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Theory of Currency Basket: Incomplete Exchange Rate Pass-through and Its Weight

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This paper shows a relationship between incomplete exchange rate pass-through and currency basket weights under a currency basket policy. It is concluded that trade share weights adopted in many previous studies are the optimal currency basket weights to stabilize terms of trade, under the law of one price. However, in the case of incomplete exchange rate pass-through, adopting a trade-weighted currency basket is not sufficient to stabilize terms of trade because gaps in the exchange rate pass-through cause mismatches between real exchange rates and terms of trade. In this case, we indicate that authorities can stabilize terms of trade by attaching greater weight to the currency exhibiting relatively high exchange rate pass-through.

1 Introduction

Since the currency crisis, a currency basket policy has been considered one of the possible answers to stabilize the trade balance through the stabilization of terms of trade.[1] Many studies analyze the policy based on the concept that it can protect the trade balance from foreign exchange rate fluctuations between major countries while stabilizing the effective exchange rate. Although a large number of studies find the benefits of the policy and examine a method of selecting constituting countries, only some take a theoretical approach for the currency basket weight, in spite this being the largest concern. The reason is that most previous papers that consider currency baskets have figured the currency basket weight as a weighted average of the trade volume, as in Williamson (1996) (2000), Ito, Ogawa and Sasaki (1998) and Ogawa and Shimizu (2006) which are empirical analyses; theoretical assessment of the currency basket, especially a relationship between incomplete exchange rate pass-through and its weight is still difficult to find today.

However, there is a problem with this way of defining the weights. Fluctuations of terms of trade deriving from incomplete exchange rate pass-through, create a gap in the economic

1) "Fear of Floating" is behind the argument about a currency basket policy. According to Calvo and Reinhart (2002), in a small open economy such as in developing countries, where foreign transactions account for a large share of the GDP and there is only an incomplete financial market without any hedge tools to cover exchange risks, the influence of foreign exchange rate fluctuations adversely destabilizes the macro economy. The paper verifies the threat of foreign exchange rate fluctuation in these emerging markets. As shown in the paper, it is reasonable for developing countries to choose a fixed exchange rate regime if their authorities fail to do enough to maintain and stabilize export competitiveness.

relationship between real effective exchange rate and terms of trade. Therefore, this method of determination assumes that the pass-through is complete in any trade or otherwise at a perfectly comparable level.[2] This strong assumption does not hold in reality; the currency basket policy using trade volume share may be flawed.

In this paper, we arrange the background of the currency basket policy theoretically, which few previous theoretical studies have done, and clear up the problem that exists between a basket of currencies and incomplete exchange rate pass-through.

The paper is structured as follows. In Section 2, we lay out a model to explain important issues related to the currency basket policy. Section 3, we show the relationship between a basket of currencies and incomplete exchange rate pass-through and Section 4 concludes.

2 The model of currency basket

First, we show that under the law of one price (LOP), the trade share currency basket weight corresponds to the optimal weight for stabilizing the trade balance through the stabilization of terms of trade, as in previous studies.

Our model is a small open economy[3] and the rest of the world is composed of country A and country B. For simplification, we assume that all goods are tradable and their prices are rigid. This nominal rigidity gives the exchange rate policy an influence on real activity. Variables marked by small letters are logarithms of the original variables originally marked by capital letters. Variables with a superscript*hold for the rest of the world.[4]

We consider the currency basket policy. Under the policy, the weighted geometric mean[5] is generally used. Accordingly, the currency basket policy rule is described as

$$(E_t^A)^{\omega}(E_t^B)^{1-\omega}=1, \tag{1}$$

where $E_t^j (j=A, B)$ denotes a nominal exchange rate between country A or B and small open economy, ω is the currency basket weight for currency A.

We assume that E_t^{BA} denotes a nominal exchange rate, the exchange rate between B's and A's currencies. Plugging Eq.(1) into $E_t^A=E_t^B E_t^{BA}$ by triangular arbitrage, each nominal exchange rate is rewritten as follows:

$$E_t^A=(E_t^{BA})^{1-\omega}, \quad E_t^B=(E_t^{BA})^{\omega}. \tag{2}$$

The log-linearization of Eq.(2) around a steady state[6] yields

$$e_t^A=(1-\omega)\, e_t^{BA}, \quad e_t^B=-\omega e_t^{BA}, \tag{3}$$

where $e_t^j (j=A, B)$ denotes the log-linearized form of E_t^j.

Using Eq.(3), we can write the nominal effective exchange rate $NEER_t$[7] as

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2) When adopting a currency basket, the optimum currency basket weight only equals the trade share where the price elasticity of export and import correspond with the elasticity of the foreign exchange rate.

3) Therefore, foreign variables are exogenous.

4) This means a trade weighted index.

5) This is because the constitution currency weight does not change for exchange fluctuations in the weighted geometric mean, while 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.

6) In the steady state, we assume $P_{H,t}=P_{A,t}=P_{B,t}$.

