Choices of Optimal Monetary Policy Instruments under the Floating and the Basket-peg Regimes*

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February 11, 2010

Abstract

This paper determines whether adopting the basket-peg rather than the floating regime is optimal for emerging countries. Under the basket-peg regime, there is a trade-off between practical usefulness and welfare losses associated with the movements of capital across countries. We use a small open-economy model with micro foundations to provide a simple basket weight rule. Although this is sub-optimal, we show it is practical and easy to implement. After calibration using Singaporean and Thai data for the period 1997Q3-2006Q2 and comparison among the cumulative losses associated with the policy instrument rules, we show that a commitment to the basket weight rule is superior to other instrument rules under the floating regime for small open emerging countries like Singapore and Thailand.

Key words: basket-peg regime, monetary policy instruments, small open economy, exchange rate regime

JEL classification: F33, F41

1 Introduction

After the Asian financial crisis in 1997-98, many economists have advocated the superiority of the basket-peg regime relative to the *de facto* dollar-peg regime in East Asia[1]. One of the rationale was that for countries with close economic relationships with the US, Japan and the European Union (EU), exchange rate stabilization vis-a-vis a basket comprising these currencies was beneficial, because it eliminated the problem of having large fluctuations of exchange rates.

*The paper has been circulated with the title "Simple rule for basket weight under basket-peg regime". We are grateful to Akira Ariyoshi, Yougesh Khatri, Yoichiro Kimura, Robert McCauley, Jair Ojeda, Scott Roger, Chad Steinberg, Mark Stone, Shengzu Wang, Min Ye, Jack Zhang, Zhiwei Zhang, and seminar participants at the ADBI-Keio, IMF OAP, Far-Eastern South Asia Meeting of Econometric Society, and Singapore Economic Review conferences for comments and suggestions. Only the authors are responsible for the errors.

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[1]Kawai (2002), Ito, Ogawa and Sasaki (1998), Ogawa and Ito (2002), Yoshino, Kaji, and Suzuki (2004) recommend that East Asian countries adopt the basket-peg regime.

Together with the basket-peg regime, the floating regime is the other possible alternative which East Asian countries may choose, as detailed in Yoshino, Kaji, and Asonuma (2004). However, according to Yoshino, Kaji, and Ibuka (2003), there are also drawbacks in adopting the floating regime as too much fluctuation of exchange rates will negatively affect the economy. Thus, there still remains a big question which regime is desirable for those countries.

Moreover, when dealing with the basket-peg regime, there is a clear trade-off between optimality taking into account the impacts of capital movements across countries, and practical usefulness to implement. On one hand, under the model which incorporates capital movements across countries, the optimal weight of the basket is determined by a highly complicated equation[2]. But, this weight is quite difficult to implement in the real world since a country's monetary authority may find it challenging to calculate many variables and coefficients simultaneously. On the other hand, under a model which lacks capital movements across countries, using the trade weight as the basket weight is optimal, which is also quite easy to practically implement as it is simple to compute the trade weight[3]. This implies that studying the impacts associated with capital movements across countries increases the difficulty of implementing the optimal basket weight.

This paper aims to solve the two puzzles presented above. First, we propose a simple basket weight rule, which is sub-optimal but practically easy to implement in terms of the number of variables taken into account using a small open-economy stochastic dynamic general equilibrium model. Contrary to the Monetary Authority of Singapore (MAS) framework proposed by McCallum (2007), our basket weight rule is one which inflation and output gap are main target variables with the basket weight being used primarily as an instrument. Apart from the basket weight rule, we also present the open-economy interest rate rule and money supply rule[4].

Second, we examine the superiority of basket weight rule relative to interest rate rule, money supply rule under the floating regime, and trade weight rule under the basket peg regime. Reflecting the calibration outcomes with Singaporean and Thai data, we compare impulse responses of the output gap and inflation rate to a variety of exogenous shocks. Then, we calculate the cumulative

[2] The optimal basket weight equation under the model with capital movements across countries is shown in Yoshino, Kaji, and Suzuki (2004) or Yoshino, Kaji, and Asonuma (2004). Furthermore, the optimal basket weight equation under dynamic general equilibrium model is shown in Yoshino, Kaji, and Asonuma (2009). The optimal weights under the general equilibrium model clearly deviate from the trade weights, which are practically easy to implement.

[3] The optimal basket weights under this model are shown in Ito, Ogawa and Sasaki (1998), and Ogawa and Ito (2002).

[4] Different monetary policy instruments are used across East Asian countries.

losses using the actual shock data for the period from 1997Q3 to 2006Q2 under the five instrument rules, and discuss the superiority of basket weight rule relative to interest rate rule, money supply rule, or trade weight rule in terms of welfare losses which the monetary authority attempts targets to minimize. Furthermore, we also contrast the cumulative loss under the basket weight rule with those under other four policy instrument rules, computed for the long span (60 quarters) using the random shocks drawn from the distributions of the shocks for post-Asian Currency Crisis period and consider the optimal instrument rule for the span.

There are three major implications in this paper. The first is that we obtain a simple basket weight rule, which is sub-optimal in aspect of deviation from the optimal weight derived in Yoshino, Kaji, and Asonuma (2004, 2009), but is easy to practically implement as the monetary authority needs to calculate only two key variables such as inflation and the output gap similar to the Taylor rule in Taylor (1993).

The second implication is that we can show that the relative superiority of basket weight rule when compared to the interest rate rule, money supply rule, or trade weight rule in a small-open economy like Singapore and Thailand where the exchange rate variances are moderate (around 5%) by comparing the welfare losses associated with policy instruments. There are two reasons for relative superiority of the basket weight rule: one is that the monetary authority can focus only on effects of the yen exchange rate, since the dollar rate is endogenous, but determined solely by the yen exchange rate as long as it maintains the weighted averages of exchange rates at the constant value by foreign market interventions. The other is that by committing to the basket weight rule, the monetary authority is able to stabilize the impacts on the output gap and inflation rate through exchange rate channels which are missing under the interest rate rule or money supply rule.

Lastly, in the long span which the variances of the exchange rates are really low, the interest rate rule could also be one of the options for the monetary authority as shown in the simulation case of Singapore.

Needless to say, our analysis can be applied to any small open country deliberating upon the optimal choice between adopting the basket-peg or floating regimes.

The paper is organized as follows; Section 2 overviews the previous literature. We provide a small-open economy model in the Section 3. We define and derive the equilibrium depending on exchange rate regimes in Section 4. Later in Section 5, we specify the optimal instrument rules. Numerical analysis using Singaporean and Thai data on the basis of theoretical study, are presented in Section 6. Lastly, a brief conclusion summarizes the discussion.

2 Literature Review

The paper is related to several studies that have concentrated on the basket-peg regime in East Asia. Ito, Ogawa and Sasaki (1998) and Ogawa and Ito (2002) analyze the optimal basket-peg regime under a partial equilibrium model, which does not involve capital movements. Yoshino, Kaji, and Suzuki (2004) and Yoshino, Kaji, and Asonuma (2004) study the optimal basket-peg regime under a general equilibrium model which includes capital movements across countries. Furthermore, Yoshino, Kaji, and Asonuma (2009) examine the transitional path from the dollar-peg regime to the basket-peg regime under a general equilibrium model. For more recent studies, Shioji (2006a, 2006b) discusses the basket-peg regime under two different invoicing schemes, producer currency pricing (PCP) and vehicle currency pricing (VCP). Our paper differs from these papers in that our concern focuses on the optimality between adopting the floating and the basket-peg regimes[5][6].

Furthermore, there is one stream of the literature discussing interactions of monetary policy and exchange rates under a small open-economy with micro foundations as Clarida, Gali and Gertler (2002), or Gali and Monacelli (2005). For example, Clarida, Gali and Gertler (2002) show that to the extent there is perfect exchange rate pass through, they find that the central bank should target domestic inflation and allow the exchange rate to float, despite the impact of the resulting exchange rate variability on the consumer price index. On the other hand, Gali and Monacelli (2005) analyze the relative superiority of three policy regimes in terms of their implied volatility for nominal exchange rate and the terms of trade. This paper improves upon in this aspect by including in the basket weight as the instrument policy for the monetary authority under the basket-peg regime.

[5] Rajan and Siregar (2002) consider and contrast the experiences of Hong Kong and Singapore to discuss whether the small and open economies in Asia should commit to rule out exchange rate adjustments or to precede domestic policy objectives such as output and employment growth.

[6] Devereux (2003) also explores the role of the exchange rate regime in small economies with particular interest on the differing cases of Hong Kong and Singapore.

3 Basic Model

In this section, we explain the model. Our model is a small-open economy model, which the rest of the world is comprised of two big countries. It is an extended version of Clarida, Gali and Gertler (2002). There are four modifications with respect to their model. Firstly there are two foreign countries which are relatively large compared with home country in our model, while Clarida, Gali and Gertler (2002) assume one foreign country. The second modification is that our focus is not only on the floating regime and the fixed regime as in Clarida, Gali and Gertler (2002), but also on the basket-peg regime. Thirdly, unlike perfect capital mobility in Clarida, Gali and Gertler (2002), we assume imperfect capital mobility across home and foreign countries. Lastly, in contrast to assumption that symmetric firms which use only labor inputs, serve both domestic and foreign markets in Clarida, Gali and Gertler (2002), we consider asymmetric firms serving domestic and foreign markets with different input shares of labor and imported intermediate goods (such as oil).

We assume that there are three countries as shown in Figure 1; Thailand (Home), Japan (Foreign A) and the US (Foreign B). In our home country, there are three sectors; households, firms, and the central bank. We denote home country with the superscript ^{h}, Japan with the superscript ^{J}, and the US with superscript ^{US}. These countries share the same preferences and technologies. These countries produce traded goods, which are imperfect substitutable in utility. While capital is mobile between two foreign countries, it is imperfectly mobile between home and foreign countries.

[Insert Figure 1 here]

3.1 Consumption goods, price index, and demands

The consumption basket of household in the home country, is defined as follows.

$$C_t = \left[(\lambda_H)^{\frac{1}{\theta}} \left(C_t^H \right)^{\frac{\theta-1}{\theta}} + (\lambda_J)^{\frac{1}{\theta}} \left(C_t^J \right)^{\frac{\theta-1}{\theta}} + (\lambda_{US})^{\frac{1}{\theta}} \left(C_t^{US} \right)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad (1)$$

where $\lambda_i,\ i = H, J, US$ expresses the preference on goods produced in i [7]. $C_t^i,\ i = H, J, US$ is the demand of the home household for goods produced in country i, and θ is the elasticity of substitution among goods produced in three countries.

