The Stabilizing Role of a Dual Currency Board

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Abstract:

The present paper develops a formal model of a dual currency board as an alternative to the standard currency board. This is attractive for countries that are exposed to more than one foreign currency. A dual currency board should be more stabilizing for output than a range of alternatives. We derive the conditions under which this is the case.

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1. Introduction

Many developing countries and emerging markets are still characterized by problems in the institutional set up of monetary policies. In addition, they often lack capital markets that are well enough developed to make floating exchange rates a stable and viable solution (Hausmann et al. 1999). Moreover, many are exposed to liabilities in foreign currency (Eichengreen and Hausmann 1999, McKinnon 2005), which make them vulnerable to changing currency values. Therefore, there still is a large degree of "fear of floating" (Calvo and Reinhardt 2002).

For many small and very open economies the standard solution to this problem is, of course, to peg to a stable currency. In most cases, the currency of choice is the US dollar. But these pegs often create other problems since many countries are also trading a lot with the euro-area with the euro becoming an international rival to the predominant role of the dollar. A simple peg to the dollar thus imports the dollar's variability against other important currencies. While this would suggest that a basket might be an appropriate solution for this type of problem, a basket has the problem that it is often less transparent and credible than a hard peg. In particular, several proposals, such as favored by Williamson (2000), compound the problem by suggesting that basket weights are not publicly revealed. For countries that suffer from a history of high and variable inflation a soft peg with variable weights is arguably not a practical solution because it is not likely to inspire much trust.

We therefore believe a more useful solution for these countries would be to move to a hard peg in the form of a currency board in order to solve the credibility problem. Yet, because standard currency boards suffer from the problem that they are not able to reflect adequately countries' exposition to more than one currency in trade or financial flows, we propose a dual currency board instead.

Argentina, for which this proposal had been first advanced by its minister of finance Domingo Cavallo before the collapse of its currency board, is a good example how a dual currency board could help avoid the problems that are inherent to a single currency board (Oppers 2000). Argentina was on a currency board with the US-dollar and suffered from the strong revaluation of the dollar in its trade with euro-denominated trade (being roughly exposed to a similar extent in its trade to Europe as to the US) and in its trade with regional partners. The strong revaluation (up to some 40 percent against Brazil) contributed significantly to Argentina's problems and hastened the collapse of its currency board.[1] As demonstrated by Busse et al. (2006), a dual currency board could have helped to avoid the collapse to the Argentine currency board had it been introduced as suggested.

In the present paper, we develop a formal model of a dual currency board and compare its stabilizing role with other solutions. We derive explicit conditions under which a dual currency board dominates a standard currency board. The main advantage is that it can be considered as an insurance against having to follow an anchor currency that revalues against other trading partners. The dual currency board would allow changing the nominal currency anchor and thereby avoiding that competitiveness problems arise. It would thus be a more flexible solution than the standard peg, in particular when exposure to individual countries might change over time, while providing a similar degree of credibility. A small cost would lie in a modest increase in inflation that could, however, in some cases even be welcome.

Based on our formal set up, we argue that this solution is sensible for countries that suffer from a credibility problem in their domestic monetary policy or lack the instruments more generally to able to live with floating exchange rates. This arguably includes countries in Latin America, as well as countries in the Commonwealth of Independent States (CIS) or countries in the Middle East (we provide some examples in the next section).

The paper is structured as follows. The next section derives the case for a dual currency board by discussing several examples of countries to which this could be relevant and how it

[1] This is not to argue that these were the only reasons that contributed to the collapse of the currency board in Argentina. See Bleany (2004) or Gurtner (2004).

would work. Sections 3 and 4 develop a model that demonstrates when and under what circumstances a hard peg dominates monetary autonomy, and when a dual currency board would welfare dominate a single currency board. Section 5 concludes.

2. The Case for a Dual Currency Board

The main basis of a dual currency board is a central bank's promise to exchange domestic currency at a fixed rate into either the two foreign anchor currencies (which we call the dollar and the euro). Unlike the standard case, it would be at the discretion of the central bank to exchange domestic currency (call it the peso) into either dollar or euro, depending on the availability of currency reserves. In the standard case, of course, the commitment is only made with reference to one currency so that the central bank has no choice between reserve currencies.[2]

By declaring a fixed rate between the domestic currency and both foreign currencies, the central bank would implicitly declare a fixed relation at which it would be willing to exchange dollars against euros as well.[3] Since market participants will arbitrage between the two anchor currencies whenever market rates begins to diverge from the official rate, the central bank needs to use its discretion to trade in one currency at the declared rate only.[4] An increase in the demand for dollars vis-à-vis the euro would not lead to an appreciation of the dollar as long as market participants could obtain dollar reserves from the central bank but continuing demand would finally exhaust the dollar reserves of the central bank, from which moment onwards it would only change domestic currency against euros at the official rate.

[2] As long as the central bank is in possession of both reserve currencies, it should trade in both. It is important, however, that the bank is able to refuse to deal in a currency once its reserves of this currency are exhausted.

[3] There would be a (small) band defined by transaction costs around the official rate in which no arbitrage would take place. Arbitrage would keep the market rate close to the official rate as long as the central bank has enough reserves.

[4] This should be an automatic process to prevent the central bank itself from arbitraging its dual currency reserves. Otherwise, its credibility might be undermined. In a currency board, the central bank should be considered passive.

