rate regimes which we compare.

(1) Trade balance equilibrium as the policy objective

We begin with a special case. In analyses of currency baskets, often the trade weights (exports plus imports with a particular trade-partner country divided by overall exports plus imports) are used as the weights on the currencies in the basket[2]. In fact, Gan Yeo and Lim (1999) find that Singapore uses trade weights as the weights in its currency basket. But as we show in the analyses below, optimal currency weights are often complicated functions of partial derivatives. The purpose of this subsection is to show one set of sufficient conditions for trade weights to be indeed the optimal weights in a currency basket, and thereby emphasize how special such a case is.

Assume that the small country (Thailand) cares only about its trade. The country's authority's loss function can be described as

$$L = (TR - \overline{TR})^2 \tag{13}$$

where TR is Thailand's total trade (exports plus imports) with the rest of the world, and $\overline{TR}$ is its long-run equilibrium value. Thailand is assumed to trade only with the USA and Japan, whose respective trade weights are w_1 and $1-w_1$. For reasons that become clear shortly, we assume that Thailand's trade depends only on nominal exchange rates, and that the elasticity of total trade with respect to the nominal exchange rate takes the same value ε for trade with USA and trade with Japan. Then we have

$$TR - \overline{TR} = w_1 \varepsilon (e^{\$} - \overline{e}^{\$}) + (1-w_1)\varepsilon(e^{¥} - \overline{e}^{¥}) . \tag{14}$$

In the following subsections, we compare the performance of different exchange rate regimes in minimizing loss functions such as equation (13). But here, we consider only one exchange rate regime, the basket-peg, because

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[2] See for instance Kan (1999). Kan (1995, Chapter 7) notes that Black (1976) also suggests using trade-weights while Branson and Katseli-Papaefstratiou (1980) suggest use of market dominance in export and import markets. Kan (1995, Chapter 7) argues that the weight on the yen in a basket should be the ratio of "response of production to changes in the yen-dollar rate" to "response of production to adjustment in the domestic exchange rate".

the purpose is to show a set of conditions under which the trade weights turn out to be the optimal currency weights in the basket.

Substituting $e^{\$} = \alpha - (1-\nu)e^{\$/¥}$ **and** $e^{¥} = \alpha + \nu e^{\$/¥}$ **into equation (14) we have**

$$TR - \overline{T}R = w_1\varepsilon\left\{-(1-\nu)(e^{\$/¥} - \overline{e}^{\$/¥})\right\} + (1-w_1)\varepsilon\nu(e^{\$/¥} - \overline{e}^{\$/¥}). \quad \textbf{(15)}$$

Substituting this into the objective function (13), the first order condition for minimization with respect to ν **gives us**

$$\nu = w_1 \quad \textbf{(16)}$$

indicating that the optimal weights are indeed the trade weights.

This case is definitely a special case, which satisfies the following conditions; ① the country's objective is to minimize fluctuations in the value of total trade, ② exports and imports depend only on nominal exchange rates and ③ the elasticity of total trade with respect to the nominal exchange rate is the same for all trade-partner countries whose currencies are in the basket, ④ there are only two trading partners whose currencies are the only two currencies in the basket, and ⑤ the shock to the economy takes the form of a change in the exchange rate between the two currencies in the basket.

These are not necessary conditions, and there be other cases in which trade weights are optimal as currency weights. However, the following analyses show that, under several different policy goals, the optimal values for currency weights are functions of partial derivatives which would not in general be equal to trade weights.

(2) GDP stability as the policy objective

Now we begin comparing different exchange rate regimes for each policy objective[3]. Consider the case where the Thai government wants to minimize fluctuations in GDP. The loss function which the authorities minimize is

$$L = (y - \overline{y})^2. \quad \textbf{(17)}$$

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[3] Here in the text we only state the results. Appendix 2 contains the mathematical expressions.

We will compare the effect of an exogenous change in the yen-dollar rate on this loss function, under floating exchange rates, the dollar-peg and the basket-peg.

The yen-dollar rate changes from $\bar{e}^{\$/¥}$ to $\bar{\bar{e}}^{\$/¥}$. If the country does not have a dollar-peg regime, the bahts-dollar rate fluctuates along with the yen-dollar rate. So does the bahts-yen rate. The bahts-dollar and bahts-yen fluctuations imply increased exchange risk, which is damaging to GDP. If the country does have a dollar-peg regime, and the yen-dollar rate change is in the direction of a stronger dollar, authorities must sell dollars and buy bahts to maintain the fixed parity (unless for some reason the bahts –yen rate moves in such a way that the bahts-dollar rate naturally remains constant). The resulting loss in foreign exchange reserves can lead to higher expectation of devaluation. This also means higher exchange risk. Therefore, in general the effect of the original change in the yen-dollar rate on GDP can be divided into four parts, some of which are not present under some exchange rate regimes;

① direct effect of the original yen-dollar exchange rate change (expression ① in each subsection of Appendix 2).

② indirect effect of increased exchange risk due to the induced swing in the bahts-dollar exchange rate on all four markets (goods, domestic bonds, dollar-denominated assets and yen-denominated assets) (expression ② in each subsection of Appendix 2, where applicable).

③ indirect effect of increased exchange risk due to the induced swing in the bahts-yen exchange rate on all four markets (goods, domestic bonds, dollar-denominated assets and yen-denominated assets) (expression ③ in Appendix 2).

④ indirect effect of an increased expectation of devaluation of the bahts against the dollar, due to loss of foreign exchange reserves (expression ④ in each subsection of Appendix 2, where applicable).

We examine the relative superiority of the flexible, the dollar-peg and the basket-peg regimes using Thailand's data below. In this section we indicate which of the four effects exists under each of the three regimes, and discuss their relative strengths.

Under flexible exchange rates (between the dollar and the bahts), we have the first three effects. In contrast, under the dollar-peg regime, the second and fourth of these effects do not exist, if the market believes the fixed rate can be maintained. In such a case, the larger the effects of exchange risk, the smaller the GDP fluctuation under the dollar-peg than under floating[4]. However if loss of foreign exchange reserves leads the market to expect the peg will be abandoned, the fourth effect will be present. And if the peg is indeed abandoned, the second effect will also come into play. Therefore we can conclude that in comparing the flexible and dollar-peg regimes, the latter is more conducive to GDP stability if it is credible and can be maintained.

Under a basket-peg, the bahts-dollar exchange rate fluctuates. Therefore, GDP changes comprise the first three effects, as in the case of flexible exchange rates. However, given the yen-dollar rate, the bahts-dollar rate and the bahts-yen rate always change in opposite directions. Because of this, compared to the dollar-peg, the direct effect on the current account (and hence the direct effect on GDP) is smaller[5]. With the dollar-peg, the bahts-yen rate reflects the total change in the yen-dollar rate. This affects Thai exports to Japan, and hence Thai GDP. But with the basket, the

[4] This provides an important reminder that, even though monetary policy cannot be employed to stabilize GDP under fixed exchange rates, it may be the case that the original GDP fluctuation may be smaller under fixed exchange rates than under flexible exchange rates. The superiority of floating over fixed exchange rates on account of autonomous use of monetary policy presupposes that whatever changes in GDP will be successfully and completely offset by such policy. As we confirm in our empirical analysis, obviously if monetary policy is used to minimize the loss function, losses are zero under flexible exchange rates. If for some reason, monetary policy is only partially (or not at all) effective, then the superiority does not necessarily hold true.

[5] In Appendix 2, this is reflected in the first row of the matrix in the numerator of the expression for total loss under the basket peg.

bahts-dollar rate absorbs part of the change in the yen-dollar rate. Furthermore, because the bahts-dollar and bahts-yen rates change in opposite directions, Thai exports to the USA and Japan are affected in opposite directions, assuming that trade with the USA is denominated in US dollars and trade with Japan is denominated in yen. This last assumption is a rather important one[6]. It shows that, if a small open economy like Thailand wished to benefit from the introduction of a basket currency, it must diversify the use of foreign currencies to include the different currencies in the basket. The basket-peg will serve to stabilize GDP more if the economy is equally exposed to all exchange rates within the basket[7].

The fourth effect, i.e. the increase in expectation of devaluation due to loss in foreign exchange reserves is smaller with the basket-peg than the dollar-peg. The reason is because the two exchange rates in the basket move in opposite directions. In fact, we mentioned in section that if the two rates move in just such a way that their weighted average turns out to be zero, no intervention is necessary.

This brings our attention to the choice of weights. Until now, we have treated the weights in the basket as unknown and fixed. But the weights on currencies in the basket (ν and 1-ν) can be considered an additional policy tool, while monetary policy is busy intervening to maintain the value of the basket. They are exogenous variables that can be chosen by the policy

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[6] In reality, 80 to 85% of Thai trade takes place in US dollars, while only 6 to 8% is in yen.

[7] As for the indirect effects, the comparison is less clear because it depends on how market perceptions of risk change. Under the dollar-peg, the perceived risk is likely to increase, but only with regard to the bahts-yen rate. Under the basket-peg, perceived risk will increase not just due to the bahts-yen rate change but also the bahts-dollar rate change. The combined effects on GDP may be smaller than the sole effect of increased bahts-yen exchange rate risk, if the economy is dependent on the bahts-yen and bahts-dollar exchange rates in such a way that the effects of their changes cancel each other out. But this is a hypothetical situation.

authorities, to minimize the loss arising from given shocks to the economy. With this in mind, we calculate the optimal value of one of the weights (the value of the other follows because there are only two currencies in the basket and the sum of the two weights are one).