[7] We assume $\lambda_H + \lambda_J + \lambda_{US} = 1$

By cost minimization of the home representative household, we obtain the following demand conditions;

$$C_t^i = \lambda_i \left(\frac{P_t^i}{P_t^C} \right)^{-\theta} C_t, \quad i = H, J, US \tag{2}$$

where P_t^C is the consumer price index (CPI) defined as follows and P_t^i and the price index of goods produced in country i denominated in Home currency respectively.

$$P_t^C = \left[(\lambda_H) \left(P_t^H \right)^{1-\theta} + (\lambda_J) \left(P_t^J \right)^{1-\theta} + (\lambda_{US}) \left(P_t^{US} \right)^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{3}$$

We assume that the law of one price holds for goods produced in foreign countries. It implies that

$$P_t^J = S_t^{B/Y} P_t^{J*} \tag{4}$$

$$P_t^{US} = S_t^{B/\$} P_t^{US*} \tag{5}$$

where P_t^{J*} and P_t^{US*} are the foreign currency price of foreign-produced goods respectively and $S_t^{B/Y}$ and $S_t^{B/\$}$ are the nominal baht-yen and baht-dollar exchange rates. For simplicity, we assume that all Japanese goods are sold for price P_t^J and all US goods are sold for price P_t^{US} in home country. These specifications imply that exchange rate pass through is complete.

As was the case of New Keynesian model, we concentrate on the percentage deviations around the steady state[8]. Letting lower letters denote percentage deviations around the steady state of the corresponding upper letters.

Equation (4) and (5) can be written as

$$p_t^J - p_t^C = e_t^{B/Y} \tag{4'}$$

$$p_t^{US} - p_t^C = e_t^{B/\$} \tag{5'}$$

Equation (1), (2), (3) can be expressed as

$$c_t = \lambda_H c_t^H + \lambda_J c_t^J + \lambda_{US} c_t^{US} \tag{1'}$$

[8] See for example Clarida, Gali and Gertler (2001, 2002)

$$c_t^H = -\theta\left(p_t^H - p_t^C\right) + c_t, \qquad c_t^J = -\theta e_t^{B/Y} + c_t, \qquad c_t^{US} = -\theta e_t^{B/\$} + c_t \tag{2'}$$

$$p_t^C = \lambda_H p_t^H + \lambda_J e_t^{B/Y} + \lambda_{US} e_t^{B/\$} \tag{3'}$$

Now we can denote inflation at t, such as

$$\pi_t^C = \lambda_H \pi_t^H + \lambda_J\left(e_t^{B/Y} - e_{t-1}^{B/Y}\right) + \lambda_{US}\left(e_t^{B/\$} - e_{t-1}^{B/\$}\right) \tag{6}$$

In this expression, CPI inflation depends on both PPI (producer price index) inflation rate π_t^H, and changes of real exchange rates.

3.2 Households and asset market

The utility function of a representative household in Home country at time t is defined as:

$$U_t = E_t \sum_{s=t}^{\infty} \beta^{s-t}\left[\frac{1}{1-\sigma}\left(C_s\right)^{1-\sigma} + \frac{\chi}{1-b}\left(\frac{M_s}{P_s^C}\right)^{1-b} - \frac{1}{1+\eta}\left(L_s\right)^{1+\eta}\right] \tag{7}$$

Inside the bracket, the first term captures the instantaneous utility from consumption and the second term expresses the instantaneous utility from money holdings, where M_t denotes a representative household's money holdings. The last term defines the disutility from labor effort, where L_t is the labor supply by a representative household. Discount rate is denoted by β.

A representative household consumes, holds nominal domestic money M_t and a nominal bond denominated in the Home currency, B_t, and a nominal bond denominated in the US dollar, B_t^{US}. Only Home residents are assumed to hold the money in the domestic economy. The household budget constraint in real term is therefore:

$$C_t = \frac{W_t}{P_t^C} L_t - \frac{B_t^h - \left(1 + i_{t-1}\right) B_{t-1}^h}{P_t^C} - \frac{M_t - M_{t-1}}{P_t^C} - \frac{S_t^{R/\$}\left[B_t^{US,h} - \left(1 + i_{t-1}^{US}\right)\Psi_t B_{t-1}^{US,h}\right]}{P_t^C} + \frac{\Pi_t}{P_t^C} \tag{8}$$

where i_t and i_t^{US} are the nominal yields on the bonds in terms of the Home currency and in terms of the US dollar; Π_t is the dividends from firms.

A representative household maximizes (7) subject to (8). Euler, money demand equation, and labor-leisure optimality equations are derived from first-order condition respect to domestic bonds holding, money holdings and labor.

$$\frac{(C_t)^{-\sigma}}{P_t^C} = \beta E_t \left[(1+i_t) \frac{(C_{t+1})^{-\sigma}}{P_{t+1}^C} \right] \tag{9}$$

$$\frac{\chi \left(\frac{M_t}{P_t^C} \right)^{-b}}{C_t^{-\sigma}} = \frac{i_t}{1+i_t} \tag{10}$$

$$\frac{W_t}{P_t^C} = \frac{(L_t)^{\eta}}{(C_t)^{-\sigma}} \tag{11}$$

With first order condition of US bonds holding and (9), we fulfill the uncovered interest parity condition between domestic and US bonds incorporating the risk premium Ψ_{t+1} , shown as

$$E_t \left\{ \frac{(C_{t+1})^{-\sigma} P_t^C}{P_{t+1}^C} (1+i_t) \right\} = E_t \left\{ \frac{(C_{t+1})^{-\sigma} P_t^C}{P_{t+1}^C} (1+i_t^{US}) \Psi_{t+1} \frac{S_{t+1}^{R/\$}}{S_t^{R/\$}} \right\} \tag{12}$$

Log-linearized version of equation (9)-(12) are shown as

$$c_t = E_t c_{t+1} - \left(\frac{1}{\sigma} \right) \left(i_t - E_t \pi_{t+1}^C \right) \tag{9'}$$

$$m_t - p_t^C = \left(\frac{1}{b} \right) (\sigma c_t - i_t) \tag{10'}$$

$$\eta l_t + \sigma c_t = w_t - p_t^C \tag{11'}$$

$$i_t = i_t^{US} + E_t s_{t+1}^{B/\$} - s_t^{B/\$} + E_t \psi_{t+1} \tag{12'}$$

3.3 Firms

There are two types of firms in home country: firms serving domestic market and firms exporting to foreign markets.

3.3.1 Firms serving domestic market

There is a continuum of firms selling products in the domestic market indexed $[0, n_H]$. Producer price index (PPI) is composite of prices set by individual firms defined as follows:[9].

$$P_t^H = \left[\left(\frac{1}{n_H} \right) \int_0^{n_H} \left(p_t^H(z) \right)^{1-\mu} dz \right]^{\frac{1}{1-\mu}} \tag{13}$$

Firms maximize the expected profits subject to three constraints. The first one is a production function summarizing available technology. The technology for a monopolistically competitive firm z in country i is:

$$Y_t^H(z) = F_t L_t^H(z)^{\alpha} \left(H_t^H(z) \right)^{1-\alpha} \tag{14}$$

where $Y_t^H(z)$ is the output of the firm z in period t and F_t is a country specific productivity shifter. $L_t^H(z)$ and $H_t^H(z)$ express labor employed and imported raw materials used by firm z respectively. The second constraint on the firm is the demand curve each firm faces. This is given by $C_t^H(z) = \left(\frac{p_t^H(z)}{P_t^H} \right)^{-\mu} \left(\frac{P_t^H}{P_t^C} \right)^{-\theta} C_t$.

The third constraint is that each period some firms are not able to adjust their prices. The specific model of price stickiness we will use is based on Calvo (1983). Each period, the firms that adjust their prices are randomly selected, and a fraction $1 - \omega$ of all firms adjusts, while the remaining ω fraction does not adjust. The parameter ω is a measure of the degree of nominal rigidity; a larger ω implies that fewer firms adjust each period and the expected time interval between price changes is longer. Those firms that adjust their prices at time t do so to maximize the expected discounted value of current and future profits. Profits at some future date $t + s$ are affected by the choice of price at time t only if the firm has not received another opportunity to update its price between t and $t + s$. The probability of this is ω^s.

Before analyzing the firm's pricing decision, we consider its cost minimization problem which involves minimizing cost of labor and imported raw materials subject to (14). This problem can be

[9] Similarly, the goods produced in Home can be defined as follows; $C_{h,t}^i = \left[\left(\frac{1}{n_H} \right)^{1/\mu} \int_0^{n_h} \left(C_{h,t}^i(z) \right)^{\frac{\mu-1}{\mu}} dz \right]^{\frac{\mu}{\mu-1}}$, where μ is the degree of substitutability among the goods produced in Home. So that demand for good z can be expressed as $C_t^H(z) = \left(\frac{p_t^H(z)}{P_t^H} \right)^{-\mu} \left(\frac{P_t^H}{P_t^C} \right)^{-\theta} C_t$

written, in real terms (divided by producer price index), as

$$\min_{L_t^H(z),H_t^H(z)} \left(\frac{W_t}{P_t^H}\right) L_t^H(z) + \left(\frac{Q_t}{P_t^H}\right) H_t^H(z) + \phi_t(z) \left[Y_t^H(z) - F_t \left(L_t^H(z)\right)^{\alpha} \left(H_t^H(z)\right)^{1-\alpha}\right]$$

where ϕ_t^H denotes the real marginal cost of firms serving domestic market. The first order condition implies

$$\phi_t^H = \frac{\left(\frac{W_t}{P_t^H}\right)^{\alpha} \left(\frac{Q_t}{P_t^H}\right)^{1-\alpha}}{F_t \left(\alpha\right)^{\alpha} \left(1-\alpha\right)^{1-\alpha}}$$

The log-linearized version can be expressed as

$$mc_t^h = \alpha w_t + (1-\alpha) q_t - p_t^H - f_t \tag{15}$$

The firm's pricing decision problem then involves picking $p_t^H(z)$ to maximize

$$E_t \sum_{s=0}^{\infty} \omega^s d_{s,t+s} \left[\left(\frac{p_t^H(z)}{P_{t+s}^H}\right) C_{t+s}^H(z) - \phi_{t+s}^H C_{t+s}^H(z)\right]$$

where discount factor $d_{s,t+s}$ is given by $\beta^s \left(\frac{C_{t+s}}{C_t}\right)^{-\sigma}$ and demand function $C_{t+s}^H(z) = \left(\frac{p_{t+s}^H(z)}{P_{t+s}^H}\right)^{-\mu} \left(\frac{P_{t+s}^H}{P_{t+s}^C}\right)^{-\theta} C_{t+s}$.

