Preliminary Draft

Currency War vs. Currency Peace:
The Dollar and Renminbi in a World of Portfolio and Current Account Imbalances

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Abstract: This paper analyzes the stability of foreign trade, currency markets and international portfolio balances with the help of a model which captures the interactions between current account balances and the international asset portfolios for domestic and foreign investors in a stock-flow framework. It argues that the stability of such interaction may be affected by shifts in the preferences of investors; by the relative rate of return of different assets; as well as, more importantly, by the institutional arrangements. The model is used for policy analysis based on numerical simulations for the interplay of US and China, in terms of exchange rate, foreign exchange reserves and foreign debt. The conditions for the existence of dynamic equilibria, and whether they can be attained, are derived under alternative policy assumptions. Simulations of the model show that "trade space" (the range of trade and foreign liability imbalances that can be absorbed without triggering an unstable sequence of adjustments) is sensitive to the policy regimes in place; and to the preferences of investors and particular strategies employed by policymakers within those regimes. Our benchmark scenario, representing today's conditions for the US and China, shows trade space is comfortably larger that the adjustments usually said to be necessary. That would be satisfactory if we start from equilibrium. Unfortunately we do not.

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1. Introduction

In the years preceding the financial crisis of 2007-2008 the persistence of wide payment imbalances between the United States and its creditor countries did not seem to concern those who regarded the current international monetary and financial system as a revived Bretton Woods System[1]. In that view, the old periphery of the 1960s - Europe and Japan - had been replaced by a new periphery consisting of the emerging economies of Asia and Latin America with the United States playing the role of the core country that benefits from issuing the main reserve currency and shows a tendency to live beyond its means. According to others[2], however, there was a serious risk that the new core-periphery relation was intrinsically stable and that the system might collapse soon, as it eventually did.

The outbreak of the crisis has revealed the contradictions affecting the international economy; it has helped to create a better view of the risks associated to the persistence of global imbalances, and has made such risks a compelling issue that needs to be solved cooperatively[3]. In such a spirit, at their September 2009 Pittsburgh Summit, the G-20 Leaders have launched the "Framework for Strong, Sustainable, and Balanced Growth", according to which, G-20 economies would adopt the policies aimed at the achievement of their national objectives in a mutually coherent framework. Such a paradigm, the so-called "mutual assessment process" (MAP) would help preventing negative spillovers and mutual inconsistencies among individual goals. Further steps have followed in the coordination process. In their Meeting in Paris last February, the Finance Ministers and Central Bank Governors have agreed on a set of indicators focused "on those persistently large imbalances which require policy actions".

For this effort to be effective, a broad consensus is needed on the necessity of a rapid adjustment. This is certainly the case with the payments imbalance between the United States and China, a problem that is widely recognized as one to be addressed sooner than later. Once the largest world's creditor, the United States is today the largest debtor, with China being among its main creditors. The reasons for this imbalance are complex and often a source of disagreement among experts. However, the perception that the exchange rate of the dollar vis-à-vis the Renmimbi is not consistent with the aim of reducing trade imbalances between the United States and China is almost unanimous. The range of different estimates on the size of the misalignment is nonetheless quite broad. Moreover, some scholars have challenged the idea that exchange policy alone would suffice to reduce the Chinese trade surplus[4]. Others have suggested that there are factors other than the exchange rate to explain China's surplus; among those the household savings, fiscal policy, tax incentives and subsidies offered to exporters and investors[5]. The recognition that a Renminbi revaluation would have a favorable impact on China has induced the Chinese authorities to allow a gradual revaluation of their currency in recent years, and

[1] See Dooley, Folkerts-Landau, and Garber (2003). A critical analysis of the international monetary setting in the Sixties is found in James and Martinez Oliva (2009).
[2] Among these see: Mussa (2004), Bergsten and Williamson (2004), and Roubini and Setser (2005).
[3] For a survey of the problem and its possible solutions see Martinez Oliva (2010 and 2011).
[4] See Y. W. Cheung, M. D. Chinn, and E. Fuji (2007), and the comment of Jeffrey Frankel. See also Lafrance (2008).
[5] See for example Shimelse and Dadush (2011).

more recently to review the issue of a growing internationalization of the Renminbi. This would imply, among other things, a rigorous regulatory oversight to enforce good corporate governance and disclosure rules, and a sound financial system which includes foreign participation[6]. It will also require that complete capital liberalization be pursued, and achieved; such a move would enhance China's integration in the international financial system, albeit at the cost of a lesser freedom of exchange rate and monetary policy[7]. The numerous experiments successfully undertaken by Chinese monetary authorities suggest that the internationalization of the Renminbi is under way[8].

