Dynamic Effect of Change in Exchange Rate System -From the Fixed Exchange Rate Regime to the Basket-peg or Floating Regime*

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Abstract

The basket-peg and the floating are discussed to be two options of desirable regimes in East Asia. However, there still remains a question of how the countries, which adopt the *de facto* dollar-peg regime, shift to the desirable stable regimes. We attempt to compute the dynamic effect of shift from the dollar-peg regime to the basket-peg regime or to the floating regime and obtain the transition path for three transition policies.

We find that countries will be better off to shift to the basket-peg or floating regime in the long-run perspective. Furthermore, concerning the choices between gradual adjustment (policy (2)) or a sudden shift to the stable basket-peg regime (policy (3)), the longer the transition period of adjustments, the more benefits the country will gain from reaching stable regime at once. Finally, for the choice between a sudden shift to the basket-peg regime (policy (3)) and to the floating regime (policy (4)), our numerical analysis using Thai data shows that the country will be better off shifting to the basket-peg regime rather than the floating regime.

Key Word: Exchange rate regime, basket-peg, transitional path
JEL Codes: F33, F41

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1 Introduction

One of the two major culprits of the 1997-98 Asian financial crisis was the adoption of the *de facto* dollar-peg by some countries in East Asia[1]. The other was the discrepancy in maturity of lending by financial institutions in East Asian economies. Financial institutions in Thailand, Indonesia and Korea borrowed in short-term from abroad and lent to domestic firms in long-term. Sudden withdrawal of funds to abroad made East Asian banks vulnerable to the crisis[2].

Several economists advocate desirability of the basket-peg regime in Asia. For example, Kawai (2002), Ito and Park (2004), Yoshino, Kaji, and Suzuki (2004), and Ogawa and Ito (2002) recommend that East Asian countries adopt the basket-peg regime[3]. The main reason for adopting the basket-peg regime was that for countries with close economic relationships with the European Union, Japan and the United States, exchange rate stabilization vis-a-vis a basket comprising these currencies was beneficial, because it removed the problem of large fluctuations of exchange rates.

Furthermore, Yoshino, Kaji, and Asonuma (2004) show that together with the basket-peg regime, the floating regime is also one of the options for East Asian countries[4]. Moreover, Adams and Semblat (2004) advocate that one of the currency regime options is adopting the floating regime with inflation targeting.

The desirability of the basket-peg or the floating regime relative to the dollar-peg regime has been analyzed in the static context, not in dynamic context. For countries like China and Malaysia on the other hand, there is still a big question of how to get from the *de facto* fixed exchange rate with the US dollar to the other exchange rate regimes. Before adopting the basket-peg or floating regime, these countries need to abandon the *de fecto* dollar-peg[5]. The shift from dollar-peg regime to stable basket-peg regime would take either one of two processes: (1) starting with the dollar-peg regime with strict capital control, shifting to the basket-peg regime with loose capital control, and finally reaching the basket-peg regime with no capital control, or (2) starting with the dollar-peg regime with

[1] Ito, Ogawa and Sasaki (1998) and Ogawa and Ito (2000) both stress this point and advocate adoption of a basket-peg regime in East Asia, in order to avoid being negatively affected by fluctuations in the dollar-yen exchange rate.

[2] On the other hand, McKibbin and Martin (1999) also insist that the primary cause of the East Asia was a fundamental reassessment of the profitability of investments in the region.

[3] Concerning the composition of the basket, Ogawa and Ito (2002) and Kawai advocate the G-3 (US dollar, Japanese yen, euro) basket, while Yoshino, Kaji and Asonuma (2005a) stresses that East Asian countries adopt the basket consisted of both G-3 currencies and also East Asian currencies. Moreover, Yoshino, Kaji, and Asonuma (2005b) discusses the optimal weights and composition of basket currency in East Asia.

[4] However, there is also a drawback in adopting floating regime; too much fluctuations of the exchange rates affect negatively to the economy as shown in Yoshino, Kaji, and Ibuka (2003).

[5] The Chinese government announced its change in exchange rate system from the dollar-peg system into a managed floating system "with reference to" a currency basket and also with a band (plus and minus 0.3% around the base rate on July 21, 2005. However, the observing the reference target, weight on the US dollar is very close to 1, implying that the Chinese government is still adopting the *de facto* dollar-peg regime.

strict capital control, then suddenly shifting to the stable basket-peg regime with no capital control by removing capital control. On the other hand, the shift to the floating regime would involve the following process: starting with the dollar-peg regime with strict capital control and suddenly shifting to the floating regime by removing capital control. Therefore, it is necessary to analyze the effects of these shifts in the dynamic context.

This paper attempts to compute the dynamic effect of the shift from the fixed exchange rate regime to the stable basket peg regime or the stable floating regime. We obtain two transition paths from the dollar-peg to the basket-peg regime (gradual adjustment and sudden shift) and one transition path from the dollar-peg to the floating regime (sudden shift).

The major findings are as follows. First, the value of the cumulative losses of four policies (three transition policies mentioned above plus maintaining the dollar-peg regime) are obtained theoretically as well as empirically[6]. We find that maintaining the dollar-peg regime is desirable only in the short term, indicating that the country will be better off shifting to either the basket-peg regime or the floating regime in the long-run perspective.

Second, concerning the choices between gradual adjustment (policy (2)) toward the stable basket-peg regime or sudden shift to the stable basket-peg regime (policy (3)), the longer the transition period of adjustments, the more benefits the country will gain from reaching the stable regime at once.

Finally, for the choices between a sudden shift to the basket-peg regime (policy (3)) and to the floating regime (policy (4)), our numerical analysis using Thai data shows that the country will be better off shifting to the basket-peg regime rather than to the floating regime[7].

The paper is related to two streams of literatures. The first of these has examined the basket-peg regime in East Asia. Ito, Ogawa and Sasaki (1998) and Ogawa and Ito (2002) analyze the desirability of the basket-peg under the general equilibrium model which does not include capital movements. Yoshino, Kaji, and Suzuki (2004) and Yoshino, Kaji, and Asonuma (2004) also advocate that it is better for the country to adopt the basket-peg rather than the dollar-peg regime under the general equilibrium model which includes capital movements across countries. For recent studies, Shioji (2006a, 2006b) consider the basket-peg regime under two different invoicing schemes, producer currency pricing and vehicle curency pricing. For empirical analysis, McKibbin and Le (2004) investigate which exchange rate the East Asian Countries should peg to using several shocks, which involve country specific (asymmetric) shock, and regional (symmetric) shocks.

On the other hand, the other literature discusses the desirability of the floating regime in East Asia. Adams and Semblat (2004) advocate that one of the

[6] Appendix C provides the simulation results using the Thai data to support the theoretical results.

[7] Moreover, Yoshino, Kaji, and Asonuma (2008) analyze the choices between basket-peg and floating regime by applying some instrument rules. Our numerical analysis shows that in the case of Thailand, applying basket weight rule will lead to smaller cumulative loss than ones under interest rate rule or money supply rule under floating regime.

currency regime options is adopting the floating regime with inflation targeting. At the same time, Sussangkarn and Vichyanond (2007) stress that the managed floating plus inflation targeting suits the emering market environment as in Thailand. Furthermore, Yoshino, Kaji and Asonuma (2004) find out that the floating regime is also the possible regimes for East Asian countries together with the basket-peg regime. Lastly, Kim and Lee (2008) show that the exchange rate flexibility provides greater monetary policy independence based on their empirical findings.

The rest of the paper is organized as follows. Section 2 provides a small open economy model. Section 3 analyzes how the economy reaches the stable equilibrium under the following four cases: (A) the dollar-peg regime with strict capital control, (B) the basket-peg regime with loose capital control, (C) the basket-peg regime without capital control, and (D) the floating regime without capital control. Section 4 defines the four transitional policies: (1) maintaining the dollar-peg regime with strict capital control, (2) gradual adjustment of both basket weights and capital control to the stable basket-peg regime, (3) sudden shift to the basket peg regime and removal of capital control, and finally (4) sudden shift to the floating regime by removing capital control. Section 5 analyzes the optimal policy which the home country adopts. A brief conclusion summarizes the discussion. Appendix C provides the simulation using the Thai data to support the theoretical findings[8]. Moreover, Appendix D shows the relationship between the optimal weights under basket-peg regime and the time span.

2 Small Open Economy Model

In this section, we provide a small open economy model. As in Yoshino, Kaji and Suzuki (2002) and Dornbusch (1976), we conduct a dynamic analysis with small open general equilibrium model. Though our equilibrium conditions are not based on optimal behaviors of households and firms, our equilibrium conditions are quite the same with ones in Yoshino, Kaji, and Asonuma (2008) which are derived from optimal conditions of households and firms. There are three countries in this model: China, the US, and Japan. We assume China as home country and the US and Japan as the rest of the world (ROW), since the paper analyzes the effect of the changes from the fixed exchange rate regime to the basket-peg or the floating regime. The yen-dollar exchange rate is exogenous to China.

Figure 1: The model

[8] It is apparent that the optimal basket weight derived from the numerical analysis is different with one mentioned in Ogawa and Shimizu (2006), which is calculated based on shares in regional GDP measured at PPP and their trade volume share (the sum of the exports and imports).

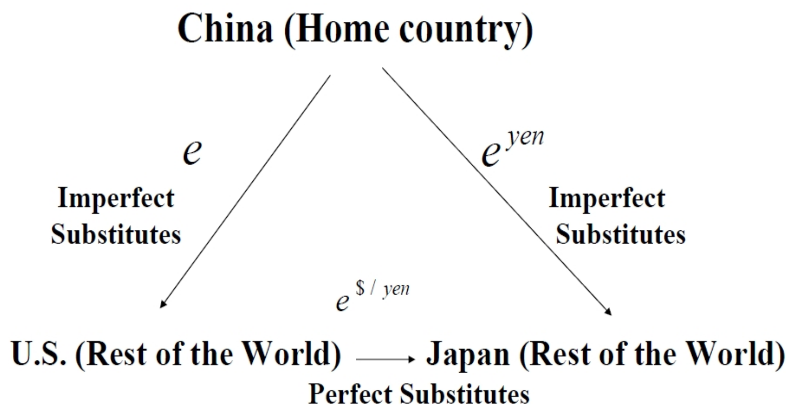


Table 1: Table of notation:

m : stock of money supply
p : domestic price level
p^e : the expected domestic price level
p^* : the price level in the US
p^{yen} : the price level in Japan
i : domestic interest rate
i^* : US interest rate
y : domestic GDP
$\bar{y}$: potential domestic GDP
e : Chinese renminbi-dollar exchange rate
e^{yen} : Chinese renminbi-yen exchange rate
$e^{\$/yen}$: dollar/yen exchange rate
υ : basket weight on US dollar rate
α: total productivity of China

Note: All the variables except interest rates and exchange rates are defined in natural log.

We assume that Chinese and foreign assets are imperfect substitutes whereas US assets and Japanese assets are perfect substitutes for domestic investors. Thus the equation of interest parity is

$$i_{t+1} - i_t = -\lambda \left[i_t - \{ i_t^* + e_{t+1} - e_t - \sigma(e_t) \} \right] \tag{1}$$

where λ denotes the adjustment speed of the home interest rate, which also expresses the degree of capital control. If λ approaches to 0, it implies that domestic interest rate does not respond to the change in foreign interest rate. It means that the domestic interest rate is exogenous variable and totally independent. We regard it as the case of strict capital control. On the other hand, if λ approaches to 1, it implies that domestic interest rate responds completely to the change in foreign interest rate, which we regard it as the case without capital control.

Furthermore, $\sigma(e_t)$ shows the risk premium. It depends on the renminbi-dollar exchange rate. The depreciation of the home currency will increase the stock of foreign assets held by domestic investors, and will decrease the home interest rate. If $\lambda = 1$, equation (1) can be rewritten as

$$i_{t+1} = i_t^* + e_{t+1} - e_t - \sigma(e_t) \tag{1'}$$

As we mention later in Section 3.1., under the dollar peg with the capital control, equation (1) will not hold. The equilibrium condition for the money market is

$$m_t - p_t = -\epsilon i_{t+1} + \phi (y_t - \bar{y}) \tag{2}$$

Assume that demand for goods depends on real exchange rates, real interest rate and exchange rate risks shown as

$$y_t - \bar{y} = \delta (e_t + p^* - p_t) + \theta (e_t^{yen} + p^{yen} - p_t) - \rho \left\{ i_{t+1} - \left(p_{t+1}^e - p_t^e \right) \right\} - \tau \Delta e - \varsigma \Delta e^{yen} \tag{3}$$

where the term $\left(p_{t+1}^e - p_t^e \right)$ shows expected rate of inflation. Δe captures the renminbi-dollar exchange rate risk and Δe^{yen} denotes the renminbi-yen exchange rate risk.