We assume p_t^{H*} be the optimal price chosen by all firms adjusting at time t[10]. The first order condition for the optimal price of p_t^{H*} is

$$\frac{p_t^{H*}}{P_t^H} = \left(\frac{\mu}{\mu-1}\right) \frac{E_t \sum_{s=0}^{\infty} \omega^s \beta^s C_{t+s}^{1-\sigma} \phi_{t+s} \left(\frac{p_t^H}{P_t^H}\right)^{\mu} \left(\frac{P_{t+s}^H}{P_{t+s}^C}\right)^{-\theta}}{E_t \sum_{s=0}^{\infty} \omega^s \beta^s C_{t+s}^{1-\sigma} \left(\frac{p_t^H}{P_t^H}\right)^{\mu-1} \left(\frac{P_{t+s}^H}{P_{t+s}^C}\right)^{-\theta}} \tag{16}$$

Consider a case in which all firms are able to adjust their price every period ($\omega = 0$). When $\omega = 0$, (16) reduces to

$$\frac{p_t^{H*}}{P_t^H} = \left(\frac{\mu}{\mu-1}\right) \phi_t = \bar{\mu}_M \phi_t \tag{16'}$$

When prices are flexible, all firms charge the same price. In this case, $p_t^{H*} = P_t^H$ and $\phi_t = \frac{1}{\bar{\mu}_M}$.

[10] Though individual firms produce differenciated products, they all have the same production function technology and face a demand function with constant and identical demand elasticities. In other words, they are essencially identical, except that they may have set their current prices at different dates in the past. However, all firms adjusting in period t face the same problem, so all adjusting firms will set the same price.

Using the expression for real marginal cost, this implies

$$\left(\frac{W_t}{P_t^H}\right)^{\alpha}\left(\frac{Q_t}{P_t^H}\right)^{1-\alpha} = \frac{F_t\alpha^{\alpha}(1-\alpha)^{1-\alpha}}{\bar{\mu}_M}$$

When prices are sticky ($\omega > 0$), output can differ from the flexible-price equilibrium level. Because the firms will not adjust their prices every period, they must take into account expected future marginal cost as well as current marginal cost whenever they have an opportunity to adjust their prices. The aggregate price index is an average of the prices charged by the fraction $1-\omega$ of firms setting their prices in period t and the average price of remaining fraction ω of firms setting their prices in earlier periods. However, because the adjusting firms were selected randomly among all firms, the average price of non-adjusters is the average of prices of firms that prevailed in period $t-1$. Thus, from definition of PPI, the average price in period t satisfies,

$$\left(P_t^H\right)^{1-\theta} = (1-\omega)\left(p_t^{H*}\right)^{1-\theta} + \omega\left(P_{t-1}^H\right)^{1-\theta} \tag{17}$$

Equation (16) and (17) can be approximated around a zero-average inflation, steady-state equilibrium to obtain an expression for aggregate inflation of the economy;

$$\pi_t^H = \beta E_t\pi_{t+1}^H + \kappa\hat{mc}_t^H \tag{18}$$

where, $\kappa = \frac{(1-\omega)(1-\beta\omega)}{\omega}$ and $\hat{mc}_t$ is the real marginal cost defined with the producer price index, expressed by a percentage deviation around its steady-state value.

Using equation (6),

$$\begin{aligned}\pi_t^C &= \beta E_t\pi_{t+1}^C + \lambda_H\kappa\hat{mc}_t^H - \beta\lambda_J\left(E_te_{t+1}^{B/Y} - e_t^{B/Y}\right) - \beta\lambda_{US}\left(E_te_{t+1}^{B/\$} - e_t^{B/\$}\right) \\ &\quad + \lambda_J\left(e_t^{B/Y} - e_{t-1}^{B/Y}\right) + \lambda_{US}\left(e_t^{B/\$} - e_{t-1}^{B/\$}\right)\end{aligned} \tag{18'}$$

Current CPI inflation rate depends on both expected inflation rate and real marginal cost, which are the same factors appear in the inflation adjustment equation mentioned in Clarida, Gali and Gertler (2002) and Walsh (2003). Furthermore, in this open economy, the current and expected future change in the real exchange rates also affect inflation. Current appreciation of domestic currency

$(e_t^{B/Y} - e_{t-1}^{B/Y} < 0$, or $e_t^{B/\$} - e_{t-1}^{B/\$})$ leads to reduce current inflation, while expected appreciation of domestic currency $(E_t e_{t+1}^{B/Y} - e_t^{B/Y} < 0$, or $E_t e_{t+1}^{B/\$} - e_t^{B/\$})$ will lead to increase current inflation.

3.3.2 Exporting firms

Similarly, there is a continuum of exporting firms index $[0, n_{EX}]$. Export price P_t^{EX} is composite of prices set by individual firms defined as follows;

$$P_t^{EX,i} = \left[\left(\frac{1}{n_{EX}}\right)\int_0^{n_{EX}} \left(p_t^{EX}(z)\right)^{1-\mu} dz\right]^{\frac{1}{1-\mu}}$$

Each exporting firm maximizes the expected profits subject to two constraints. The first one is a production function summarizing available technology shown as

$$Y_t^{EX} = F_t \left(L_t^{EX}\right)^{\alpha'} \left(H_t^{EX}\right)^{1-\alpha'} \tag{14'}$$

The other constraint on the firm is the demand curve each firm faces. This is given by $C_t^{EX,i}(z) = \left(\frac{p_t^{EX,i}(z)}{P_t^{EX,i}}\right)^{-\mu}\left(\frac{P_t^{EX,i}}{P_t^{i*}}\right)^{-\theta} Y_t^i$ for $i \in [J, US]$. Contrary to firms serving domestic markets, these exporting firms can adjust their price every period.

We consider the firms' cost minimization problem which involves minimizing the cost of labor and imported raw materials subject to (14'), which is quite similar to firms serving only the domestic market. The first order condition of this problem implies

$$\phi_t^{EX,i} = \frac{\left(\frac{W_t}{P_t^{EX,i}}\right)^{\alpha'}\left(\frac{Q_t}{P_t^{EX,i}}\right)^{1-\alpha'}}{F_t\left(\alpha'\right)^{\alpha'}\left(1-\alpha'\right)^{1-\alpha'}}$$

where ϕ_t^{EX} is equal to the exporting firm's real marginal cost.

We assume that the exporting firms serves with local currency pricing (LCP)[11]. The firm pricing problem then involves $p_t^{EX,i}(z)$ to maximizes

$$S_t^{B/i}\left(\frac{p_t^{EX,i}(z)}{P_t^{EX,i}}\right) C_t^{EX,i}(z) - \phi_t^{EX,i} C_t^{EX,i}(z)$$

[11] We assume that foreign countries are large relative to home country, thus their CPI inflation is not affected by home exporting firms' pricing behavior. Moreover, the foreign markets are more competitive relative to domestic firms, the exporting firms adjust the prices more frequently than one serving domestic firms.

We obtain a similar equation as in Section 3.3.1, such as

$$\frac{p_t^{EX,i*}}{P_t^{EX,i}} = \left(\frac{\mu}{\mu-1}\right)\frac{\phi_t^{EX,i}}{S_t^{B/i}} = \bar{\mu}_M \frac{\phi_t^{EX,i}}{S_t^{B/i}} \qquad for \quad i \in [J, US]$$

As price is flexible, we assume that $p_t^{EX,i*} = P_t^{EX,i}$ and $\phi_t^{EX,i} = \frac{S_t^{B/i}}{\bar{\mu}_M}$. Using definition of marginal cost, it implies that

$$\left(\frac{W_t}{P_t^{EX,i}}\right)^{\alpha'} \left(\frac{Q_t}{P_t^{EX,i}}\right)^{1-\alpha'} = \frac{F_t \alpha'^{\alpha'}(1-\alpha')^{1-\alpha'} S_t^{B/i}}{\bar{\mu}_M}$$

The log-linearized version can be expressed as

$$p_t^{EX,i} - p_t^{i*} = \alpha' w_t + (1-\alpha')q_t - p_t^C - e_t^{B/i} \qquad for \quad i \in [J, US] \tag{19}$$

3.4 Foreign countries

In order to have the analysis simple, we assume that foreign countries are large relative to our home country. It follows that it is now unnecessary to distinguish between CPI inflation and PPI inflation in the foreign countries. Moreover, it also implies that foreign output level is the same with their consumption level.

Goods produced in Home are sold to both domestic residents and foreign residents. Home exporting firms serve foreign markets with local currency pricing (LCP). Let $C_t^{J,H}$ and $C_t^{US,H}$ be foreign consumption of home produced good. Assuming that foreign households have the same preferences as those of the home residents (so the demand elasticity is the same), we have

$$C_t^{J,H} = \left(\frac{P_t^{EX,J}}{P_t^{J*}}\right)^{-\theta} Y_t^J, \qquad C_t^{US,H} = \left(\frac{P_t^{EX,US}}{P_t^{US*}}\right)^{-\theta} Y_t^{US} \tag{20}$$

where $Y_t^J = C_t^{J*}$ and $Y_t^{US} = C_t^{US*}$

Log-linearized version of equations (20) are

$$c_t^{J,H} = -\theta(p_t^{EX,J} - p_t^{J*}) + y_t^J, \qquad c_t^{US,H} = -\theta(p_t^{EX,US} - p_t^{US*}) + y_t^{US} \tag{20'}$$

Euler equations for foreign households respectively imply,

$$y_t^J = E_t y_{t+1}^J - \frac{1}{\sigma}\left(i_t^J - E_t \pi_{t+1}^J\right), \qquad y_t^{US} = E_t y_{t+1}^{US} - \frac{1}{\sigma}\left(i_t^{US} - E_t \pi_{t+1}^{US}\right) \tag{21}$$

3.5 Central bank

With regards to the policy instruments of the central bank, we analyze five cases; (1) the interest rate rule under the floating regime, (2) money supply rule under the floating regime, (3) basket weight rule under the basket-peg regime, (4) trade weight rule under the basket-peg regime, and lastly (5) fixed rate rule under the dollar-peg regime. The balance sheet of the home central bank can be defined as

$$B_t^c + S_t^{R/\$} B_t^{US,c} = M_t \tag{22}$$

where the central bank holds domestic bonds (B_t^c) and US bonds ($B_t^{US,c}$ denominated in US dollar) on the assets and holds money supply on the liability.

3.5.1 Interest rate rule

We start by assuming that the home central bank adopts the floating regime and implements the interest rate rule. We consider this open-economy interest rate rule under imperfect capital mobility across home and foreign countries, similar to open-economy "Taylor rule" discussed in Clarida, Gali, and Gertler (2001, 2002), and Svensson (2000)[12]. Svensson (2000) also derives the reaction function (instrument rule) under flexible CPI inflation targeting in an open-economy.

3.5.2 Monetary Supply rule

Next, we focus on an open-economy money supply rule such that the central bank commits to output gap and inflation rate under the floating regime. As an example of money supply rule, Chowdhury and Schabert (2003) shows that the government commits the money growth rate only to its inflation rate. Furthermore, Evans and Honkapohja (2003) discuss Friedman's k-percent money supply rule. They show that Friedman's rule can generate equilibria that are determinate and stable. McCallum

[12] Clarida, Gali and Gertler (2001, 2002) analyze the interest rate rule of a small open economy under perfect capital mobility across home and foreign. On the other hand, we consider the interest rate rule under imperfect capital mobility across home and foreign countries.

and Nelson (1999) use the money supply rule that sets its interest rate in response to deviation of nominal GDP growth from a target path in a open-economy model with optimizing agents.

