Exchange rate risks in a small open economy

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Abstract

Purpose – This study aims to analyze exchange rate risks and the choice of exchange rate policies in a small open economy indebted in foreign currency, incorporating the financial accelerator mechanism.

Design/methodology/approach – To examine discussions on the fear of floating, this study develops a dynamic stochastic general equilibrium model in which a small open economy model has an open economy financial accelerator mechanism as the external borrowing restriction. The author then compares and analyzes the macroeconomic dynamics in response to an exchange rate shock under different exchange rate systems.

Findings – The most interesting finding is that the currency peg for a foreign currency used in borrowing is more efficient than the trade-weighted currency basket policy, regardless of trade openness or trade share.

Practical implications – The result implies that in discussions on the fear of floating, more attention needs to be paid to exchange rate risks in finance. It also suggests that exchange rate policy used to mitigate exchange rate risks in finance stabilizes macroeconomic volatility more efficiently.

Originality/value – The paper provides an answer to the question: which is the more serious problem in the fear of floating and to what would the regime be anchored.

Keywords Exchange rate risk, Fear of floating, Balance-sheet effect, Currency mismatch

Paper type Research paper

1. Introduction

This study analyzes exchange rate risks and exchange rate policy choices in a small open economy to determine the most serious problem in the fear of floating.

After the Bretton Woods regime took effect, the world's major currencies transitioned to the floating exchange rate system. Since then, the "fix or float" question in optimal exchange rate policy has been one of the greatest concerns in the field of international finance, and the subject has been discussed extensively.

Whether authorities should respond to exchange rate fluctuations is still controversial. Taylor (2001) shows that there is little evidence to support, including the exchange rate explicitly in the central bank's policy reaction function. Additionally, Galí and Monacelli's (2005) representative small open economy dynamic stochastic general equilibrium (DSGE) model highlights the effectiveness of combining the floating exchange rate system with inflation targeting rather than a fixed exchange rate system. Benigno and Benigno (2003) show a similar result in the context of a two-country DSGE model.

However, considering some important problems and phenomena in international finance could change the results. Phenomena in trade is a typical example, notably the controversial subject of the degree of trade openness and exchange rate pass-through.

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Devereux and Engel (2003) show that a fixed exchange rate regime minimizes welfare costs if exporters set prices according to local currency pricing[1]. Devereux *et al.* (2006) find that the degree of exchange rate pass-through plays an important role in monetary rule assessment. Pavasuthipaisit (2010) also show that it is optimal for the central bank to pay more attention to exchange rate movement when there is a high degree of exchange rate pass-through and capital mobility.

There is also a serious problem with procuring funds in international financial markets. The Bank for International Settlements reported that as of April 2013, US dollar transactions constituted 87 per cent of the total foreign exchange currencies turnover (a total of 200 per cent). The sum of US dollar, euro and Japanese Yen account for 143.4 per cent. In short, as shown in Aghion *et al.* (2001), Eichengreen and Hausman (1999), Eichengreen and Panizza (2005), Devereux (2001), and McKinnon and Schnabl (2004), among others, most economies, and especially emerging economies, have difficulty raising funds to manage external debts denominated in developed country currencies. The problem causes currency mismatches in balance sheets. Aghion *et al.* (2001) show that sticky prices prevent the nominal value of firms' output from rising with the value of their debt during a currency depreciation, damaging firms' balance sheets. They find that the balance sheet effect is a key element in the onset of endogenous currency crises. Magud (2009) shows that when balance sheet effects are present and nominal rigidities exits, the degree of openness plays an important role in choosing an exchange rate regime for a small open economy.

These phenomena are particularly important factors for emerging economies. Most emerging economies cannot hedge exchange rate risks in forward markets because most of these economies operating in forward markets involving the domestic currency are either non-existent or thin and illiquid. Therefore, monetary authorities in emerging economies must focus more on exchange rate fluctuations to stabilize their economies. Calvo and Reinhart (2002) verify the "fear of floating", namely, the threat of foreign exchange rate fluctuations in these emerging markets because of their high trade openness, high pass-through and problem of original sin. These authors show that it is reasonable for developing countries to choose fixed exchange rate systems if their authorities fail to maintain and stabilize their macroeconomy sufficiently by conducting monetary policies and face the fear of floating. Cavoli (2009) examines a range of policy configurations in a small open economy macro-model, including the above problems, and finds that fear of floating policies perform well.

However, these findings lead to a number of unanswered questions, such as what is the more serious problem in the fear of floating and to what would the regime be anchored. For example, a sharp appreciation might lower export competitiveness, but a depreciation would increase foreign debt obligations via the balance sheet effect and, in the case of high degrees of exchange rate pass-through, lead to creeping inflation. On which of these issues should authorities focus?

These questions provide the backdrop for discussions about fixed exchange rate policies, especially a comparison of the currency basket policy with the US dollar peg. Most previous studies of the currency basket policy, such as Williamson (1996, 2000), Ito *et al.* (1998), Kwan (2001), Ogawa and Shimizu (2006) and Shioji (2006) focus on exchange rate risks in international trade to stabilize the macroeconomy through trade balances. On the contrary, Eichengreen and Hausman (1999), Eichengreen and Panizza (2005) and McKinnon and Schnabl (2004) emphasize on the role of the US dollar as an invoicing currency and a source of balance sheet effects. These studies stress that the balance sheet effects caused by currency mismatches in finance have a substantial macroeconomic impact. Eichengreen and Hausman (1999) describe developing countries' inability to borrow abroad in their local currency as the "original sin" of emerging economies, and Eichengreen and Panizza (2005) describe damage from the balance sheet effect as the "pain of original sin". However, these discussions are based on intuition rather than theoretical comparative verification in comprehensive frameworks.