From the first order condition $\frac{\partial L}{\partial v} = 0$**, we have**

$$v = \frac{(Y_{e\$/¥} - Y_{e\$})B_r - (B_{e\$/¥} - B_{e\$})Y_r}{-(Y_{e\$}B_r - B_{e\$}Y_r)} - \frac{Y_{\Delta e\$}B_r - B_{\Delta e\$}Y_r}{(Y_{e\$}B_r - B_{e\$}Y_r)} \frac{(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$})}{(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥})} - \frac{Y_{\Delta e¥}B_r - B_{\Delta e¥}Y_r}{(Y_{e\$}B_r - B_{e\$}Y_r)} \frac{(\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥})}{(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥})} \quad \textbf{(18)}$$

where $(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥})$ **and** $(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$})$ **show, respectively, the initial change in the yen-dollar exchange rate and the induced increase in exchange risk.**

We can see that the optimal weights depend on the following partial derivatives:

(i) response of domestic bond demand to changes in the domestic interest rate (β_1**)**

(ii) response of domestic bond demand to changes in the returns on foreign bonds (β_2**,** β_3**)**

(iii) response of domestic bond demand to changes in real wealth (β_5**)**

(iv) response of domestic bond demand to changes in exchange risk (β_7**)**

(v) response of domestic investment to changes in the domestic interest rate (γ_2**)**

(vi) response of demand for domestic product to changes in real exchange rates (γ_4**,** γ_8**)**

(vii) response of demand for domestic product to changes in real exchange rates (γ_{11}**).**

If the value given in equation (18) is chosen, the basket-peg can achieve the goal of GDP stabilization. True, there may be occasions in which the right-hand-side of equation (18) happens to equal the trade-weight of a given country. But this cannot expect to be true in general. It follows that if the policy objective is GDP stability, choosing trade-weights as weights on the

corresponding exchange rate in the basket does not have theoretical support. The obvious problem is the complexity of calculating values such as the on given by equation (18). Countries that choose to use trade-weights as weights in the basket are doing so out of convenience more than anything else[8].

(3) Current account stability as the policy objective

Some countries choose current account stability as their policy objective. In that case, the objective function is

$$L = (ca - c\bar{a})^2. \qquad (19)$$

The current account is affected by the yen-dollar rate through four possible effects, as in the case when GDP stability is the policy goal in subsection (2) above. The effects that exist are ①, ② and ③ under floating exchange rates, ①, ② and ④under the dollar-peg and ①, ② and ③ under the basket-peg.

The difference with the case of the GDP objective is that here the direct effect (①) is itself a set of four effects, a subset of which exists under the different regimes. These four effects are ①–a: direct effect of the yen-dollar rate swing, ①-b: indirect effect through effects on GDP, ①–c: indirect effect through effects on the bahts-dollar rate and ①-d: indirect effect through changes in foreign exchange reserves. Under floating exchange rates, effects ①–a, b and c exist. Under both the dollar-peg and the basket-peg, effects ①–a, b and d exist. Effect ①–d and effect ①–a work in opposite directions. Comparing the dollar-peg and the basket-peg, effect ①–a is smaller under the latter.

[8] That trade-weights are not necessarily the ideal weights in a currency basket is in fact an intuitive argument. Currencies are not used solely as medium of exchange in trade. They are also used as store of value, a fact that is reflected in our general equilibrium model. If exchange rate stability is desired for more purposes than stability in trade, it is easy to see that trade-weights will not serve well.

The optimal weight in the basket is

$$
\begin{aligned}
v = {} & \frac{\begin{array}{l}(\gamma_6+\gamma_{10})\{(Y_{e\$/¥}-Y_{e\$})B_r-(B_{e\$/¥}-B_{e\$})Y_r\}- \\ (Y_yB_r-B_yY_r)(F_{e\$/¥}-F_{e\$})-(B_yF_r-F_yB_r)(Y_{e\$/¥}-Y_{e\$}) \\ +(F_yY_r-Y_yF_r)(B_{e\$/¥}-B_{e\$})+(\gamma_4+1)|M_\$|\end{array}}{\begin{array}{l}(-\gamma_6-\gamma_{10})(Y_{e\$}B_r-Y_rB_{e\$})+(Y_yB_r-B_yY_r)F_{e\$}+(B_yF_r-F_yB_r)Y_{e\$} \\ +(F_yY_r-Y_yF_r)B_{e\$}+|M_\$|(\gamma_8+\gamma_4+2)\end{array}} \\
& +\frac{(\gamma_6+\gamma_{10})\{Y_{\Delta e\$}B_r-B_{\Delta e\$}Y_r\}-\gamma_7|M_\$|}{\begin{array}{l}(-\gamma_6-\gamma_{10})(Y_{e\$}B_r-Y_rB_{e\$})+(Y_yB_r-B_yY_r)F_{e\$}+(B_yF_r-F_yB_r)Y_{e\$} \\ +(F_yY_r-Y_yF_r)B_{e\$}+|M_\$|(\gamma_8+\gamma_4+2)\end{array}}\frac{(\Delta\overline{\overline{e}}^{\$}-\Delta\overline{e}^{\$})}{(\overline{\overline{e}}^{\$/¥}-\overline{e}^{\$/¥})} \\
& +\frac{(\gamma_6+\gamma_{10})\{Y_{\Delta e¥}B_r-B_{\Delta e¥}Y_r\}-\gamma_{11}|M_\$|}{\begin{array}{l}(-\gamma_6-\gamma_{10})(Y_{e\$}B_r-Y_rB_{e\$})+(Y_yB_r-B_yY_r)F_{e\$}+(B_yF_r-F_yB_r)Y_{e\$} \\ +(F_yY_r-Y_yF_r)B_{e\$}+|M_\$|(\gamma_8+\gamma_4+2)\end{array}}\frac{(\Delta\overline{\overline{e}}^{¥}-\Delta\overline{e}^{¥})}{(\overline{\overline{e}}^{\$/¥}-\overline{e}^{\$/¥})}
\end{aligned}
\tag{20}
$$

We can see that the optimal weight depends on the following.

(i) response of domestic bond demand to changes in the domestic interest rate (β_1 **)**

(ii) response of domestic bond demand to changes in the returns on foreign bonds (β_2 **,** β_3 **)**

(iii) response of domestic bond demand to changes in real wealth (β_5 **)**

(iv) response of domestic bond demand to changes in exchange risk (β_7 **)**

(v) response of domestic bond demand to changes in GDP (β_4 **)**

(vi) response of domestic investment to changes in the domestic interest rate (γ_2 **)**

(vii) response of demand for domestic product to changes in real exchange rates (γ_4 **,** γ_8 **)**

(viii) response of demand for domestic product to changes in exchange risk (γ_{11} **)**

(ix) response of demand for domestic product to changes in GDP (γ_{10} **).**

(x) response of foreign bond demand to changes in the domestic interest rate (η_1 **)**

(xi) response of foreign bond demand to changes in the rate of return on foreign investment ($\eta_2 - \eta_3$, $j_2 - j_3$)

(xii) response of foreign bond demand to changes in GDP ($\eta_5 + j_5$)

(xiii) response of domestic bond demand to changes in real wealth ($\eta_6 + j_6$)

(4) Exchange rate stability as the policy objective

We assume that the policy goal is to stabilize the bahts-dollar rate. The objective function is

$$L = \left(e^{\$} - \bar{e}^{\$}\right)^2 . \qquad \textbf{(21)}$$

Evidently, the best choice is the regime that fixes the bahts-dollar rate at a constant level. Compared to the dollar peg, the basket peg is inferior unless the weight on the US dollar v is set to 1. This is confirmed by solving the first-order condition $\frac{\partial L}{\partial v} = 0$ for v, which gives us

$$v = 1 . \qquad \textbf{(22)}$$ [9]

(5) Policy objectives and optimal regimes; a summary

Table 1 is a summary of our results so far. One obvious result is that the optimality of the different exchange rate regimes depends on the policy goal. Further, the weights on currency rates in the basket can be used as a policy tool. The value of the optimal weight in a basket depends on the policy objective. Table 2 shows the different partial derivatives that affect such optimal weights. For convenience, the table also shows which partial derivatives are found to affect the optimal weights in our empirical analysis in the next section. Clearly, these weights depend in a complicated manner on reactions by many agents and in general do not coincide with trade weights.

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[9] **Appendix 2 (3) contains the details.**

＜＜＜＜＜＜ **Table 1 The effects that exist under each regime**＞＞＞＞＞＞

Objective function	regime	①	②	③	④
GDP	floating	★	★	★	
	Dollar-peg	★		★	★
	Basket-peg	★(small)	★	★	
Current account	floating	★	★	★	
	Dollar-peg	★		★	★
	Basket-peg	★(small)	★	★	
Bahts-dollar exchange rate	floating		★		
	Dollar-peg				
	Basket-peg	★			

＜＜＜＜ **Table 2 factors that affect the optimal weight in a basket**＞＞＞＞

Policy objective	GDP stability	Current account stability	Bahts-dollar rate stability
Response of domestic bond demand to change in domestic interest rate	× ✓	× ✓	
Response of domestic bond demand to change in return on foreign bonds	× ✓	× ✓	
Response of domestic bond demand to change in real wealth	×	×	
Response of domestic bond demand to change in exchange risk	×	×	
Response of domestic bond demand to change in GDP		×	
Response of investment to change in domestic interest rate	× ✓	× ✓	

Response of goods demand to changes in real exchange rates	x ✓	x ✓	
Response of goods demand to change in exchange risk	x	x	
Response of demand to change in GDP		x ✓	
Response of foreign bond demand to change in interest rate		x	
Response of foreign bond demand to change in return on foreign bonds		x ✓	
Response of foreign bond demand to change in GDP		x ✓	
Response of foreign bond demand to change in real wealth		x	

x : theoretically shown to affect

✓ : empirically shown to affect using Thai data

6. Empirical analysis using Thai data

We use Thailand's annual data from 1971 to 1999, and the Instrumental Variables Method to estimate the equations in the theoretical part of our paper. The results are shown in Table 3. Because the exogenous variables are different according to whether floating or fixed exchange rates are adopted, we have two sets of results.