7) In non-linear form, $NEER_t=(E_t^A)^{\gamma}(E_t^B)^{1-\gamma}$.

$$neer_t = \gamma e_t^A + (1-\gamma)\, e_t^B = (\gamma - \omega)\, e_t^{BA},$$

where γ is the trade share of country A.

In the case of $\omega = \gamma$, we can eliminate the influence of exchange fluctuations from the terms of trade, adopting trade share weight.[8] This is the theoretical grounding used by most previous studies adopting this weight.

In adopting a currency basket policy, how should the authority set an interest rate? For simplicity's sake, we assume complete securities markets. We define uncovered interest rate parity[9] between the small open economy and country A or B as $R_t = R_t^j E_t\left(\frac{E_{t+1}^j}{E_t^j}\right)(j = A, B)$ where R_t denotes a nominal domestic interest rate and R_t^j denotes a nominal interest rate of country j. The relationship in its log-linear form is given by:

$$r_t - r_t^j = E_t \Delta e_{t+1}^j, \quad j = A, B. \tag{4}$$

where Δ denotes the first difference operator (i.e., $\Delta e_t^j = e_t^j - e_{t-1}^j$).

Thus, under an exchange rate peg, the authority loses the independence of a monetary policy to peg the exchange rate. In the case of a currency basket policy, the authority must maintain the following rule.

$$R_t = R_t^{CB} = (R_t^A)^{\omega} (R_t^B)^{1-\omega},$$

where R_t^{CB} denotes a target interest rate under the currency basket policy.[10]

We explain the above interest rate rule in detail in the following. First, the authorities have to satisfy the following relationship because a currency basket exchange rate e_t^{CB} must be maintained in the future.

$$E_t \Delta e_{t+1}^{CB} = \omega E_t\{\Delta e_{t+1}^A\} + (1-\omega)\{\Delta e_{t+1}^B\} = 0. \tag{5}$$

We rewrite Eq.(4) using e_t^{BA} :

$$r_t - r_t^A = (1-\omega)\, E_t\{\Delta e_{t+1}^{BA}\}; r_t - r_t^B = -\omega E_t\{\Delta e_{t+1}^{BA}\}. \tag{6}$$

Uncovered interest parity between country A and B is

$$r_t^B - r_t^A = E_t \Delta e_{t+1}^{BA}. \tag{7}$$

Substituting these equations for Eq.(5)

$$\begin{aligned} \omega E_t\{\Delta e_{t+1}^A\} + (1-\omega)\{\Delta e_{t+1}^B\} &= \omega(1-\omega)\, E_t\{\Delta e_{t+1}^{BA}\} - \omega(1-\omega)\, E_t\{\Delta e_{t+1}^{BA}\} \\ &= \omega(r_t - r_t^A) + (1-\omega)(r_t - r_t^B) = 0. \end{aligned}$$

We rewrite the above equation; finally, the authority maintains the following interest rate rule.[11]

$$r_t = \omega r_t^A + (1-\omega)\, r_t^B. \tag{8}$$

Under the currency basket policy, the authority conforms the domestic interest rate to a weighted average rate of foreign interest rate, which is weighted by the prestige of the currency basket. Thus, the monetary policy in the small open economy has to be exogenously determined depending on the policy in the rest of the world. The famous open-economy trilemma[12] causes

8) Therefore, if the authorities try to stabilize the trade balance, this weight becomes the optimal weight.
9) In a steady state, each interest rate is equal under the assumption of complete securities markets.
10) This is a weighted average of the interest rate of two large countries.
11) R_t^* is an aggregate index of interest rates in the rest of the world and in log-linear form: $r_t^* = \gamma r_t^A + (1-\gamma)\, r_t^B$.

such a loss of monetary policy independence. Moreover, the relationship has generality because in the case of $\omega=1$, Eq.(8) becomes a pegging system for a single currency.

The terms of trade express $S_t=\frac{P_{F,t}}{P_{H,t}}$, where $P_{H,t}$ and $P_{F,t}$ denote the price indexes for domestic and imported goods, respectively. In log-linear form,

$$s_t=p_{F,t}-p_{H,t}. \tag{9}$$

We assume that $P_t^j(j=A, B)$ denotes the import price index expressed in foreign currency and the LOP $E_t^jP_t^j=P_{j,t}$ holds. Using a nominal effective exchange rate, we can rewrite this relationship with a view to aggregate level; the relationship in its log-linear form is given by $neer_t+p_t^*=p_{F,t}$.[13] Combining this equation with Eq.(9), we obtain the following:

$$s_t=neer_t+p_t^*-p_{H,t}. \tag{10}$$

This equation implies that the stabilization of the nominal effective exchange rate leads to the stabilization of the terms of trade as indicated in previous studies.