The dual currency board could no longer stabilize the bilateral rate between dollars and euros and the market exchange rate would begin to move away from the official rate. This implies as well that the central bank would frequently be either on the dollar or the euro standard. But given the central bank's right to choose the currency in which to trade domestic currency against reserves, such arbitrage would not make a dual currency board more vulnerable than the single currency board. Moreover, the central bank would not incur losses due to the reserve switch because reserves would always be valued at the official rates and it would never have to report losses due to a switch of the reserve currency since the total stock of reserves, valued at the official rate, remains constant.

On a dual currency board the country would automatically be always pegged to the relatively depreciated currency. Thus, its real exchange rate would remain relatively competitive throughout but as long as the two anchor currencies are non-inflationary the dual currency board would not lead to a significant increase in inflation. This should ensure that the country would not lose its competitiveness against the other currency area or other trading partners that do not follow a, say, appreciating dollar. Thereby, a dual currency board would arguably be much more credible than the standard case.

First, it would be less vulnerable to exchange-rate movements between the currencies of the main trading partners, that is the dollar-euro rate, than a standard currency board.[5] Second, it would restrict exchange rate movements between the members of a regional arrangement to a significant degree if they jointly implement the arrangement. Unlike a standard basket peg, both anchor currencies would have the same importance and weight, making the system stable, transparent and simple. With both major international currencies in the "basket," the problems associated with trading with one currency area and being indebted in another would

[5] Of course, this could also be other currencies than the dollar and the euro, but dollar and euro are most likely to become the dominant currencies in international trade and financial markets.

as well be sharply reduced because the trade and financial dimensions would be addressed at the same time.

When relative exchange rate changes between the two anchor currencies move due to real influences, such as productivity differences, the dual currency board might as well help to stabilize the domestic economy. If, for instance, the dollar appreciates against the euro because of a positive productivity shock in the US, the peso would soon follow the euro rather than the dollar and thereby profit from the depreciation of the euro. With a single dollar peg, the peso would appreciate and thus experience export and output losses.

Of course, the currency would have to follow the interest rate of the relatively depreciated currency, implying that the domestic interest rate might rise. In addition, since the anchor currency can change, there might be a slightly higher currency risk premium than under a standard currency board. While these two negative effects exist they are likely more than compensated by a positive credibility effect if the country is not pegged to an overvalued anchor currency.

As these aspects of a dual currency board make clear, they are not appropriate for all countries at all times. First, it has to be established that countries need a hard peg. This is obviously mostly the case for countries with a history of high and variable rates of inflation which therefore have a credibility problem (Fischer et al. 2002). This is the credibility argument for fixed rates, and it can be expected that standard pegs are probably not enough to avoid speculative pressure on those pegs.[6] Not well developed financial markets, where the instruments to live with floating rates are absent, are another reason for fixed rates. Further arguments are, in line with the theory of optimum currency areas, that the countries are highly open, so that floating rates do not have much of an insulating property, and that fixed rates

[6] This is so-called bipolar view, stating that only extreme regimes like full floating and hard pegs are viable over long time horizons (Fischer 2001). While this hypothesis has been refuted as a general statement (Frankel 1999), it remains convincing for certain types of countries.

should help to foster international trade (Alesina et al. 2002, Mc Kinnon 2005, Rose 2000). Finally, the country might be indebted in foreign currency so that variable exchange rates cause balance sheet effects (Eichengreen and Hausmann 1999, Goldstein and Turner 2003).[7]

On top of these standard arguments for fixed exchange rates and hard pegs, it must be the case that the country is not only exposed to one major currency area. Thus, countries in Eastern Europe that are oriented toward the European Union (EU) would probably not qualify because for them a single peg to the euro is dominant. Nor would it probably make sense for many East-Asian nations, which trade with more than one major trading partner, but have meanwhile developed instruments to live with floating rates. Inflation targeting for them might be much more interesting than a hard peg (IMF 2006).

For several countries in Latin America (such as for Argentina, as argued by Cavallo and Busse et al.) this might have been a good instrument. Whether Argentina is able to weather financial market turmoil with its current regime remains to be seen. It clearly is, however, an interesting solution for CIS countries. These trade equally with the EU and other CIS countries (where intra-CIS trade is mostly denominated in dollar), they are mostly indebted in US-dollar, and they depend, to the extent that they export natural resources, on the dollar in their export values. These countries are thus more or less equally exposed to the dollar and the euro, and they generally do not have a credible tradition of independent and successful central banking. Instead, most come from a history of high to hyper-inflation which might make it difficult to pursue independent monetary policy in an integrated financial market (Pomfret 2006).

A dual currency board, because of its higher credibility, might thus also help to integrate further into international financial markets as well. Countries that are vulnerable to

[7] As Mc Kinnon (2005) points out, this not only applies to countries which might devalue and thus increase their foreign debt by devaluing. Countries might also be afraid of revaluing because this would reduce their wealth denominated in foreign currency.

speculative flows could use a hard peg to open up their financial markets which they might keep controlled when following constrained floating.