The functions we estimated are the consumption function, the investment function, the export function (to the USA and to Japan), the import function (from the USA and from Japan), the demand function for domestic bonds, the demand function for foreign bonds, the demand function for money. The fist column of the table shows the explanatory variables. The second column shows the coefficients, the third column the t-values. Two asterisks on t-values indicate the level of significance is 1%, one asterisk indicates it is 5%.

Thailand had fixed exchange rates against the US dollar, but has been devaluing since 1981. To take this fact into account, we introduced a coefficient dummy on the exchange rate for the periods before 1983 and after 1984. We also introduced a constant dummy variable in estimating the investment function for 1986 and 1987, because there was a marked drop in investment during these years. For exchange risk, we used the variance of monthly exchange rate data as proxy.

＜＜＜＜＜＜ **Table 3 Estimated functions** ＞＞＞＞＞＞

Domestic bonds (RBOND)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	1314	1.198	1055	.9027
Lending rate (LRATE)	377.4	2.879**	340.6	2.354**
One-year dollar return (YLDUS)	-257.1	-1.869*	-192.7	-1.069
One-year yen return (YLDJPN)	-332.8	-2.559**	-325.2	-2.565**
GDP (GDP)	-1.243	-5.917**	-1.186	-5.152**
Real wealth (RWEALTH)	970.6	7.924**	971.5	8.190**
Dollar exchange risk (RSIKDOLL)	7.926	.0466	-34.03	-.1861
Yen exchange risk (RISKYEN)	-.5706E-05	-2.057**	-.5073E-05	-1.1725*
R-squared	.9225		.9272	
Adjusted R-squared	.8838		.8908	
Durbin-Watson	3.503		3.458	

Log of foreign assets (LNFASSET)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	-4.724	-3.767**	-5.688	-3.633**

Lending rate (LRATE)	.155	.2261	-.0104	-.1367
One-year dollar return (YLDUS)	.1304	1.778*	.2066	2.034**
One-year yen return (YLDJPN)	-.0990	-1.466	-.1029	-1.435
GDP(log) (LNGDP)	1.332	6.745**	1.472	6.101**
Real wealth (log) (LNRWEALTH)	-.1409	-.6322	-.1447	-.6118
Dollar exchange risk （log） (LNRSIKDOLL)	-.0907	-1.160	-.1422	-1.513
Yen exchange risk (log) (LNRISKYEN)	.3850	2.913**	.4740	2.970**
R-squared	.9821		.9799	
Adjusted R-squared	.9695		.9658	
Durbin-Watson	2.651		2.699	

Consumption (log) (LNCONSP)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	.1744	2.946**	.1739	2.938**
GDP(log) (LNGDP)	.9116	90.41**	.9117	90.41**
Real wealth (log) (LNRWEALTH)	-.0453	-2.091**	-.0454	-2.097**
R-squared	.9991		.9991	
Adjusted R-squared	.9990		.9990	
Durbin-Watson	.7406		.7406	

Investment (log) (LNINV)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	3.443	7.824**	3.535	7.893**
Constant dummy (1986) (D3)	-1.910	-3.904**	-1.953	-3.959**
Constant dummy (1987) (D4)	-2.843	-6.156**	-2.868	-6.167**
Money market rate (MMRATE)	-.0692	-1.807*	-.0775	-1.987**
R-squared	.7826		.7801	
Adjusted	.7324		.7294	

R-squared		
Durbin-Watson	2.272	2.299

Exports to USA (log) (LNEXUS)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	-52.02	-3.500**	-52.70	-5.369**
Real bahts-dollar exchange rate (log)(LNRBDEX)	1.93	2.162**	-6.295	2.877**
USGDP (log) (LNUSGDP)	3.42	12.11**	5.098	11.55**
Exchange rate dummy after 1981 (LNDRBDEX)	-.1.07	-5.154**	-.4096	-2.244**
Exchange rate dummy after 1984 (LND1RBDEX)	-.69	-2.682**	-.6349	-3.059**
Dollar exchange risk (log) (LNRSIKDOLL)	.0017	.4984	.1291	1.455
Yen exchange risk (log) (LNRISKYEN)	.1330E+10	.9664	.0529	.4992
R-squared	.9645		.9958	
Adjusted R-squared	.9543		.9933	
Durbin-Watson	.8984		1.859	

Exports to Japan (log) (LNEXJPN)	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	-54.21	-2.331**	-52.29	-6.123**
Real bahts-yen exchange rate (log)(LNRBDEX)	-9.13	-.4645	-1.208	-2.394**
Japanese GDP (log) (LNUSGDP)	3.11	5.131**	4.710	7.244**
Exchange rate dummy after 1981 (LNDRBDEX)	.2329E+07	.2.134**	.1941E-02	.2263E-02
Exchange rate dummy after			.7677	1.957*

1984 (LND1RBDEX)				
Dollar exchange risk （ log ） (LNRSIKDOLL)	.1197E+09	1.167	.2733	1.017
Yen exchange risk (log) (LNRISKYEN)	.1142E+03	.0673	-.0398	-.1399
R-squared	.9752		.9571	
Adjusted R-squared	.9604		.9314	
Durbin-Watson	1.279		2.147	

Imports from USA (log) （LNIMUS）	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	-5.364	-.8169	-12.77	-1.083
Real bahts-dollar exchange rate (log)(LNRBDEX)	1.014	.5328	3.154	.9231
GDP(log) (LNGDP)	1.355	9.750**	1.510	6.229**
Exchange rate dummy after 1984 (LND1RBDEX)	-2360	-1.5336	-.4197	-1.483
Dollar exchange risk （ log ） (LNRSIKDOLL)	.0205	.4706	.3059E-02	.0580
Yen exchange risk (log) (LNRISKYEN)	-.0808	-.7533	-.0263	-.1983
R-squared	.9779		.9751	
Adjusted R-squared	.9679		.9638	
Durbin-Watson	2.080		2.219	

Imports from Japan (log) （LNIMJPN）	Fixed exchange rates		Floating exchange rates	
variable	Estimated value	t-value	Estimated value	t-value
constant (c)	-3.888	-4.114**	-4.204	-3.975**
Real bahts-yen exchange rate (log)(LNRBDEX)	-.8076	-3.253**	-.7628	-2.790**
GDP(log) (LNGDP)	1.554	17.065**	1.630	14.78**

Exchange rate dummy after 1981 (LND1RBDEX)	.3169	2.300**	.5190	2.508**
Dollar exchange risk （log） (LNRSIKDOLL)	-.0325	-.3093	-.0782	-.6554
Yen exchange risk (log) (LNRISKYEN)	.0669	.9931	.1582	10608
R-squared	.9845		.9815	
Adjusted R-squared	.9774		.9731	
Durbin-Watson	1.172		1.779	

Using the estimated coefficients[10], we calculated the basket weights that minimize the loss functions corresponding to the three different policy goals. The result is shown in Table 4, where we show only the optimal weights on the bahts-dollar exchange rate. The optimal weights on the bahts-yen exchange rate can easily be found by subtracting the optimal weights on the bahts-dollar exchange rate from 1.

＜＜＜＜＜＜ Table 4 Optimal weights ＞＞＞＞＞＞

Policy objective	v
GDP	0.61
Current account	0.56
Bahts-dollar exchange rate	1

Also by using the estimated coefficients, we compared the values of loss functions under the floating, dollar-peg and basket-peg regimes[11]. For the

10 Coefficients that were not significant at the 1% level were set equal to zero. In particular, we found that coefficients on exchange rate risk were not significant. This may be due to the fact that Thailand had a fixed exchange rate regime during all but the very end of the period of our estimation.

11 In the empirical analysis, we omitted the indirect effect of the induced expectation for devaluation under the dollar-peg regime for lack of adequate data.

floating exchange rates and basket-peg regimes, we considered two cases, one sub-optimal and one optimal. The sub-optimal case for floating exchange rates is when money supply is not changed at all, in spite of the fact that it is available as a policy tool. The sub-optimal case for the basket-peg is when the weights are the trade-weights. In the latter case, we used Thai data to find that v is equal to 0.4. The welfare consequences are shown in Table 5.

As expected, both regimes attain zero loss when the respective policy variables take the optimal values. The dollar-peg attains zero loss when the objective is stability in the bahts-dollar rate. Also, our results indicate that using trade-weights as basket-weights under the basket-peg leads to higher losses than using no monetary policy at all under floating exchange rates.