We can combine Eq.(10) with Eq.(4) to yield the following stochastic difference equation:

$$s_t=E_ts_{t+1}+(r_1^*-E_t\pi_{t+1}^*)-(r_t-E_t\pi_{H,t+1}).$$

where $\pi_{H,t}=p_{H,t}-p_{H,t-1}$ and $\pi_t^*=p_t^*-p_{t-1}^*$. The solution achieved by forward iterations gives:

$$s_t=E_t\sum_{k=0}^{\infty}[(r_{t+k}^*-\pi_{t+k+1}^*)-(r_{t+k}-E_t\pi_{H,t+k+1})]. \tag{11}$$

Therefore, in view of the interest rate rule, adopting a trade-weighted average $(r=r^*)$ cancels out foreign shocks.

In the aforementioned model, we describe the traditional background of a currency basket policy under simple assumptions. This model indicates that theoretically, a trade-weighted currency basket becomes optimal for stabilizing the terms of trade. The result corresponds with those of previous studies such as Williamson (1996) (2000) and Ito et al. (1998). However, the results depend on the assumption of the LOP. In following subsection, we take incomplete exchange rate pass-through which disturbs the LOP into consideration.

3 Incomplete exchange rate pass-through and terms of trade

Now we try to modify the aforementioned model in view of the circumstances in which incomplete exchange rate pass-through disturbs the LOP. The result implies that incompleteness of exchange rate pass-through has an influence on terms of trade.

Nominal exchange rates denote $E_t^j(j=A, B)$. We suppose that incomplete exchange rate pass-through exists, so the LOP does not strictly hold. In this case, the LOP can be expressed as

$$LOP_t^j=\frac{E_t^jP_t^{j*}}{P_t^j}. \tag{12}$$

A law of one price gap is the difference between the foreign world price and the domestic price of imports.[14] On the aggregate level, the LOP is described as follows:

12) Liberalized capital movement, a fixed exchange rate regime and autonomous monetary policy cannot coexist at the same time.

13) P_t^* is an aggregate price index in the rest of the world and in log-linear form: $p_t^*=\gamma P_t^A+(1-\gamma)p_t^B$.

$$LOP_t = \frac{NEER_t P_t^*}{P_{F,t}}. \tag{13}$$

Log-linearizing the above equation, we obtain

$$\psi_t = neer_t + p_t^* - p_{F,t}, \tag{14}$$

where ψ_t denotes the log-linear form of LOP_t.[15]

Combining Eq.(9) with Eq.(14), we can rewrite the terms of trade as

$$s_t = neer_t + p_t^* - p_{H,t} - \psi_t. \tag{15}$$

Combining Eq.(15) with Eq.(4) yields the following stochastic difference equation:

$$s_t = E_t s_{t+1} + (r_t^* - E_t \pi_{t+1}^*) - (r_t - E_t \pi_{H,t+1}) + E_t \Delta\psi_{t+1}.$$

The solution achieved by forward iterations gives:

$$s_t = E_t \sum_{k=0}^{\infty} [(r_{t+k}^* - \pi_{t+k+1}^*) - (r_{t+k} - E_t \pi_{H,t+k+1}) + \Delta\psi_{t+k+1}], \tag{16}$$

where $\Delta\psi_{t+k+1} = \gamma\Delta\psi_{A,t+k+1} + (1-\gamma)\Delta\psi_{B,t+k+1}$. The result shows that the terms of trade are a function of the current and expected real interest rate differential and the gap in the LOP. In other words, incomplete exchange rate pass-through influences the terms of trade.

Eq.(16) has important implications for the weight of the currency basket. In the case of incomplete pass-through, trade-weighted currency baskets cannot work.[16] The existence of the friction displaces the optimal currency basket from the trade-weighted currency basket.

Moreover, This equation implies that we need to attach weight to the currency with the relatively high exchange rate pass-through to stabilize terms of trade. This is because the higher exchange rate pass-through has faster and more significant impacts on the economy.

4 Conclusion

We show that under the LOP, a trade-weighted currency basket theoretically becomes optimal for stabilizing the terms of trade. This result corresponds to previous studies.

However, in the case of incomplete exchange rate pass-through, adopting a trade-weighted currency basket is not sufficient to stabilize the terms of trade because gaps in the exchange rate pass-through cause mismatches between real exchange rates and terms of trade. This result implies that degrees of exchange rate pass-through have an influence on the weight of the currency basket and that we need to decide that weight based on those influences.

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14) If the LOP holds exactly ($LOP_t^j = 1$) the foreign price index equals the import price index expressed in foreign currency ($P_t^j = E_t^j P_t^{j*}$).

15) We define ψ_t as $\psi_t \equiv \gamma\psi_t^A + (1-\gamma)\psi_t^B$.

16) In the special case in which both pass-throughs are strictly equal ($\Delta\psi_{t+k+1}^A = \Delta\psi_{t+k+1}^B$, for all k), the trade-weighted strategy works because the LOP gaps cancel each other out. However, in reality, many previous studies show that the degree of incompleteness of exchange rate pass-through differs from one currency to another.

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