Finally, as argued above, a common peg could support regional integration. Attempts at stronger integration in Mercosur countries were crucially affected by the devaluation of the real against the peso which would not have been the case under a common peg of Mercosur countries to a dual currency board. Likewise, CIS countries have long aimed a stronger integration among themselves, without making much progress so far (Pomfret 2006). A common move to a dual currency board for those countries could accommodate different trading patterns with the dollar and euro area, as well as trade with Russia (and China for some) and other CIS states which is based on the dollar as well. Single pegs to the dollar or the euro are less able to serve as a common anchor because of different trade patterns of individual CIS states.

3. The Basic Model

3.1. The Economy

In order to discuss the choice of monetary and exchange rate regimes for a small open economy and the properties of a dual currency board, we use a standard setup such as in Canzoneri (1982) or Kohler (2002). The model is formulated in logs. The level of natural output is normalized to unity, so its log is zero.[8] The timing we assume is (i) the government decides about the currency regime, (ii) wage setters set their nominal wage demands, (iii) shocks (to be specified below) occur, (iv) monetary policy is set (in case of monetary autonomy), (v) output is realized. The economy produces a single traded (composite) good.

The model is given by the following equations:

(1) $$y = \alpha(p - p^e) + \varepsilon_s$$

(2) $$m - p = y + \varepsilon_m$$

[8] For a detailed derivation of the model, see Canzoneri (1982).

(3) $y = \theta_{\$}\, z_{\$} + \theta_{€}\, z_{€} + \varepsilon_d$

(4) $z_{\$} = p_{\$} + e_{\$} - p$

(5) $z_{€} = p_{€} + e_{€} - p$

(6) $q = (1 - \theta)\, p + \theta_{\$}\, e_{\$} + \theta_{€}\, e_{€}$

(7) $e_{€} = e_{\$} + x$

In equation (1), we assume that aggregate supply is an increasing function of a surprise increase of the price of the domestic good. That is, whenever prices of domestic goods increase above expected prices, output will increase. This can be derived from assuming that wage setters wish to stabilize employment at its full employment level and set their nominal wage demands equal to expected price increases of the domestic good. Unexpectedly larger price increases lower real wages and thus increase employment and output. ε_s is a supply shock with mean zero and variance σ_{ε}^2.

Equation (2) represents money demand, determined by a simple Cambridge equation, where ε_m is a velocity shock with mean zero and variance σ_m^2.

In equation (3), aggregate demand is assumed to be a function of the real exchange rates with the two main trading partners of the home country. We measure exposure against any single trading partner by θ_i and denote the two main trading partner as those trading relations based on the US-dollar ($) and those based on the euro (€). This need not literally mean trade with the euro area or the US, but comprises all trade that is denominated in these currencies. It would thus also capture regional and other trade that is based on either of these vehicle currencies. Since we are considering only small and very open developing countries, it is reasonable to assume that international trade is denominated in foreign currencies. Then, aggregate demand is the sum of the exposure to these currencies and the real exchange rates z_i against partners pricing trade in those currencies. In addition, there is a demand shock ε_d, with mean zero and variance σ_d^2.

Equation (4) shows the real exchange against the dollar trade, $z_{\$}$. It is determined by the price level of the dollar zone, the domestic price level and the nominal exchange rate $e_{\$}$, measuring the price of foreign currency in domestic units. A similar equation, (5), holds for the real exchange rate of the euro. To keep matters simple, we assume throughout the paper that (the logs of) foreign prices are equal to 0 ($p_{\$} = p_{€} = 0$).

Equation (6) determines the domestic consumer price index, as a weighted average of the price of domestically produced goods p and the prices of foreign goods, where $\theta = \theta_{\$} + \theta_{€}$ measure the openness of the economy.

Equation (7) assumes that bilateral exchange rates are linked trough a standard triangular arbitrage condition. The bilateral exchange rate between the dollar and the euro is denoted by x, an exogenous shock with mean zero and variance σ_x^2. A positive x reflects a nominal appreciation of the euro against the dollar.

For simplicity, we finally assume that shocks are iid and that hence all covariances among shocks are zero.

3.2. Preferences

We next describe social preferences. We follow most of the literature that uses this kind of linearized model and assume that social preferences are mainly to stabilize output around its natural level and to stabilize the (log of the) consumer price index around zero. The relative weight of the latter in the loss function is measured as λ, $0 < \lambda \leq \infty$.

(8) $\quad E[L] = E[y^2 + \lambda\, q^2]$

As long as the mean values of the levels of output and consumer price index are zero, the objective function can be rewritten as minimizing an average of the variances of output and CPI:

(9) $\quad V = V[y] + \lambda\, V[q]$ with $V = E[L]$ for $E[y] = E[q] = 0$.

However, as shown below, the mean value of CPI may be different from zero.

4. Exchange Rate Regime Options

In this section, we discuss the properties of monetary regimes which, from a purely analytical point of view, fall into two main categories, as is standard in open economy macroeconomics: flexible exchange rate regimes, in which some degree of monetary autonomy make m an exogenous variable in our model; and fixed exchange regimes, in which m is endogenous and some exchange rate is exogenous.