Therefore, I apply a theoretical approach in this study to examine discussions about the fear of floating. For this purpose, I developed the DSGE model in which a small open economy has an open economy financial accelerator mechanism as the external borrowing restriction. I then compare and analyze the macroeconomic dynamics in response to an exchange rate shock under different exchange rate systems: a peg to a foreign currency used in borrowing and a trade-weighted currency basket policy[2]. The comparative verification indicates the more serious issue in the fear of floating, namely, exchange risks in trade or in finance, because each exchange rate policy controls different exchange rate risks in our model.

Our most important and interesting finding is that regardless of trade openness or trade share, exchange rate risks caused by currency mismatches in balance sheets have more serious impacts on small open economies. Therefore, we suggest that authorities in emerging economies operate their own exchange rate policies to stabilize exchange rate risks in finance[3].

The remainder of the paper is structured as follows. In Section 2, I describe the dynamic general equilibrium model. In Section 3, I examine the relationship between exchange rate risks and two exchange rate policies: a currency basket policy and a single currency peg. Section 4 numerically analyzes the macroeconomic response to exchange rate fluctuations and compares the results. Section 5 concludes.

2. The model

Our model is a small open economy composed of consumer/worker households, tradable goods firms with capital producers and entrepreneurs. The rest of the world is composed of Country A and Country B, which are large economies. Households have infinite horizons, and their basic activities are working, consuming and saving. Capital producers purchase output to produce capital that is used in the following period. Entrepreneurs, assumed to be risk-neutral, borrow in A's currency in the rest of the world to add to their net worth to purchase capital from capital producers. This capital is then rented to firms. In turn, firms also hire workers. Variables with a superscript A, B and * stand for Country A, Country B and the rest of the world, respectively.

In the context of this setup, I analyze the economy's dynamics in response to an exchange rate shock that occurs in the rest of the world under different exchange rate systems.

2.1 Households

A typical small open economy is inhabited by household $i \in [0,1]$ that seeks to maximize

$$\begin{aligned} &\max_{C_{i_t}, L_{i_t}} E_t\left\{\beta_t\left[\ln C_{i,t+j} - \frac{\kappa}{\epsilon} L_{i,t+j}^{\epsilon}\right]\right\} \\ &s.t.\ \ W_{it}L_{it} + B_{t-1}R_t = P_t C_{i,t} + B_t \end{aligned} \tag{1}$$

where C_{it} is the level of consumption of household i in period t, L_{it} is the labor supply of household i, W_t is the nominal wage for i, B_{t+1} is the nominal payoff in period $t+1$ of the portfolio held at the end of period t, R_t is the nominal interest rate, P_t is the overall consumer price index (CPI), $\kappa \equiv \sigma - 1 / \sigma$ is a scale parameter which consists of the elasticity of labor demand σ and ʃ is the inverse of labor supply elasticity. All previous variables are expressed in units of the domestic currency. I assume that households have access to a complete set of contingent claims traded internationally[4].

In line with Uribe and Schmitt-Grohe (2004), I assume that the function β_t incorporates an endogenous rate of time preference[5]:

$$\beta_t = \exp\left\{-\beta \ln\left[1 + \ln C_{it} - \frac{\kappa}{\epsilon}(L_{it})^{\epsilon}\right]\right\}. \tag{2}$$

The composite consumption index C_{it} is defined by a CES aggregator with shares $(1-\alpha)$ and α, respectively, as follows:

$$C_{it} = \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,it}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,it}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}};\ C_{F,it} = \left[\gamma^{\frac{1}{\eta}} C_{A,it}^{\frac{\eta-1}{\eta}} + (1-\gamma)^{\frac{1}{\eta}} C_{B,it}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{3}$$

where $C_{H,it}$ is an index of the consumption of domestic goods, $C_{F,it}$ is an index of that of imported goods, $C_{A,it}$ and $C_{B,it}$ are indexes of the consumption of imported goods produced in Countries A and B, respectively, and $\eta > 0$ denotes the elasticity of substitution among the goods in each category.

The CPI P_t is given by:

$$P_t \equiv \left[(1-\alpha)P_{H,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}};\ P_{F,t} \equiv \left[\gamma \mathcal{E}_t^{A} P_{A,t}^{*\,1-\eta} + (1-\gamma)\mathcal{E}_t^{B} P_{B,t}^{*\,1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{4}$$

where $P_{H,t}$ and $P_{F,t}$ denote the price indexes for domestic and imported goods, respectively, and $P_{A,t}$ and $P_{B,t}$ denote the price indexes of imported goods produced in Countries A and B, respectively.

Then, I can rewrite the remaining optimality conditions for the household i problem as follows:

$$\frac{C_{F,it}}{C_{H,it}} = \frac{\alpha}{1-\alpha}\left(\frac{P_{F,t}}{P_{H,t}}\right)^{-\eta} \tag{5}$$

$$\kappa L_{it}^{\epsilon-1} C_{it} = \frac{W_{it}}{P_t} \tag{6}$$

$$E_t\left\{\beta_t R_t \left(\frac{C_t}{C_{t+1}}\right)\left(\frac{P_t}{P_{t+1}}\right)\right\} = 1. \tag{7}$$

2.2 Domestic firms

Firms purchase labor L_t from households and capital K_{t-1} from entrepreneurs are used to produce their goods Y_t in period t with a Cobb–Douglas technology:

$$Y_t = A L_t^{1-a} K_{t-1}^{a} \tag{8}$$

where A denotes total-factor productivity (TFP) and constant and $a \in (0,1)$ denotes capital intensity.