Since one of the three exchange rates is not independent, the renminbi-yen rate can be expressed as

$$e_t^{yen} = e_t + e_t^{\$/yen} \tag{4}$$

The inflation rate depends on the total productivity, the excess demand for goods, the real renminbi-dollar rate, and the expected rate of inflation, shown as

$$p_{t+1} - p_t = -\alpha_t + \psi (y_t - \bar{y}) + \eta (e_t + p^* - p_t) + \left(p_{t+1}^e - p_t^e \right) + \chi \Delta e \tag{5}$$

where the first term on right-hand side shows the total productivity, which includes effects of foreign direct investments (FDI) from Japan, and last term denotes the renminbi-dollar exchange rate risk. We assume the production depends on total productivity, imported materials from US, and inflation rate. We assume that China imports materials from the US, exports the final goods to Japan and the US.

Among the variables, α_t, $\bar{y}$, p^*, p^{yen}, $e_t^{\$/yen}$, Δe, and Δe^{yen} are common exogenous variables under any exchange rate regimes. We assume that all exogenous variables except $e_t^{\$/yen}$, p_{t+1}^e, and p_t^e are constant (=0) in the analysis below. All the coefficients above are positive.

3 Exchange rate regimes

In this section, we derive the long-term equilibrium as well as the equilibrium values at period t. We consider four cases;

(A) Dollar-peg regime with strict capital control,
(B) Basket-peg regime with weak capital control,
(C) Basket-peg regime without capital control and,
(D) Floating regime without capital control

At first, we start our analysis from the case (A) which China adopts the fixed exchange rate with US dollar and restricts capital movements. Second, we consider the case (B) where China adopts the basket-peg regime with loose capital control. This assumption reflects the transition period from the fixed exchange rate with capital control to the basket-peg regime, which basket is composed of the renminbi-dollar and the renminbi-yen rate, with weak capital control. Thirdly, we analyze the case (C) where China adopts the basket-peg regime without capital control. Lastly we discuss the case (D) where China adopts the floating regime without capital control.

3.1 Dollar-peg regime with strict capital control (A)

Under the dollar-peg regime, the exchange rate (e_t) becomes exogenous ($e_t = 0$). Therefore, the expectation of the exchange rate will be the same with current exchange rate. Furthermore, in this case, money supply (m_t) becomes endogenous. Since the monetary authority restricts domestic residents' holding foreign assets, equation (1) does not exit. Domestic interest rate (i_{t+1}) in this case is exogenous variables, since there is no equation expressing the substitutability between domestic assets and foreign assets. Since the exchange rate is fixed, from equation (4),

$$e_t^{yen} = e_t^{\$/yen} \tag{4'}$$

Substitute equation (4') into equation (3), we can obtain,

$$y_t - \bar{y} = \delta\left(-p_t\right) + \theta\left(e_t^{\$/yen} - p_t\right) - \rho\left\{-\left(p_{t+1}^e - p_t^e\right)\right\} - \varsigma\Delta e^{yen} \tag{3'}$$

The endogenous variables for this model are m_t, y_t, and p_t. Solving the equation (2), (3'), and (5) for the price level and the money supply, the following semi-reduced form equations are obtained:

$$p_{t+1} - p_t = -\alpha_t + \left[\psi(\delta+\theta)+\eta\right]p_t + \psi\theta e_t^{\$/yen} + (1+\psi\rho)\left(p_{t+1}^e - p_t^e\right) - \psi\varsigma\Delta e^{yen} \tag{6}$$

$$m_t = [1 - \phi(\delta + \theta) + \eta]\, p_t + \phi\theta e_t^{\$/yen} + \phi\rho\left(p_{t+1}^e - p_t^e\right) - \phi\varsigma\Delta e^{yen} \quad (7)$$

Since $p_{t+1} = p_t$ in the long-run equilibrium, the long-run equilibrium values for the price level and the money supply are[9]

$$\bar{p} = \frac{1}{D}\left[\psi\theta\bar{e}^{\$/yen} - \bar{\alpha}\right] \quad (8)$$

$$\bar{m} = \left[\frac{1 - \phi(\delta + \theta)}{D}\psi\theta + \phi\theta\right]\bar{e}^{\$/yen} - \frac{1 - \phi(\delta + \theta)}{D}\bar{\alpha} \quad (9)$$

where $D = \psi(\delta + \theta) + \eta$.

We define that $\hat{X}_t = X_t - \bar{X}$ expresses the deviation from the long-run equilibrium value. We assume the dollar-yen rate moved from its initial equilibrium value ($= 0$) to $\hat{e}_t^{\$/yen}$ at time t and remained at the new equilibrium after time $t + 1$ ($=\hat{e}_t^{\$/yen}$). Since the price level is sticky in the short run, $p_0 = 0$ at time 0. We assume the initial equilibrium values ($\bar{p}_0 = \bar{e}_0 = 0$), and new equilibrium values after dollar-yen rate change are

$$\bar{p}' = \frac{1}{D}\left[\psi\theta\hat{e}_t^{\$/yen} + (1 + \psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \psi\varsigma\Delta\hat{e}_t^{yen}\right] \quad (10)$$

where $\hat{p}_{t+1}^e = p_{t+1}^e - \bar{p}^e$ and we assume that total productivity will not be affected by exchange rate change i.e. $\hat{\alpha}_t = 0$.

The difference equation (6) can be solved as

$$p_t - \bar{p}' = -\frac{1}{D}\left[\psi\theta\hat{e}_t^{\$/yen} + (1 + \psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \psi\varsigma\Delta\hat{e}^{yen}\right]\{1 - \psi(\delta + \theta) - \eta\}^t \quad (11)$$

We solve for the rational expectation and obtain the expression for $y_t - \bar{y}'$ and $p_t - \bar{p}'$ such as[10][11]

$$(y_t - \bar{y}')_A = A_1(t)\hat{e}_t^{\$/yen} + A_2(t)\Delta\hat{e}^{yen} \quad (12)$$

$$(p_t - \bar{p}')_A = A_1^p(t)\hat{e}_t^{\$/yen} + A_2^p(t)\Delta\hat{e}^{yen} \quad (12a)$$

[9] We assume that $p_{t+1}^e = p_t^e$, and $\Delta e^{\$/yen} = 0$ in long-rum equilibrium.

[10] We show how to solve for rational expectation and derive equation (12) in Appendix.

[11] Expression $A_1(t)$, $A_2(t)$, $A_1^p(t)$, and $A_2^p(t)$, are shown in Appendix A.

3.2 Basket-peg regime with weak capital control (B)

As the basket-peg is one type of fixed exchange rate regimes, endogenous variables are the same as under the dollar peg regime. As mentioned above, basket is a weighted average of the renminbi-dollar rate and the renminbi-yen rate. We have equation (1) together with the basket equation, which is

$$\upsilon e_t + (1-\upsilon) e_t^{yen} = \Gamma \tag{13}$$

where Γ is the value of basket. From this equation and equation (4), we can obtain

$$e_t = -(1-\upsilon) e_t^{\$/yen} \tag{13a}$$

$$e_t^{yen} = \upsilon e_t^{\$/yen} \tag{13b}$$

Substitute equation (13a) and (13b), then we can obtain

$$y_t - \bar{y} = -(\delta+\theta)p_t + \{-\delta(1-\upsilon)+\theta\upsilon\} e_t^{\$/yen} - \rho i_{t+1} + \rho\left(p_{t+1}^e - p_t^e\right) - \tau\Delta e - \varsigma \Delta e^{yen} \tag{3”}$$

Solving the equation (1), (3”), and (5) for the price level and the interest rate, the following semi-reduced form equations are obtained:

$$\begin{aligned} p_{t+1} - p_t \;=\; & -\alpha_t + \{\psi(\delta+\theta)+\eta\} p_t + \left[\psi\{\theta\upsilon - \delta(1-\upsilon) - \rho\lambda(1+\sigma)(1-\upsilon)\} - \eta(1-\upsilon)\right] e_t^{\$/yen} \\ & \psi\rho\lambda(1-\upsilon) e_{t+1}^{\$/yen} + (1+\psi\rho)\left(p_{t+1}^e - p_t^e\right) - (\psi\tau - \chi)\Delta e - \psi\varsigma\Delta e^{yen} \end{aligned} \tag{14}$$

$$i_{t+1} - i_t = -\lambda i_t - \lambda(1-\upsilon) e_{t+1}^{\$/yen} + \lambda(1+\sigma)(1-\upsilon) e_t^{\$/yen} \tag{15}$$

The long-run equilibrium value is derived as

$$\bar{p} = \frac{\psi\{\theta\upsilon - \delta(1-\upsilon) + \rho\sigma(1-\upsilon)(2\lambda-1) + \eta(1-\upsilon)\}}{\psi(\delta+\theta)+\eta} \bar{e}^{\$/yen} - \frac{1}{\psi(\delta+\theta)+\eta}\bar{\alpha} \tag{16}$$

$$\bar{\imath} = (1-\upsilon)\sigma \bar{e}_t^{\$/yen} \tag{17}$$

As in Section 3.1, we assume dollar-yen rate moved from its initial equilibrium value ($=0$) to $\hat{e}_t^{\$/yen}$ at time t and remained at the new equilibrium after time $t+1$ ($=\hat{e}_t^{\$/yen}$). Since the price level is sticky in the short-run, ($\bar{p}_0 = \bar{e}_0 = 0$), and new equilibrium values after dollar-yen rate change are

$$\bar{p}' = \frac{1}{D}\left\{ \begin{array}{c} \left[\psi\{\theta\upsilon - \delta(1-\upsilon) - \rho\lambda(1+\sigma)(1-\upsilon)\} - \eta(1-\upsilon)\right] \hat{e}_t^{\$/yen} \\ +(1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - (\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen} \end{array} \right\} \tag{18}$$

$$\bar{\imath}' = (1-\upsilon)\sigma \hat{e}_t^{\$/yen} \tag{19}$$

where $D = \psi(\delta+\theta)+\eta$.

The difference equations (14) and (15) can be solved as follows;

$$p_t - \bar{p}' = -\frac{1}{D}\left[\begin{array}{c} \left[\psi\left\{\theta\upsilon - \delta(1-\upsilon) - \rho\lambda(1+\sigma)(1-\upsilon)\right\} - \eta(1-\upsilon)\right]\hat{e}_t^{\$/yen} \\ +(1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - (\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen} \end{array}\right]\left\{1-\psi(\delta+\theta)-\eta\right\}^t \tag{20}$$

$$(i_t - \bar{\imath}') = -(1-\upsilon)\sigma(1-\lambda)^t \hat{e}_t^{\$/yen} \tag{21}$$

We solve for the rational expectation and obtain the expression for $y_t - \bar{y}'$ and $p_t - \bar{p}'$ such as[12][13]

$$(y_t - \bar{y}')_B = B_1(t)\upsilon\hat{e}_t^{\$/yen} + B_2(t)\hat{e}_t^{\$/yen} + B_3(t)\hat{z}_t \tag{22}$$

$$(p_t - \bar{p}')_B = B_1^p(t)\upsilon\hat{e}_t^{\$/yen} + B_2^p(t)\hat{e}_t^{\$/yen} + B_3^p(t)\hat{z}_t \tag{22a}$$

3.3 Basket-peg regime with no capital control (C)

As in Section 3.2, we have the same equation (13a) and (13b) such as

$$e_t = -(1-\upsilon)e_t^{\$/yen} \tag{13a}$$

$$e_t^{yen} = \upsilon e_t^{\$/yen} \tag{13b}$$

Since we assume perfect capital moblity, we have equation (1') with $\lambda = 1$. Substituting equation (13a) and (13b), we have the same equation (3").