<<<<<< **Table 5 The values of loss functions** >>>>>>

Floating exchange rates	**Floating exchange rates without optimal monetary policy (no change in money supply)**	**Floating exchange rates with optimal monetary policy**	**Dollar peg**	**Basket peg with trade weights as currency weights**	**Basket-peg with optimal weights**
GDP	$(0.02e^{\$/¥} - 0.35R)^2$ ***3.10***	***0***	$(0.62e^{\$/¥})^2$ ***2.16***	$(2.05e^{\$/¥})^2$ ***23.60***	***0***
Current account	$(-4.75e^{\$/¥} + 1.10R)^2$ ***31.06***	***0***	$(0.016e^{\$/¥})^2$ ***0.0014***	$(-6.63e^{\$/¥})^2$ ***246.90***	***0***
Bahts-dollar exchange rate	$(-0.15e^{\$/¥})^2$ ***0.13***	***0***	***0***	$(0.6e^{\$/¥})^2$ ***2.02***	***0***

$e^{\$/¥}$ **indicates size of the original dollar-yen rate change,** R **indicates the resulting rise in the bahts-yen exchange rate risk. Italic entries are when** $e^{\$/¥}$ **and** R **are averages of the relevant period.**

7. The Appendices

Appendix 1: Deriving the equilibrium values in reduced forms of Section 3

The equilibrium values that appear in the reduced forms shown in Section 3-(1) are as follows

$$\bar{y}=\frac{1}{|M_e|}\begin{vmatrix}
\begin{bmatrix}\gamma_3\bar{g}+(\gamma_7+\gamma_{11})\Delta\bar{e}^{\$2}+(\gamma_8+\gamma_{11})\bar{e}^{\$/\yen}+\gamma_4\bar{p}^{\$}\\ -(\gamma_4+\gamma_5)\bar{p}+\gamma_5\bar{y}^{\$}+\gamma_8\bar{p}^{\yen}+\gamma_9\bar{y}^{\yen}\end{bmatrix} & Y_r & Y_{e\$}\\
\begin{bmatrix}(\beta_6+\beta_7)\Delta\bar{e}^{\$2}-(\beta_5-\beta_7)\bar{e}^{\$/\yen}+\beta_2\bar{e}^{\$e}+\bar{b}^{g}+\bar{b}^{c}+(\beta_5-1)\bar{p}\\ +\beta_2\bar{r}^{\$}+\beta_3\bar{r}^{\yen}+\beta_3\bar{e}^{\yen e}-\beta_5\bar{w}\end{bmatrix} & B_r & B_{e\$}\\
\begin{bmatrix}(\eta_4+j_4)\Delta\bar{e}^{\$2}+(-\eta_3+j_3+j_4-\eta_6-j_6)\bar{e}^{\$/\yen}+(-\eta_2+j_2)\bar{e}^{\$e}\\ -\overline{\$}^{g}+(\eta_6+j_6)\bar{p}+(-\eta_2+j_2)\bar{r}^{\$}+(\eta_3-j_3)\bar{r}^{\yen}+(\eta_3-j_3)\bar{e}^{\yen e}\\ -(\eta_6+j_6)\bar{w}+\overline{\$}^{f}+\overline{\yen}^{f}+\overline{\yen}^{g}\end{bmatrix} & F_r & F_{e\$}
\end{vmatrix}$$

$$\bar{r}=\frac{1}{|M_e|}\begin{vmatrix}
Y_y & \begin{bmatrix}\gamma_3\bar{g}+(\gamma_7+\gamma_{11})\Delta\bar{e}^{\$2}+(\gamma_8+\gamma_{11})\bar{e}^{\$/\yen}+\gamma_4\bar{p}^{\$}\\ -(\gamma_4+\gamma_5)\bar{p}+\gamma_5\bar{y}^{\$}+\gamma_8\bar{p}^{\yen}+\gamma_9\bar{y}^{\yen}\end{bmatrix} & Y_{e\$}\\
B_y & \begin{bmatrix}(\beta_6+\beta_7)\Delta\bar{e}^{\$2}-(\beta_5-\beta_7)\bar{e}^{\$/\yen}+\beta_2\bar{e}^{\$e}+\bar{b}^{g}-\bar{b}^{c}+(\beta_5-1)\bar{p}\\ +\beta_2\bar{r}^{\$}+\beta_3\bar{r}^{\yen}+\beta_3\bar{e}^{\yen e}-\beta_5\bar{w}\end{bmatrix} & B_{e\$}\\
F_y & \begin{bmatrix}(\eta_4+j_4)\Delta\bar{e}^{\$2}+(-\eta_3+j_3+j_4-\eta_6-j_6)\bar{e}^{\$/\yen}+(-\eta_2+j_2)\bar{e}^{\$e}\\ -\overline{\$}^{g}+(\eta_6+j_6)\bar{p}+(-\eta_2+j_2)\bar{r}^{\$}+(\eta_3-j_3)\bar{r}^{\yen}+(\eta_3-j_3)\bar{e}^{\yen e}\\ -(\eta_6+j_6)\bar{w}+\overline{\$}^{f}+\overline{\yen}^{f}+\overline{\yen}^{g}\end{bmatrix} & F_{e\$}
\end{vmatrix}$$

$$\bar{e}^{\$}=\frac{1}{|M_e|}\begin{vmatrix}
Y_y & Y_r & \begin{bmatrix}\gamma_3\bar{g}+(\gamma_7+\gamma_{11})\Delta\bar{e}^{\$2}+(\gamma_8+\gamma_{11})\bar{e}^{\$/\yen}+\gamma_4\bar{p}^{\$}\\ -(\gamma_4+\gamma_5)\bar{p}+\gamma_5\bar{y}^{\$}+\gamma_8\bar{p}^{\yen}+\gamma_9\bar{y}^{\yen}\end{bmatrix}\\
B_y & B_r & \begin{bmatrix}(\beta_6+\beta_7)\Delta\bar{e}^{\$2}-(\beta_5-\beta_7)\bar{e}^{\$/\yen}+\beta_2\bar{e}^{\$e}+\bar{b}^{g}-\bar{b}^{c}+(\beta_5-1)\bar{p}\\ +\beta_2\bar{r}^{\$}+\beta_3\bar{r}^{\yen}+\beta_3\bar{e}^{\yen e}-\beta_5\bar{w}\end{bmatrix}\\
F_y & F_r & \begin{bmatrix}(\eta_4+j_4)\Delta\bar{e}^{\$2}+(-\eta_3+j_3+j_4-\eta_6-j_6)\bar{e}^{\$/\yen}+(-\eta_2+j_2)\bar{e}^{\$e}\\ -\overline{\$}^{g}+(\eta_6+j_6)\bar{p}+(-\eta_2+j_2)\bar{r}^{\$}+(\eta_3-j_3)\bar{r}^{\yen}+(\eta_3-j_3)\bar{e}^{\yen e}\\ -(\eta_6+j_6)\bar{w}+\overline{\$}^{f}+\overline{\yen}^{f}+\overline{\yen}^{g}\end{bmatrix}
\end{vmatrix}$$

Appendix 2: Policy objectives and optimal exchange rate regimes

In section 4 we discussed the direct and indirect effects of an exogenous yen-dollar rate changes from $\bar{e}^{\$/\text{¥}}$ to $\bar{\bar{e}}^{\$/\text{¥}}$. This part of the appendix contains mathematical expressions that support the arguments.

(1) GDP stability as the policy objective

- **Floating exchange rates**

  ① **Direct effect of the original dollar-yen exchange rate swing**

  The direct effect of this dollar-yen rate on GDP is

$$L=(y-\bar{y})_D{}^2=\frac{\begin{vmatrix} \overset{(+)}{Y_{e\$/\text{¥}}} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ \overset{(-)}{B_{e\$/\text{¥}}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ \overset{(+)}{F_{e\$/\text{¥}}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}^2}{|M_e|^2}(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}})^2$$

  ② **Indirect effect of increased exchange risk due to the induced swing in the baths-dollar exchange rate**

  The changes in dollar-yen rate induces the change in bahts-dollar rate as

$$(e^{\$}-\bar{e}^{\$})^2=\frac{\begin{vmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & \overset{(+)}{Y_{e\$/\text{¥}}} \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & \overset{(-)}{B_{e\$/\text{¥}}} \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & \overset{(+)}{F_{e\$/\text{¥}}} \end{vmatrix}^2}{|M_e|^2}(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}})^2 .$$

  This will increase market participants' perception of exchange risk. Assume that the increase in the perceived exchange risk is from $\Delta\bar{e}^{\$}$ to $\Delta\bar{\bar{e}}^{\$}$. Then the effect on GDP is

$$L=(y-\bar{y})_{I2}{}^2=\frac{\begin{vmatrix} \overset{(?)}{Y_{\Delta e\$}}+ & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ \overset{(-)}{B_{\Delta e\$}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ \overset{(+)}{F_{\Delta e\$}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}^2}{|M_e|^2}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})^2$$

  ③ **Indirect effect of an increased exchange risk due to the induced**

swing in the baths-yen exchange rate

From the triangular relationship $e^{¥} = e^{\$} + e^{\$/¥}$**, the baths-yen rate changes by** $(e^{¥} - \overline{e}^{¥}) = (e^{\$} - \overline{e}^{\$}) + (e^{\$/¥} - \overline{e}^{\$/¥})$[1] **or**

$$(e^{¥} - \overline{e}^{¥})^2 = \left(\frac{\begin{vmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & \overset{(+)}{Y_{e\$/¥}} \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & \overset{(-)}{B_{e\$/¥}} \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & \overset{(+)}{F_{e\$/¥}} \end{vmatrix}^2}{|M_e|^2} - 1\right)(\overline{e}^{\$/¥} - \overline{e}^{\$/¥})^2$$

This will increase market participants' perception of baths-dollar exchange risk. Assume the increase is from $\Delta\overline{e}^{¥}$ **to** $\Delta\overline{\overline{e}}^{¥}$**. Then the effect on GDP is**

$$L = (y - \overline{y})_{I3}{}^2 = \frac{\begin{vmatrix} \overset{(?)}{Y_{\Delta e ¥}} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ \overset{(-)}{B_{\Delta e ¥}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ \overset{(+)}{F_{\Delta e ¥}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}^2}{|M_e|^2} (\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥})^2$$

The fourth effect (i.e. the indirect effect of an increased expectation of devaluation of the bahts against the dollar) does not exist under floating exchange rates. Therefore, in order to derive the value of the loss function, we simply add losses arising from ①, ② and ③ and square the sum. The value of the loss function (total loss) under flexible exchange rates is

$$L = (y - \overline{y})^2 = \frac{\begin{vmatrix} Y_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + Y_{\Delta e\$}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) + Y_{\Delta e ¥}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + B_{\Delta e\$}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) + B_{\Delta e ¥}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + F_{\Delta e\$}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) + F_{\Delta e ¥}(\Delta\overline{\overline{e}}^{\$} - \Delta\overline{e}^{\$}) & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}^2}{|M_e|^2}.$$

Under flexible exchange rates, monetary policy is available as a policy tool. What policy authorities should do when a loss arises is to minimize this loss using monetary policy.