Moreover, L_t is composed of workers $i \in [0,1]$, which we assume are monopolistically competitive in the sense of Dixit–Stiglitz. Thus, aggregate labor L_t is given by:

$$L_t = \left[\int_0^1 L_{i,t}^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \tag{9}$$

where σ is the intra-temporal elasticity of demand for labor i at t, and the wage index W_t is represented by

$$W_t = \left[\int_0^1 W_{it}^{1-\sigma} di \right]^{\frac{1}{1-\sigma}}. \tag{10}$$

Firms solve the following standard cost minimization problem:

$$\max_{K,L} \Pi_t = P_{H,t} A L_t^{1-a} K_{t-1}^{a} - V_t K_{t-1} - \int_0^1 W_{it} L_{it} di \tag{11}$$

where V_t denotes the nominal rental cost of capital. The real return to capital is the marginal product of the capital and labor demand functions[6], respectively, which are derived as:

$$\frac{W_t}{P_{H,t}} = \frac{(1-\alpha) Y_t}{L_t} \tag{12}$$

$$\frac{V_t}{P_{H,t}} = \frac{\alpha Y_t}{K_{t-1}}. \tag{13}$$

Following this cost minimization problem, demand for labor i is as follows:

$$L_{it} = \left(\frac{W_{it}}{W_t} \right)^{-\sigma} L_t. \tag{14}$$

I also assume that workers set their wages in a staggered fashion, as in Calvo (1983) and Yun (1996). Hence, the measure $1-\theta$ of randomly selected workers sets a new wage in each period, with an individual worker's probability of re-optimization in any given period being independent of the time elapsed since the wage was last reset. Let $\bar{W}_t$ denote the adjusted price set by workers, which have the chance to change their prices at t:

$$W_t = \left[\theta W_{t-1}^{1-\sigma} + (1-\theta) \bar{W}_t^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{15}$$

Because output Y_t is consumed by households, capital producers or foreigners, I can write the market-clearing condition as follows:

$$Y_t = C_{H,t} + C^*_{H,t} + K_t. \quad (16)$$

2.3 Entrepreneurs

Entrepreneurs purchase capital K_{t+1} at the nominal capital price Z_t from capital producers in period t and then invest it in firms at price $aP_{H,t+1}Y_{t+1} / Z_tK_t$ in period $t + 1$. Firms then use it as capital to produce domestic goods. Purchases of capital are financed by entrepreneurs' net worth and by borrowing. Entrepreneurs have access to an international financial market, but the existence of currency preferences forces them to borrow in Currency A and take on unhedged foreign currency debt. Currency A-denominated debts are affected by the risk-free interest rate in Country A R^A_t, which is known at t, and the risk premium rate, $1 + \varrho_t$. Entrepreneurs are risk-neutral and have a finite expected horizon for planning purposes. The probability that an entrepreneur will survive into the next period is δ[7]. Entrepreneurs issue debt contracts to finance their desired capital stock in excess of their net worth.

Entrepreneurs' budget constraint[8] in nominal terms is given by:

$$Z_tK_t = P_{H,t}N_t + \mathcal{E}^A_t B^A_t \quad (17)$$

where B^A_t denotes the amount of bonds borrowed abroad in Currency A, and $P_{H,t}N_t$ is their nominal net worth in period t.

Because I assume entrepreneurs are risk-neutral, the expected rate of return to capital in equilibrium should equal the cost of borrowing:

$$E_t\left\{\frac{aP_{H,t+1}Y_{t+1}}{Z_tK_t}\right\} = R^A_t(1 + \varrho_t)E_t(\Delta\mathcal{E}^A_{t+1}). \quad (18)$$

Bernanke *et al.* (1998) assume the existence of an agency problem that makes external finance more expensive than internal funds[9] and solve a financial contract that maximizes the payoff to the entrepreneur, subject to the lender earning the required rate of return. They show that given the parameter values associated with the cost of monitoring the borrower, characteristics of the distribution of entrepreneurial returns and expected lifespan of firms and their contract essentially imply an external finance premium that depends on the entrepreneurs' leverage ratio. The underlying parameter values determine the elasticity of the external finance premium with respect to the firm's leverage.

Thus, lenders charge a higher risk premium when they observe that a lower proportion of the capital investment is financed out of an entrepreneur's own net worth. That is, the risk premium is an increasing function of the value of investment relative to net worth[10]. Following Bernanke *et al.* (1998), I assume that the risk premium is given by:

$$1 + \varrho_t = \Psi\left(\frac{Z_tK_t}{P_{H,t}N_t}\right), \quad (19)$$

$$\Psi(1) = 1, \Psi'(\cdot) > 0, \Psi(\infty) = \infty.$$

At the beginning of each period, after observing the realization of the nominal exchange rate $\mathcal{E}_t$, entrepreneurs receive the capital return and repay the foreign debt. As a consequence, their net worth is[11]:

$$P_{H,t}N_t = \delta\left[\frac{V_t}{P_{H,t}}Z_{t-1}K_{t-1} - R_t^A(1+\varrho_{t-1})\mathcal{E}_t^A B_{t-1}^A\right]. \tag{20}$$

The first and second terms on the right-hand side of equation (20) denote the asset side and debt side of the balance sheet, respectively. This equation shows that domestic currency depreciation increases the *ex post* debt burden, reduces entrepreneurial net worth and, thus, reduces future capital. Thus, fluctuations in entrepreneurs' balance sheets influence capital formation through changes in the risk premium.