Solving the equation (2), (3"), and (5) for the price level and money supply, the following semi-reduced form equations are obtained:

$$\begin{aligned} p_{t+1} - p_t \quad = \quad & -\alpha_t - \left\{\psi(\delta+\theta)+\eta\right\}p_t + \left[\psi\left\{\theta\upsilon - \delta(1-\upsilon) - \rho(1+\sigma)(1-\upsilon)\right\} - \eta(1-\upsilon)\right]e_t^{\$/yen} \\ & +\psi\rho(1-\upsilon)e_{t+1}^{\$/yen} + (1+\psi\rho)\left(p_{t+1}^e - p_t^e\right) - (\psi\tau-\chi)\Delta e - \psi\varsigma\Delta e^{yen} \end{aligned} \tag{23}$$

$$\begin{aligned} m_t \quad = \quad & \left[1-\phi(\delta+\theta)\right]p_t + (\epsilon+\phi\rho)(1-\upsilon)e_{t+1}^{\$/yen} + \phi\rho\left(p_{t+1}^e - p_t^e\right) - \phi\varsigma\Delta e^{yen} - \phi\tau\Delta e \\ & + \left[\phi\left\{-\delta(1-\upsilon)+\theta\upsilon\right\} - (\epsilon+\phi\rho)(1-\upsilon)(1+\sigma)\right]e_t^{\$/yen} \end{aligned} \tag{24}$$

[12] We show how to solve for rational expectation and derive equation (19) in Appendix A.2.

[13] Expression $B_1(t)$, $B_2(t)$, $B_3(t)$, $B_1^p(t)$, $B_2^p(t)$, and $B_3^p(t)$ are shown in Appendix A.

The long-run equilibrium value is derived as

$$\bar{p} = \frac{\psi\left\{\theta\upsilon - \delta(1-\upsilon) - \rho\sigma(1-\upsilon)\right\} - \eta(1-\upsilon)}{\psi(\delta+\theta)+\eta}\bar{e}^{\$/yen} - \frac{1}{\psi(\delta+\theta)+\eta}\bar{\alpha} \quad (25)$$

$$\bar{m} = \left[1-\phi(\delta+\theta)\right]\bar{p} + \left[\phi\left\{-\delta(1-\upsilon)+\theta\upsilon\right\} - \sigma\left(\epsilon+\phi\rho\right)(1-\upsilon)\right]\bar{e}^{\$/yen} \quad (26)$$

As in Section 3.1, we assume dollar-yen rate moved from its initial value to $\hat{e}_t^{\$/yen}$ at period t and moved back to its initial value at $t+1$ ($\hat{e}_{t+1}^{\$/yen} = 0$) and remains at new equilibrium after time $t+1$ $(=\hat{e}_{t+1}^{\$/yen})$. Since the price level is sticky in the short-run, ($\bar{p}_0 = \bar{e}_0 = 0$), and new equilibrium values after dollar-yen rate change are

$$\bar{p}' = \frac{-1}{D}\left\{\begin{array}{c}\left[\psi\left\{\theta\upsilon - \delta(1-\upsilon) - \rho(1+\sigma)(1-\upsilon)\right\} - \eta(1-\upsilon)\right]\hat{e}_t^{\$/yen} \\ +(1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - (\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen}\end{array}\right\} \quad (27)$$

$$\begin{aligned}\bar{m}' \; = \; & \left[1-\phi(\delta+\theta)\right]\bar{p}' + \left[\phi\left\{-\delta(1-\upsilon)+\theta\upsilon\right\} - \sigma\left(\epsilon+\phi\rho\right)(1-\upsilon)\right]\hat{e}^{\$/yen} \\ & +\phi\rho\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \phi\varsigma\Delta\hat{e}^{yen} - \phi\tau\Delta\hat{e} \quad (28)\end{aligned}$$

where $D = \psi(\delta+\theta)+\eta$.

The difference equations (23) can be solved as follows;

$$p_t - \bar{p}' = \frac{-1}{D}\left[\begin{array}{c}\left[\psi\left\{\theta\upsilon - \delta(1-\upsilon) - \rho(1+\sigma)(1-\upsilon)\right\} - \eta(1-\upsilon)\right]\hat{e}_t^{\$/yen} \\ +(1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - (\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen}\end{array}\right]\left\{1-\psi(\delta+\theta)-\eta\right\}^t \quad (29)$$

We solve for the rational expectation to obtain expression for $y_t - \bar{y}'$ and $p_t - \bar{p}'$ such as[14][15]

$$\left(y_t - \bar{y}'\right)_C = C_1(t)\upsilon\hat{e}_t^{\$/yen} + C_2(t)\hat{e}_t^{\$/yen} + C_3(t)\hat{z}_t \quad (30)$$

$$\left(y_t - \bar{y}'\right)_C = C_1^p(t)\upsilon\hat{e}_t^{\$/yen} + C_2^p(t)\hat{e}_t^{\$/yen} + C_3^p(t)\hat{z}_t \quad (30a)$$

3.4 Floating regime with no capital control (D)

Under the floating regime, money supply (m_t) becomes exogenous. From (1') to (5), we derive following two difference equations.

[14] We show how to solve for rational expectation and derive equation (30) in Appendix A.3.

[15] Expression $C_1(t)$, $C_2(t)$, $C_3(t)$, $C_1^p(t)$, $C_2^p(t)$, and $C_3^p(t)$ are shown in Appendix A.

$$e_{t+1} - e_t = f_1 e_t + f_2 p_t - \frac{\phi}{\epsilon + \phi\rho} \left[\begin{array}{c} \theta e_t^{\$/yen} + \rho\left(p_{t+1}^e - p_t^e\right) \\ -\tau\Delta e - \varsigma\Delta e^{yen} \end{array} \right] - \frac{1}{\epsilon + \phi\rho} m_t \quad (31)$$

$$\begin{aligned} p_{t+1} - p_t \quad = \quad & f_3 e_t + f_4 p_t + \frac{\psi\rho}{\epsilon + \phi\rho} m_t + \left[\frac{\psi\rho^2\phi}{\epsilon + \phi\rho} + 1 + \psi\rho\right]\left(p_{t+1}^e - p_t^e\right) - \alpha_t \quad (32) \\ & + \frac{\psi\epsilon\theta}{\epsilon + \phi\rho} e_t^{\$/yen} + \left(\chi - \psi\tau\left(1 + \frac{\phi\rho}{\epsilon + \phi\rho}\right)\right)\Delta e - \psi\varsigma\left(1 + \frac{\phi\rho}{\epsilon + \phi\rho}\right)\Delta e^{yen} \end{aligned}$$

where $f_1 = \left[\sigma + \frac{\phi(\delta+\theta)}{\epsilon+\phi\rho}\right]$, $f_2 = \left[\frac{1+\phi(\delta+\theta)}{\epsilon+\phi\rho}\right]$, $f_3 = \left[\eta + \frac{\epsilon[\psi(\delta+\theta)+\eta]}{\epsilon+\phi\rho}\right]$, and $f_4 = \left[-\eta - \frac{\psi(\delta+\theta)(\epsilon+2\phi\rho)}{\epsilon+\phi\rho}\right]$.

The long-run equilibrium value is derived as

$$\bar{e} = -\frac{f_4 + \psi\rho f_2}{E(\epsilon + \phi\rho)}\bar{m} - \frac{\phi\theta f_4 + \psi\theta\epsilon f_2}{E(\epsilon + \phi\rho)}\bar{e}^{\$/yen} + \frac{f_2}{E}\bar{\alpha} \quad (33)$$

$$\bar{p} = \frac{f_3 + \psi\rho f_1}{E(\epsilon + \phi\rho)}\bar{m} + \frac{\phi\theta f_3 + \psi\theta\epsilon f_1}{E(\epsilon + \phi\rho)}\bar{e}^{\$/yen} - \frac{f_1}{E}\bar{\alpha} \quad (34)$$

where $E = f_2 f_3 - f_1 f_4$

Under the some assumptions mentioned in Appendix B, this system has saddle path stability. After solving for the characteristic roots of the difference equations, we obtain following saddle path[16].

$$e_t - \bar{e} = \kappa(p_t - \bar{p}) \quad (35)$$

where $\kappa = \frac{\omega_2 - 1 - f_4}{f_3}$, and $\omega_2 = \frac{1}{2}\left(2 + f_1 + f_4\right) - \frac{1}{2}\sqrt{\left(2 + f_1 + f_4\right)^2 - 4\left(1 + f_1 + f_4 + E\right)}$

Now we assume dollar-yen rate moved from its initial equilibrium value ($=0$) to $\hat{e}_t^{\$/yen}$ at time t and remained at the new equilibrium after time $t+1$ ($=\hat{e}_t^{\$/yen}$). Initial equilibrium values are $\bar{p}_0 = \bar{e}_o = 0$, and the new equilibrium values after dollar-yen rate change are

$$\bar{p}' = \frac{f_3 + \psi\rho f_1}{E(\epsilon + \phi\rho)} m_t + \frac{\phi\theta f_3 + \psi\theta\epsilon f_1}{E(\epsilon + \phi\rho)}\hat{e}^{\$/yen} + g_1\left(p_{t+1}^e - p_t^e\right) + g_2\Delta e + g_3\Delta e^{yen} \quad (36)$$

$$\bar{e}' = -\frac{f_4 + \psi\rho f_2}{E(\epsilon + \phi\rho)} m_t - \frac{\phi\theta f_4 + \psi\theta\epsilon f_2}{E(\epsilon + \phi\rho)}\hat{e}_t^{\$/yen} + g_1'\left(p_{t+1}^e - p_t^e\right) + g_2'\Delta e + g_3'\Delta e^{yen} \quad (37)$$

where $g_1 = \frac{\phi\rho f_3 + \left(1 + \rho\psi\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_1}{E(\epsilon+\phi\rho)}$, $g_2 = \frac{-\phi\tau f_3 + \left(\chi - \psi\tau\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_1}{E(\epsilon+\phi\rho)}$, $g_3 = \frac{\phi\varsigma f_3 - \left(\psi\varsigma\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_1}{E(\epsilon+\phi\rho)}$, $g_1' = -\frac{\phi\rho f_4 + \left(1 + \rho\psi\rho\psi\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_2}{E(\epsilon+\phi\rho)}$, $g_2' = -\frac{-\phi\tau f_4 + \left(\chi - \psi\tau\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_2}{E(\epsilon+\phi\rho)}$, $g_3' = \frac{-\phi\varsigma f_4 - \left(\psi\varsigma\left(1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}\right)\right) f_2}{E(\epsilon+\phi\rho)}$

The new saddle path is

[16] We show that this system satisfies the saddle path stability in Appendix B.

$$e_t - \bar{e}' = \kappa(p_t - \bar{p}') \tag{38}$$

Assuming that the agents have perfect foresight and can always be on the saddle path, the economy can jump on this new saddle path. Furthermore, we assume that the price is sticky in the short-run and does not move from the initial value, implying $p_0 = 0$. Substituting this into the new saddle path, the exchange rate at time 0 is

$$e_0 = \bar{e}' - \kappa\bar{p}' \tag{39}$$

which shows that the exchange rate undershoots its new equilibrium value. Now using p_0, and e_0 as initial values,

$$p_t - \bar{p}' = -\omega_2^t\bar{p}' \tag{40}$$

$$e_t - \bar{e}' = -\kappa\omega_2^t\bar{p}' \tag{41}$$

Substituting those expressions into equation (3) and solving for the rational expectation yields the following expression, for $y_t - \bar{y}'$ and $p_t - \bar{p}'$[17]

$$(y_t - \bar{y}')_D = D_1(t)\hat{e}_t^{\$/yen} + D_2(t)\hat{z}_t + D_3(t)m_t \tag{42}$$

$$(p_t - \bar{p}')_D = D_1^p(t)\hat{e}_t^{\$/yen} + D_2^p(t)\hat{z}_t + D_3^p(t)m_t \tag{42a}$$

4 Path to the stable exchange rate regime

In this section, we derive four transition policies. Based on the results of static analysis shown by Yoshino, Kaji and Suzuki (2004)[18], we regard the stable desirable regimes are either basket peg regime without capital control (C) or floating regime without capital control (D). We consider following three transition paths to the stable regimes plus maintaing current regime such as dollar-peg regime with capital control (A).