4.1. Flexible Exchange Rates

Before comparing results for the different possibilities of pegging to a foreign currency, we derive the case of monetary autonomy as a benchmark. This implies flexible exchange rates and allows the central bank (whose preferences are assumed to be equal to society's preferences) to set monetary policy independently. In this case, the model can be solved for y, p, q, $z_{\$}$, $z_{€}$, $e_{\$}$ and $e_{€}$, as functions of m, p^e, x and the ε's. Since wage setters from rational expectations before they know the results of shocks, p^e is the unconditional expectation of p. It follows from equations (1) and (2) that: $p^e = m^e$. The solution for y and q, which enter the objective function, is given by:

(10) $$y = \frac{\alpha}{1+\alpha}(m - m^e - \varepsilon_m) + \frac{1}{1+\alpha}\varepsilon_s$$

(11) $$q = m - \varepsilon_m - \varepsilon_d$$

If the central bank is able to commit credibly to its monetary policy course, and follows a non contingent rule, then m is constant and $m = m^e = \mu$, where μ is the pre-announced rate of money supply increases. In this case, output and CPI follow:

(12) $$y = \frac{1}{1+\alpha}\varepsilon_s - \frac{\alpha}{1+\alpha}\varepsilon_m$$

(13) $q = \mu - \varepsilon_m - \varepsilon_d$

Society's expected loss is:

(14) $$E[L] = \lambda \mu^2 + \left(\frac{\alpha^2}{(1+\alpha)^2} + \lambda \right) \sigma_m^2 + \lambda \, \sigma_d^2 + \frac{1}{(1+\alpha)^2} \, \sigma_s^2$$

This expression is obviously lowest for $\mu = 0$, meaning that a non-contingent rule does best when announcing a money supply rule of $m = 0$, i.e. in line with long term equilibrium.

If, instead, monetary policy is allowed to react to shocks, the optimal contingent rule, obtained by minimizing L, is:

(15) $$m = \varepsilon_m + \frac{\lambda(1+\alpha)^2}{\alpha^2 + \lambda(1+\alpha)^2} \varepsilon_d - \frac{\alpha}{\alpha^2 + \lambda(1+\alpha)^2} \varepsilon_s$$

which leads to:

(16) $$y = \frac{\lambda(1+\alpha)}{\alpha^2 + \lambda(1+\alpha)^2} (\varepsilon_s + \alpha \, \varepsilon_d)$$

(17) $$q = \frac{\alpha}{\alpha^2 + \lambda(1+\alpha)^2} (\varepsilon_s + \alpha \, \varepsilon_d)$$

(18) $$E[L] = \frac{\lambda}{\alpha^2 + \lambda(1+\alpha)^2} \left(\sigma_s^2 + \alpha \sigma_d^2 \right)$$

Not surprisingly, we see that a contingent monetary policy rule that allows for correcting economic shocks dominates a non-contingent rule which precludes the central bank from stabilizing economic shocks. This follows because the velocity shock can be fully stabilized and the supply shock can be stabilized better than under a non-contingent rule. This is also for the demand shock if α is not too small.[9] Thus, if monetary policy has a sufficiently strong impact on output it increases social welfare to be able to use monetary policy in order to stabilize output.

[9] Formally, the condition is that $\sigma_s^2 \alpha^2 / \left((1+\alpha)^2 \left(\alpha^2 + \lambda (1+\alpha)^2 \right) \right)$ + $\sigma_m^2 \left(\lambda + \alpha^2 / (1+\alpha)^2 \right)$ $+ \lambda \sigma_d^2 \left(\lambda (1+\alpha)^2 - \alpha(1-\alpha) \right) / \left(\alpha^2 + \lambda (1+\alpha)^2 \right)$ is positive which is clearly the case for the first two expressions and also for the third part if λ is relatively large and α is not too small.

4.2. Credibly Fixed Exchange Rates

We distinguish three types of fixed exchange rate regimes in our model. The first type is the standard peg to one given foreign currency (either the dollar or the euro), in which case either $e_{\$}$ (dollar-peg) or $e_{€}$ (euro-peg) is exogenous (and set equal to 0 in the model). The second type is a basket-peg. The nominal exchange rate is following a weighted average of the two anchor currencies $e_b = (1 - \beta)\, e_{\$} + \beta\, e_{€}$, where β is the weight of the euro in the basket, and e_b is exogenous. The third type of fixed exchange rate regime is the dual currency board. To keep matters simple, we assume that the implicit euro-dollar exchange rate is set at its long term equilibrium level, i.e. 0 in our set-up.[10] It might of course differ from the market rate which is equal to x. As argued above, the fundamental characteristic of a dual currency board is that it allows the pegging currency to move with the relatively lower valued currency. In our case, this would imply that for all $x > 0$, the home currency would be pegged to the dollar, whereas it would switch to a euro peg if $x < 0$.

Under fixed exchange rate regimes, the model can be first solved for y, p, q, $z_{\$}$, $z_{€}$, and m as functions of $e_{\$}$, $e_{€}$, p^e and the ε's. It can easily be shown that the solution for the expected values of y and q is:

(19) $\quad E[y] = 0$

(20) $\quad E[q] = E[p] = \dfrac{1}{\theta}\, E[\theta_{\$}\, e_{\$} + \theta_{€}\, e_{€}]$

That the expected increase in output is equal to zero follows from (1) and our assumptions about the expected value of shocks. Expected price increases are only driven by expected devaluations against the two anchor currencies if exchange are expected to move.

[10] Estimates of the equilibrium exchange rate between dollar and euro differ widely. A survey of these estimates can be found in Stein (2001).