The optimal open market operation which minimizes this loss is

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[1] **Note that since baths-dollar rate and yen-dollar rate changes different direction, the change in baths-yen rate will be very small.**

$$b^c - b^c = -\frac{\hat{Y}B_r F_{e\$} - \hat{Y}F_r B_{e\$} + \hat{B}F_r Y_{e\$} - \hat{B}Y_r F_{e\$} + \hat{F}Y_r B_{e\$} - \hat{F}B_r Y_{e\$}}{F_r Y_{e\$} - Y_r F_{e\$}}$$

where, $\hat{Y} = Y_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + Y_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + Y_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$})$

$$\hat{B} = B_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + B_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + B_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$})$$

$$\hat{F} = F_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + F_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + F_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$})\ .$$

When this policy is conducted, the value of loss function is

$$L = (y - \bar{y})^2 = \frac{\begin{vmatrix} Y_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + Y_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + Y_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + B_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + B_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + (b^c - \bar{b}^c) & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen}) + F_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) + F_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}^2}{|M_e|^2}$$

and this value is confirmed in our empirical analysis to be equal to zero.

- **The dollar-peg**

  ① **Direct effect of the original yen-dollar rate swing**

  The direct effect of the dollar-yen rate on GDP is

$$(y - \bar{y})_D{}^2 = \frac{\begin{vmatrix} \overset{(+)}{Y_{e\$/\yen}} & \overset{(+)}{Y_r} & 0 \\ \overset{(-)}{B_{e\$/\yen}} & \overset{(++)}{B_r} & 0 \\ \overset{(+)}{F_{e\$/\yen}} & \overset{(-)}{F_r} & 1 \end{vmatrix}^2}{|M_\$|^2}(\bar{\bar{e}}^{\$/\yen} - \bar{e}^{\$/\yen})^2$$

  The second indirect effect (i.e. effect of increased exchange risk due to swing in the bahts-dollar rate) does not exist under the present regime.

  ③ **Indirect effect of increased exchange risk due to the induced swing in the baths-yen exchange rate**

  Since $(e^{\yen} - \bar{e}^{\yen}) = (e^{\$} - \bar{e}^{\$}) + (e^{\$/\yen} - \bar{e}^{\$/\yen})$ **and** $(e^{\$} - \bar{e}^{\$}) = 0$ **, the entire change in dollar-yen rate translates into the change in the baths-yen rate as** $(e^{\yen} - \bar{e}^{\yen})^2 = (e^{\$/\yen} - \bar{e}^{\$/\yen})^2$**.**

This will increase market participants' perception of baths-yen exchange risk. Assume the increase is from $\Delta\overline{e}^{¥}$ to $\Delta\overline{\overline{e}}^{¥}$. The effect on GDP is

$$(y-\overline{y})_{I2}{}^2 = \frac{\begin{vmatrix} \overset{(+)}{Y}_{\Delta e¥} & \overset{(+)}{Y}_r & 0 \\ \overset{(-)}{B}_{\Delta e¥} & \overset{(++)}{B}_r & 0 \\ \overset{(+)}{F}_{\Delta e¥} & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2} (\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥})^2$$

④ **Indirect effect of an increased expectation of devaluation**

In the case of an appreciation of the dollar against the yen, foreign exchange reserves decrease by

$$\$^g - \overline{\$}^g = \frac{\begin{vmatrix} \overset{(++)}{Y}_y & \overset{(+)}{Y}_r & \overset{(+)}{Y}_{e\$/¥} \\ \overset{(+)}{B}_y & \overset{(++)}{B}_r & \overset{(-)}{B}_{e\$/¥} \\ \overset{(+)}{F}_y & \overset{(-)}{F}_r & \overset{(+)}{F}_{e\$/¥} \end{vmatrix}}{|M_\$|} (\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) > 0.$$

Assume this decrease in foreign reserves increases the expectation of devaluation from $\overline{e}^{\$e}$ to $\overline{\overline{e}}^{\$e}$. This increase in the devaluation expectation will affect GDP by

$$(y-\overline{y})_{I4}{}^2 = \frac{\begin{vmatrix} 0 & \overset{(+)}{Y}_r & 0 \\ \overset{(+)}{B}_{e\$^e} & \overset{(++)}{B}_r & 0 \\ \overset{(-)}{F}_{e\$^e} & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2} (\overline{\overline{e}}^{\$e} - \overline{e}^{\$e})^2.$$

Adding ①, ③ and ④ and squaring, the value of the loss function (total loss) is

$$(y-\overline{y})^2 = \frac{\begin{vmatrix} Y_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + Y_{\Delta e¥}(\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥}) & \overset{(+)}{Y}_r & 0 \\ B_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + B_{\Delta e¥}(\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥}) + B_{e\$^e}(\overline{\overline{e}}^{\$e} - \overline{e}^{\$e}) + & \overset{(++)}{B}_r & 0 \\ F_{e\$/¥}(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}) + F_{\Delta e¥}(\Delta\overline{\overline{e}}^{¥} - \Delta\overline{e}^{¥}) + F_{e\$^e}(\overline{\overline{e}}^{\$e} - \overline{e}^{\$e}) + & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2}.$$

- **The basket peg**

  ① **Direct effect of the original yen-dollar exchange rate swing**

  The direct effect of the dollar-yen change is

$$(y-\bar{y})_D{}^2 = \frac{\begin{vmatrix} \{\overset{(+)}{Y}_{e\$/¥} - (1-\nu)\overset{(+)}{Y}_{e\$}\} & \overset{(+)}{Y}_r & 0 \\ \{\overset{(-)}{B}_{e\$/¥} - (1-\nu)\overset{(-)}{B}_{e\$}\} & \overset{(++)}{B}_r & 0 \\ \{\overset{(+)}{F}_{e\$/¥} - (1-\nu)\overset{(+)}{F}_{e\$}\} & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2} (\overline{\overline{e}}^{\$/¥} - \bar{e}^{\$/¥})^2$$

  ② **Indirect effect of increased exchange risk due to the induced swing in the baths-dollar exchange rate**

  The change in the dollar-yen rate induces the bahts-dollar rate to change as follows:

  $(e^\$ - \bar{e}^\$) = -(1-\nu)(\overline{\overline{e}}^{\$/¥} - \bar{e}^{\$/¥})$ **.**

  Assume this will increase perceived exchange risk from $\Delta\bar{e}^\$$ **to** $\Delta\overline{\overline{e}}^\$$**. The effect on GDP is**

$$(y-\bar{y})_{I2}{}^2 = \frac{\begin{vmatrix} \overset{(?)}{Y}_{\Delta e^\$} & \overset{(+)}{Y}_r & 0 \\ \overset{(-)}{B}_{\Delta e^\$} & \overset{(++)}{B}_r & 0 \\ \overset{(+)}{F}_{\Delta e^\$} & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2} (\Delta\overline{\overline{e}}^\$ - \Delta\bar{e}^\$)^2$$

  ③ **Indirect effect of increased exchange risk due to the induced swing in the baths-yen exchange rate**

  As a result of the dollar-yen rate change, the bahts-yen rate changes as $(e^¥ - \bar{e}^¥) = \nu(\overline{\overline{e}}^{\$/¥} - \bar{e}^{\$/¥})$ **.**

  Assume this will increase the perceived bahts-yen exchange risk from $\Delta\bar{e}^¥$ **to** $\Delta\overline{\overline{e}}^¥$**. The effect on GDP is**

$$(y-\bar{y})_{I3}{}^2 = \frac{\begin{vmatrix} \overset{(?)}{Y}_{\Delta e¥} & \overset{(+)}{Y}_r & 0 \\ \overset{(-)}{B}_{\Delta e¥} & \overset{(++)}{B}_r & 0 \\ \overset{(+)}{F}_{\Delta e¥} & \overset{(-)}{F}_r & 1 \end{vmatrix}^2}{|M_\$|^2} (\Delta\overline{\overline{e}}^¥ - \Delta\bar{e}^¥)^2$$

Adding ①, ② and ③ and squaring, the value of loss function (total loss) is

$$L=(y-\bar{y})^2=\frac{\left|\begin{matrix} \{Y_{e\$/\yen}-(1-\nu)Y_{e\$}\}(\overline{\overline{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+Y_{\Delta e^{\$}}(\Delta\overline{\overline{\overline{e}}}^{\$}-\Delta\bar{e}^{\$})+Y_{\Delta e\yen}(\Delta\overline{\overline{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(+)}{Y_r} & 0 \\ \{B_{e\$/\yen}-(1-\nu)B_{e\$}\}(\overline{\overline{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+B_{\Delta e^{\$}}(\Delta\overline{\overline{\overline{e}}}^{\$}-\Delta\bar{e}^{\$})+B_{\Delta e\yen}(\Delta\overline{\overline{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(++)}{B_r} & 0 \\ \{F_{e\$/\yen}-(1-\nu)F_{e\$}\}(\overline{\overline{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+F_{\Delta e^{\$}}(\Delta\overline{\overline{\overline{e}}}^{\$}-\Delta\bar{e}^{\$})+F_{\Delta e\yen}(\Delta\overline{\overline{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(-)}{F_r} & 1 \end{matrix}\right|^2}{|M_{\$}|^2}$$

.