(1) Maintaining dollar-peg (with strict capital control) ((A)- (A)- (A))

(2) Gradual shift from dollar-peg to the stable basket-peg (gradual adjustment of both capital controls and basket weight) ((A)- (B)- (C))

[17] We show how to solve for rational expectation and derive equation (43) in Appendix A.4.

[18] Yoshino, Kaji, and Suzuki (2004) shows that for small open economy like Thailand, it would be desirable to adopt basket-peg or floating rather than dollar-peg under static analysis. Furthermore, Yoshino, Kaji, and Asonuma (2004) confirms that this statement is also true under two-country general equilibrium model.

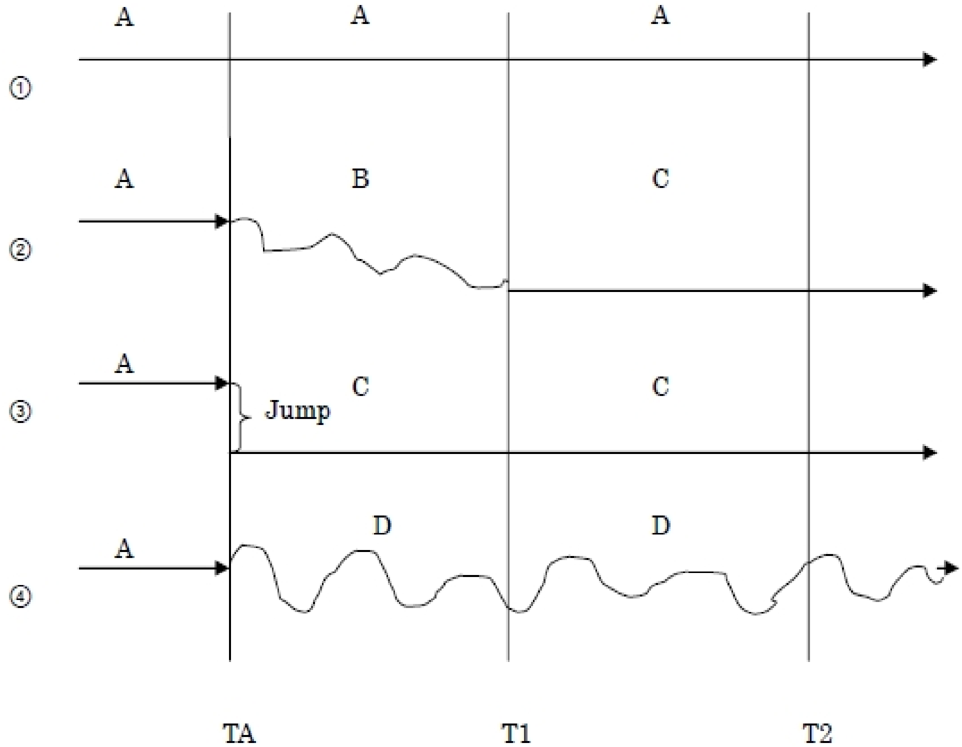
(3) Sudden shift from dollar-peg to the stable basket-peg (sudden removal of capital control and sudden shift of basket weights) ((A)- (C) – (C))

(4) Sudden shift from dollar-peg to the floating regime (sudden removal of capital control and sudden increase of flexibility in exchange rate) ((A) – (D) – (D))

The first policy is maintaining dollar-peg regime. In order to maintain dollar-peg regime, the monetary authority restricts capital control and fixes the dollar rate weight to 1. The second policy is that it includes the transition period (B), which reflects the adjustment period of capital control and basket weights. It starts from dollar-peg regime and undergoes the transition period (B) and finally arrives at stable basket-peg regime without capital control (C).

The third policy is that it does not includes the transition period (B), so therefore, the monetary authority shifts from dollar-peg regime to the stable basket-peg regime without transition period, implying the economy will jump to the stable basket-peg. Lastly, fourth policy is that the monetary authority shifts from dollar-peg to floating regime without transition period, implying the economy will suddenly jump to floating regime. We assume that time interval for initial dollar-peg regime is T_A. Furthermore, we regard the transition period as T_1 and the time interval after the authority adopts stable regime as T_2. We assume that discount factor is β. Figure 2 displays the four policies respectively. Throughout Section 4, we assume the loss which the monetary authority minimizes is output gap. We also derive the cumulative loss for stabilization of the price level.

Figure 2: Four policies toward stable regimes



4.1 Maintaining dollar-peg regime

In this subsection, we derive the cumulative loss for maintaining the dollar-peg regime. We use the cumulative loss of maintaining the dollar-peg regime later in Section 5. The country maintains dollar-peg regime for the entire time period $T_A + T_1 + T_2$. The cumulative loss for maintaining dollar-peg for $T_1 + T_2$ after the initial dollar-peg period T_A is expressed as follows[19].

$$L_1\left(T_1+T_2\right)=\sum_{t=1}^{T_A+T_1+T_2}\beta^{t-1}(y_t-\bar{y}')_A^2=\sum_{t=1}^{T_A+T_1+T_2}\beta^{t-1}\left[A_1(t)\hat{e}_t^{\$/yen}+A_2(t)\Delta\hat{e}^{yen}\right]^2 \tag{43}$$

[19] The cumulative loss evaluated in term of deviation of the price level from the steady state level is shown as follows;

$$L_1^p\left(T_1+T_2\right)=\sum_{t=1}^{T_A+T_1+T_2}\beta^{t-1}(p_t-\bar{p}')_A^2=\sum_{t=1}^{T_A+T_1+T_2}\beta^{t-1}\left[A_1^p(t)\hat{e}_t^{\$/yen}+A_2^p(t)\Delta\hat{e}^{yen}\right]^2 \tag{43a}$$

4.2 Gradual shift from dollar-peg regime to the basket-peg with no capital control

In this section, we first define the cumulative loss for policy (2) with transitional period. Then we derive the optimal weight of the basket which the monetary authority targets as the goal under stable basket-peg.

First, we define the optimal weight of the basket as υ^* assuming that $0 \leq \upsilon^* \leq 1$. As we mentioned above, the monetary authority starts with adopting the dollar-peg regime with capital control (A) implying weight of basket is equal to 1. Then it shifts to the basket-peg regime and gradually loose the degree of capital control under regime (B). During the transiton period, the monetary authority adjusts its basket weight constantly (decrease its weight by $\frac{1-\upsilon^*}{T_1}$ each period) in order to reach at υ^* when it reaches basket-peg regime adopting the optimal weight (υ^*) under regime (C). The cumulative loss of transitional policy (2) with optimal basket weight υ^*, tranition period T_1, and stable regime period T_2, and can be expressed as[20]

$$\begin{aligned} L_2\left(\upsilon^*, T_1, T_2\right) &= \sum_{t=1}^{T_A} \beta^{t-1}(y_t - \bar{y}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1} \beta^{t-1}(y_t - \bar{y}')_B^2 + \sum_{t=T_A+T_1+1}^{T_A+T_1+T_2} \beta^{t-1}(y_t - \bar{y}')_C^2 \\ &= \sum_{t=1}^{T_A} \beta^{t-1}(y_t - \bar{y}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1} \beta^{t-1} \left[B_1(t)\upsilon(t)\hat{e}_t^{\$/yen} + B_2(t)\hat{e}_t^{\$/yen} + B_3(t)\hat{z}_t\right]^2 \\ &\quad + \sum_{t=T_A+T_1+1}^{T_A+T_1+T_2} \beta^{t-1} \left[C_1(t)\upsilon^*\hat{e}_t^{\$/yen} + C_2(t)\hat{e}_t^{\$/yen} + C_3(t)\hat{z}_t\right]^2 \qquad (44) \end{aligned}$$

where $(y_t - \bar{y}')_A^2 = \left[A_1(t)\hat{e}_t^{\$/yen} + A_2(t)\Delta\hat{e}^{yen}\right]^2$ and $\upsilon(t) = 1 - \frac{1-\upsilon^*}{T_1}(t - T_A)$.

We differenciate the cumulative loss by $L_2\left(\upsilon^*, T_1, T_2\right)$ respect to υ^*. From $\frac{\partial L_2(\upsilon^*, T_1, T_2)}{\partial \upsilon^*} = 0$, we obtain the optmial weight as

[20] The cumulative loss evaluated in term of deviation of the price level from the steady state level is defined as follows;

$$\begin{aligned} L_2^p\left(\upsilon_p^*, T_1, T_2\right) &= \sum_{t=1}^{T_A} \beta^{t-1}(p_t - \bar{p}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1} \beta^{t-1}(p_t - \bar{p}')_B^2 + \sum_{t=T_A+T_1+1}^{T_A+T_1+T_2} \beta^{t-1}(p_t - \bar{p}')_C^2 \\ &= \sum_{t=1}^{T_A} \beta^{t-1}(p_t - \bar{p}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1} \beta^{t-1} \left[B_1^p(t)\upsilon(t)\hat{e}_t^{\$/yen} + B_2^p(t)\hat{e}_t^{\$/yen} + B_3^p(t)\hat{z}_t\right]^2 \\ &\quad + \sum_{t=T_A+T_1+1}^{T_A+T_1+T_2} \beta^{t-1} \left[C_1^p(t)\upsilon_p^*\hat{e}_t^{\$/yen} + C_2^p(t)\hat{e}_t^{\$/yen} + C_3^p(t)\hat{z}_t\right]^2 \qquad (44a) \end{aligned}$$

where $(p_t - \bar{p}')_A^2 = \left[A_1^p(t)\hat{e}_t^{\$/yen} + A_2^p(t)\Delta\hat{e}^{yen}\right]^2$, $\upsilon_p(t) = 1 - \frac{1-\upsilon_p^*}{T_1}(t - T_A)$ and υ_p^* is the optimal weight for the transitional policy of stabilizing the price level.

$$\upsilon^* = -\frac{1}{H_1}\left[\begin{array}{c}\sum_{t=T_A+T_1+1}^{T_A+T_1+T_2}\beta^{t-1}C_1(t)\hat{e}_t^{\$/yen}\left(C_2(t)\hat{e}_t^{\$/yen}+C_3(t)\hat{z}_t\right)\\ +\sum_{t=T_A+1}^{T_A+T_1}\beta^{t-1}B_1(t)\hat{e}_t^{\$/yen}\left(\frac{t-T_A}{T_1}\right)\left\{B_1(t)\hat{e}_t^{\$/yen}\left(\frac{t-T_A}{T_1}\right)+B_2(t)\hat{e}_t^{\$/yen}+B_3(t)\hat{z}_t\right\}\end{array}\right] \tag{45}$$

where $H_1 = \left[\sum_{t=T_A+1}^{T_A+T_1}\beta^{t-1}\left\{B_1(t)\hat{e}_t^{\$/yen}\left(\frac{t-T_A}{T_1}\right)\right\}^2+\sum_{t=T_A+T_1+1}^{T_A+T_1+T_2}\beta^{t-1}\left(C_1(t)\hat{e}_t^{\$/yen}\right)^2\right]$

4.3 Sudden shift from dollar-peg regime to the basket-peg with no capital control

In this sub-section, we first derive the cumulative loss from the dollar-peg regime with capital control (A) to the stable basket-peg regime with no capital control (C) without transition period. Then we derive the optimal weight under stable basket-peg, which is different from the one derived in section 4.2.

First of all, we define the optimal weight of the basket as υ^{**} under stable basket-peg regime. We will later show that weight of basket is different from υ^*, which we have derived in section 4.2. As we mentioned above, home country starts with adopting the dollar-peg regime with capital control (A) implying that weight is fixed at 1, and suddenly it shifts to the basket-peg regime adopting the optimal weight (υ^{**}) with no capital control (C). The cumulative loss for policy (C) with optimal basket weight υ^{**} and stable regime period T_1+T_2 is shown as follows[21],

$$\begin{aligned} L_3(\upsilon^{**}, T_1+T_2) &= \sum_{t=1}^{T_A}\beta^{t-1}(y_t-\bar{y}')_A^2+\sum_{t=T_A+1}^{T_A+T_1+T_2}\beta^{t-1}(y_t-\bar{y}')_C^2 \qquad (46)\\ &= \sum_{t=1}^{T_A}\beta^{t-1}(y_t-\bar{y}')_A^2+\sum_{t=T_A+1}^{T_A+T_1+T_2}\beta^{t-1}\left[C_1(t)\upsilon^{**}\hat{e}_t^{\$/yen}+C_2(t)\hat{e}_t^{\$/yen}+C_3(t)\hat{z}_t\right]^2 \end{aligned}$$

where $(y_t-\bar{y}')_A^2 = \left[A_1(t)\hat{e}_t^{\$/yen}+A_2(t)\Delta\hat{e}^{yen}\right]^2$ and note that exchange rate volatility after the shift is included in the last term of second line of equation (46).