Let us define $\tilde{e} \equiv \frac{1}{\theta}(\theta_{\$}\, e_{\$} + \theta_{€}\, e_{€})$ as the trade-weighted average nominal exchange rate. The solutions for y and q are then given by:

$$(21)\quad y = \frac{\alpha\theta}{\alpha+\theta}(\tilde{e} - \mathrm{E}[\tilde{e}]) + \frac{\theta\varepsilon_s + \alpha\varepsilon_d}{\alpha+\theta}$$

$$(22)\quad q = \mathrm{E}[\tilde{e}] + \frac{(1+\alpha)\theta}{\alpha+\theta}(\tilde{e} - \mathrm{E}[\tilde{e}]) + \frac{1-\theta}{\alpha+\theta}(\varepsilon_d - \varepsilon_s)$$

Thus, under fixed exchange rate output increases can be due to surprises in the exchange rate, that is, an unexpected devaluation, and to supply and demand shocks. Likewise, changes in the CPI are driven by expected devaluations, surprise devaluation and the difference between demand and supply shocks (the former pushing prices up, the latter lowering them).

The model is completed by adding the equations governing the exchange rates, which depend on the particular type of the fixed exchange rate regime. We begin by discussing standard currency boards before we move to baskets and dual currency boards.

4.3. A Standard Currency Board Arrangement

The main feature of a standard currency board arrangement is that it is a credible peg to a single currency. In our set-up, under a dollar-based currency-board, we therefore have, recalling (7), $e_{\$} = 0$ with $\mathrm{E}[e_{\$}] = 0$ and $\mathrm{V}[e_{\$}] = 0$ and $e_{€} = x$ with $\mathrm{E}[e_{€}] = 0$ and $\mathrm{V}[e_{€}] = \sigma_x^2$, implying $\tilde{e} = \frac{\theta_{€}}{\theta} x$ with $\mathrm{E}[\tilde{e}] = 0$.

From (21) and (22), we directly obtain

$$(23)\quad y = \frac{\alpha}{\alpha+\theta}\theta_{€}\, x + \frac{\theta\varepsilon_s + \alpha\varepsilon_d}{\alpha+\theta}$$

$$(24)\quad q = \frac{1+\alpha}{\alpha+\theta}\theta_{€}\, x + \frac{1-\theta}{\alpha+\theta}(\varepsilon_d - \varepsilon_s)$$

Thus, output and CPI are only affected by shocks and by movements in the other exchange rate to which the currency is not pegged.

The mean values and variances of output and inflation follow as

$$(25)\quad \text{E}[y] = 0 \text{ and } \text{V}[y] = \frac{\alpha^2\theta_€^{\,2}}{(\alpha+\theta)^2}\ \sigma_x^2 + \frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$$

$$(26)\quad \text{E}[q] = 0 \text{ and } \text{V}[q] = \frac{(1+\alpha)^2\theta_€^{\,2}}{(\alpha+\theta)^2}\ \sigma_x^2 + \frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$$

Because the peg is completely credible, expected output and CIP are equal to their long-run averages and only shock move output and inflation away from those values.

If instead the country chooses a euro-based currency-board, the exchange-rate assumptions are $e_€ = 0$, $e_\$ = -x$, and $\tilde{e} = -\frac{\theta_\$}{\theta}\,x$, implying:

$$(27)\quad y = -\frac{\alpha}{\alpha+\theta}\theta_\$\, x + \frac{\theta\varepsilon_s+\alpha\varepsilon_d}{\alpha+\theta}$$

$$(28)\quad q = -\frac{1+\alpha}{\alpha+\theta}\theta_\$\, x + \frac{1-\theta}{\alpha+\theta}\,(\varepsilon_d - \varepsilon_s)$$

$$(29)\quad \text{E}[y] = 0 \text{ and } \text{V}[y] = \frac{\alpha^2\theta_\$^{\,2}}{(\alpha+\theta)^2}\ \sigma_x^2 + \frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$$

$$(30)\quad \text{E}[q] = 0 \text{ and } \text{V}[q] = \frac{(1+\alpha)^2\theta_\$^{\,2}}{(\alpha+\theta)^2}\ \sigma_x^2 + \frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$$

which is analogous to the single dollar currency board.

Under a dollar-based (\$CB) and a euro-based (€CB) currency board, the expected social losses are respectively given by:

$$(31)\quad \text{E}[L \mid \$\text{CB}] = \frac{\alpha^2+\lambda(1+\alpha)^2}{(\alpha+\theta)^2}\theta_€^2\sigma_x^2 + \frac{\theta^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_s^2 + \frac{\alpha^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_d^2$$

$$(32)\quad \text{E}[L \mid €\text{CB}] = \frac{\alpha^2+\lambda(1+\alpha)^2}{(\alpha+\theta)^2}\theta_\$^2\sigma_x^2 + \frac{\theta^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_s^2 + \frac{\alpha^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_d^2$$

All else equal, we find that the dollar-peg is preferable to the euro-peg if $\theta_€ < \theta_\$$, i.e. if the country is more open to the dollar area than it is to the euro area. If the two weights are equal, then the two regimes are obviously equivalent and the country is indifferent between choosing one or the other.