(2) Current account stability as the policy objective

The current account consists of the trade balance and net investment income.[2] Thus

$$CA=NX^{\$}+NX^{\yen}+r_{\$}E^{\$}\tilde{\$}^{f}+r_{\yen}E^{\yen}\tilde{\yen}^{f}$$

($E^{\$}$ **and** $E^{\yen}$ **are respectively the bahts-dollar and the bahts-yen rates,** $\tilde{\$}^{f}$ **and** $\tilde{\yen}^{f}$ **are respectively dollar and yen denominated assets held by Thailand.)**
Using the goods market equation, the equation above can be rewritten as

$$\begin{aligned} ca &= \gamma_4\left(e^{\$}+p^{\$}-p\right)+\gamma_5 y^{\$}-\gamma_6 y+\gamma_7\Delta e^{\$}+r_{\$}+e^{\$}+\$^{f} \\ &+\gamma_8\left(e^{\yen}+p^{\yen}-p\right)+\gamma_9 y^{\yen}-\gamma_{10}y+\gamma_{11}\left(\Delta e^{\yen}\right)+r_{\yen}+e^{\yen}+\yen^{f}. \end{aligned}$$

- **Floating exchange rates**

In the case of flexible exchange rates, the divergence of the current account from its equilibrium value can be expressed as:

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2 Current account = Merchandise Trade balance + Invisible balance (Export Import of services + Net investment income) + Unilateral transfer. Here, we assume that Export Import of service and unilateral transfer are zero.

$$(ca-\overline{ca})=\left[-\gamma_6-\gamma_{10}\quad 0\quad \gamma_4+\gamma_8+2\quad \gamma_8+1\quad \gamma_7\quad \gamma_{11}\right]\begin{bmatrix}(y-\bar{y})\\(r-\bar{r})\\(e^{\$}-\bar{e}^{\$})\\(e^{\$/\yen}-\bar{e}^{\$/\yen})\\(\Delta e^{\$}-\Delta\bar{e}^{\$})\\(\Delta e^{\yen}-\Delta\bar{e}^{\yen})\end{bmatrix}$$

$$=\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\overset{(+)}{\begin{vmatrix}Y_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+Y_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+Y_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(+)}{Y_r} & \overset{(-)}{Y_e}\\ B_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+B_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+B_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(++)}{B_r} & \overset{(+)}{B_e}\\ F_{e\$/\yen}(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen})+F_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+F_{\Delta e\yen}(\Delta\bar{\bar{e}}^{\yen}-\Delta\bar{e}^{\yen}) & \overset{(-)}{F_r} & \overset{(--)}{F_e}\end{vmatrix}}}{|M_e|}$$

$$+\left(\overset{(+)}{\gamma_4+\gamma_8+2}\right)\frac{\overset{(-)}{\begin{vmatrix}Y_y & Y_r & Y_{e\$/\yen}\left(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen}\right)\\ B_y & B_r & B_{e\$/\yen}\left(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen}\right)\\ F_y & F_r & F_{e\$/\yen}\left(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen}\right)\end{vmatrix}}}{|M_e|}+\left(\overset{(++)}{\gamma_8+1}\right)\left(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen}\right)+(\gamma_7)(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+(\gamma_{11})(\Delta\bar{\bar{e}}^{\yen}-\Delta\bar{e}^{\yen}$$

$$=\left\{\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\overset{(+)}{\begin{vmatrix}Y_{e\$/\yen} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e}\\ B_{e\$/\yen} & \overset{(++)}{B_r} & \overset{(+)}{B_e}\\ F_{e\$/\yen} & \overset{(-)}{F_r} & \overset{(--)}{F_e}\end{vmatrix}}}{|M_e|}+\left(\overset{(+)}{\gamma_4+\gamma_8+2}\right)\frac{\overset{(-)}{\begin{vmatrix}Y_y & Y_r & Y_{e\$/\yen}\\ B_y & B_r & B_{e\$/\yen}\\ F_y & F_r & F_{e\$/\yen}\end{vmatrix}}}{|M_e|}+\left(\overset{(++)}{\gamma_8+1}\right)\right\}\left(\bar{\bar{e}}^{\$/\yen}-\bar{e}^{\$/\yen}\right)$$

$$+\left\{\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\overset{(+)}{\begin{vmatrix}Y_{\Delta e\$} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e}\\ B_{\Delta e\$} & \overset{(++)}{B_r} & \overset{(+)}{B_e}\\ F_{\Delta e\$} & \overset{(-)}{F_r} & \overset{(--)}{F_e}\end{vmatrix}}}{|M_e|}+(\gamma_7)\right\}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+\left\{\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\overset{(+)}{\begin{vmatrix}Y_{\Delta e\yen} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e}\\ B_{\Delta e\yen} & \overset{(++)}{B_r} & \overset{(+)}{B_e}\\ F_{\Delta e\yen} & \overset{(-)}{F_r} & \overset{(--)}{F_e}\end{vmatrix}}}{|M_e|}+(\gamma_{11})\right\}(\Delta\bar{\bar{e}}^{\yen}-\Delta\bar{e}^{\yen})$$

Evidently, there are three components to this divergence:

① **The effect from the original yen-dollar exchange rate swing**

The yen-dollar exchange rate can affect CA directly, through GDP and through the bahts-dollar rate swing.

Thus the effect of the yen-dollar rate swing on CA is

$$(ca-\bar{ca})_{e\$/\text{¥}}=\left\{\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} Y_{e\$/\text{¥}} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{e\$/\text{¥}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{e\$/\text{¥}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}}{|M_e|}+\overset{(+)}{\left(\overset{(+)}{\gamma_4+\gamma_8+2}\right)\frac{\begin{vmatrix} Y_y & Y_r & \overset{(-)}{Y_{e\$/\text{¥}}} \\ B_y & B_r & B_{e\$/\text{¥}} \\ F_y & F_r & F_{e\$/\text{¥}} \end{vmatrix}}{|M_e|}}+\left(\overset{(++)}{\gamma_8+1}\right)\right\}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)$$

Within the expression

$$\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} Y_{e\$/\text{¥}} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{e\$/\text{¥}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{e\$/\text{¥}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}}{|M_e|}+\overset{(+)}{\left(\overset{(+)}{\gamma_4+\gamma_8+2}\right)\frac{\begin{vmatrix} Y_y & Y_r & \overset{(-)}{Y_{e\$/\text{¥}}} \\ B_y & B_r & B_{e\$/\text{¥}} \\ F_y & F_r & F_{e\$/\text{¥}} \end{vmatrix}}{|M_e|}}+\left(\overset{(++)}{\gamma_8+1}\right),$$

the first term corresponds to ①–b, the second term corresponds to ①-c and the third term corresponds to ①-a in the text.

② **Indirect effect of increased exchange risk due to the induced swing in the bahts-dollar rate**

The change in the dollar-yen rate induces the change in the bahts-dollar rate and thus, increases the perception of exchange risk from $\Delta\bar{e}^{\$}$ to $\Delta\bar{\bar{e}}^{\$}$. The effect on the current account is

$$(ca - c\bar{a})_{\Delta e\$} = \left\{ \left(-\overset{(-)}{\gamma_6} - \gamma_{10} \right) \frac{\overset{(+)}{\begin{vmatrix} Y_{\Delta e\$} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{\Delta e\$} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{\Delta e\$} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}}}{|M_e|} + (\gamma_7) \right\} (\Delta\bar{\bar{e}}^{\$} - \Delta\bar{e}^{\$}) .$$

③ **Indirect effect of increased exchange risk due to the induced swing in the baths-yen rate**

The change in the dollar-yen rate induces the change in the bahts-yen rate, and thus increases the perceived exchange risk from $\Delta\bar{e}^{\text{¥}}$ to $\Delta\bar{\bar{e}}^{\text{¥}}$. The effect on the current account is

$$(ca - c\bar{a})_{\Delta a\text{¥}} = \left\{ \left(-\overset{(-)}{\gamma_6} - \gamma_{10} \right) \frac{\overset{(+)}{\begin{vmatrix} Y_{\Delta e\text{¥}} & \overset{(+)}{Y_r} & \overset{(-)}{Y_e} \\ B_{\Delta e\text{¥}} & \overset{(++)}{B_r} & \overset{(+)}{B_e} \\ F_{\Delta e\text{¥}} & \overset{(-)}{F_r} & \overset{(--)}{F_e} \end{vmatrix}}}{|M_e|} + (\gamma_{11}) \right\} (\Delta\bar{\bar{e}}^{\text{¥}} - \Delta\bar{e}^{\text{¥}}) .$$

The total loss (value of the loss function) is the squared value of the sum of effects ① to ③ above.

Under floating exchange rates, monetary policy is available as a tool to minimize this loss. The optimal monetary policy is

$$(b^c - \bar{b}^c) = \frac{\begin{array}{l} (-\gamma_6 - \gamma_{10})(\hat{Y}B_r F_{e\$} - \hat{Y}F_r B_{e\$} + \hat{B}F_r Y_{e\$} - \hat{B}Y_r F_{e\$} + \hat{F}Y_r B_{e\$} - \hat{F}B_r Y_{e\$}) \\ + (\gamma_4 + \gamma_8 + 2)(Y_y B_r F_{e\$/\text{¥}} - Y_r F_r B_{e\$/\text{¥}} + B_y F_r Y_{e\$/\text{¥}} - B_y Y_r F_{e\$/\text{¥}} + F_y Y_r B_{e\$/\text{¥}} - F_y B_r Y_{e\$/\text{¥}}) \\ + |m_e|(\gamma_8 + 1) + |m_e|\gamma_e \Delta e^{\$} + |m_e|\gamma_{11}\Delta e^{\text{¥}} \end{array}}{(-\gamma_6 - \gamma_{10})(F_r Y_{e\$} - Y_r F_{e\$}) + (\gamma_4 + \gamma_8 + 2)(Y_y F_r - F_y Y_r)}$$

Again, the value of the loss function is zero when this value is substituted into it.