[21] The cumulative loss for stabilizing the price level is shown as follows;

$$\begin{aligned} L_3(\upsilon^{**}, T_1+T_2) &= \sum_{t=1}^{T_A}\beta^{t-1}(p_t-\bar{p}')_A^2+\sum_{t=T_A+1}^{T_A+T_1+T_2}\beta^{t-1}(p_t-\bar{p}')_C^2 \qquad (46a)\\ &= \sum_{t=1}^{T_A}\beta^{t-1}(p_t-\bar{p}')_A^2+\sum_{t=T_A+1}^{T_A+T_1+T_2}\beta^{t-1}\left[C_1^p(t)\upsilon_p^{**}\hat{e}_t^{\$/yen}+C_2^p(t)\hat{e}_t^{\$/yen}+C_3^p(t)\hat{z}_t\right]^2 \end{aligned}$$

where $(p_t-\bar{p}')_A^2 = \left[A_1^p(t)\hat{e}_t^{\$/yen}+A_2^p(t)\Delta\hat{e}^{yen}\right]^2$ and υ_p^{**} is the optimal weight for stabilizing the price level.

We differenciate the cumulative loss by $L_3(\upsilon^{**}, T_1 + T_2)$ respect to υ^{**}. From $\frac{\partial L_3(\upsilon^{**}, T_1+T_2)}{\partial \upsilon^{**}} = 0$, we obtain the optmial weight as

$$\upsilon^{**} = -\frac{1}{H_2}\left[\sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1} C_1(t)\hat{e}_t^{\$/yen}\left(C_2(t)\hat{e}_t^{\$/yen} + C_3(t)\hat{z}_t\right)\right] \tag{47}$$

where $H_2 = \left[\sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^t \left(C_1(t)\hat{e}_t^{\$/yen}\right)^2\right]$

Comparing with weight obtained in section 4.2., υ^{**} is different from υ^* as long as $T_1 \neq 0$. This is because υ^{**} is the weight which minimizes the loss under stable basekt peg regime period while υ^* is the weight which minimizes the sum of the discounted loss under transition period and stable basket-peg regime period.

4.4 Sudden shift from dollar-peg to the floating regime

Lastly, we calculate the cumulative loss for policy (4) which the monetary authority shifts from dollar-peg regime to floating regime with no capital control (D) without transition period. We assume the optimal money supply as m^*. The monetary authority starts with adopting the dollar-peg regime with capital control (A) implying that weight is fixed at 1, and suddenly it jumps to floating regime with no capital control. The cumulative loss under policy (4) with stable regime period $T_1 + T_2$ and optimal money supply m^* is shown as follows[22],

$$\begin{aligned} L_4(m^*, T_1 + T_2) &= \sum_{t=1}^{T_A} \beta^{t-1}(y_t - \bar{y}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1}(y_t - \bar{y}')_D^2 \qquad (48) \\ &= \sum_{t=1}^{T_A} \beta^{t-1}(y_t - \bar{y}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1}\left[D_1(t)\hat{e}_t^{\$/yen} + D_2(t)\hat{z}_t + D_3(t)m^*\right]^2 \end{aligned}$$

where $(y_t - \bar{y}')_A^2 = \left[A_1(t)\hat{e}_t^{\$/yen} + A_2(t)\Delta\hat{e}^{yen}\right]$ and note that exchange rate volatility after the shift is included in the last term of second line of equation (48).

[22] The cumulative loss for stabilizing the price level is defined as follows;

$$\begin{aligned} L_4^p(m^*, T_1 + T_2) &= \sum_{t=1}^{T_A} \beta^{t-1}(p_t - \bar{p}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1}(p_t - \bar{p}')_D^2 \qquad (48a) \\ &= \sum_{t=1}^{T_A} \beta^{t-1}(p_t - \bar{p}')_A^2 + \sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1}\left[D_1^p(t)\hat{e}_t^{\$/yen} + D_2^p(t)\hat{z}_t + D_3^p(t)m_p^*\right]^2 \end{aligned}$$

where $(p_t - \bar{p}')_A^2 = \left[A_1^p(t)\hat{e}_t^{\$/yen} + A_2^p(t)\Delta\hat{e}^{yen}\right]$ and m_p^* is the optimal money supply for stabilizing the price level.

We differenciate the cumulative loss by $L_4(m^*, T_1+T_2)$ respect to m^*. From $\frac{\partial L_4(m^*, T_1+T_2)}{\partial m^*} = 0$, we obtain the optimal money supply,

$$m^* = \frac{-1}{H_3}\left[\sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1} \frac{\rho}{(\epsilon+\phi\rho)} \left(D_1(t)\hat{e}_t^{\$/yen} + D_2(t)\hat{z}_t\right)\right] \tag{49}$$

where $H_3 = \left[\sum_{t=T_A+1}^{T_A+T_1+T_2} \beta^{t-1}\left(\frac{\rho^2}{(\epsilon+\phi\rho)^2}\right)\right]$

5 Comparison of the cumulative losses

Using the derived cumulative losses depending on the transition policies, we analyze what the optimal policy for the monetary authority to stabilize GDP fluctuation is in this section.

We have two goals in this section. One is to consider whether maintaing dollar-peg regime is optimal for the monetary authority in the long-term perspective and the other is to discuss the optimal policy, given that it is not optimal to maintain dollar-peg in the long-run. In order to do them, at first step, we reflect the results of static analysis in this dynamic model. Next, we compare the current policy which is expressed as policy (1), with other transition policies to stable basket-peg or floating regime.

Reflecting the results that dollar-peg is not desirable in the long-run, at the second step, we examine the optimal policy for the monetary authority among the three policies. As one of the case study, we provide the simulation results using the Thai data to support the theoretical results in Appendix C.

5.1 Reflecting the results of static analysis

Before discussing the desirability of dollar-peg in the long term, we reflect the some implications from the static analysis in this subsection. Using static small open general equilibrium model, Yoshino, Kaji, and Suzuki (2004) shows that it is not optimal for small open economy to adopt dollar-peg compared with basket-peg or floating regimes[23]. In other words, the value of the loss under dollar-peg is higher than ones under basket-peg or floating regime at the static level.

We can express these implications by using one-period losses in this model as follows[24];

[23] Furthermore, Yoshino, Kaji, and Asonuma (2004) describe the same implications under static two-country general equilibrium model.

[24] Similarly, we can express these implications by using one-period losses in term of the deviation of the price level from the steady state as follows;

$$(p_t - \bar{p})_A > (p_t - \bar{p})_C \tag{50a}$$

$$(p_t - \bar{p})_A > (p_t - \bar{p})_D \tag{51a}$$

$$(y_t - \bar{y})_A > (y_t - \bar{y})_C \tag{50}$$

$$(y_t - \bar{y})_A > (y_t - \bar{y})_D \tag{51}$$

Note that these results hold under regimes which has been maintained for several periods,

5.2 Comparison of policy (1) and other transition policies

In this subsection, we discuss the desirability of dollar-peg in the long-term by comparing policy (1) and other transition policies to basket-peg or floating regime. First, we consider comparison betweeen maintaining dollar-peg (policy (1)) and shift to the stable basket-peg regime (policy (3)). We define threshold time period T_C^* such that

$$L_1(T_C^*) = L_3\left(\upsilon^{**}, T_C^*\right)$$

imlying the time intervals under which cumulative loss of maintaing dollar-peg is equal to one of shift to basket-peg. Based on fact that equation (50) holds under stable regime period[25], we obtain the following statements;

$$L_1(t) < L_3\left(\upsilon^{**}, t\right) \quad if\ t < T_C^*$$

$$L_1(t) > L_3\left(\upsilon^{**}, t\right) \quad if\ t > T_C^*$$

It means that if t is shorter than threshold time period T_C^*, then the cumulative loss of maintaining dollar-peg is smaller than one of transition policy to basket-peg. This could happen only if the exchange rate volatility affects negatively to the economy[26]. On the other hand, if t is longer than threshold time period T_C^*, then the cumulative loss of maintaining dollar-peg is higher than one of transition policy to basket-peg. In other wods, longer the stable time period, the more benefits the country can obtain from shifting to basket-peg regime as shown in equation (50).

[25] For the price level stability, the similar statements will be satisfied;

$$L_1^p(t) < L_3^p\left(\upsilon_p^{**}, t\right) \quad if\ t < T_C^{*p}$$

$$L_1^p(t) > L_3^p\left(\upsilon_p^{**}, t\right) \quad if\ t > T_C^{*p}$$

where

$$L_1^p(T_C^{*p}) = L_3^p\left(\upsilon_p^{**}, T_C^{*p}\right)$$

[26] As we explained in section 4.3, the effect of exchange rate volatility due to the shift is included in the expression of cumulative loss under policy (3). Therefore, at the short-horizon, maintaining current regime can avoid the effect of exchange rate volatility and lead to smaller loss.

Next, we contrast the losses under maintaining dollar-peg (policy (1)) and shift to the stable floating regime (policy (4)). Similarly, we define time period T_D^* such that

$$L_1(T_D^*) = L_4\left(m^*, T_D^*\right)$$

imlying the time intervals under which cumulative loss of maintaing dollar-peg is equal to one of shift to floating regime. Reflecting that equation (51) holds under stable regime period, the following statements hold[27];

$$L_1(t) < L_4\left(m^*, t\right) \qquad if \;\; t < T_D^*$$

$$L_1(t) > L_4\left(m^*, t\right) \qquad if \;\; t > T_D^*$$

Similar to the comparison of dollar-peg and shift to basket-peg, longer the stable period of floating regime, the more benefits the country can obtain from shifting to floating regime as shown in equation (51).

Summarizing the results mentioned, the maintaining dollar-peg regime is desirable only in the short-term, i.e. $t < Min\left[T_C^*, T_D^*\right]$[28]. As the longer the stable time period, the more benefits the country can obtain from shifting to either basket-peg or floating regime.

5.3 Comparison among transition policies

At the second step, we examine the optimal policy for the monetary authority among the three transition policies. There are costs and benefits for three transition policiy (2), (3), and (4), shown in Table 2. For components of the costs, estimates based on numerical analysis are provided in Table 3.

Table 2: Costs and benefits of each transition policy

[27] For the price level stability, the similar statements will be satisfied;

$$L_1^p(t) < L_4^p\left(m^*, t\right) \quad if\; t < T_D^{*p}$$

$$L_1^p(t) > L_4^p\left(m^*, t\right) \quad if\; t > T_D^{*p}$$

where

$$L_1^p(T_D^{*p}) = L_4^p\left(m^*, T_D^{*p}\right)$$

[28] For the case of the price stability, $t < Min\left[T_C^{*p}, T_D^{*p}\right]$

Policy	Benefits	Costs
(1) Maintaining	a. no volatility of e	a. no monetary tool
the dollar-peg		
(2) Gradual shift	a. small volatility of i	a. time to reach stable
to basket-peg	b. small volatility of e, e^{yen}	regime
		b. adjustment costs
(3) Sudden shift	a. reaching stable regime at once	a. high volatility of i
to basket-peg	(more benefits of stable regime)	b. high volatility of e, e^{yen}
	b. no adjustment costs	
(4) Sudden shift	a. reaching stable regime at once	a. high volatility of i
to floating	(more benefits of stable regime)	b. high volatility of e, e^{yen}
	b. no adjustment costs	

Table 3: Estimates of the costs under three policies

Policy	Costs	Estimates	Sum
(1) Maintaining	a. no monetary tool	3.0e-3 *1	3.0e-3
dollar-peg			
(2) Gradual shift	a. time to reach stable regime	9.607e-5 *2	9.689e-5
to basket-peg	b. adjustment costs	7.9120e-7 *3	
(3) Sudden shift	a. high volatility of i	3.4668e-7 *4	1.813e-4
to basket-peg	b. high volatility of e, e^{yen}	1.8096e-4 *5	
(4) Sudden shift	a. high volatility of i	3.7798e-6 *4	5.004e-3
to floating	b. high volatility of e, e^{yen}	0.0050 *5	

Note: *1 the estimate is based on the cumulative loss for time period of total 9 quarters (one initial period and two years).