2.4 Capital producers

Capital producers use a concave production function that reflects the convex capital adjustment costs incurred to produce capital goods sold at the end of period t. They use the final domestic goods purchased from firms as investment goods and produce new capital goods K_t. For simplicity, I assume a depreciation rate of 100 per cent. Therefore, the production function looks as follows:

$$K_t = \Phi\left(\frac{K_t}{K_{t-1}}\right)K_{t-1},\ \Phi' > 0,\ \Phi'' < 0. \tag{21}$$

From equation (21), capital producers' optimization problem in real terms consists of choosing the quantity of capital K_t to maximize their profits, so that:

$$\max_{K_t} E_t\left[Z_t K_t - P_{H,t}\Phi\left(\frac{K_t}{K_{t-1}}\right)K_{t-1}\right]. \tag{22}$$

The first order condition (FOC) is

$$\frac{Z_t}{P_{H,t}} - \left[\Phi'\left(\frac{K_t}{K_{t-1}}\right)\right]^{-1} = 0 \tag{23}$$

which is the standard Tobin's Q equation that relates the price of capital to the marginal adjustment costs.

3. Exchange rate policies and central bank

3.1 Exchange rate policies

Under the currency basket policy, the weighted geometric mean[12] is generally used. Accordingly, the currency basket policy rule is described as:

$$CB_t = (\mathcal{E}_t^A)^{\omega}(\mathcal{E}_t^B)^{1-\omega} = 1 \tag{24}$$

where $\mathcal{E}_t^j$ $(j = A,B)$ denotes the bilateral nominal exchange rate between Countries A or B and the small open economy, and ω is the currency basket weight for Currency A.

We assume that the law of one price holds in the world. Each import goods price can, thus, be expressed as follows:

$$P_{A,t} \equiv \mathcal{E}_t^A P_{A,t}^*,\ P_{B,t} \equiv \mathcal{E}_t^B P_{B,t}^*. \tag{25}$$

By using the nominal effective exchange rate $NEER_t$, we can rewrite this relationship at the aggregate level:

$$P_{F,t} = NEER_t P^*_{F,t}. \quad (26)$$

We assume that $\mathcal{E}_t^{BA}$ denotes the nominal exchange rate between the currencies of Countries A and B. By plugging equation (24) into $\mathcal{E}_t^A = \mathcal{E}_t^B \mathcal{E}_t^{BA}$ by triangular arbitrage, each nominal exchange rate is rewritten as follows:

$$\mathcal{E}_t^A = (\mathcal{E}_t^{BA})^{1-\omega}, \ \mathcal{E}_t^B = (\mathcal{E}_t^{BA})^{-\omega}. \quad (27)$$

The nominal effective exchange rate *NEER* is defined as

$$NEER_t = (\mathcal{E}_t^A)^{\gamma}(\mathcal{E}_t^B)^{1-\gamma}. \quad (28)$$

Therefore, the source of exchange rate fluctuations under the fixed exchange rate system can be represented by changes in exchange rates between the major powers. For our purpose, we consider exchange rate fluctuations in the rest of the world as a source of shocks[13].

Now, we consider what would happen in each of the exchange rate policies. In the case of adopting the currency basket policy, we can mitigate fluctuations in the CPI by stabilizing exchange rate risks in trade instead of tolerating the development of the balance sheet effect:

$$\mathcal{E}_t^A = (\mathcal{E}_t^{BA})^{1-\gamma}, \ NEER_t = 1. \quad (29)$$

By contrast, in the case of adopting the Currency A peg, we can mitigate exchange rate risks in finance instead of tolerating fluctuations in the CPI[14]:

$$\mathcal{E}_t^A = 1, \ NEER_t = (\mathcal{E}_t^{BA})^{\gamma-1}. \quad (30)$$

Thus, both these exchange rate policies are different in that the authorities emphasize on exchange rate risks in trade or in finance.

3.2 Interest rate rule for fixed exchange rate policies

According to trilemma of international finance, authorities would have to abandon autonomous monetary policies if capital movements were liberalized and exchange rates were stabilized by fixed exchange rate policies. Therefore, a central bank in a small open economy sets the domestic interest rate to fix the target exchange rates behind the fixed exchange rate policies.

However, the interest rate policy attempting to use uncovered interest parity results in an indeterminate exchange rate. As Obstfeld and Rogoff (1996) and Benigno *et al.* (2007) show, although a fixed exchange rate implies equality between the domestic and foreign interest rates, simply pegging the domestic interest rate to the foreign rate is not sufficient to hold the exchange rate in all periods. Moreover, there exists a multiplicity of fixed exchange rate equilibria.

To overcome this problem, following Benigno *et al.*'s (2007) solution that maintains generality and indicates an interest rate rule for a fixed exchange rate regime[15], and I assume that the central bank adopts the following credible interest rate rule:

$$R_t = R_t^* f\left(\frac{CB_t}{\bar{C}B}\right), \textit{where } f(1) = 1, \tag{31}$$

where $R_t^* = (R_t^A)^{\omega}(R_t^B)^{1-\omega}$, $\overline{CB}$ denotes a target exchange rate and $f(\cdot)$ is a continuous monotone non-decreasing function and differentiable[16]. The rule enables a unique rational expectations equilibrium with a fixed target exchange rate ($CB_t = \bar{C}B$).