3.5.3 Basket-peg regime

Case (3) and (4) are analyzed under the basket-peg regime[13]. The basket is a weighted average of the real baht-yen rate and real baht-dollar rate. The home central bank intervenes into foreign exchange market to maintain the basket equation expressed in log-linearized form given as[14]

$$(1-\nu)\, e_t^{B/Y} + \nu e_t^{B/\$} = 0 \tag{23}$$

Equation (23) shows that the baht-dollar rate has a one-to-one relationship with the baht-yen rate. It indicates that the baht-dollar and baht-yen rates always change in opposite directions if equation (23) is maintained. The baht-dollar rate is endogenous, but determined solely by what happened to the baht-yen rate. As the Home central bank must intervene in the foreign exchange market to move the baht-yen and baht-dollar rates in just such a way that equation (23) is maintained. Clearly, adopting the basket-peg does not free the central bank from the burden of intervention. Thus, money supply will be endogenously adjusted reflecting the foreign market intervention (changes in domestic currency assets B_t^c and foreign currency assets $B_t^{US,c}$) to sustain equation (23) with respective rules.

We consider two rules under the basket-peg regime: one is that the home central bank commits to the basket weight rule where the weight depends on inflation and output gap, and the other is that its implements the trade weight rule such that the weight is always equal to its trade share[15].

3.5.4 Dollar-peg regime

Lastly, we regard the dollar-peg regime as an extreme case of the basket-peg regime such that the basket weight of the baht-dollar rate is always equal to 1. Therefore, the home central bank intervenes into the foreign exchange market to maintain the following special basket equation expressed in log-

[13] The optimality of basket-peg regime in East Asian countries has been discussed in Ito, Ogawa and Sasaki (1998), Ogawa and Ito (2002), Yoshino, Kaji, and Asonuma (2004, 2009) and Yoshino, Kaji, and Suzuki (2004).

[14] While Yoshino, Kaji, and Asonuma (2004, 2009) and Yoshino, Kaji and Suzuki (2004) consider the basket comprised of nominal exchange rates, we consider the basket comprised of real exchange rates.

[15] Implementing trade weight under the basket-peg regime is stressed in Ito, Ogawa and Sasaki (1998) and Ogawa and Ito (2002).

linearlized form,

$$e_t^{B/\$} = 0 \tag{23a}$$

implying that the home central bank stabilizes only the baht-dollar exchange rate. Once again, equation (23a) is maintained by foreign market intervention of the home central bank. Thus, each time the home central bank adjusts its domestic and foreign assets, total money supply in the domestic economy will be affected simultaneously.

4 Equilibrium

In this section, we define the equilibrium of this economy. First of all, we derive equilibrium equations from optimality conditions which we obtained in the previous section. Based on the flexible-price equilibrium values specified in Appendix B, we calculate the deviation of variables from their flexible-price equilibrium values. For the special case, equilibrium conditions under the basket-peg regime are discussed in Section 4.3.

4.1 Equilibrium Conditions

The uncovered interest parity (UIP) conditions can be shown as follows based on equation (12')[16]

$$i_t - E_t\pi_{t+1}^C = r_t^J + E_t e_{t+1}^{B/Y} - e_t^{B/Y} + E_t\psi_{t+1}, \qquad i_t - E_t\pi_{t+1}^C = r_t^{US} + E_t e_{t+1}^{B/\$} - e_t^{B/\$} + E_t\psi_{t+1} \tag{24}$$

Equilibrium condition for domestic bonds can be written as

$$B_t^h + B_t^c = B_t$$

where B_t is the total supply of domestic bonds.

Equilibrium requires that production equals consumption[17]. For domestically produced output, it requires that

$$Y_t \equiv Y_t^H + Y_t^{EX} = C_t^H + C_t^{J,H} + C_t^{US,H}$$

[16] Since we assume capital mobility across two foreign countries, the same amount of risk premium appears in both equations.

[17] We do not explicitly define the equilibrium condition for labor and imported materials which can be defined as follows; $L_t = \int_0^{n_H} L_t(z)dz + \int_0^{n_H^{EX}} L_t^{EX}(z)dz$ and $H_t^S = \int_0^{n_H} H_t(z)dz + \int_0^{n_H^{EX}} H_t^{EX}(z)dz$.

In the log-linearized version,

$$y_t \equiv \vartheta_H y_t^H + (1-\vartheta_H) y_t^{EX} = \vartheta_H c_t^H + \vartheta_J c_t^{J,H} + \vartheta_{US} c_t^{US,H} \tag{25}$$

Using (1'), (2'), (3') (9'), (11'), (20') and (21), we obtain the IS curve for the economy, such as

$$\begin{aligned} y_t &= E_t y_{t+1} + \frac{A_1}{A} E_t \pi_{t+1}^C - \frac{\vartheta_H \theta \lambda_J}{A \lambda_H} \left(E_t e_{t+1}^{B/Y} - e_t^{B/Y} \right) - \frac{\vartheta_H \theta \lambda_{US}}{A \lambda_H} \left(E_t e_{t+1}^{B/\$} - e_t^{B/\$} \right) \\ &\quad - \frac{A_2}{A} \left(i_t - E_t \pi_{t+1}^C \right) - \frac{\vartheta_J}{\sigma} \left(i_t^J - E_t \pi_{t+1}^J \right) - \frac{\vartheta_{US}}{\sigma} \left(i_t^{US} - E_t \pi_{t+1}^{US} \right) - \frac{A_3}{A} \left(E_t q_{t+1} - q_t \right) \end{aligned} \tag{25'}$$

where details of the coefficients are shown in Appendix.

For money demand equations, we have

$$m_t = \frac{\sigma B_1}{bB} y_t + \frac{\sigma B_2}{bD} q_t + \left[1 - \frac{\sigma B_3}{bB} \right] \pi_t^C - \frac{\sigma B_4}{bB} e_t^{B/Y} - \frac{\sigma B_5}{bB} e_t^{B/\$} - \frac{1}{b} i_t + \left[1 - \frac{\sigma B_3}{bB} \right] p_{t-1}^C \tag{26}$$

4.2 Deviations from the flexible-price equilibrium

When prices are sticky, output and real exchange rates can differ from their flexible-price equilibrium values specified in Appendix B. We define output gap $x_t \equiv y_t - y_t^o$. We express $\hat{a}_t$ as its percentage deviation from the flexible-price equilibrium value.

Real marginal cost, given by equation (15) can be shown as follows using equation (3') (11'), (A1)

$$\begin{aligned} \widehat{mc}_t^H &= \left(\alpha\eta + \frac{\sigma B_1}{B} \right) x_t + \left[\alpha\eta \left(\frac{1-\alpha}{\alpha} + \frac{1-\alpha'}{\alpha'} \right) + \frac{\sigma B_2}{B} \right] \hat{q}_t - \left[\frac{\sigma B_3}{B} + \frac{1}{\lambda_H} \right] \pi_t^C \\ &\quad + \left[\frac{\lambda_J}{\lambda_H} - \frac{\sigma B_4}{B} \right] \hat{e}_t^{B/Y} + \left[\frac{\lambda_{US}}{\lambda_H} - \frac{\sigma B_5}{B} \right] \hat{e}_t^{B/\$} \end{aligned}$$

where we assume $e_{t-1}^{B/Y} = e_{t-1}^{B/Y,o}$, $e_{t-1}^{B/\$} = e_{t-1}^{B/\$,o}$ and $p_{t-1}^H = p_{t-1}^{H,o}$.

Substituting this expression into equation (18'), we obtain the AS curve such as;

$$\pi_t^C = \frac{\beta}{D} E_t \pi_{t+1}^C + \frac{D_1}{D} x_t + \frac{D_2}{D} \hat{q}_t - \frac{\beta}{D} \left[\lambda_J E_t \hat{e}_{t+1}^{B/Y} + \lambda_{US} E_t \hat{e}_{t+1}^{B/\$} \right] + \frac{1}{D} \left[D_3 \hat{e}_t^{B/Y} + D_4 \hat{e}_t^{B/\$} \right] \tag{27}$$

where we assume $e_{t-1}^{B/Y} = e_{t-1}^{B/Y,o}$ and $e_{t-1}^{B/\$} = e_{t-1}^{B/\$,o}$, $p_{t-1}^H = p_{t-1}^{H,o}$ for simplicity.

For IS curve, from (25') and using uncovered interest parity condition (UIP),

$$\begin{aligned} x_t &= E_t x_{t+1} + \frac{A_1}{A} E_t \pi^C_{t+1} - \left[\frac{A_2}{A} + \frac{(1-\lambda_H)}{\sigma}\right](i_t - i^o_t) - \frac{A_3}{A}\left(E_t \hat{q}_{t+1} - \hat{q}_t\right) + \frac{(1-\lambda_H)}{\sigma} E_t \hat{\psi}_{t+1} \\ &\quad - \left[\frac{\vartheta_H \theta \lambda_J}{A \lambda_H} - \frac{\vartheta_J}{\sigma}\right]\left(E_t \hat{e}^{B/Y}_{t+1} - \hat{e}^{B/Y}_t\right) - \left[\frac{\vartheta_H \theta \lambda_{US}}{A \lambda_H} - \frac{\vartheta_{US}}{\sigma}\right]\left(E_t \hat{e}^{B/\$}_{t+1} - \hat{e}^{B/\$}_t\right) \qquad (28) \end{aligned}$$

Moreover, for LM curve, we obtain[18],

$$(m_t - m^o_t) = \frac{\sigma B_1}{bB} x_t + \frac{\sigma B_2}{bD} \hat{q}_t + \left[1 - \frac{\sigma B_3}{bB}\right] \pi^C_t - \frac{\sigma B_4}{bB} \hat{e}^{B/Y}_t - \frac{\sigma B_5}{bB} \hat{e}^{B/\$}_t - \frac{1}{b}(i_t - i^o_t) \qquad (29)$$

Compared to IS and AS curves in the closed economy, there are two key differences: one is both AS and IS depend on $E_t \hat{e}^{B/i}_{t+1}$, $\hat{e}^{B/i}_t$ for $i = J, US$ since Home CPI depends on exchange rates. The latter is that they also depend on $E_t \hat{q}_{t+1}$, and $\hat{q}_t$ as the price decisions of both domestic firms and exporting firms rely on the price of imported intermediate goods. Therefore, these two conditions depend on deviation of exchange rates and the price of imported intermediate goods from the flexible-price equilibrium values.