4.4. A Basket Peg

An alternative to a single peg that has received some support recently is the choice of a basket peg (see Williamson). Depending on the exact design of such a currency basket peg, it might be more or less transparent (as countries might announce the weights of anchor currencies or not), and it be could more or less credible (depending on how high the exit costs of such a basket peg are). As we argued above, we do not believe that a country that cannot solve its monetary credibility problems domestically is able to do this with a simple peg to a foreign currency. However, for the sake of completeness, we consider how such a regime would fare in comparison with the alternatives as well.

In our set-up, the determination of y and q given in equations (21) and (22) is completed by (7) and the following exchange rate determination $e_b = (1 - \beta)\, e_\$ + \beta\, e_€$, where e_b is exogenous; the authorities intervene in the foreign exchange market so as to keep the weighted average of the euro and the dollar exchange rate equal to a given target. Then $e_\$ = e_b - \beta\, x$ and $e_€ = e_b + (1 - \beta)\, x$, and

$$(33) \qquad \tilde{e} = e_b + \left(\frac{\theta_€}{\theta} - \beta \right) x$$

Under a credible basket-peg, the parameters of the basket, e_b and β, are implemented as announced, so that they are also perfectly anticipated, with $E[\tilde{e}] = e_b$. Therefore, y and q and their mean values and variances are given by:

$$(34) \qquad y = \frac{\alpha}{\alpha+\theta}\,(\theta_€ - \beta\,\theta)\, x + \frac{\theta\varepsilon_s + \alpha\varepsilon_d}{\alpha+\theta}$$

(35) $q = e_b + \frac{1+\alpha}{\alpha+\theta}(\theta_€ - \beta\,\theta)\,x + \frac{1-\theta}{\alpha+\theta}(\varepsilon_d - \varepsilon_s)$

As before, output and inflation are affected by the different shocks and by the weighted and unexpected movement of exchange rates. Inflation is also influenced by the announced peg since the private sector knows about the basket weights of the two currencies. The mean values and variances of output and inflation follow as

(36) $E[y] = 0$ and $V[y] = \frac{\alpha^2}{(\alpha+\theta)^2}(\theta_€ - \beta\,\theta)^2\,\sigma_x^2 + \frac{\theta^2\sigma_s^2 + \alpha^2\sigma_d^2}{(\alpha+\theta)^2}$

(37) $E[q] = e_b$ and $V[q] = \frac{(1+\alpha)^2}{(\alpha+\theta)^2}(\theta_€ - \beta\,\theta)^2\,\sigma_x^2 + \frac{(1-\theta)^2(\sigma_s^2 + \sigma_d^2)}{(\alpha+\theta)^2}$

In contrast to the standard hard peg, a basket peg leads to an expected rate of CPI inflation different from zero. This is because the public is aware that the exchange rate between the two anchor currencies can move which, because of the dual peg, will then also influence domestic prices.

In this case, the expected social loss is

(38) $E[L] = \lambda\,e_b^2 + \frac{\alpha^2 + \lambda(1+\alpha)^2}{(\alpha+\theta)^2}(\theta_€ - \theta\beta)^2\,\sigma_x^2 + \frac{\theta^2 + \lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_s^2 + \frac{\alpha^2 + \lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_d^2$

which is lowest for $\beta = \frac{\theta_€}{\theta}$, i.e. when the basket weights are equal to the relative shares of trade with each anchor currency area, and $e_b = 0$, i.e. when the targeted weighted average exchange rate does not systematically deviate from its long term value. Then, the expected loss under a credible basket peg (CBP) collapses to

(40) $E[L \mid CBP] = \frac{\theta^2 + \lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_s^2 + \frac{\alpha^2 + \lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_d^2$

That is, the optimum basket weights neutralize the effects of shocks on the euro-dollar exchange rate and allow for complete stabilization of exchange rate movements. It therefore dominates a standard peg for countries that trade with several partners. As we argued above, however, such a peg might not be credible, and it might be difficult to find the optimal weights for the currency in practical application.[11]

4.5. A Dual Currency Board

Finally, we come to the solution for the dual currency board. As argued above, when x > 0, we assume that the country shifts to a dollar peg, and when x < 0 it will move to the euro-peg with $e_€ = 0$, following the relatively more depreciated currency. Formally, $e_\$ = 0$ and $e_€ = x$ if $x \geq 0$ and $e_€ = 0$ and $e_\$ = -x$ if $x \leq 0$. This implies $\tilde{e} = \frac{1}{\theta}\theta_i x$ where $\theta_i x = \theta_€ x$ if $x \geq 0$ and $\theta_i x = -\theta_\$ x$ if $x \leq 0$.