4. Numerical analysis

In this section, I illustrate the equilibrium behavior of the small open economy under these alternative policies using the log-linear form of the model above around the steady state[17]. After the following baseline calibration, I analyze and compare the economy's dynamics in response to an exchange rate shock that occurs in the rest of the world under different exchange rate systems.

4.1 Baseline calibration

We first establish the baseline parameter values. This is not intended to be a strict calibration exercise, but simply a theoretical tool to illustrate the issue at hand and to analyze the implications of the model. Therefore, I take most of the parameter values from previous studies of small open DSGE models, though use these as a benchmark[18]. I will change some parameters involving responses to exchange rate risks in the next section to discuss and check for robustness.

I assume a discount factor β of 0.9615[19], the inverse of labor supply elasticity $\int$ equals 3, and the elasticity of labor demand σ is 2.5[20], which implies that the scale parameter κ is set to 0.6. The elasticity of substitution among consumption goods η is set to 2[21]. These parameters are in line with Magud (2009). As is common in the literature on the Calvo (1983) pricing technology, I assume that the wage stickiness parameter θ equals 0.75, consistent with an average period of one year between wage adjustments.

In addition, the small open economy has an openness index α value of 0.5, as in Gertler *et al.* (2007). We assume that the trade share value γ is 0.5, consistent with the currency basket weight ω. However, I present a sensitivity analysis result using alternative values for parameters involving exchange rate risks in trade.

As in Bernanke *et al.* (1998) and Gertler *et al.* (2007), I use value of 0.9728 for the survival rate of entrepreneurs δ, implying an expected working life for entrepreneurs of 36 years. Following Magud (2009), I set the steady-state leverage ratio $ZK / P_H N$ to 3.2. The elasticity of the external finance premium with respect to a change in the leverage position of entrepreneurs ψ is set to 0.05. The share of capital in production function a is set to 0.32, so the steady state capital/output ratio K / Y is 0.326. We follow Bernanke *et al.* (2000) by considering ϕ, the price elasticity of capital, equals 0.25.

Finally, the persistence of changes in the exchange rate between the major powers is set to 0.6, in line with Garcia *et al.* (2011). I can now use these settings to calculate steady-state values and solve the model numerically according to the Blanchard and Kahn's (1980) method.

4.2 Macroeconomic volatility

To illustrate the model dynamics under these alternative exchange rate policies, I plot the impulse responses of the key macroeconomic variables to the exchange rate shocks between the major powers. Figure 1 displays the impulse responses to a 1 per cent shock to the exchange rate. Each variable's response is expressed as the percentage deviation from its steady-state level. Figures 1(a) and (b) show the macroeconomic responses to the exchange rate shock under the currency basket policy and Currency A peg, respectively. Figure 2 compares the output responses between these two exchange rate policies. Figure 3 compares the policy outcomes with domestic currency debt financing.

First, as shown in Figure 1(a), the currency basket policy mitigates the influence of exchange rate fluctuations through the trade channel because of the fixed nominal effective exchange rate. However, because of increases in external debt on a domestic currency basis, the shock causes a significant decrease in net worth and a rise in the risk premium. Entrepreneurs, thus, fail to purchase enough capital stock for the next period, creating a sharp decline in output. Further, although the nominal effective exchange rate is fixed, CPI inflation changes slightly, resulting in a decrease in domestic prices.

Next, as shown in Figure 1(b), by adopting the Currency A peg, the shock influences the macroeconomy only through changes in the terms of trade by mitigating exchange rate fluctuations in finance, as discussed in the previous section. In this case, the shock causes the nominal effective exchange rate to appreciate, which decreases CPI inflation. This decrease in CPI inflation affects household decisions and decreases the domestic price index (DPI) by adjusting labor supply, which in turn drives down the costs of capital production and increases the marginal return to capital. Finally, capital stock increases and output rises.

Figure 2 compares the output responses to the shock for both exchange rate policies and shows that fluctuations in output under the currency basket policy are considerably larger than those under the Currency A peg. This finding means that exchange rate risks in finance are relatively large, and, thus, when discussing the fear of floating, we need to pay more attention to exchange rate risks in finance. In other words, the result suggests that an exchange rate policy of mitigating exchange rate risks in finance stabilizes macroeconomic volatility more efficiently.

By contrast, Figure 3 shows that the currency basket policy works well to resolve currency mismatches in balance sheets, as it completely removes the influence of exchange rate fluctuations. This result is consistent with those of many previous studies of the currency basket policy.

Figures 4-6 present the results of various robustness checks under alternative parameters deemed to influence our result. Figure 4 illustrates that output responds to these alternative policies when the trade share of Country B increases. When $\gamma = 0$, which means that the small open economy trades only with Country B, I find that the Currency A peg becomes unstable compared to $\gamma = 0.5$. However, the currency basket policy also becomes more unstable because of the increased exchange rate risks in finance[22].