4.3 Equilibrium condition under the basket-peg regime

Under the basket-peg regime, using the basket equation (24), IS, AS, and LM can be expressed as

$$\pi^C_t = \frac{\beta}{D} E_t \pi^C_{t+1} + \frac{D_1}{D} x_t + \frac{D_2}{D} \hat{q}_t - \frac{\beta}{D}\left[\lambda_J + \lambda_{US}(1-\nu^*)\right] E_t \hat{e}^{B/Y}_{t+1} + \frac{1}{D}\left[D_3 + D_4(1-\nu^*)\right] \hat{e}^{B/Y}_t \qquad (27a)$$

$$\begin{aligned} x_t &= E_t x_{t+1} + \frac{A_1}{A} E_t \pi^C_{t+1} - \left[\frac{A_2}{A} + \frac{(1-\lambda_H)}{\sigma}\right](i_t - i^o_t) - \frac{A_3}{A}\left(E_t \hat{q}_{t+1} - \hat{q}_t\right) + \frac{(1-\lambda_H)}{\sigma} E_t \hat{\psi}_{t+1} \\ &\quad - \left[\left(\frac{\vartheta_H \theta \lambda_J}{A \lambda_H} - \frac{\vartheta_{US}}{\sigma}\right) + \left(\frac{\vartheta_H \theta \lambda_{US}}{A \lambda_H} - \frac{\vartheta_{US}}{\sigma}\right)(1-\nu^*)\right]\left(E_t \hat{e}^{B/Y}_{t+1} - \hat{e}^{B/Y}_t\right) \qquad (28a) \end{aligned}$$

$$(m_t - m^o_t) = \frac{\sigma B_1}{bB} x_t + \frac{\sigma B_2}{bD} \hat{q}_t + \left[1 - \frac{\sigma B_3}{bB}\right] \pi^C_t - \frac{\sigma}{bB}\left[B_4 + B_5(1-\nu^*)\right] \hat{e}^{B/Y}_t - \frac{1}{b}(i_t - i^o_t) \qquad (29a)$$

where $\nu^* = \frac{1}{\nu}$.

[18] For simplicity, we assume $\pi^{C,o}_t = 0$, and $p^C_{t-1} - p^{C,o}_{t-1} = 0$

5 Optimal instrument rules

In this section, we define the rules for policy instruments. Throughout this section, we assume that home central bank attempts to minimize the following quadratic function, which is defined in terms of inflation and output gap.

$$L_t = E_t \sum_{i=0}^{\infty} \beta^i \left[\left(\pi_{t+i}^C \right)^2 + \varpi \left(x_{t+i} \right)^2 \right] \tag{30}$$

Furthermore, we assume that home central bank commits to an instrument rule such that it allows to choose credibly, one for all an optimal state-contingent plan.

5.1 Interest rate rule under the floating regime

We start from the interest rate rule under the floating rate regime. We define the interest rate rule, one type of the "Taylor rule" introduced by Taylor (1993), which relates periodic adjustments in a money market interest rate made in response to existing inflation and output gap measures:

$$i_t - (E_t \pi_{t+1} + r_t^o) = \gamma_x x_t + \gamma_\pi \pi_t \tag{31}$$

In addition, we also consider the "augmented interest rate rule" which a money market interest rate adjusts in response to the baht-dollar exchange rate together with inflation output gap:

$$i_t - (E_t \pi_{t+1} + r_t^o) = \gamma_x x_t + \gamma_\pi \pi_t + \gamma_e e_t^{B/\$} \tag{31'}$$

System with interest rate rule is shown as

$$\min L_t$$

subject to equation (27), (28) and (31) or (31'). Note we do not need LM curve here as the central bank chooses the optimal level of real interest rate which directly affects the IS curve.

5.2 Money supply rule under the floating regime

Next, we consider the money supply rule. In this case, nominal money supply is used as an instrument for specifying policy actions that are designed to keep inflation and output gap at the target level:

$$m_t - m_t^o = \chi_x x_t + \chi_\pi \pi_t \chi_\pi \tag{32}$$

System with money supply rule are

$$\min L_t$$

subject to equation (27), (28), (29) and (32). Change in nominal money supply will have impacts on the economy through LM curve shown as equation (29).

5.3 Basket weight rule under the basket-peg regime

Now, we analyze instrument rules under the basket-peg regime. We define the exogenous shock (Λ_t) as follows;

$$\Lambda_t = \hat{e}_t^{B/Y} \equiv e_t^{B/Y} - e_t^{B/Y,o}$$

We specify the basket weight rule which relates periodic adjustments in a multiple of basket weight and exogenous shock in response to existing inflation and output gap measures:

$$\nu^* \Lambda_t = \kappa_x x_t + \kappa_\pi \pi_t \tag{33}$$

Then we can express the systems with basket-weight rule as follows;

$$\min L_t$$

subject to equation (27a), (28a), (29a), and (33).

5.4 Trade weight rule under the basket-peg regime

Next, we consider the rule such that the home central bank commits the basket weight to its trade weight:

$$\nu^* = \frac{1}{TR_{US}} \tag{34}$$

where TR_{US} is the US trade weight shown as $\frac{EX_{US}+IM_{US}}{EX_{US}+EX_J+IM_{US}+IM_J}$. By implementing the trade weight rule, the central bank can also affect the exchange rates as in the basket weight rule case.

We can express system using the trade-weight rule as follows:

$$\min L_t$$

subject to equation (27a), (28a), (29a), and (34).

5.5 Fixed rate rule under the dollar-peg regime

Lastly, under the dollar-peg regime, we analyze the following rule such that the weight for the baht-dollar exchange rate is always equal to one shown as:

$$\nu^* = 1 \tag{35}$$

We can express system with the fixed rate as follows:

$$\min L_t$$

subject to equation (27a), (28a), (29a), and (35).

6 Numerical analysis: case of Singapore and Thailand

In this section, we present quantitative analysis based on calibration results with Singaporean and Thai data. We use both quarterly data from the IMF, International Financial Statistics (IFS) and annual data from the IMF Direction of Trade statistics (DOT)[19]. Thailand had adopted the fixed exchange rate against the US dollar, but it has shifted to the floating regime since 1997Q3. In order

[19]We will provide the data as well as matlab codes and methods of calculation upon requests.

to take this into account, we define our sample period from 1997Q3 to 2006Q2. The majority of the variables, exempting the interest rates and exchange rate risks, are denominated in natural log.

The procedure of simulations is comprised of 4 steps. First, we set some parameters in the model based on the data set and calculate the deviations from their flexible-price equilibrium values. Next, we apply unit root tests and co-integration tests. In the third step, we estimate policy instrument equations and specify exogenous shock processes. Finally, we calibrate the model with the designated parameters to examine impulse responses of the output gap and inflation rate with respect to exogenous shocks. By using actual data for exogenous shocks, we calculate proxy cumulative losses under five policy instruments, which correspond to losses under the period 1997Q3 to 2006Q2.

6.1 Selected parameters and variables

Before applying unit root tests of variables, we need to specify some parameters in the model. As in standard international real business cycle model (IRBC) as Arellano (2008), we set the intertemporal elasticity of substitution σ to 2. As in Walsh (2006), we enumerate $\beta = 0.99$, which implies a risk-free annual return of about 4% in the steady state. Following Gali and Monacelli (2005), we define $\eta = 3$, which implies a labor supply elasticity of 1/3 and $\mu = 6$ consistent with the markup (μ_M) is equal to 1.2 in the steady state. Similarly, b is targeted to 2/3, which corresponds to elasticity of real money holdings respect to interest rate as 3/2. We set elasticity of goods across countries $\theta = 2$, as in Shioji (2006b). Parameter ω is defined as 0.75, consistent with an average period of one year between price adjustments as in Gali and Monacelli (2005). Thus, it leads to $\kappa = 0.086$.

We calculate the preference parameters using the annual export and import shares of both Singapore and Thailand in 2002 from the IMF DOT, together with the annual consumption and GDP data from the IMF IFS.

[Insert Table 1 here]

Next, by removing the non-trend components, we denote the flexible-price equilibrium values of variables as Hodrik-Prescot (H-P) filtered trend values of the variables. For the expected value, we use next-period H-P filtered trend values as the cyclical components have been deleted from the variables and we assume the cyclical components follow the i.i.d. process. Furthermore, we derive deviations from the flexible-price equilibrium values. For a risk premium, we use the standard deviation of monthly exchange rate as a proxy.

We assign $\alpha = \alpha' = 0.18$ for Singapore and $\alpha = \alpha' = 0.17$ on Thailand reflecting the cost share of labor and imported intermediate goods in the final goods sector from Institute of Developing Economies (2006). For the U.S. trade weight, we calculate the trade weight using export and import data from IMF Direction of Trade Statistics (DOT), which is equal to 0.60 and 0.44 respectively.

6.2 Unit root and co-integration tests

This subsection provides results of unit root and co-integration tests. First, we apply the Dicky-Fuller General Least Square (DF-GLS) unit root test. Results of these unit root tests are summarized in Table 2.

[Insert Table 2 here]

For Thailand, we apply the Johansen co-integration tests before estimating policy instruments, since our unit root results indicate that both output gap and inflation have an unit root. However, as shown in Table 3, we do not find any co-integration relationships for four equations.

[Insert Table 3 here]

6.3 Estimation of policy instruments and shock processes

Reflecting the results of our unit root and co-integration tests presented above, we regress the policy instrument rules and optimality conditions using Singaporean and Thai quarterly data. For Thai output gap and inflation which have a unit root, we use the first difference of these variables in order to satisfy the stationarity. Next, for the basket weight, we define the optimal basket weight as $\nu = 0.68$ ($\nu^* = 1.47$) which is derived in Yoshino, Kaji and Asonuma (2009)[20]. Results of the Generalized Method of Moments (GMM) estimation are shown in Table 4.

[Insert Table 4 here]

[20] This weight corresponds to the the optimal weight under the stable basket-peg regime minimizing cumulative loss for fixed 36 quarter period.

For exogenous shocks, we fit AR(1) processes to (log) real baht-dollar exchange rate, real baht-yen exchange rate, a risk premium and oil price respectively using quarterly data for the specified sample. Table 5 summarizes the parameter values we set.

[Insert Table 5 here]

6.4 Impulse responses

In this paper, we focus primarily on two issues. One of them is difference in impacts of exogenous shocks on the output gap and inflation rate under the policy instrument rules. The other is comparison of cumulative losses under the specified instrument rules.

To facilitate the first interest, we calibrate the model using parameters defined above. Figure 2-5 display the impulse responses of the output gap and inflation under the policy instrument rules following a 1 % temporary increase in four different shocks; the baht-yen exchange rate, a risk premium, the oil price, and the baht-dollar exchange rate in the case of Thailand. Variables in Figure 2-5 are expressed in terms of percentage deviations from their steady-state values.

Following are the distinguished features concerning the response under the floating and basket-peg regimes. First of all, the output gap and inflation rates are largely affected by both the dollar and yen exchange rates under two regimes. Thus, one of the advantages under the basket-peg regime is that the central bank can focus only on effects of the yen exchange rate, since the dollar rate is endogenous, but determined solely by the yen exchange rate as long as the central bank maintains equation (23) by foreign market interventions.