Recalling (21) and (22), y and q can be written

$$(41) \quad y = \frac{\alpha}{\alpha+\theta}(\theta_i x - E[\theta_i x]) + \frac{\theta\varepsilon_s + \alpha\varepsilon_d}{\alpha+\theta}$$

$$(42) \quad q = \frac{1}{\theta}E[\theta_i x] + \frac{1+\alpha}{\alpha+\theta}(\theta_i x - E[\theta_i x]) + \frac{1-\theta}{\alpha+\theta}(\varepsilon_d - \varepsilon_s)$$

The appendix shows that the mean value and variance of y and q can be derived as

$$(43) \quad E[y] = 0 \text{ and } V[y] = \left((1-h)\theta_\$^2 + h\theta_€^2\right)\frac{\alpha^2}{(\alpha+\theta)^2}\sigma_x^2 + \frac{\theta^2\sigma_s^2 + \alpha^2\sigma_d^2}{(\alpha+\theta)^2}$$

$$(44) \quad E[q] = k \text{ and } V[q] = \left((1-h)\theta_\$^2 + h\theta_€^2\right)\frac{(1+\alpha)^2}{(\alpha+\theta)^2}\sigma_x^2 + \frac{(1-\theta)^2(\sigma_s^2 + \sigma_d^2)}{(\alpha+\theta)^2}$$

As before, we see that expected output is stable. Expected inflation, however, is not longer equal to zero but positive. This is because the public is aware of the domestic currency switch in case the bilateral exchange rate between dollar and euro moves. Since this implies

[11] This is because the model neglects the influence of capital flows. A basket peg is relatively easy to implement if countries only trade; it becomes more complicated if financial flows are also denominated in foreign currencies, which is usually the case for developing countries and emerging markets.

that the currency will follow the depreciated currency, domestic prices will go up. The dual currency board hence stabilizes inflation around a positive value and no longer around zero, which is, by definition, a loss of social utility.[12]

Demand and supply shocks have the same influence as before, but the influence of the exchange rate shock between dollar and euro is now a function of the distribution of this shock, that is, the probabilities that that x might move up or down.

The expected social loss under a dual currency board (DCB) is

$$(45)\quad E[L \mid DCB] = \lambda k^2 + \left((1-h)\theta_{\$}^{\ 2} + h\,\theta_{€}^{\ 2}\right)\frac{\alpha^2+\lambda(1+\alpha)^2}{(\alpha+\theta)^2}\,\sigma_x^2 + \frac{\theta^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_s^2 + \frac{\alpha^2+\lambda(1-\theta)^2}{(\alpha+\theta)^2}\sigma_d^2$$

4.6. Comparing Regimes

All four credible fixed exchange rate regimes stabilize supply and demand shocks, ε_s and ε_d,, to the same extent and can be disregarded when comparing regimes. This is due to the fact that we have assumed that foreign monetary policy is stable and does not react to any shocks. If dollar and euro would react to shocks that affect the US or euro-zone economies separately, pegging to one of these currencies would import this policy and thus also the stabilizing influence of foreign monetary policy. In this case, the stabilization of domestic shocks would depend on their correlation with foreign shocks. Since this is ruled out by assumption, the regimes differ only with respect to the stabilization of the euro-dollar exchange rate.

The credible basket peg, if the basket weights can be chosen optimally, completely isolates the economy from shocks to the euro-dollar exchange rate, so that it produces the

[12] Clearly, positive inflation targets might in reality play a role if countries, for instance, rely on seigniorage financing part of their budgets.

lowest variance of y and q among all fixed exchange rate regimes. This regime thus dominates all others, but we would argue that this is more a theoretical possibility than a practical alternative. This is because a standard basket peg is unlikely to be credible, in particular if weights are changing or not revealed. Then it boils down to an ordinary peg that can be manipulated and is therefore not an attractive option for countries with credibility problems. They are likely to need to have a hard peg.

When comparing the stabilization capabilities of the different currency board regimes, the first result is that they do not depend on the particular distribution of shocks to the dollar-euro exchange rate x. Since the country is exposed to both anchor currencies, independent of the peg that it chooses, it is clear that will be affected by these exchange rate shocks between the dollar and the euro. If pegged to the dollar, for instance, a movement in x affects its relation to the euro-area and vice versa.[13] The case of the dual board means as well that the country will be following one currency and thus move against the other, even if the anchor currency can be switched. Thus, exposure to changing currency values does not change through the dual currency board and hence the influence of x cannot be eliminated.

Comparing expected losses for the three cases, by comparing (31) and (45) we find that

(46) $\mathrm{E}[L \mid \$\mathrm{CB}] > \mathrm{E}[L \mid \mathrm{DCB}]$ iff $\lambda k^2 + (1-h)(\theta_{\$}^2 - \theta_{€}^2) < 0$

That is, expected losses under a currency board are lower than under a single currency board to the dollar if the country is sufficiently more exposed to the euro than to the dollar (second term). Countries for which inflation aversion is very important, λ is high, far worse under the dual currency board because a dual currency board stabilizes inflation around a higher level than a single board (first term).

By comparing (32) and (45), however, we have

(47) $\mathrm{E}[L \mid €\mathrm{CB}] > \mathrm{E}[L \mid \mathrm{DCB}]$ iff $\lambda k^2 + h(\theta_{€}^2 - \theta_{\$}^2) < 0$

[13] Since we are looking at expected values and the variance, it is irrelevant whether x is positive or negative.

which states that a dual currency board is dominated by a single board to the euro if the country is more exposed to the euro than to the dollar.

Thus, a dual currency board will only dominate both single pegs at the same time if the country for some reason does not aim to stabilize inflation around zero, such a countries dependent on seigniorage revenue or affected by the so-called Balassa-Samuelson effect which make a higher rate of inflation than that of the anchor currency optimal.