Figure 5 compares the responses under high trade openness, $\alpha = 0.9$, which is thought to increase exchange rate risks in trade. Thus, compared with Figure 4, the Currency A peg becomes unstable. However, I find that the impacts of exchange rate

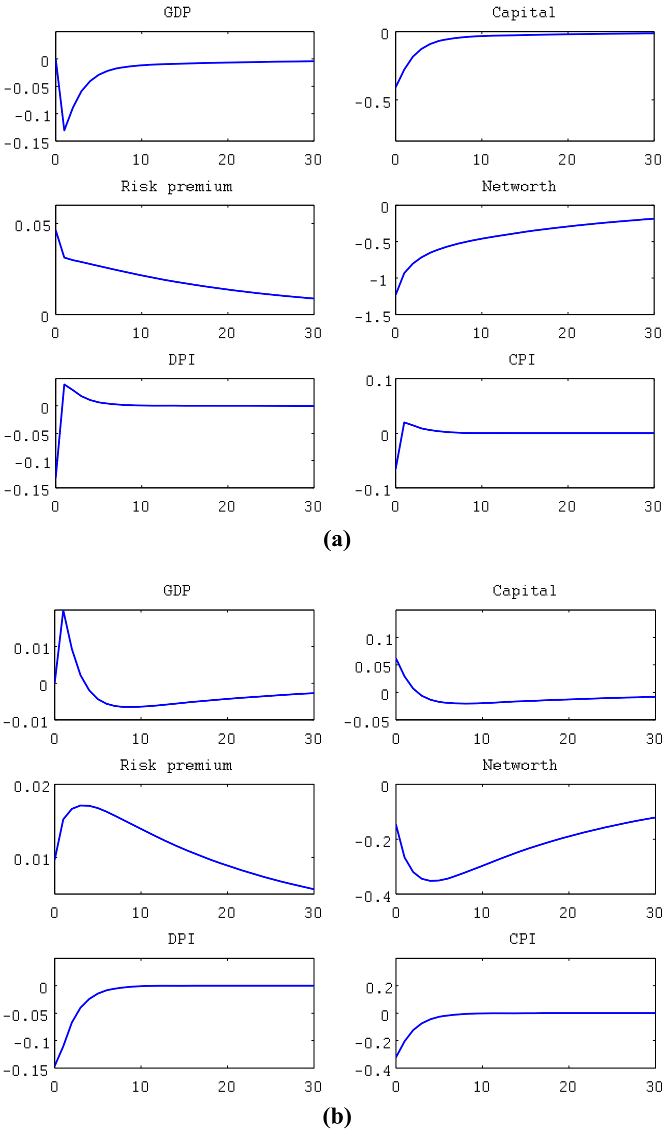

Figure 1.
Impulse response to an exchange rate shock between the major powers

Notes: (a) In the case of adopting the currency basket policy; (b) in the case of adopting the Currency A peg fluctuations in finance are insurmountable, even with high trade openness and a high share of trade with Country B.

Finally, Figure 6 provides the results using a small elasticity of external finance premiums. The smaller elasticity of the external finance premium should diminish the balance sheet effect. However, I find that although this small elasticity increases the performance of the currency basket policy slightly, it has little effect on our results.

Based on these results, exchange rate risks in finance are a serious problem for a small open economy.

5. Concluding remarks

This study examined the severity of the problems related to the fear of floating and exchange risks in trade or in finance. I find that the currency peg to a foreign currency used for borrowing is more efficient than the trade-weighted currency basket policy, regardless of trade openness or trade share. This result implies that in the fear of floating, exchange rate risks from currency mismatches in balance sheets have more serious impacts on small open economies.

This result has an important policy implication, because it suggests that authorities in emerging economies should operate their own exchange rate policies to stabilize exchange rate risks in international finance. Currency mismatches in balance sheets are an important consideration when setting exchange rate policies.