Since the time when the Renminbi will become an international currency is fast approaching, it is important to assess its implications in terms of exchange rate parities, global payment flows, and the distribution of international financial assets and liabilities.

The paper aims at addressing these issues with the help of a model which captures the interactions between current account balances and the international asset portfolios for domestic and foreign investors in a stock-flow framework[9]. It argues that the stability of such interaction may be affected by shifts in the preferences of investors; by the relative rate of return of different assets; as well as, more in general, by the institutional arrangements. The model is used for policy analysis based on numerical simulations. The conditions for the existence of dynamic equilibria, and whether they can be attained, are derived under alternative assumptions on investor's behavior and exchange rate management.

2. A Model of the Current Account and Portfolio Balances

Open economy macroeconomics provides a wide choice of models which are, at least in principle, suitable to meet the needs of research projects on global imbalances. In order to understand the interactions among the foreign trade, currency markets and international portfolio balances, a model of current account balances and internationally held asset balances is needed to capture the capacity of the former to supply the net interest payments or rents that need to be paid on the latter. To the extent that a country has insufficient capacity to make those payments, or that there is a shift in the trade balance, or a change in preferences for domestic vs. foreign assets, then there has to be some adjustment in exchange rates (or rates of return), or in the underlying trade balance and asset positions, to re-establish equilibrium (assuming of course that these adjustments are a stable process and that an equilibrium exists). The model we use should be able to track a persistent external imbalance; such as in the Unites States, where a current account deficit started in the mid-1970s, persisted into the eighties, grew larger in the nineties, and widened dramatically in the 2000's (before the financial collapse in 2007).

[6] A number of regulatory agencies are already working on these issues: the China Bank Regulatory Commission; the China Securities Regulatory Commission; the China Insurance Regulatory Commission; the State-Owned Assets Supervision and Administration Commission. See Xiao and Kimball (2006).

7 A thorough analysis is found in Ma and McCauley (2007).

8 See Chen and Cheung (2011). However, it is suggested by the two authors that compared with the size of the Chinese economy, the current scale of the use of the RMB remains at the moment quite small.

[9] See Hughes Hallett and Martinez Oliva (2011).

This cannot be done, for example, with a dynamic stochastic general equilibrium (DSGE) model. In spite of other appealing features, such models do not appear capable of tracking situations of persistent disequilibria. On the contrary, they are self-equilibrating because agent's expectations anticipate imbalances and adjust accordingly. They are therefore not suitable for describing a situation where, far from adjusting, the imbalances have actually continued to widen year-on-year over a period of 35 years. Indeed, to use a model based on self-stabilizing actions by agents with forward-looking expectations would be to rule out *by assumption* one of the key possibilities we need to investigate – the possibility that, in some circumstances, there may be no equilibrium at all.

Second, current accounts and portfolio balances both affect exchange rates, and rates of return, and hence each other indirectly. It is obvious that these two variables need to be modeled jointly. Normally that is done implicitly, by assuming assets are perfectly substitutable between countries, and that markets adjust instantaneously and completely, so that uncovered interest parity applies. However, given that we are dealing with a problem where current account imbalances are persistent, and may have to be limited by other means, it is far from obvious that such a model is in itself appropriate in a world of global imbalances and market distortions due to sticky prices, fixed exchange rates, capital controls, or revealed preferences for holding home assets or foreign reserves and foreign assets – any more than it would be to model the European debt crisis by assuming that Ricardian equivalence holds in the affected economies. The lack of explicit modeling of the asset markets, capital movements, and portfolio balances, elements which in DSGE are either absent or left passive under uncovered interest parity in DSGE models[10], suggest that we need a different approach.

A more general approach, with interest parity as a special case, is provided by Blanchard, Giavazzi and Sa (2005), who model current account and portfolio balances directly, and the adjustment processes between them. This model allows us to consider imperfect asset substitutability (hence asset preferences), and the stability of the adjustment process in asset holdings which follows from a change in, or imposed limit on, trade imbalances. In fact, this model turns out to be more appropriate when compared with more recent DSGE models. Some authors have incorporated asset markets under imperfect substitutability in DSGE models, but limited it to short versus long term securities in a single economy (no international markets). They find this approach is unable to generate the kind of persistent imbalances and repayment risks that we have seen in international asset markets[11]. Similar considerations hold when the closed economy model is extended to include international assets. If capital movements are not modeled explicitly, and there are neither portfolio balance equations nor imperfect substitutability as such, the observed exchange rate volatility may be captured; but not the required persistence of changes in the exchange rate, nor in international lending or borrowing.[12] This can be fixed, to some extent, by imposing arbitrary (negative) correlations between risk premia and expected exchange rate changes. The fact we have to impose such a change, demonstrates the need to relax the DSGE cross-equation restrictions or go to a different type of model, if we wish to get an adequate representation of the data.