Second, the output gap and inflation are not affected by the oil price shock under the floating regime, while they are largely affected under the basket-peg regime. By committing directly to the output gap and inflation under the interest rate rule or money supply, the central bank successfully reduces the impacts of the oil price shock on the output and inflation. On contrary, under the basket-peg, as effects of commitment to the specified rules are transmitted through the exchange rate channels, the central bank can not efficiently reduces the impacts of oil price shock on the output gap and inflation.

Thirdly, for the basket-peg regime, impacts of both baht-yen exchange rate and oil price shocks on inflation are larger under the trade weight rule than those under the basket weight rule. This difference in the magnitude of impacts clearly reflects the disadvantage of trade weight rule such that the central bank can not commit its basket weight to its target variables.

Lastly, neither the output gap nor inflation rate are significantly affected by a risk premium shock under two regimes.

[Insert Figure 2 here]

[Insert Figure 3 here]

[Insert Figure 4 here]

[Insert Figure 5 here]

6.5 Cumulative losses

In this subsection, we discuss the relative superiority of policy instrument rules in terms of cumulative losses. We calculate two sets of cumulative losses for two countries; (1) using the actual exogenous shock data for the period from 1997Q3 to 2006Q2 and (2) using the random exogenous shock data for the long span (60 quarters).

6.5.1 Cumulative losses with actual data (fixed time periods)

We start from the cumulative losses using the actual exogenous shock data for the period from 1997Q3 to 2006Q2. We use a discount factor $\beta = 0.99$ and relative importance of policy objectives of two countries ($\varpi = 0.075$ for Singapore and $\varpi = 0.10$ for Thailand).

[Insert Table 6 here]

Some implications are obtained from Table 6; First, the cumulative loss under the basket weight rule is the smallest among five policy instrument rules in both countries. It reflects that the central bank can effectively minimize the impacts on the output gap and inflation through the exchange rate channels by committing to its basket weight to the target variables.

Second, the cumulative loss under the augmented interest rate rule is smaller than one under the interest rate rule. It shows the clear advantage of committing to the rule which includes the dollar exchange rate as one of the targets since both the output gap and inflation are largely affected by fluctuations of the dollar exchange rate.

Third, the higher values of cumulative losses under the trade weight rule and the fixed rate rule compared to one under the fixed rate rule are due to the disadvantage of the rules such that the central bank can not adjust the basket weight smoothly to its target variables.

6.5.2 Cumulative losses with the long span

Next, we analyze which optimal instrument rule is desirable for the long span (60 quarters). In order to consider the cumulative losses during the tranquil period, we calculate the loss for each policy instrument using the random exogenous shocks derived from normal distributions with variances of shocks under post-Asian Currency Crisis period (from 1999Q3 to 2006Q2). The variances of the shocks are shown in Table 7.

[Insert Table 7 here]

We set the time span as 60 quarters (15 years). Again, we use a discount factor $\beta = 0.99$ and relative importance of policy objectives of two countries ($\varpi = 0.075$ for Singapore and $\varpi = 0.10$ for Thailand).

[Insert Figure 6 here]

We obtain some implications from Figure 6; first, in the case of Singapore, the cumulative loss under the interest rate rule is smaller than one under the basket weight rule as the time span is longer than 53 quarters. It reflects the advantage of the interest rate rule under the long and tranquil period which the variance of the real baht-dollar rate shock is small ($\sigma^p_{eB/\$} = 0.023$).

Second, in the case of Thailand, the cumulative loss under the basket weight rule remains the smallest as the time span gets longer. As the variances of both the baht-dollar and baht-yen exchange rates are moderate (around 0.05), the central bank still be able to gain the advantage of efficiency of commitment to the rule through the exchange rate channels.

6.5.3 Comparison of interest rate and basket weight rules

Lastly, we consider the comparison of interest rate rule and basket weight rules.

[Insert Table 8 here]

Table 8 indicates that in the case of Singapore, it is desirable for the central bank to implement the interest rate rule which commits to the output gap and inflation, rather than the augmented interest rate rule which have three target variables such as exchange rate together with the output gap and inflation. As mentioned above, this is highly associated with low variance of real baht-dollar exchange rate in the sample period.

On the other hand, in the case of Thailand, adopting the augmented interest rate rules leads to lower cumulative losses compared one of the interest rate rule. These results possibly depend on the fact that the variances of the real baht-dollar and baht-yen exchange rates are moderate (around 0.05). However, the cumulative losses under the augmented interest rate rule are still higher than one of the basket weight rule.

As a brief summary, with high or moderate variances of exchange rates, it is desirable to implement the basket weight rule taking into account the efficiency of exchange rate channels to the targets. At the same time, the augmented interest rate rules which includes the exchange rates as the target variables might be possible options. On contrary, with low variances of exchange rates, the central bank can obtain the low cumulative loss by committing to the interest rate rule.

7 Conclusion

This paper attempts to solve two puzzles concerning the basket-peg regime. For the first puzzle, there still remains the question as to whether or not adopting the basket-peg regime rather than the floating regime is optimal for East Asian countries. Furthermore, under the basket-peg regime, there is a trade-off between optimality based on the consideration of the capital movements across countries and practical usefulness. On the basis of a small open-economy model with micro foundations under imperfect capital mobility, we derive a simple basket weight rule, which is sub-optimal but practically easy to implement. With an exercise of comparison among the calibrated cumulative losses using Singaporean and Thai quarterly data from 1997Q3 to 2006Q2, we show that adopting the basket weight rule is superior to the implementation of the interest rate or money supply rule under the floating regime or trade weight rule under the basket peg regime for an open-economy like Thailand. There are two reasons for relative superiority of the basket weight rule: one is that the monetary authority can focus only on effects of the yen exchange rate, since the dollar rate is endogenous, but determined solely by the yen exchange rate as long as it maintains the weighted averages of exchange rates at the constant value by foreign market interventions. The other is that by committing to the basket weight rule, the monetary authority is able to stabilize the impacts on the output gap and inflation rate through exchange rate channels which are missing under the interest rate rule or money supply rule. Although our focus is specific to East Asian countries, our analysis can be applied to any open economy which has close economic relationships with several countries.

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A The equilibrium conditions

The IS curve is shown as,

$$\begin{aligned} y_t &= E_t y_{t+1} + \frac{A_1}{A} E_t \pi^C_{t+1} - \frac{\vartheta_H \theta \lambda_J}{A \lambda_H} \left(E_t e^{B/Y}_{t+1} - e^{B/Y}_t \right) - \frac{\vartheta_H \theta \lambda_{US}}{A \lambda_H} \left(E_t e^{B/\$}_{t+1} - e^{B/\$}_t \right) \\ &\quad - \frac{A_2}{A} \left(i_t - E_t \pi^C_{t+1} \right) - \frac{\vartheta_J}{\sigma} \left(i^J_t - E_t \pi^J_{t+1} \right) - \frac{\vartheta_{US}}{\sigma} \left(i^{US}_t - E_t \pi^{US}_{t+1} \right) - \frac{A_3}{A} \left(E_t q_{t+1} - q_t \right) \end{aligned} \tag{25'}$$

where $A = [1 + (1 - \vartheta_H)\theta\alpha'\eta]$, $A_1 = \left[\vartheta_H \left(\frac{1}{\lambda_H} - 1 \right) + (1 - \vartheta_H)\alpha' \right]$, $A_2 = \left[\frac{\vartheta_H}{\sigma} - (1 - \vartheta_H)\theta\alpha' \right]$, $A_3 = (1 - \vartheta_H)\theta\alpha'\eta \left(\frac{1-\alpha}{\alpha} + \frac{1-\alpha'}{\alpha'} \right)$.

From the market clearing condition for goods produced in Home, we obtain the expression for c_t,

$$c_t = \frac{B_1}{B} y_t + \frac{B_2}{B} q_t - \frac{B_3}{B} p^C_t - \frac{B_4}{B} e^{B/Y}_t - \frac{B_5}{B} e^{B/\$}_t \tag{A1}$$

where $B = \left[(1 - \lambda_H) - \lambda_H \frac{(1-\vartheta_H)}{\vartheta_H} \theta\alpha'\sigma \right]$, $B_1 = \frac{\lambda_H}{\vartheta_H} A$, $B_2 = \frac{\lambda_H (1-\vartheta_H)\theta}{\vartheta_H} \left[(1 - \alpha') + \alpha'\eta \left(\frac{1-\alpha}{\alpha} + \frac{1-\alpha'}{\alpha'} \right) \right]$, $B_3 = \frac{\lambda_H (1-\vartheta_H)\theta}{\vartheta_H} (1 + \alpha')$, $B_4 = \theta \left(\lambda_J + \frac{\lambda_H \vartheta_J}{\vartheta_H} \right)$, $B_5 = \theta \left(\lambda_{US} + \frac{\lambda_H \vartheta_{US}}{\vartheta_H} \right)$

For money demand equations, we have

$$m_t = \frac{\sigma B_1}{bB} y_t + \frac{\sigma B_2}{bD} q_t + \left[1 - \frac{\sigma B_3}{bB} \right] \pi^C_t - \frac{\sigma B_4}{bB} e^{B/Y}_t - \frac{\sigma B_5}{bB} e^{B/\$}_t - \frac{1}{b} i_t + \left[1 - \frac{\sigma B_3}{bB} \right] p^C_{t-1} \tag{26}$$

The AS curve of the economy can be rewritten as,

$$\pi^C_t = \frac{\beta}{D} E_t \pi^C_{t+1} + \frac{D_1}{D} x_t + + \frac{D_2}{D} \hat{q}_t - \frac{\beta}{D} \left[\lambda_J E_t \hat{e}^{B/Y}_{t+1} + \lambda_{US} E_t \hat{e}^{B/\$}_{t+1} \right] + \frac{1}{D} \left[D_3 \hat{e}^{B/Y}_t + D_4 \hat{e}^{B/\$}_t \right] \tag{27}$$

where $D = \left[1 + \lambda_H \kappa \left(\frac{\sigma B_3}{B} + \frac{1}{\lambda_H} \right) \right]$, $D_1 = \lambda_H \kappa \left(\alpha\eta + \frac{\alpha B_1}{B} \right)$, $D_2 = \lambda_H \kappa \left[\alpha\eta \left(\frac{1-\alpha}{\alpha} + \frac{1-\alpha'}{\alpha'} \right) + \frac{\sigma B_2}{B} \right]$, $D_3 = \left[\lambda_J \left(\frac{1}{\lambda_H} + \beta + 1 \right) - \frac{\sigma B_4}{B} \right]$, $D_4 = \left[\lambda_{US} \left(\frac{1}{\lambda_H} + \beta + 1 \right) - \frac{\sigma B_5}{B} \right]$