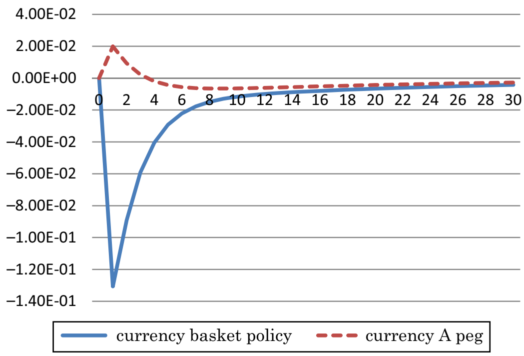

Figure 2.
Baseline case – output responses under alternative policies

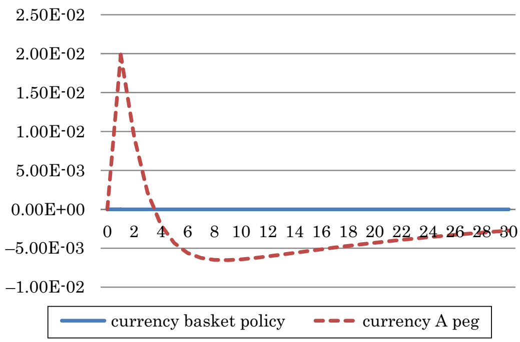

Figure 3.
Output responses in the case of domestic-currency debt financing

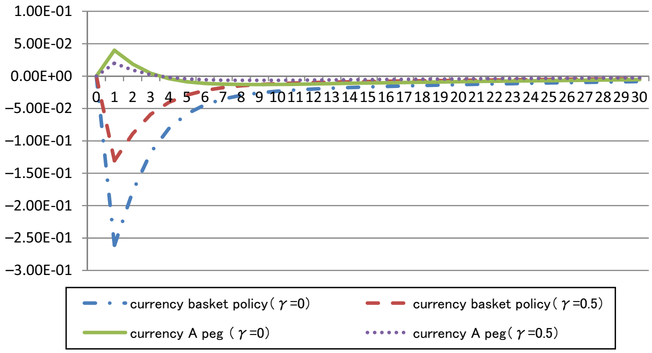

Figure 4.
Policy comparison under alternative trade share

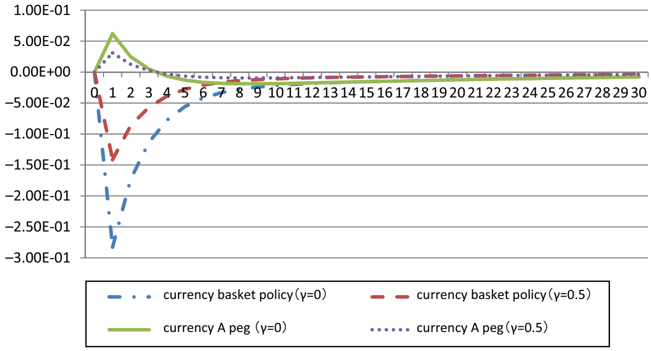

Figure 5.
Policy comparison under high trade openness ($\alpha = 0.9$)

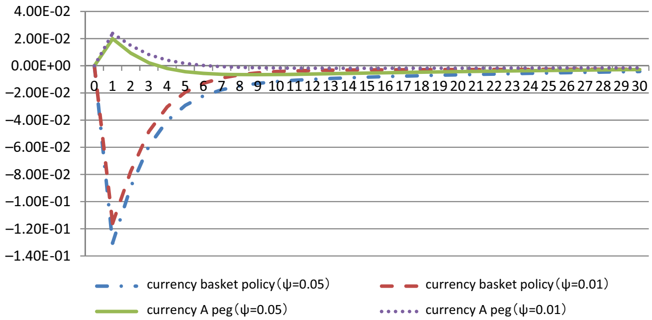

Figure 6.
Policy comparison under alternative elasticity of the external finance premium

Thus, in the case of external financing in multiple foreign currencies, it is desirable to manage exchange rate policy with reference to a basket of currencies using the financing ratio.

Moreover, these results lead to the conclusion that promoting local currency bond markets, such as the Asian bond market, is an important mechanism that would allow emerging economies to escape the fear of floating because the currency mismatch in finance is a significant risk factor. In that case, authorities mitigate exchange rate risks simply by adopting a trade-weighted currency basket policy, that is, paying close attention to nominal effective exchange rates.

Notes

1. See also Corsetti and Pesenti (2002) and Engel (2002).
2. For simplicity, I assume complete exchange rate pass-through.
3. In this regard, I note that this result does not imply that authorities in emerging markets ought to adopt a single currency peg.
4. I assume that firms face complete and competitive markets.
5. This assumption is made to avoid the non-stationarity problem typical of small open economies. For more details about this problem, see Uribe and Schmitt-Grohe (2004).
6. Because of complete markets, firms make zero profits in equilibrium.
7. This assumption ensures that entrepreneurial net worth will never be enough to fully finance the new capital acquisitions.
8. This budget constraint expresses entrepreneurs' balance sheets.
9. Entrepreneurs costlessly observe their output, which is subject to a random outcome. Financial intermediaries incur an auditing cost to observe the output. After observing their project outcome, entrepreneurs decide whether to repay their debt or to default. If they default, financial intermediaries audit the loan and recover the project's generated value less the monitoring costs.
10. For concreteness, I assume the following functional form for Ψ: $\Psi(g) = g^{\psi}$, $\psi > 0$.
11. I assume that entrepreneurial consumption is small and that it drops out of the model.
12. This is because the constitution currency weight does not change for exchange fluctuations in the weighted geometric mean, whereas the weight of an appreciated currency rises in the arithmetic weighted average and the weight of a depreciated currency rises in the harmony weighted average.
13. The log-linearization of the exchange rate change around the steady state is described according to the AR(1) process.
14. This means that the trade balance becomes unstable.
15. For details, see Benigno *et al.* (2007).
16. The percentage deviations from steady-state levels are described as follows: $r_t = r_t^* + \lambda cb_t$, $\lambda > 0$.
17. In the steady state, I assume $P_{H,t} = P^*_{A,t} = P^*_{B,t} = Z_t$.
18. When I check for robustness, the qualitative results do not change for different values of these parameters.
19. This assumption implies that the international riskless interest rate is 4 per cent.
20. I check the case where $\sigma = 2$, in line with Cespedes *et al.* (2001) and Garcia *et al.* (2011), but the quantitative results remain the same.
21. For simplicity, I assume the same elasticity of substitution among domestic goods and between domestic and foreign goods.
22. For $\gamma = 0$, the currency basket policy is consistent with the de facto Currency B peg.

References

Aghion, P., Bacchetta, P. and Banerjee, A. (2001), "Currency crises and monetary policy in a credit-constrained economy", *European Economic Review*, Vol. 45 No. 1, pp. 1121-1150.

Benigno, G. and Benigno, P. (2003), "Price stability in open economies", *Review of Economic Studies*, Vol. 70 No. 4, pp. 743-764.

Benigno, G., Benigno, P. and Ghironi, F. (2007), "Interest rate rules for fixed exchange rate regimes", *Journal of Economic Dynamics and Control*, Vol. 31 No. 7, pp. 2196-2211.