*2 the estimate is based on the difference between values of the cumulative loss under transition period of 14 quarters and 18 quarters.

*3 the estimate of adjustment costs is based on difference between the cumulative losses based on the baseline λ and based on 20% deviation from the baseline λ.

*4 the estimates of high volatility of i are based on cumulative losses of change in interest rate originally caused by 0.001 unit deviation of $e^{\$/yen}$ shock.

*5 the estimates of high volatility of e, e^{yen} are based on cumulative losses caused by 0.001 unit deviation of $e^{\$/yen}$ shock.

Moreover, these benefits and costs are taken into account by evaluating the cumulative losses expressed by equation (44), (46), and (48). By comparing the cumulative losses, we can analyze the optimal transition policy given that the monetary authority perfers to deviate from the dollar-peg regime.

We start from comparing between gradual shift to basket-peg (policy (2)) and sudden shift to basket-peg (policy (3)). Given time period T_A, and T_2,we define T_1^* such that

$$L_2\left(\upsilon^*, T_1^*, T_2\right) = L_3\left(\upsilon^{**}, T_1^* + T_2\right)$$

reflecting the time interval for transition period under which cumulative loss of gradual adjustment policy is equal to one of sudden shift policy to basket-peg. Based on the fact that terms in $L_3\left(\upsilon^{**}, T_1 + T_2\right)$ includes high volatility of exchange rate and interest rate due to the shift, it is apparent that following results will hold[29];

$$L_2\left(\upsilon^*, T_1, T_2\right) < L_3\left(\upsilon^{**}, T_1 + T_2\right) \quad if \;\; T_1 < T_1^*$$

$$L_2\left(\upsilon^*, T_1, T_2\right) > L_3\left(\upsilon^{**}, T_1 + T_2\right) \quad if \;\; T_1 > T_1^*$$

It implies that longer the transition period of adjustment, more benefits the country can gain from reaching stable regime suddenly. However, as long as time span for transition period is in the certain range, $T_1 < T_1^*$, the monetary authority will gain benefits from avoiding large fluctuations of exchange rates.

Next, we consider the choices between policy (3) and policy (4). We can not obtain explicit conditions for optimality between policy (3) and policy (4) theoretically. Instead of theretical analysis, we rely on our numerical analysis using Thai data which is explained in Appendix C.

It shows that it is optimal for the country to adopt sudden shift to the basket peg rather than to the floating regime, given the country adopts money supply rules under floating regime. Table 4 shows the values of cumulative loss and optimal values of instruments for four policies. Our numerical analysis shows that the value of cumulative loss with sudden shift to the basket peg regime is smaller than one with sudden shift to the floating regime. It indicates that the country will be better off choosing sudden shift to the basket peg regime. Moreover, Yoshino, Kaji, and Asonuma (2008) stress that the country will be better off adopting basket weight rules under basket peg regime compared with adopting interest rate rule or money supply rule under floating regime. Focusing on the basket-peg regime, Appendix D dicsusses the relationship between otimal weights and time span for transition period and stable period.

Table 4: Values of cumulative loss and optimal values of instruments[30]

[29] For the case of the price level stability, the similar statements will hold as follows;

$$L_2^p\left(\upsilon_p^*, T_1, T_2\right) < L_3^p\left(\upsilon_p^{**}, T_1 + T_2\right) \quad if \;\; T_1 < T_1^{*p}$$

$$L_2^p\left(\upsilon_p^*, T_1, T_2\right) > L_3^p\left(\upsilon_p^{**}, T_1 + T_2\right) \quad if \;\; T_1 > T_1^{*p}$$

where

$$L_2^p\left(\upsilon_p^*, T_1^{*p}, T_2\right) = L_3^p\left(\upsilon_p^{**}, T_1^{*p} + T_2\right)$$

[30] Table 4 is the same with Table A5 in Appendix C.

	Policy (1)	Policy (2)	Policy (3)	Policy (4)
Stable regime	Dollar-peg	Basket-peg	Basket-peg	Floating
Adjustment	-	gradual	sudden	sudden
Instrument value	-	$\upsilon^* = 0.68$	$\upsilon^{**} = 0.62$	$m^* = 0.0082$
Cumulative loss (value)	0.0069	0.0006	0.0026	0.0052
Cumulative loss (% of $(\bar{y}^2)$*)	15.03	1.31	5.66	11.33

* We calculate the value of $\bar{y}^2$ shown in section 3 and obtain $\bar{y}^2 = 0.0459$

Summarizing the results in this subsection, concerning with optimality between policy (2) and policy (3), the longer the transition period of adjustments, more benefits the monetary authority will gain from arriving at stable regime at once. For the contrust between policy (3) and policy (4), from the numerical analysis, we find that it is optimal for the country to shift sudenly to the basket peg regime rather than the floating regime, given the country adopts money supply rule under floating regime. As for the case study, we provide the numerical analysis using Thai data in Appendix C to support the theretical findings mentioned above.

6 Conclusion

There is broad debate on desirable exchange regimes for East Asian countries. The dollar-peg which the most of East Asian country adopted before the Asian currency crisis, is blamed as one of the culprits of the crisis. Several economists advocate desirability of the basket-peg regimes in Asia. The main reason for adopting the basket-peg regime was that for countries with close economic relationships with the United States, Japan and the European Union, exchange rate stabilization vis-a-vis a basket comprising these currencies was beneficial, because it removed the problem of large fluctuations of exchange rates. Furthermore, Yoshino, Kaji, and Asonuma (2004) show that together with the basket-peg regime, the floating regime is also one of the options for East Asian countries.

The states which the previous research analyzes are those that an East Asian country arrives at, once it has adopted the basket-peg or the floating. For countries like China and Malaysia on the other hand, there is still a big question of how to get there.

This paper attempts to compute the dynamic effect of changing from the fixed exchange rate regime to the stable basket peg regime or the stable floating regime. We obtain two transition paths from the dollar-peg to the basket-peg regime (gradual adjustment of basket weight, or sudden shift) and one transition path from the dollar-peg to the floating regime.

The major findings are as follows. First, the value of the cumulative losses of four policies (three transition policies mentioned above plus maintaining the dollar-peg regime) are obtained theoretically as well as empirically. We find that maintaining the dollar-peg regime is desirable only in the short term, implying that the country will be better off shifting to either basket-peg regime or the floating regime.

Second, concerning the optimality between gradual adjustment (policy (2)) toward stable basket-peg regime or sudden shift to the stable basket-peg regime (policy (3)), the longer the transition period of adjustments, the more benefits the country will gain from reaching stable regime at once.

Finally, for the choice between a sudden shift to the basket-peg regime (policy (3)) and to the floating regime (policy (4)), our numerical analysis using Thai data shows that the country will be better off shifting to the basket-peg regime rather than the floating regime.

However, there is still a question remaining that how the country adjusts from the basket-peg regime to the floating exchange rate regime suppose the country will be better off having the floating exchange rate regime given that the country will be better off adopting the floating regime in the long horizons (about 20 years).

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A Solving for rational expectation

A.1 Dollar-peg regime (A)

Substituting equation (11) into equation (3'), we obtain following equation such as

$$y_t - \bar{y}' = \frac{-(\delta+\theta)}{D}\left[\begin{array}{c}\psi\theta\hat{e}_t^{\$/yen} + (1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) \\ -\psi\varsigma\Delta\hat{e}^{yen} - \hat{\alpha}_t\end{array}\right]\left[1 - \{1-\psi(\delta+\theta)-\eta\}^t\right] + \theta\hat{e}_t^{\$/yen} + \rho\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \varsigma\Delta\hat{e}^{yen} \quad \text{(A1)}$$

We take the expectation of both sides of equation (11)[31] and solve for $\hat{p}_{t+1}^e$.

$$\hat{p}_{t+1}^e = a_1\hat{e}_t^{\$/yen} + a_2\hat{p}_t^e \quad \text{(A2)}$$

Then we substitute for $\hat{p}_{t+1}^e$ in equation (11) and obtain expression for $\hat{p}_t^e$ such that

$$\hat{p}_t^e = a_3\hat{e}_t^{\$/yen} \quad \text{(A3)}$$

Substititing equation (A2) and (A3) into equation (A1), we obtain

$$y_t - \bar{y}' = A_1(t)\hat{e}_t^{\$/yen} + A_2(t)\Delta\hat{e}_t^{yen} \quad (12)$$

where $A_1(t) = -\frac{(\delta+\theta)[\psi\theta+(1+\psi\rho)(a_1+a_2a_3-a_2)]}{D}\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right] + \theta + \rho(a_1+a_2a_3-a_2)$

$A_2(t) = -\frac{\psi\zeta(\delta+\theta)}{D}\left\{1-\{1-\psi(\delta+\theta)-\eta\}^t\right\} - \varsigma.$

Furthermore, substiting equation (A2) and (A3) into equation (11), we obtain

$$p_t - \bar{p}' = A_1^p(t)\hat{e}_t^{\$/yen} + A_2^p(t)\Delta\hat{e}_t^{yen} \quad \text{(12a)}$$

$A_1^p(t) = -\frac{[\psi\theta+(1+\psi\rho)(a_1+a_2a_3-a_2)]}{D}\{1-\psi(\delta+\theta)-\eta\}^t$ and $A_2^p(t) = -\frac{\psi\zeta}{D}\{1-\psi(\delta+\theta)-\eta\}^t$

[31] We assume that the disturbance term is mean zero, implying $E(\Delta^{yen}) = 0$.

A.2 Basket-peg regime with weak capital control (B)

Substituting equation (20) into equation (3"), we obtain following equation such as

$$y_t - \bar{y}' = \frac{-(\delta+\theta)}{D}\left[\begin{array}{c}\bar{G}\hat{e}_t^{\$/yen} + (1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) \\ -(\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen}\end{array}\right]\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right] \quad \text{(A4)}$$
$$+\{-\delta(1-\upsilon)+\theta\upsilon\}\hat{e}_t^{\$/yen} - \rho\left[1-(1-\lambda)^t\right](1-\upsilon)\sigma\hat{e}_t^{\$/yen} + \rho\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \tau\Delta\hat{e} - \varsigma\Delta\hat{e}^{yen}$$

where $\bar{G} = [\psi\{\theta\upsilon - \delta(1-\upsilon) - \rho\lambda(1+\sigma)(1-\upsilon)\} - \eta(1-\upsilon)]$

We take the expectation of both sides of equation (20)[32] and solve for $\hat{p}_{t+1}^e$.

$$\hat{p}_{t+1}^e = (b_1\upsilon + b_1')\hat{e}_t^{\$/yen} + b_2\hat{p}_t^e \quad \text{(A5)}$$

Then we substitute for $\hat{p}_{t+1}^e$ in equation (20) and obtain expression for $\hat{p}_t^e$ such that

$$\hat{p}_t^e = (b_3\upsilon + b_3')\hat{e}_t^{\$/yen} \quad \text{(A6)}$$

Substituting equation (A5) and (A6) into equation (A4), we obtain

$$y_t - \bar{y}' = B_1(t)\upsilon\hat{e}_t^{\$/yen} + B_2(t)\hat{e}_t^{\$/yen} + B_3(t)\hat{z}_t \quad (22)$$

where $B_1(t) = \frac{-(\delta+\theta)}{D}\left[\left\{\begin{array}{c}\eta+\psi\{\theta+\delta+\rho\lambda(1+\delta)\} \\ +(1+\psi\rho)(b_1+b_2b_3-b_3)\end{array}\right\}\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right]\right]+$ $(\delta+\theta)+\rho\sigma\left[1-(1-\lambda)^t\right]+\rho(b_1+b_2b_3-b_3)$

$B_2(t) = \frac{-(\delta+\theta)}{D}\left[\left\{\begin{array}{c}-\eta+\psi\{-\delta-\rho\lambda(1+\delta)\} \\ +(1+\psi\rho)(b_1'+b_2b_3'-b_3')\end{array}\right\}\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right]\right]-$ $\delta-\rho\sigma\left[1-(1-\lambda)^t\right]+\rho(b_1'+b_2b_3'-b_3')$