- **The dollar Peg**

In the case of the dollar-peg system, the divergence of the current account can be expressed as

$$(ca-\bar{ca})=\begin{bmatrix}-\gamma_6-\gamma_{10} & 0 & 1 & \gamma_8+1 & \gamma_{11}\end{bmatrix}\begin{bmatrix}(y-\bar{y})\\(r-\bar{r})\\(\$^g-\bar{\$}^g)\\(e^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}})\\(\Delta e^{\text{¥}}-\Delta\bar{e}^{\text{¥}})\end{bmatrix}$$

$$=\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)+\overset{(+)}{Y_{\Delta e\text{¥}}}\left(\Delta\bar{\bar{e}}^{\text{¥}}-\Delta\bar{e}^{\text{¥}}\right) & Y_r & 0\\ B_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)+B_{e\$e}\left(\bar{\bar{e}}^{\$e}-\bar{e}^{\$e}\right)+B_{\Delta e\text{¥}}\left(\Delta\bar{\bar{e}}^{\text{¥}}-\Delta\bar{e}^{\text{¥}}\right) & B_r & 0\\ F_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)+F_{e\$e}\left(\bar{\bar{e}}^{\$e}-\bar{e}^{\$e}\right)+F_{\Delta e\text{¥}}\left(\Delta\bar{\bar{e}}^{\text{¥}}-\Delta\bar{e}^{\text{¥}}\right) & F_r & 1\end{vmatrix}}{|M_\$|}$$

$$+\frac{\begin{vmatrix}Y_Y & Y_r & Y_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)\\ B_Y & B_r & B_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)\\ F_Y & F_r & F_{e\$/\text{¥}}\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)\end{vmatrix}}{|M_\$|}+\left(\overset{(++)}{\gamma_8}+1\right)\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)+\gamma_{11}(\Delta e^{\text{¥}}-\Delta\bar{e}^{\text{¥}})$$

$$=\left[\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{e\$/\text{¥}} & Y_r & 0\\ B_{e\$/\text{¥}} & B_r & 0\\ F_{e\$/\text{¥}} & F_r & 1\end{vmatrix}}{|M_\$|}+\frac{\begin{vmatrix}\overset{(+)}{Y_Y} & Y_r & Y_{e\$/\text{¥}}\\ B_Y & B_r & B_{e\$/\text{¥}}\\ F_Y & F_r & F_{e\$/\text{¥}}\end{vmatrix}}{|M_\$|}+(\gamma_8+1)\right]\left(\bar{\bar{e}}^{\$/\text{¥}}-\bar{e}^{\$/\text{¥}}\right)$$

$$+\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}0 & \overset{(+)}{Y_r} & 0\\ B_{e\$e} & B_r & 0\\ F_{e\$e} & F_r & 1\end{vmatrix}}{|M_\$|}\left(\bar{\bar{e}}^{\$e}-\bar{e}^{\$e}\right)+\left[\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{\Delta e\text{¥}} & \overset{(+)}{Y_r} & 0\\ B_{\Delta e\text{¥}} & B_r & 0\\ F_{\Delta e\text{¥}} & F_r & 1\end{vmatrix}}{|M_\$|}+\gamma_{11}\right](\Delta e^{\text{¥}}-\Delta\bar{e}^{\text{¥}})$$

.

There are three components, which are effects ①, ② and ④.

① The effect from the original yen-dollar exchange rate swing

The yen-dollar rate can affect the current account directly, through GDP and through changes in foreign reserves.

$$(ca-c\bar{a})_{e\$/¥}=\left[\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{e\$/¥} & Y_r & 0\\ B_{e\$/¥} & B_r & 0\\ F_{e\$/¥} & F_r & 1\end{vmatrix}}{|M_\$|}+\frac{\begin{vmatrix}\overset{(+)}{Y_Y} & Y_r & Y_{e\$/¥}\\ B_Y & B_r & B_{e\$/¥}\\ F_Y & F_r & F_{e\$/¥}\end{vmatrix}}{|M_\$|}+(\gamma_8+1)\right]\left(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥}\right)$$

Within the expression

$$\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{e\$/¥} & Y_r & 0\\ B_{e\$/¥} & B_r & 0\\ F_{e\$/¥} & F_r & 1\end{vmatrix}}{|M_\$|}+\frac{\begin{vmatrix}\overset{(+)}{Y_Y} & Y_r & Y_{e\$/¥}\\ B_Y & B_r & B_{e\$/¥}\\ F_Y & F_r & F_{e\$/¥}\end{vmatrix}}{|M_\$|}+(\gamma_8+1),$$

the first term corresponds to ①–b, the second term corresponds to ①-d and the third term corresponds to ①-a in the text.

③ **Indirect effect of increased exchange risk due to the baths-yen exchange rate swing**

Under the dollar peg, the baths-yen rate changes by $(e^{¥}-\bar{e}^{¥})=(e^{\$/¥}-\bar{e}^{\$/¥})$**. This induces the perceived exchange risk to change from** $\Delta\bar{e}^{¥}$ **to** $\Delta\bar{\bar{e}}^{¥}$**. The effect on the current account is**

$$(ca-c\bar{a})_{\Delta e¥}=\left[\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{\Delta e¥} & \overset{(+)}{Y_r} & 0\\ B_{\Delta e¥} & B_r & 0\\ F_{\Delta e¥} & F_r & 1\end{vmatrix}}{|M_\$|}+\gamma_{11}\right](\Delta e^{¥}-\Delta\bar{e}^{¥})$$

④ **Indirect effect of an increased expectation of evaluation**

In the case of an appreciation of the dollar against the yen, foreign exchange reserves decreases. Assume this decrease in foreign reserves increases the expectation of devaluation from $\bar{e}^{\$e}$ **to** $\bar{\bar{e}}^{\$e}$**. This increase in the devaluation expectation will affect the current account by**

$$(ca-c\overline{a})_{e\$e}=\left(-\overset{(-)}{\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}0 & \overset{(+)}{Y_r} & 0\\ B_{e\$e} & B_r & 0\\ F_{e\$e} & F_r & 1\end{vmatrix}}{|M_\$|}\left(\overline{\overline{e}}^{\$e}-\overline{e}^{\$e}\right).$$

The total loss (value of the loss function) is the squared value of the sum of effects ①, ② and ④ above.

- **The basket peg**

Under the basket peg system, since $e^{\$}=\alpha-(1-\nu)e^{\$/¥}$ **and** $e^{¥}=\alpha+\nu e^{\$/¥}$**, the divergence of the current account can be re-written as**

$$
(ca-\bar{ca})=\left[-\gamma_6-\gamma_{10} \quad 1 \quad (\overset{(+)}{\gamma_8}+1)-(1-\nu)(\overset{(+)}{\gamma_8}+\gamma_4+2) \quad \gamma_7 \quad \gamma_{11}\right]\begin{bmatrix} y-\bar{y} \\ \$^g-\bar{\$}^g \\ e^{\$/¥}-\bar{e}^{\$/¥} \\ \Delta e^{\$}-\Delta\bar{e}^{\$} \\ \Delta e^{¥}-\Delta\bar{e}^{¥} \end{bmatrix}
$$

$$
=\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} \{Y_{e\$/¥}-(1-\nu)\overset{(+)}{Y_{e\$}}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})+Y_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+Y_{\Delta e¥}(\Delta\bar{\bar{e}}^{¥}-\Delta\bar{e}^{¥}) & Y_r & 0 \\ \{B_{e\$/¥}-(1-\nu)B_{e\$}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})+B_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+B_{\Delta e¥}(\Delta\bar{\bar{e}}^{¥}-\Delta\bar{e}^{¥}) & B_r & 0 \\ \{F_{e\$/¥}-(1-\nu)F_{e\$}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})+F_{\Delta e\$}(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+F_{\Delta e¥}(\Delta\bar{\bar{e}}^{¥}-\Delta\bar{e}^{¥}) & F_r & 1 \end{vmatrix}}{|M_{\$}|}
$$

$$
+\frac{\begin{vmatrix} Y_y & Y_r & \{Y_{e\$/¥}-(1-\nu)Y_{e\$}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥}) \\ B_y & B_r & \{B_{e\$/¥}-(1-\nu)B_{e\$}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥}) \\ F_y & F_r & \{F_{e\$/¥}-(1-\nu)F_{e\$}\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥}) \end{vmatrix}}{|M_{\$}|}+\{(\overset{(+)}{\gamma_8}+1)-(1-\nu)(\overset{(+)}{\gamma_8}+\gamma_4+2)\}(\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})
$$

$$
+\gamma_7(\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+\gamma_{11}(\Delta\bar{\bar{e}}^{¥}-\Delta\bar{e}^{¥})
$$

$$
=\left[\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} \{Y_{e\$/¥}-(1-\nu)\overset{(+)}{Y_{e\$}}\} & Y_r & 0 \\ \{B_{e\$/¥}-(1-\nu)B_{e\$}\} & B_r & 0 \\ \{F_{e\$/¥}-(1-\nu)F_{e\$}\} & F_r & 1 \end{vmatrix}}{|M_{\$}|}+\frac{\begin{vmatrix} Y_y & Y_r & \{Y_{e\$/¥}-(1-\nu)Y_{e\$}\} \\ B_y & B_r & \{B_{e\$/¥}-(1-\nu)B_{e\$}\} \\ F_y & F_r & \{F_{e\$/¥}-(1-\nu)F_{e\$}\} \end{vmatrix}}{|M_{\$}|}+\{(\overset{(+)}{\gamma_8}+1)-(1-\nu)(\overset{(+)}{\gamma_8}+\gamma_4+2)\}\right](\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})
$$

$$
+\left[\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} Y_{\Delta e\$} & \overset{(+)}{Y_r} & 0 \\ B_{\Delta e\$} & B_r & 0 \\ F_{\Delta e\$} & F_r & 1 \end{vmatrix}}{|M_{\$}|}+\gamma_7\right](\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$})+\left[\left(\overset{(-)}{-\gamma_6-\gamma_{10}}\right)\frac{\begin{vmatrix} Y_{\Delta e¥} & \overset{(+)}{Y_r} & 0 \\ B_{\Delta e¥} & B_r & 0 \\ F_{\Delta e¥} & F_r & 1 \end{vmatrix}}{|M_{\$}|}+\gamma_{11}\right](\Delta\bar{\bar{e}}^{¥}-\Delta\bar{e}^{¥})
$$