Another reason why a dual currency board might dominate both single pegs at the same time would be if, in contrast to what our model has assumed, the relative exposures to the two potential anchor currencies changes over time, possibly in an unpredictable way. If a country is not certain whether $\theta_{\$} > \theta_{€}$ or vice versa over a longer time horizon, then a dual currency board is a better solution because it a natural hedge against being tied to the "wrong" anchor currency. This aspect, however, is beyond the current model.

5. Conclusion

In this paper we have formally developed a setup that compares dual currency boards with alternative fixed exchange rate regimes. We begin from the observation that many countries are still plagued by credibility problems which make "normal" fixed exchange rate not a realistic option. Building on these considerations, we suggest that small open economies with strong credibility problems select a dual currency board. A dual currency board has the advantage that it, because countries switch their anchor currency, allows to remain relatively more competitive which is ultimately credibility increasing. It therefore seems an attractive alternative for countries in Latin America or the CIS states, which are exposed to not only one major currency but two.

It is clear, however, that a dual currency board, much like a standard currency board, is not a solution for all macroeconomic problems (Edwards 2002). In general, currency boards will only survive if these problems can be solved. Moreover, creating a well-functioning currency board is not a "trivial matter" (Ghosh et al. 2000), as it requires that reserves must be sufficient to cover the monetary base to avoid deflation. The currency board needs broad political support to rule out self-fulfilling speculative attacks, and a reasonably healthy financial system to be able to do without a lender-of-last-resort. But if the underlying macroeconomic problems cannot be solved, any alternative exchange rate system is as likely to suffer as a currency board (Aizenman 2005). The dual currency board may have better chances to succeed, as it should enjoy more credibility and be better able to avoid real overvaluation which is one factor that makes pegs vulnerable and creates adverse expectations. A dual currency board is, therefore, likely to be a more stable middle-ground solution between floating rates and a standard currency board.

As our formal model has shown, a dual currency board does not necessarily dominate alternative regimes. It is left to future work to specify more under which conditions a dual currency board can dominate alternative arrangements. The present paper should be seen as a starting point for future analysis.

Appendix 1: Expected Value and Variance under a Dual Currency Board

Denoting with $f_x(x)$ the distribution of *x*, the following results obtain[14]:

$E[\theta_i x] = -\theta_{\$} \int_{-\infty}^{0} x f_x(x)\,dx + \theta_{€} \int_{0}^{\infty} x f_x(x)\,dx = \theta k$, with $k \equiv \int_{0}^{\infty} x f_x(x)\,dx > 0$, since $E[x] = 0$.

Which follows from the definition of the expected value for x: $E[x] = \int_{-\infty}^{\infty} x f_x(x)\,dx$

$= \int_{-\infty}^{0} x f_x(x)\,dx + \int_{0}^{\infty} x f_x(x)\,dx$. Since $E[x] = 0$, $-\int_{-\infty}^{0} x f_x(x)\,dx = \int_{0}^{\infty} x f_x(x)\,dx$.

[14] If we further assume that *x* is normally distributed, which is a useful simplifying assumption, albeit not based on historical data, then: $k = \sigma_x / \sqrt{2\pi}$ where π is the mathematical constant, and $h = 1/2$.

The variance follows as $V[\theta_i\, x] = \theta_{\$}^{\,2} \int_{-\infty}^{0} x^2 f_x(x)\, dx + \theta_{€}^{\,2} \int_{0}^{\infty} x^2 f_x(x)\, dx = \left((1-h)\theta_{\$}^{\,2} + h\,\theta_{€}^{\,2}\right)\ \sigma_x^2$

with $h \equiv \frac{1}{\sigma_x^2}\int_{0}^{\infty} x^2 f_x(x)\, dx$, $0 \le h \le 1$.

The Variance is defined as $\sigma_x^2 = \int_{-\infty}^{\infty} x^2 f_x(x)\, dx = \int_{-\infty}^{0} x^2 f_x(x)\, dx + \int_{0}^{\infty} x^2 f_x(x)\, dx$. Dividing by σ_x^2, one gets $\frac{1}{\sigma_x^2}\int_{-\infty}^{0} x^2 f_x(x)\, dx + \frac{1}{\sigma_x^2}\int_{0}^{\infty} x^2 f_x(x)\, dx = 1$. We call the second term *h*, so the first is equal to 1–*h*.

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Recapitulation of Results

The variances of output and CPI under the different regimes are displayed in the following table for comparison purposes.

	V[y]	V[q]
CBP	$\frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$	$\frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$
\$CB	$\frac{\alpha^2\theta_€^{\ 2}}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$	$\frac{(1+\alpha)^2\theta_€^{\ 2}}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$
€CB	$\frac{\alpha^2\theta_\$^{\ 2}}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$	$\frac{(1+\alpha)^2\theta_\$^{\ 2}}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$
DCB	$\left(h\theta_\$^{\ 2}+(1-h)\theta_€^{\ 2}\right)\frac{\alpha^2}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{\theta^2\sigma_s^2+\alpha^2\sigma_d^2}{(\alpha+\theta)^2}$	$\left(h\theta_\$^{\ 2}+(1-h)\theta_€^{\ 2}\right)\frac{(1+\alpha)^2}{(\alpha+\theta)^2}\ \sigma_x^2+\frac{(1-\theta)^2(\sigma_s^2+\sigma_d^2)}{(\alpha+\theta)^2}$