Bernanke, B., Gertler, M. and Gilchrist, S. (1998), "The financial accelerator in a quantitative business cycle framework", NBER Working Paper, No. 6455, available at: www.nber.org/papers/w6455

Bernanke, B., Gertler, M. and Gilchrist, S. (2000), "The financial accelerator in a quantitative business cycle framework", in Taylor, J. and Woodford, M. (Eds), *Handbook of Macroeconomics, Volume I*, Elsevier Science, B. V, North Holland.

Blanchard, O.J. and Kahn, C.M. (1980), "The solution of linear difference models under rational expectations", *Econometrica*, Vol. 48 No. 5, pp. 1305-1311.

Calvo, G.A. (1983), "Staggered prices in a utility-maximizing framework", *Journal of Monetary Economics*, Vol. 12 No. 1, pp. 383-398.

Calvo, G.A. and Reinhart, C.M. (2002), "Fear of floating", *Quarterly Journal of Economics*, Vol. 117 No. 2, pp. 379-408.

Cavoli, T. (2009), "Is fear of floating justified? The East Asia experience", *Journal of Policy Modeling*, Vol. 31 No. 1, pp. 1-16.

Cespedes, L.F., Chang, R. and Velasco, A. (2004), "Balance sheets, exchange rate regimes, and credible monetary policy", mimeo.

Corsetti, G. and Pesenti, P. (2002), "Self-validating optimum currency areas", NBER Working Paper, No. 8783, available at: www.nber.org/papers/w8783

Devereux, M.B. (2001), "Financial constraints and exchange rate flexibility in emerging market economies", Working Papers 152001, Hong Kong Institute for Monetary Research, Hong Kong.

Devereux, M.B. and Engel, C. (2003), "Monetary policy in the open economy revisited: pricing setting and exchange rate flexibility", *Review of Economic Studies*, Vol. 70 No. 4, pp. 765-783.

Devereux, M.B., Lane, P.R. and Xu, J. (2006), " Exchange rates and monetary policy in emerging market economies", *Economic Journal*, Vol. 116 No. 511, pp. 478-506.

Eichengreen, B. and Hausman, R. (1999), "Exchange rates and financial fragility", NBER Working Paper, No. 7418, available at: www.nber.org/papers/w7418.

Eichengreen, B. and Panizza, U. (2005), "The pain of original sin", in Eichengreen, B., Hausman, R. (Eds), *Other people's money: Debt denomination and financial instability in emerging market economies*, University of Chicago Press, Chicago and London, pp. 13-47.

Engel, C. (2002), "The responsiveness of consumer prices to exchange rates: a synthesis of some new open economy macro models", *The Manchester School*, Vol. 70 No. 1, pp. 1-15.

Galí, J. and Monacelli, T. (2005), "Monetary policy and exchange rate volatility in a small open economy", *Review of Economic Studies*, Vol. 72 No. 3, pp. 707-734.

Garcia, C.J., Restrepo, J.E. and Roger, S. (2011), "How much should inflation targeters care about the exchange rate", *Journal of International Money and Finance*, Vol. 30, pp. 1590-1617.

Gertler, M., Gilchrist, S. and Natalucci, F.M. (2007), "External constraints on monetary policy and the financial accelerator", *Journal of Money, Credit and Banking*, Vol. 39 Nos 2/3, pp. 295-330.

Ito, T., Ogawa, E. and Sasaki, Y. (1998), "How did the dollar peg fail in Asia?", *Journal of the Japanese and International Economies*, Vol. 12 No. 1, pp. 256-304.

Kwan, C.H. (2001), *Yen Bloc: Toward Economic Integration in Asia*, Brookings Institution Press, Washington, DC.

Mckinnon, R. and Schnabl, G. (2004), "The East Asian dollar standard, fear of floating, and original sin", *Review of Development Economics*, Vol. 8 No. 1, pp. 331-360.

Magud, N.E. (2009), "Currency mismatch, openness and exchange rate regime choice", *Journal of Macroeconomics*, Vol. 32 No. 1, pp. 68-89.

Obstfeld, M. and Rogoff, K. (1996), *Foundations of International Macroeconomics*, MIT Press, Cambridge, MA.

Ogawa, E. and Shimizu, J/ (2006), "AMU deviation indicators for coordinated exchange rate policies in East Asia and their relationships with effective exchange rates", *The World Economy*, Vol. 29 No. 12, pp. 1691-1708.

Pavasuthipaisit, R. (2010), "Should inflation-targeting central banks respond to exchange rate movements?", *Journal of International Money and Finance*, Vol. 29 No. 3, pp. 460485.

Shioji, E. (2006), "Invoicing currency and the optimal basket peg for East Asia: analysis using a new open economy macroeconomic model", *Journal of the Japanese International Economies*, Vol. 20 No. 4, pp. 569-589.

Taylor, J.B. (2001), "The role of the exchange rate in monetary policy rules", *American Economic Review*, Vol. 91 No. 2, pp. 263-267.

Uribe, M. and Schmitt-Grohe, S. (2004), "Closing small open economy models", *Journal of International Economics*, Vol. 61 No. 1, pp. 163-185.

Williamson, J. (1996), *The Case for a Common Basket Peg for East Asian Currencies*, Institute for International Economics, Washington, DC, November.

Williamson, J. (2000), *Exchange Rate Regimes for Emerging Markets: Reviving the Intermediate Option*, Institute for International Economics, Washington, DC.

Yun, T. (1996), "Monetary policy, nominal price rigidity, and business cycles", *Journal of Monetary Economics*, Vol. 37 No. 2, pp. 345-370.

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