Evidently, there are three components to this divergence:

① **The direct effect of the original yen-dollar exchange rate swing**

The yen-dollar exchange rate swing affects the current account directly, through GDP and through changes in foreign reserves. Thus

$$(ca-c\bar{a})_{e\$/¥}=$$

$$\left[\left(\overset{(-)}{-\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}\{Y_{e\$/¥}-(1-\nu)Y_{e\$}\} & \overset{(+)}{Y_r} & 0\\ \{B_{e\$/¥}-(1-\nu)B_{e\$}\} & B_r & 0\\ \{F_{e\$/¥}-(1-\nu)F_{e\$}\} & F_r & 1\end{vmatrix}}{|M_\$|}+\frac{\begin{vmatrix}Y_y & Y_r & \{Y_{e\$/¥}-(1-\nu)Y_{e\$}\}\\ B_y & B_r & \{B_{e\$/¥}-(1-\nu)B_{e\$}\}\\ F_y & F_r & \{F_{e\$/¥}-(1-\nu)F_{e\$}\}\end{vmatrix}}{|M_\$|}+\{(\overset{(+)}{\gamma_8}+1)-(1-\nu)(\gamma_8+\overset{(+)}{\gamma_4}+2)\}\right](\bar{\bar{e}}^{\$/¥}-\bar{e}^{\$/¥})$$

Within the expression

$$\left[\left(\overset{(-)}{-\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}\{Y_{e\$/¥}-(1-\nu)Y_{e\$}\} & \overset{(+)}{Y_r} & 0\\ \{B_{e\$/¥}-(1-\nu)B_{e\$}\} & B_r & 0\\ \{F_{e\$/¥}-(1-\nu)F_{e\$}\} & F_r & 1\end{vmatrix}}{|M_\$|}+\frac{\begin{vmatrix}Y_y & Y_r & \{Y_{e\$/¥}-(1-\nu)Y_{e\$}\}\\ B_y & B_r & \{B_{e\$/¥}-(1-\nu)B_{e\$}\}\\ F_y & F_r & \{F_{e\$/¥}-(1-\nu)F_{e\$}\}\end{vmatrix}}{|M_\$|}+\{(\overset{(+)}{\gamma_8}+1)-(1-\nu)(\gamma_8+\overset{(+)}{\gamma_4}+2)\}\right],$$

the first term corresponds to ①–b, the second term corresponds to ①-d and the third term corresponds to ①-a in the text.

② **Indirect effect of increased exchange risk due to the induced swing in the baths-dollar rate**

Assuming the perceived exchange risk increases from $\Delta\bar{e}^{\$}$ to $\Delta\bar{\bar{e}}^{\$}$, the effect on the current account is

$$(ca-c\bar{a})_{\Delta e\$}=\left[\left(\overset{(-)}{-\gamma_6}-\gamma_{10}\right)\frac{\begin{vmatrix}Y_{\Delta e\$} & \overset{(+)}{Y_r} & 0\\ B_{\Delta e\$} & B_r & 0\\ F_{\Delta e\$} & F_r & 1\end{vmatrix}}{|M_\$|}+\gamma_7\right](\Delta\bar{\bar{e}}^{\$}-\Delta\bar{e}^{\$}).$$

③ **Indirect effect of increased exchange risk due to the induced swing in the baths-yen rate**

Assuming the perceived exchange risk increases from $\Delta\bar{e}^{¥}$ to $\Delta\bar{\bar{e}}^{¥}$, the effect on the current account is

$$(ca - \overline{ca})_{\Delta e¥} = \left[\left(-\overset{(-)}{\gamma_6} - \gamma_{10} \right) \frac{\begin{vmatrix} Y_{\Delta e¥} & \overset{(+)}{Y_r} & 0 \\ B_{\Delta e¥} & B_r & 0 \\ F_{\Delta e¥} & F_r & 1 \end{vmatrix}}{|M_\$|} + \gamma_{11} \right] (\Delta \overline{\overline{e}}^{¥} - \Delta \overline{e}^{¥})$$

The total loss (value of the loss function) is the squared value of the sum of effects ① to ③ above.

(3) Exchange rate stability as the policy objective

- **Floating exchange rates**

When the dollar-yen rate changes from $\overline{e}^{\$/¥}$ to $\overline{\overline{e}}^{\$/¥}$, the value of the loss function is

$$L = \left(e^{\$} - \overline{e}^{\$}\right)^2 = \left\{ \frac{\begin{vmatrix} \overset{(++)}{Y_y} & \overset{(+)}{Y_r} & \overset{(+)}{Y_{e\$/¥}} \\ \overset{(+)}{B_y} & \overset{(++)}{B_r} & \overset{(-)}{B_{e\$/¥}} \\ \overset{(+)}{F_y} & \overset{(-)}{F_r} & \overset{(+)}{F_{e\$/¥}} \end{vmatrix}}{|M_e|} \left(\overline{\overline{e}}^{\$/¥} - \overline{e}^{\$/¥}\right) \right\}^2$$

We can minimize this loss by monetary policy. The optimal monetary policy is

$$(b^c - \overline{b}^c) = \frac{(Y_y B_r F_{e\$/¥} - Y_r F_r B_{e\$/¥} + B_y F_r Y_{e\$/¥} - B_y Y_r F_{e\$/¥} + F_y Y_r B_{e\$/¥} - F_y B_r Y_{e\$/¥})}{(Y_y F_r - F_y Y_r)}.$$

This value is the same as the value that maintains the bahts-dollar rate constant.

- **The dollar-peg**

Since the bahts-dollar rate is fixed, the value of loss function is

$$L = \left(e^{\$} - \overline{e}^{\$}\right)^2 = 0.$$

- **The basket Peg**

Using $e^{\$} = \alpha - (1-\nu)e^{\$/¥}$, the change in the bahts-dollar rate is $e^{\$} - \bar{e}^{\$} = -(1-\nu)(e^{\$/¥} - \bar{e}^{\$/¥})$. Hence the value of loss function is $L = (e^{\$} - \bar{e}^{\$})^2 = (1-\nu)^2(\bar{\bar{e}}^{\$/¥} - \bar{e}^{\$/¥})^2$. This can be minimized by setting ν = 1, meaning that the optimal regime is the dollar-peg.

References

Black, S. W. (1976) 'Exchange Rate Policies for Less Developed Countries in a World of Floating Rates', *Essays in International Finance,* No. 119, Prineton University Press, Princeton, New Jersey

Branson, W. H. and L. T. Katseli-Papaefstratiou (1980) 'Inome Instability, Terms of Trade, and the Choice of an Exchange Rate Regime', *Journal of Development Economics*, March

Gan Wee Beng, Yeo Wai Hon and Lim Soon Chong (1999) "The Asian Currency Crisis and the Sustainability of Exchange Rate Regimes, The Case of Singapore", Monetary Authority of Singapore

Ito, Takatoshi (1999) "Capital Flows in Asia", NBER Working Paper, no. 7134

Ito, Takatoshi, Eiji Ogawa, and Yuri N. Sasaki (1998) "How did the dollar peg fail in Asia?" Journal of the Japanese and International Economies, vol.12, pp.256-304

Kan, Shiyuu (1995) *En-Ken no Keizai-Gaku (*The Economics of the yen-area), Nihon Keizai Shimbunsha, Tokyo

Kan, Shiyuu (1999) 'Ajia Tsuuka Basket' (The Asian currency Basket), Keizai-Kyoshitsu, Nihon Keizai Shimbun, 26th August

Kawai, Masahiro (1994) *Kokusai Kinyuu-ron* (International Finance), Tokyo UniversityPress, Tokyo

Ogawa, Eiji (1998a) 'Ajia Tsuuka-kiki no Riron-teki Ichizuke' (Theoretical analysis of the Asian Currency Crisis) in Kondo, Nakajima and Hayashi eds*. Ajia Tsuuka-kiki no Keizai-Gaku* (The Economics of the Asian Currency Crisis), Toyo-Keizai Shimpo-sha, Tokyo

Ogawa, Eiji (1998b) *Kokusai Kinyuu Shisutemu no Anteisei* (The Stability of the International Financial System), Toyo-Keizai Shimpo-sha, Tokyo

Ogawa, Eiji and Son（1999） 'Doru-peg-ka ni okeru Kinyuu-kiki to Tsuuka-kiki' (Financial Crises and Currency Crises under the Dollar-peg), *Keizai Keiei Kenkyuu*, No. 20-3, Nihon Kaihatsu Ginko Setsubi-toshi Kenkyuusho (Japan Development Bank Research Institute for Equipment Investment), Tokyo

Obstfeld, Maurice and Kenneth Rogoff (1996) *Foundation of International Macroeconomics*,

Shone, Ronald(1989) "Open Economy Macroeconomics", Harvester Wheatsheaf, Takagi, Shinji (1992) *Nyuumon Kokusai Kinnyuu* (Introductory International Finance) Nihon Hyoron-sha, Tokyo

Turnovsky, Stephen (1997) *International Macroeconomic Dynamics*, The MIT Press, Cambridge, MA

World Bank (1993) "The East Asian Miracle: Economic growth and Public Policy", Oxford University Press,

Yoshino, Naoyuki and Maki Fujimaru (1999) 'Kawase-reto no Basket-peg-sei, Doru-peg-sei, Hendo-soba-sei' (The Basket-peg, the Dollar-peg and Floating), Japan Centre for International Finance, Tokyo