B Flexible price equilibrium

We assume that the foreign real interest rate $r^j_t = i^j_t - E_t \pi^j_{t+1} \quad j = J, US$, is mean $\bar{r}^j_t$ white noise disturbances. Let $r^{J,o}_t$ denote the flexible-price equilibrium value of a variable r^J_t (still expressed as percentage deviations around the steady state). Then the flexible price equilibrium satisfies

$$r_t^o \equiv i_t^o - E_t\pi_{t+1}^{C,o} = r_t^{J,o} + E_t e_{t+1}^{B/Y,o} - e_t^{B/Y,o} + E_t\psi_{t+1}^o, \tag{A2}$$

$$r_t^o \equiv i_t^o - E_t\pi_{t+1}^{C,o} = r_t^{US,o} + E_t e_{t+1}^{B/\$,o} - e_t^{B/\$,o} + E_t\psi_{t+1}^o \tag{A3}$$

$$\begin{aligned} y_t^o \;\; = \;\; & E_t y_{t+1}^o + \frac{A_1}{A}E_t\pi_{t+1}^{C,o} - \frac{\vartheta_H\theta\lambda_J}{A\lambda_H}\left(E_t e_{t+1}^{B/Y,o} - e_t^{B/Y,o}\right) - \frac{\vartheta_H\theta\lambda_{US}}{A\lambda_H}\left(E_t e_{t+1}^{B/\$,o} - e_t^{B/\$,o}\right) \\ & -\frac{A_2}{A}\left(i_t^o - E_t\pi_{t+1}^{C,o}\right) - \frac{\vartheta_J}{\sigma}r_t^{J,o} - \frac{\vartheta_{US}}{\sigma}r_t^{US,o} - \frac{A_3}{A}\left(E_t q_{t+1}^o - q_t^o\right) \end{aligned} \tag{A4}$$

$$m_t^o = \frac{\sigma B_1}{bB}y_t^o + \frac{\sigma B_2}{bD}q_t^o + \left[1 - \frac{\sigma B_3}{bB}\right]\pi_t^{C,o} - \frac{\sigma B_4}{bB}e_t^{B/Y,o} - \frac{\sigma B_5}{bB}e_t^{B/\$,o} - \frac{1}{b}i_t^o + \left[1 - \frac{\sigma B_3}{bB}\right]p_{t-1}^{C,o} \tag{A6}$$

Equation (A2) (A3) are interest parity conditions at the flexible-price equilibrium. Equation (A4) which is the IS equation at the flexible-price equilibrium and is obtained from equation (25'). Equation (A5) is the LM equation which is obtained from equation (26).

We set all expected future values equal to zero because of the earlier assumption of white noise disturbances. From (A2) and (A3), we obtain $e_t^{B/Y,o} = r_t^{J,o} - r_t^o$ and $e_t^{B/\$,o} = r_t^{US,o} - r_t^o$ indicating that real exchange rate is equal to real interest rate differential. Furthermore, substituting the expressions for $e_t^{B/Y,o}$, $e_t^{B/\$,o}$ into last three equations, we obtain expressions for y_t^o

$$y_t^o = \left[\frac{\vartheta_H\theta\lambda_J}{A\lambda_H} - -\frac{\vartheta_J}{\sigma}\right]r_t^{J,o} + \left[\frac{\vartheta_H\theta\lambda_{US}}{A\lambda_H} - -\frac{\vartheta_{US}}{\sigma}\right]r_t^{US,o} - \left[\frac{\vartheta_H\theta(1-\lambda_H)}{A\lambda_H} + \frac{A_2}{A}\right]r_t^o + \frac{A_3}{A}q_t^o \tag{A7}$$

Then we can obtain the expression for m_t^o under the interest rate rule.