$B_3(t)\hat{z}_t = \frac{(\delta+\theta)}{D}\{(\psi\tau-\chi)\Delta\hat{e}+\psi\zeta\Delta\hat{e}^{yen}\}\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right]-\tau\Delta\hat{e}-$ $\varsigma\Delta\hat{e}^{yen}$

Furthermore, substituting equation (A5) and (A6) into equation (20), we obtain

$$p_t - \bar{p}' = B_1^p(t)\upsilon\hat{e}_t^{\$/yen} + B_2^p(t)\hat{e}_t^{\$/yen} + B_3^p(t)\hat{z}_t \quad \text{(22a)}$$

where $B_1^p(t) = \frac{-1}{D}\left\{\begin{array}{c}\eta+\psi\{\theta+\delta+\rho\lambda(1+\delta)\} \\ +(1+\psi\rho)(b_1+b_2b_3-b_3)\end{array}\right\}\{1-\psi(\delta+\theta)-\eta\}^t$, $B_2^p(t) =$ $\frac{-1}{D}\left\{\begin{array}{c}-\eta+\psi\{-\delta-\rho\lambda(1+\delta)\} \\ +(1+\psi\rho)(b_1+b_2b_3-b_3)\end{array}\right\}\{1-\psi(\delta+\theta)-\eta\}^t$, and

$B_3^p(t)\hat{z}_t = \frac{-1}{D}\{-(\psi\tau-\chi)\Delta\hat{e}-\psi\zeta\Delta\hat{e}^{yen}\}\{1-\psi(\delta+\theta)-\eta\}^t$

[32] We assume that the disturbance term is mean zero, implying $E(\Delta e^{yen}) = 0$ and $E(\Delta e^{yen}) = 0$

A.3 Basket-peg regime with no capital control (C)

We follow the same calculation as in Section A.2 to obtain equation (30). Substituting equation (29) into equation (3"), we obtain following equation such as

$$y_t - \bar{y} = -\frac{(\delta+\theta)}{D}\left[\begin{array}{c} \bar{G}'\hat{e}_t^{\$/yen} + (1+\psi\rho)\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) \\ -(\psi\tau-\chi)\Delta\hat{e} - \psi\varsigma\Delta\hat{e}^{yen} \end{array}\right]\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right] \quad \text{(A7)}$$

$$+\{-\delta(1-\upsilon)+\theta\upsilon-\rho(1+\sigma)(1-\upsilon)\}\hat{e}_t^{\$/yen} + \rho\left(\hat{p}_{t+1}^e - \hat{p}_t^e\right) - \tau\Delta\hat{e} - \varsigma\Delta\hat{e}^{yen}$$

where $\bar{G}' = [\psi\{\theta\upsilon - \delta(1-\upsilon) - \rho(1+\sigma)(1-\upsilon)\} - \eta(1-\upsilon)]$

We take the expectation of both sides of equation (29)[33] and solve for $\hat{p}_{t+1}^e$.

$$\hat{p}_{t+1}^e = (c_1\upsilon + c_1')\hat{e}_t^{\$/yen} + c_2\hat{p}_t^e \quad \text{(A8)}$$

Then we substitute for $\hat{p}_{t+1}^e$ in equation (29) and obtain expression for $\hat{p}_t^e$ such that

$$\hat{p}_t^e = (c_3\upsilon + c_3')\hat{e}_t^{\$/yen} \quad \text{(A9)}$$

Substituting equation (A8) and (A9) into equation (A7), we obtain

$$y_t - \bar{y}' = C_1(t)\upsilon\hat{e}_t^{\$/yen} + C_2(t)\hat{e}_t^{\$/yen} + C_3(t)\hat{z}_t \quad (30)$$

$$C_1(t) = \tfrac{-(\delta+\theta)}{D}\left[\left\{\begin{array}{c} \eta+\psi(\rho\sigma+\rho+\delta+\theta) \\ +(1+\psi\rho)(c_1+c_2c_3-c_3) \end{array}\right\}\left[\begin{array}{c} 1- \\ \{1-\psi(\delta+\theta)-\eta\}^t \end{array}\right]\right] + \left\{\begin{array}{c} (\delta+\theta)+\rho(1+\sigma) \\ +\rho(c_1+c_2c_3-c_3) \end{array}\right\}$$

$$C_2(t) = \tfrac{-(\delta+\theta)}{D}\left[\left\{\begin{array}{c} -\eta-\psi(\rho\sigma+\rho+\delta) \\ +(1+\psi\rho)(c_1'+c_2c_3'-c_3') \end{array}\right\}\left[\begin{array}{c} 1- \\ \{1-\psi(\delta+\theta)-\eta\}^t \end{array}\right]\right] + \left\{\begin{array}{c} -\theta-\rho(1+\sigma)\theta \\ +\rho(c_1'+c_2'c_3'-c_3') \end{array}\right\}$$

$$C_3(t)\hat{z}_t = \tfrac{(\delta+\theta)}{D}\left\{\begin{array}{c} (\psi\tau-\chi)\Delta\hat{e}+ \\ \psi\zeta\Delta\hat{e}^{yen} \end{array}\right\}\left[1-\{1-\psi(\delta+\theta)-\eta\}^t\right] - \tau\Delta\hat{e} - \varsigma\Delta\hat{e}^{yen}.$$

Furthermore, substituting equation (A8) and (A9) into equation (29), we obtain

$$p_t - \bar{p}' = C_1^p(t)\upsilon\hat{e}_t^{\$/yen} + C_2^p(t)\hat{e}_t^{\$/yen} + C_3^p(t)\hat{z}_t \quad (30)$$

$$C_1^p(t) = \tfrac{-1}{D}\left[\left\{\begin{array}{c} \eta+\psi(\rho\sigma+\rho+\delta+\theta) \\ +(1+\psi\rho)(c_1+c_2c_3-c_3) \end{array}\right\}\{1-\psi(\delta+\theta)-\eta\}^t\right], \quad C_2^p(t) = \tfrac{-1}{D}\left[\left\{\begin{array}{c} -\eta-\psi(\rho\sigma+\rho+\delta) \\ +(1+\psi\rho)(c_1'+c_2c_3'-c_3') \end{array}\right\}\{1-\psi(\delta+\theta)-\eta\}^t\right], \quad C_3^p(t)\hat{z}_t = \tfrac{(\delta+\theta)}{D}\left\{\begin{array}{c} (\psi\tau-\chi)\Delta\hat{e}+ \\ \psi\zeta\Delta\hat{e}^{yen} \end{array}\right\}\{1-\psi(\delta+\theta$$

[33] We assume that the disturbance term is mean zero, implying $E(\Delta e^{yen}) = 0$ and $E(\Delta e^{yen}) = 0$

A.4 Floating regime without capital control (D)

Substituting equation (41) and (42) into equation (3), we obtain following equation such as

$$\begin{aligned} y_t - \bar{y}' &= H\bar{p}' + (\delta+\theta)h_1\bar{e}' + \frac{\rho}{(\epsilon+\phi\rho)}m_t \\ &\quad +\theta h_2 \hat{e}_t^{\$/yen} + \rho h_2\left(\hat{p}^e_{t+1} - \hat{p}^e_t\right) - \tau h_2 \Delta\hat{e} - \varsigma h_2 \Delta\hat{e}^{yen} \end{aligned} \quad \text{(A10)}$$

where $H = \left[-(\delta+\theta)(1-\omega_2^t) + \frac{1+\phi(\delta+\theta)}{(\epsilon+\phi\rho)} - (\delta+\theta)h_1\kappa\omega_2^t\right]$, $h_1 = 1 - \frac{\phi\rho}{(\epsilon+\phi\rho)}$, and $h_2 = 1 + \frac{\phi\rho}{(\epsilon+\phi\rho)}$. We take the expectation of both sides of equation (40)[34] and solve for $\hat{p}^e_{t+1}$.

$$\hat{p}^e_{t+1} = d_1\hat{e}_t^{\$/yen} + d_2\hat{p}^e_t \quad \text{(A11)}$$

Then we substitute for $\hat{p}^e_{t+1}$ in equation (40) and obtain expression for $\hat{p}^e_t$ such that

$$\hat{p}^e_t = d_3\hat{e}_t^{\$/yen} \quad \text{(A12)}$$

Substituting equation (A12) and (A11) into equation (A10), we obtain

$$(y_t - \bar{y}')_D = D_1(t)\hat{e}_t^{\$/yen} + D_2(t)\hat{z}_t + D_3(t)m_t \quad (42)$$

where $D_1(t) = H\frac{\phi\theta f_3 + \psi\epsilon\theta f_1}{E(\epsilon+\phi\rho)} - (\delta+\theta)\frac{\phi\theta f_4 + \psi\epsilon\theta f_2}{E(\epsilon+\phi\rho)}h_1 + [Hg_1 + h_1 g_1'(\delta+\theta) + \rho h_2](d_1 + d_2 d_3 - d_3) + h_2\theta$

$D_2(t)\hat{z}_t = \{g_2 H + h_1 g_2'(\delta+\theta) - \tau h_2\}\Delta\hat{e} + \{g_3 H + h_1 g_3'(\delta+\theta) - \zeta h_2\}\Delta\hat{e}^{yen}$, $D_3(t) = H\frac{f_3+\psi\rho f_1}{E(\epsilon+\phi\rho)} - (\delta+\theta)h_1\frac{f_4+\psi\rho f_2}{E(\epsilon+\phi\rho)} + \frac{\rho}{(\epsilon+\phi\rho)}$

Furthermore, substituting equation (A12) and (A11) into equation (40), we obtain

$$(p_t - \bar{p}')_D = D_1^p(t)\hat{e}_t^{\$/yen} + D_2^p(t)\hat{z}_t + D_3^p(t)m_t \quad (42)$$

$D_1^p(t) = -\omega_2^t\left[\frac{\phi\theta f_3 + \psi\theta\epsilon f_1}{E(\epsilon+\phi\rho)}\hat{e}^{\$/yen} + g_1(d_1 + d_2 d_3 - d_3)\right]$, $D_2^p(t) = -\omega_2^t[g_2\Delta\hat{e} + g_3\Delta\hat{e}^{yen}]$, and $D_3^p(t) = -\omega_2^t\left(\frac{f_3+\psi\rho f_1}{E(\epsilon+\phi\rho)}\right)$

B Saddle path stability under floating regime

The characteristic roots of difference equations (31) and (32) can be derived by solving the equation below.

[34] We assume that the disturbance term is mean zero, implying $E(\Delta e^{yen}) = 0$ and $E(\Delta e^{yen}) = 0$

$$\omega^2 - (2 + f_1 + f_4)\,\omega + (1 + f_1 + f_4 + E) = 0 \tag{A13}$$

Solving this equation,

$$\omega_1, \omega_2 = \frac{1}{2}\,(2 + f_1 + f_4) \pm \frac{1}{2}\sqrt{(2 + f_1 + f_4)^2 - 4\,(1 + f_1 + f_4 + E)} \tag{A14}$$

Now we assume some assumptions to satisfy the saddle path stability, such as
(a) $(2 + f_1 + f_4)^2 - 4\,(1 + f_1 + f_4 + E) > 0$,
(b) $1 + f_1 + f_4 + E > 0$, and
(c) $(2 + f_1 + f_4) - \sqrt{(2 + f_1 + f_4)^2 - 4\,(1 + f_1 + f_4 + E)} < 2$

First, under (a) $(2 + f_1 + f_4)^2 - 4\,(1 + f_1 + f_4 + E) > 0$, both ω_1, ω_2 are real and distinct. It is easily found that $\omega_1 > 1$. Now under (b) $1 + f_1 + f_4 + E > 0$,

$$\omega_1 \omega_2 = 1 + f_1 + f_4 + E > 0$$

therefore, $\omega_2 > 0$. Lastly under (c) $(2 + f_1 + f_4) - \sqrt{(2 + f_1 + f_4)^2 - 4\,(1 + f_1 + f_4 + E)} < 2$, it simply implies $\omega_2 < 1$.