C Figures legends

Figure 1: Small open economy with the rest of the world

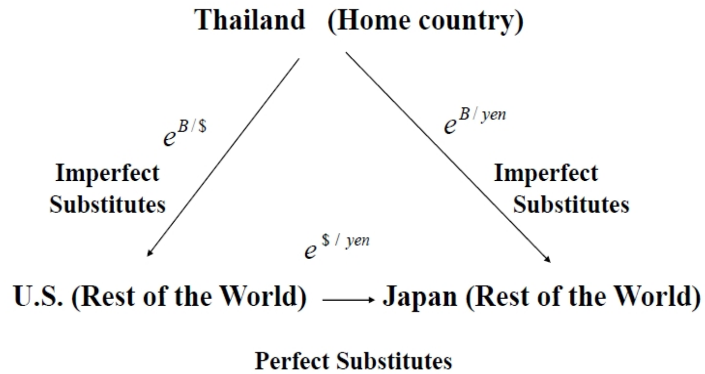


Figure 2: Impulse responses under the interest rate rule

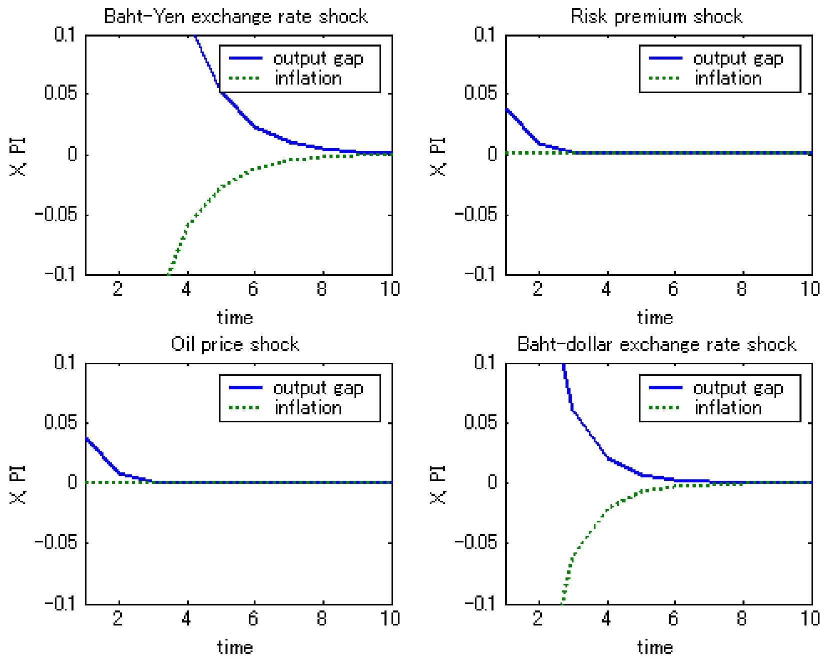


Figure 3: Impulse responses under the money supply rule

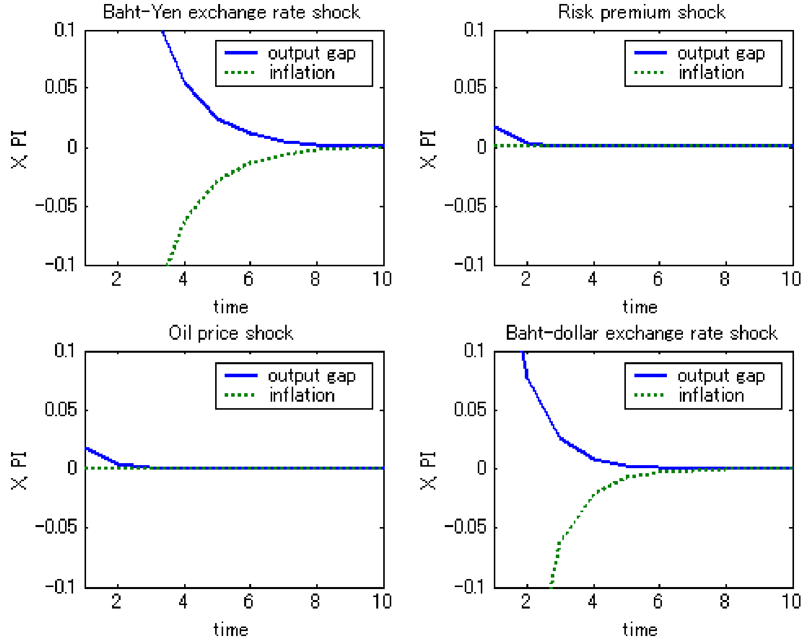


Figure 4: Impulse responses under the basket weight rule

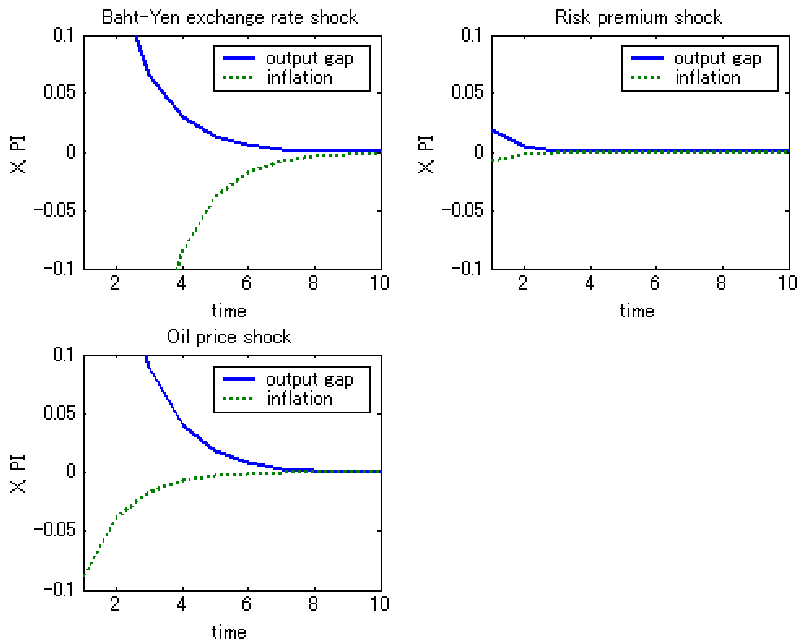


Figure 5: Impulse responses under the trade weight rule

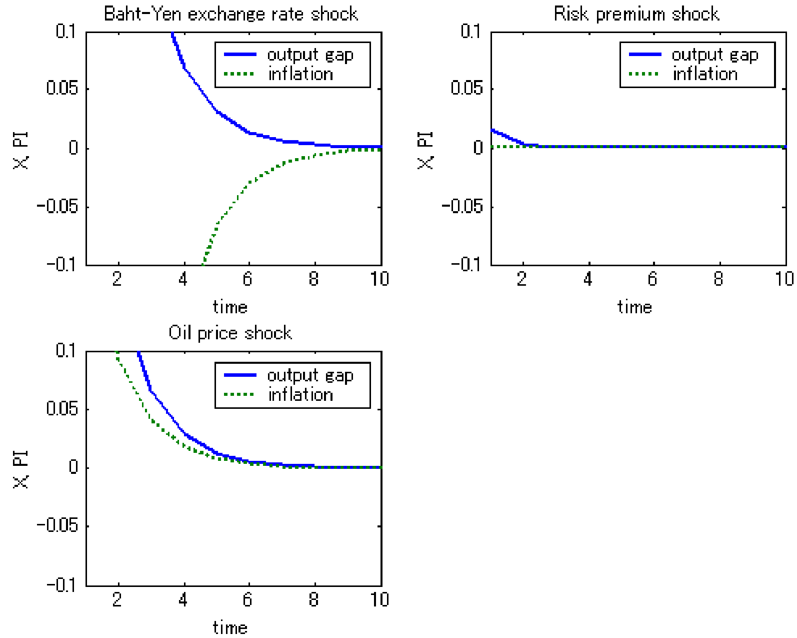
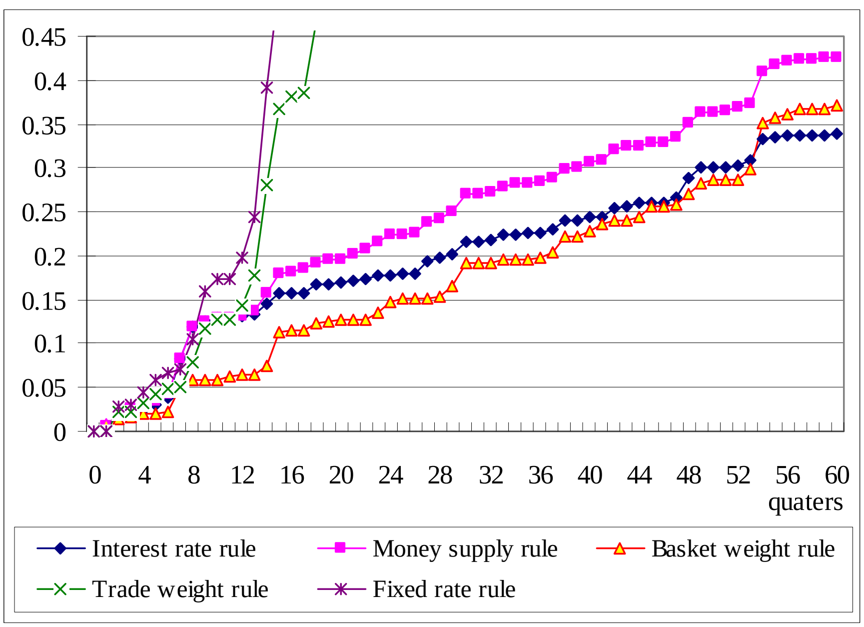
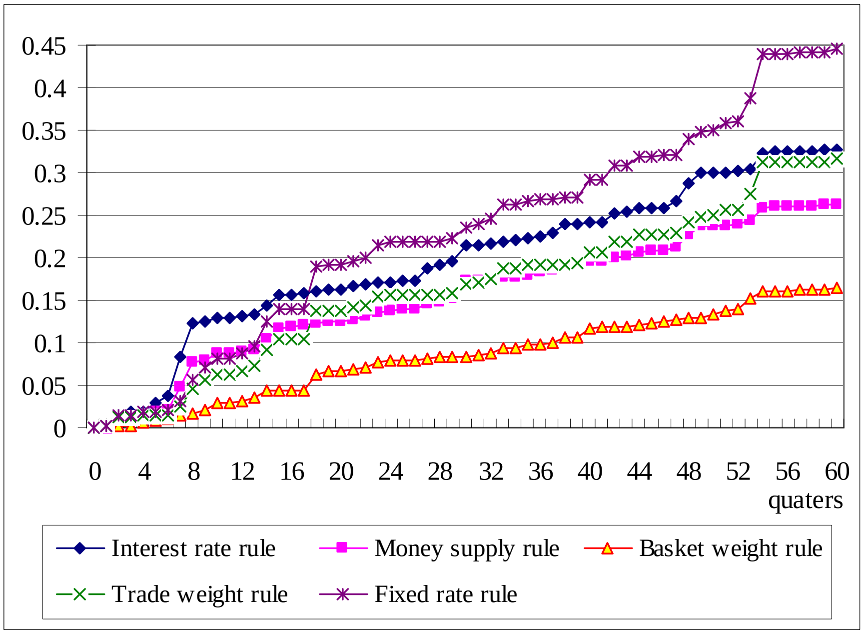


Figure 6: Cumulative losses with random shocks for long time span

(1) Singapore



(2) Thailand



D Table legends

Table 1: Preference Parameters

Parameters	(1) Singapore	(2) Thailand
λ_H	0.58	0.78
λ_J	0.20	0.15
λ_{US}	0.22	0.07
ϑ_H	0.69	0.81
ϑ_J	0.10	0.08
ϑ_{US}	0.21	0.11

Table 2: Dicky-Fuller General Least Square (DF-GLS) Tests

(1) Singapore

Variables	Degree	Trend	Lag	DF-GLS Stat.*1	Results
π_t	level	No	3	-2.07	I(0)*3
x_t	level	No	3	-1.88	I(0)*3
$m_t - m_t^o$	level	No	3	-2.39	I(0)*3
$i_t - i_t^o$	level	No	0	-2.37	I(0)*3
$e_t^{S/Y} - e_t^{S/Y,o}$	level	No	0	-2.16	I(0)*3
$e_t^{S/\$} - e_t^{S/\$,0}$	level	No	2	-1.82	I(0)*3
$q_t - q_t^o$	level	No	1	-3.098	I(0)*3
$E_t\hat{\psi}_{t+1}$	level	No			

(2) Thailand

Variables	Degree	Trend	Lag	DF-GLS Stat.*1	Results
π_t	level	No	4	-1.228	
	1st dif.	No	0	-2.734	I(1)*2
x_t	level	No	3	-0.934	
	1st dif.	No	0	-5.599	I(1)*2
$m_t - m_t^o$	level	No	3	-1.796	
	1st dif.	No	0	-6.749	I(0)*3
$i_t - i_t^o$	level	No	0	-1.944	
	1st dif.	No	1	-3.376	I(0)*3
$e_t^{B/Y} - e_t^{B/Y,o}$	level	No	2	-3.376	I(0)*3
$e_t^{B/\$} - e_t^{B/\$,0}$	level	No	0	-3.894	I(0)*3
$q_t - q_t^o$	level	No	1	-3.098	I(0)*3
$E_t\hat{\psi}_{t+1}$	level	No	0	-4.318	I(0)*3

Note: *1: The critical values for DL-GLS statistics: 5% -1.98, 10% -1.62. Our result of unit root is based on 10% critical value. *2: 'I(1)' shows that the variable has a unit root of degree 1. *3: 'I(0)' expresses that the variable follows a stationary process at the level.

Table 3: Johansen co-integration test (Unrestricted rank test) - Thailand

Equation	Variables	Trend	Hypothesis	Cri. Va.*1	P-Value*2
Interest rate	$i_t - i_t^o$	Deter.*3	None*4	47.86	0.000
	x_t		At most 1*4	29.80	0.000
	π_t		At most 2*4	15.50	0.000
	$\hat{e}_t^{B/\$}$		At most 3*4	3.84	0.002
Money supply	$m_t - m_t^o$	Deter.*3	None*4	29.80	0.000
	x_t		At most 1*4	15.50	0.003
	π_t		At most 2*4	3.84	0.011
Basket weight	$\nu^* \Lambda_t$	Deter.*3	None*4	29.80	0.000
	x_t		At most 1*4	15.50	0.000
	π_t		At most 2*4	3.84	0.010
Optimality	x_t	Deter.*3	None*4	15.50	0.000
	π_t		At most 1*4	3.84	0.003

Note: *1: Denotes 0.05% critical values. *2: Denotes the MacKinnon-Haug-Michelis (1999) p-value.

*3: Denotes ‘Deterministic trend‘. *4: Denotes rejection of the hypothesis at the 0.05 level.

Table 4: GMM estimation results

(1) Singapore

Instrument rule	x_t	π_t	Exchange rate
$i_t - i_t^o$	-0.11 (0.04***)	0.93 (0.11***)	...
$i_t - i_t^o$	0.15 (0.04***)	-0.07 (0.15)	$0.16\hat{e}_t^{S/\$}$ (0.05***)
$i_t - i_t^o$	0.17 (0.04***)	0.15 (0.15)	$-0.13\hat{e}_t^{S/Y}$ (0.02***)
$m_t - m_t^o$	0.91 (0.24***)	0.22 (0.75)	...
$\nu^* \Lambda_t$	1.34 (0.51**)	-1.46 (0.72**)	...
x_t	...	-0.88 (0.30***)	...

(2) Thailand

Instrument rule	x_t	π_t	Exchange rate
$i_t - i_t^o$	-0.55 (0.29*)	0.88 (0.27***)	...
$i_t - i_t^o$	-0.47 (0.30)	0.90 (0.31***)	$-0.04\hat{e}_t^{B/\$}$(0.10)
$i_t - i_t^o$	1.34 (0.50**)	-0.28 (0.40)	$0.42\hat{e}_t^{B/Y}$ (0.11***)
$m_t - m_t^o$	0.56 (0.04***)	0.27 (0.05***)	...
$\nu^*\Lambda_t$	1.13 (0.67*)	5.95 (1.07***)	...
x_t	...	-0.41 (0.20*)	...

Note: values in parentheses are standard errors of coefficients.

***, **, * denote significance at 1%, 5% and 10% respectively.

Table 5: Parameters used in Calibration

(a) Symmetric parameter values

Parameter	Value	Parameter	Value
β	0.99	σ	2
η	3	b	0.67
μ	6	θ	2
ω	0.75		
κ	0.086		
ρ_q	0.44		

(b) Asymmetric parameter values

Parameters	(1) Singapore	(2) Thailand
α, α'	0.18	0.17
ϖ	0.075	0.10
$\rho_{eB/\$}$	0.22	0.34
$\rho_{eB/Y}$	0.75	0.42
ρ_ψ	0.45	0.23
TR_{US}	0.60	0.44

Table 6: Discounted cumulative loss values

Regime	Policy Rule	Loss for Singapore	Loss for Thailand
Floating	Interest rate	0.446	0.279
	Augmented interest rate	0.385	0.277
	Money Supply	0.400	0.234
Basket-peg	Basket weight	0.317	0.188
	Trade weight	0.636	0.296
Dollar-peg	Fixed Rate	0.907	0.446

Note: the augmented interest rate rule is the one with three targets such as the output gap, inflation and also the baht-dollar exchange rate.

Table 7: Variances of shocks under post-Asian crisis periods

Parameters	(1) Singapore	(2) Thailand
$\sigma^p_{eB/\$}$	0.023	0.045
$\sigma^p_{eB/Y}$	0.062	0.048
$\sigma^p_{\hat{\psi}}$	0.009	0.453
σ^p_q	0.133	0.133

Table 8: Comparison of interest rate and basket weight rules

Policy rule	Loss for (1) Singapore	Loss for (2) Thailand
Interest rate	0.339	0.328
Aug. interest rate (dollar rate)	0.397	0.326
Aug. interest rate (yen rate)	0.411	0.313
Basket weight	0.371	0.165