The system is described by the unique stable saddle path. We can express the solution for the original varibles as

$$e_t - \bar{e} = \kappa(p_0 - \bar{p})\omega_2^t \tag{A15}$$

$$p_t - \bar{p} = (p_0 - \bar{p})\omega_2^t \tag{A16}$$

From the equations above, the saddle path is

$$e_t - \bar{e} = \kappa(p_t - \bar{p}) \tag{A17}$$

where

$$\kappa = \frac{\omega_2 - 1 - f_4}{f_3}$$

C Simulation results using Thai data

In this Appendix C, we provide the simulation result using the Thai data. There are two reasons we calibrate by using Thai data; (1) Based on the fact that China had been adopting the fixed regime until 2005 Q2 and has adopted *de facto* crowling-peg after that, therefore there is no sample periods of floating regime, and (2) we have enough sample periods for fixed regime and floating reflecting that Thailand had fixed exchange rates against the US dollar but had shifted to floating regime since 1997 Q3.

We use Thai quarterly data from the International Monetary Fund (IMF) International Financial Statistics (IFS)[35]. Thailand had fixed exchange rates against the US dollar, but has floated since 1997 Q3. To take this fact into account, we estimate with following sample periods (1) 1993Q1-1997Q2 for dollar-peg, and (2) 1997Q3- 2006Q1 for floating regime. Most variables except the interest rates are denominated in the natural log.

The procedure of simulations has been broken down to 4 steps. First, we apply the unit root tests as well as co-integration tests of the variables used in the model. Second, based on the results of unit root and co-integration results, we estimate the equations mentioned in Section 2. Third, by using the estimated coefficients, we calibrate the value of the cumulative loss of each policy as well as optimal basket weights, which differ with the time interval of the transition periods. Lastly optimality among the transition policies is discussed.

The section is consisted of following subsections. Section C.1 shows the results of unit root tests and co-integration tests. Then Section C.2 explains the estimate result using Thai data by instrumental variable method. The calibration of the basket weights and the loss values using the calculation method showed in Section 3 and 4, are covered in the Section C.3.

C.1 Unit root test and Co-integration tests

This subsection explains the results of unit root tests and co-integration tests. First, we apply Dicky-Fuller General Least Square (DF-GLS) unit root tests. The result of unit root test is discribed at Table A1. Based on the 10% sigificance critical value, half of the variables has a unit root. Second, based on the outcome of the unit root test, we analyze Johansen co-integration test for five equations. Table A2 provides the results of Johansen trace co-integration test. Reflecting 10% significance critical value, we do not find any co-integration relationships among four equations.

Table A1: DF-GLS Unit-Root Tests

[35] We will provide data as well as methods of calculation upon requests.

Variable	Degree	Trend	Lag	DF-GLS Stat.	Resutls
e	level	0	0	-0.905	
	1st dif.	0	0	-6.874	I(1)
e^{yen}	level	0	2	-0.704	
	1st dif.	0	4	-2.086	I(1)
i	level	0	1	-1.053	
	1st dif.	0	1	-3.036	I(1)
i^*	level	0	1	-1.937	
	1st dif.	0	1	-2.530	I(0)
$m-p$	level	0	4	0.537	
	1st dif.	0	4	-1.603	I(1)
$e+p^*-p$	level	0	0	-1.158	
	1st dif.	0	0	-7.029	I(1)
$e^{yen}+p^{yen}-p$	level	0	0	-2.398	I(0)
$e^{\$/yen}$	level	0	0	-2.205	I(0)
Δe	level	0	1	-2.253	I(0)
Δe^{yen}	level	0	2	-3.076	I(0)
$p_{t+1}-p_t$	level	0	3	-1.941	I(0)
p_t	level	0	1	0.386	
	1st dif.	0	0	-3.464	I(1)
$y-\bar{y}$	level	0	2	-1.475	
	1st dif.	0	4	-2.366	I(1)

Table A2: Johansen Co-Integration Test

Equation	Variables	Trend	Hypothesis	Trace Statistics	P-value
Money	$m-p$	Deter.	None	138.195	0.000
demand	i		at most 1	61.325	0.000
	$y-\bar{y}$		at most 2	10.827	0.002
Interest	i	Deter.	None	48.830	0.000
parity	i^*		at most 1	18.654	0.016
	e		at most 2	3.601	0.058
Aggregate	$y-\bar{y}$	Deter.	None	231.864	0.000
demand	$e+p^*-p$		at most 1	133.763	0.000
	$e^{yen}+p^{yen}-p$		at most 2	88.594	0.001
	i		at most 3	54.812	0.010
	$p_{t+1}-p_t$		at most 4	32.547	0.024
	Δe		at most 5	14.405	0.073
	Δe^{yen}		at most 6	5.129	0.024
Aggregate	$p_{t+1}-p_t$	Deter.	None	154.363	0.000
supply	$y-\bar{y}$		at most 1	67.470	0.000
	e		at most 2	26.216	0.001
	Δe		at most 3	5.126	0.022

C.2 Estimation with Thai Data

Based on the results of unit roots and co-integration, in this subsection, we estimate the macroeconomic model mentioned in Section 2 using Thai data. We use the Instrumental Variable (IV) method to estimate equations simultanously. We estimate based on two sample periods, (1) 1993Q1-1997Q2 for dollar-peg regime and (2) 1997Q3-2006Q1 for floating regime. The first column of the table shows the explanatory variables.

Table A3 display the estimation results. The second column shows the coefficients under fixed regime (basket-peg regime) period, and the third column shows ones under floating regime period. The t-values of the coefficients are shown inside the parentheses. Two asterisks on the t-values indicate the level of 1% significance and one asterisk indicates one of 5% significance. Concerning with exchange risks, we use the variance of monthly exchange rate data as proxy. For the variables which have an unit root, we take the first order difference in order to satisfy the stationary property. A dummy variable is used to exclude the effect of large exchange rate fluctuation during the Asian currency crisis period from 1997Q3 to 1998Q2.

Table A3: Estimation Results using Thai Data

Coefficients	Fixed (basket-peg)	Floating regime
λ	0.525 (4.569)**	0.523 (2.907)**
σ	0.07 (3.207)**	0.456 (2.735)**
ϵ	0.277 (-0.115)	0.68 (-0.637)
ϕ	2.235 (1.997)*	2.47 (5.502)**
δ	-0.078 (-0.018)	-0.120 (-0.951)
θ	0.034 (0.487)	0.195 (1.352)
ρ	1.015 (-0.618)	-1.11 (1.431)
τ	0.023 (0.647)	-0.089 (-0.977)
ς	-0.029 (-1.370)	0.081 (0.746)
α	0.022 (3.401)**	0.002 (0.789)
ψ	0.016 (0.195)	0.046 (0.875)
η	-0.095 (-3.083)**	-0.006 (-0.284)
χ	0.008 (3.390)**	0.001 (0.607)

C.3 Initial impacts and total impacts of the shock

Using the estimated coefficients we have obtained, we calculate the initial impacts and total impacts of one unit of exogenous dollar-yen shocks. Table A4 reports the initial impacts and total impacts on following variables.

A4: Impacts of 1% exogenous dollar-yen exchange rate shocks (denominted in term of %)

A. Dollar-peg	$(y_t - \bar{y})$	$(p_t - \bar{p})$	$(m_t - \bar{m})$
initial impact	0.034	0.0005	0.076
total impact	1.3382	0.0496	0.0496
B. Basket-peg (weak capital control)	$(y_t - \bar{y})$	$(p_t - \bar{p})$	$(i_t - \bar{\imath})$
initial impact	0.0486	0.029	0.1864
total impact	-0.7149	-3.0518	0.1864
C. Basket-peg (no capital control)	$(y_t - \bar{y})$	$(p_t - \bar{p})$	$(i_t - \bar{\imath})$
initial impact	0.0502	0.0288	0.3937
total impact	0.7579	0.6877	0.3937
D. Floating	$(y_t - \bar{y})$	$(p_t - \bar{p})$	$(i_t - \bar{\imath})$
initial impact	0.195	0.006	-1.456
total impact	1.508	2.107	-1.456

C.4 Simulation using the estimated coefficients

Then using the estimated coefficients we have obtained, we calculate the optimal basket weights and money supply according to the transition policies. Based on the optimal basket weights and money supply, we calculate the cumulative losses for four policies. For the dollar-yen exchange rate, the dollar-baht exchange rate risk, and the yen-baht exchange rate risk, we use the actual quarterly data from 1996Q4 to 2006Q2. Since we define the exogenous shocks as deviation from the long-run value, we use deviation from the H-P filtered trend value for each exogenous shock. We assume time period for the dollar-peg as 1 quarter ($T_A = 1$), the period for transition period as 18 quarters ($T_1 = 18$), and the periods for stable regime as 18 ($T_2 = 18$) quarters. Table A5 shows the cumulative losses and the values of optimal instruments of four policies.

Table A5: Cumulative losses and optimal values of instruments

	Policy (1)	Policy (2)	Policy (3)	Policy (4)
Stable regime	Dollar-peg	Basket-peg	Basket-peg	Floating
Adjustment	-	gradual	sudden	sudden
Instrument value	-	$v^* = 0.68$	$v^{**} = 0.62$	$m^* = 0.0082$
Cumulative loss (value)	0.0069	0.0006	0.0026	0.0052
Cumulative loss (% of $(\bar{y}^2)$*)	15.03	1.31	5.66	11.33

* We calculate the value of $\bar{y}^2$ shown in section 3 and obtained $\bar{y}^2 = 0.0459$

As for the results, we can comfirm the theoretical findings in Section 5. First, among the four policies, maintaining dollar-peg (policy (1)) leads to highest losses. It implies that the country will be better off shifting to the stable basket-peg regime or floating regime. Second, comparing the transition policies to the stable basket-peg regime, it is optimal for the country to adopt gradual adjustment rather than sudden shift. This is because the time period for transition periods is not long enough for the country to gain benefits of shifting suddenly to the stable regime. Moreover, the optimal weights of policy (2) and policy (3) are different as we show in Section 4.2 and 4.3.

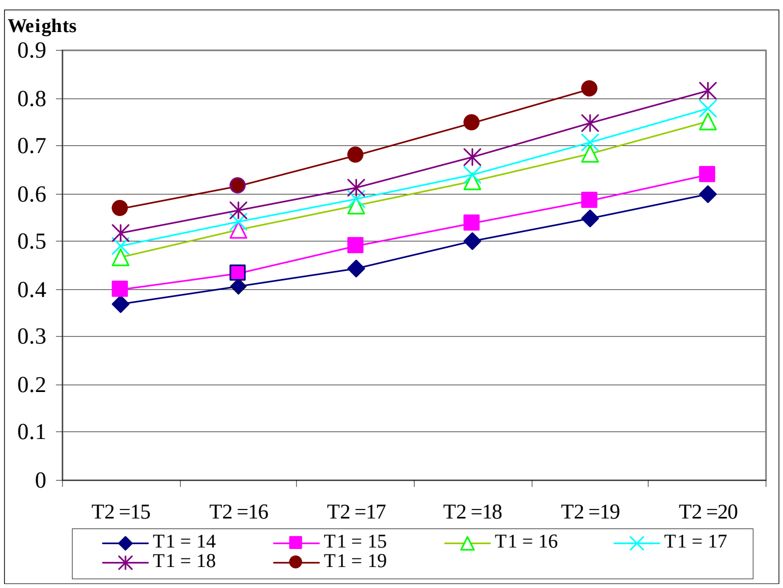
Lastly, comparing the optimality between shifting to the basket-peg or shifting to floating, shifting to the floating regime leads to higher losses. It means that the country will be better off shifting to the stable basket-peg regime. However as we mentioned in Section 5.3, the desirability of shifting to the stable basket-peg or floating regime depends on which instruments the monetary authority adopts and how the instrument rules are effective under the regime. In the case of Thailand, it is not optimal to shift to the floating regime with using money supply as instruments compared with shifting to the basket-peg regime with using basket weights as instruments.

D Optimal weights and time span

In Appendix C.3, we have derived optimal weights and values of cumulative losses given the fixed time span ($T_A = 1$, $T_1 = 18$, and $T_2 = 18$). In this secion, we focus on the relationship between the optimal weights under basket-peg and time span.

First, we consider the case of gradual adjustment to stable basket-peg regime (policy (2)). Generally speaking, optimal weight of basket is increasing respect to both the period for transition period and the period for stable regime.

Figure A6: Optimal weight and time span under policy (2)



Next, we consider the case of sudden shift to the basket-peg regime (policy (3)). Once again, the optimal weight of basket is increasing respect to the total time period.

Figure A7: Optimal weight and time span under policy (3)