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[10] See for example Chari et al. (2002).

[11] Andres et al. (2004): substitutability here is between short and long term assets, not between countries.

[12] See Adolfson et al (2005, 2007). This matches the rejection of the DSGE model by Le et al (2009).

Blanchard, Giavazzi and Sa (2005) turn to earlier models developed by Masson (1981), Henderson and Rogoff (1983), and Kouri (1983), which track current account imbalances and portfolio balances of imperfectly substitutable assets to show the gross asset positions of different countries, and the valuation effects caused by financial flows between them.[13] In this paper, we extend and adapt their model to analyze conditions for simultaneous equilibrium of trade and asset balances, and whether such equilibria are stable or not. The conditions under which those equilibria will continue to exist, and are reachable, can then be investigated under different policy regimes: namely fixed exchange rates or limits to the size of current account surpluses or deficits allowed. We assess the risk that those restrictions distort markets and undermine the long-run stability of the system.

We proceed in four steps:

2.1 Perfect Asset Substitutability

For simplicity, consider two countries: home and foreign. In each country, the foreign sector is determined by two relationships. First uncovered interest parity,

$$(1+r) = (1+r^*)E / E_{+1}^e \qquad (1)$$

where r and r^* are the home and foreign rates of interest respectively ("*" denotes foreign variables throughout); E is the real exchange rate (defined as the price of home goods relative to foreign goods), and E_{+1}^e is the real exchange rate expected next period.

Thus $$E = P/(eP^*) \qquad (2)$$

where e is the nominal exchange rate, defined as the units of domestic currency needed to purchase one unit of foreign currency: dollars per renmimbi, if the US is the home country. Thus a fall in e and a rise in E indicate a strengthening domestic currency other things equal: an appreciation of the dollar. Interest rate parity states that the expected returns on home and foreign assets must always be equal, and assumes that markets clear instantly and that there are no preferences. It therefore assumes perfect substitutability between assets.

Second, net foreign liabilities (or debt) accumulated by the home country:

$$F_{+1} = (1+r)F + D(E_{+1}, z_{+1}) \qquad (3)$$

where F is net foreign debt or liabilities of the home country denominated in the home currency (the amount of domestic currency needed to pay them off). $D(E, z)$ is the trade deficit, defined to be an increasing function of the real exchange rate. Thus $D>0$ implies a deficit, and an appreciating currency or real exchange rate will make that deficit larger (the first derivative is positive, $D_E > 0$). Conversely, $D<0$ denotes a trade surplus and a depreciating currency or real exchange rate will make it larger (more negative). This condition says net liabilities next period are equal to net foreign debt this period, plus net interest payments due, plus the current trade deficit. Thus, by analogy to the government budget constraint in fiscal policy, D plays the role of primary deficit and rF the interest payments on past debt – although the government cannot just set D in the way it does the

[13] Effects stressed in Gourinchas and Rey (2005), Lane and Milesi-Ferretti (2002, 2004), and Obstfeld (2004).

primary deficit. It also implies that the current account, $CA = D - rF$, plays the same role as gross fiscal debt.

Finally, z is a shift variable describing the impact of a trade shock, a change in preference for home goods, or other changes in spending or the pattern of spending on those goods. It is defined so that an increase in z worsens the trade balance: $D_z > 0$.

2.2 Imperfect substitutability and portfolio balance

To allow for imperfect substitutability between (national) assets, let W be the total wealth of home investors, X denote the total stock of home's assets and F the net debt position of the home economy (all in real terms). Thus:

$$W = X - F. \tag{4}$$

The corresponding expression for the wealth of foreign investors, in home's currency, is

$$W^*/E = X^*/E + F. \tag{5}$$

So the expected real rate of return from holding home's assets relative to foreign assets, is

$$R^e = [(1+r)/(1+r^*)].E^e_{+1}/E \tag{6}$$

Perfect substitutability between assets with instantaneous market clearing is therefore just a special case with $R^e = 1$ since $r = r^*$ and $E^e_{+1} = E$. In general however, home investors will distribute their wealth between home and foreign assets, putting a share α in home securities and $(1-\alpha)$ in foreign assets (likewise α^* and $1-\alpha^*$ are the shares of foreign's wealth held in domestic and external assets). It is reasonable to assume that α is increasing in the relative rate of return on home assets, R^e; and in s, defined as the preference for holding home's assets (including home bias and any safe haven effects) or any other shift factors that increase the demand for home's assets. Symmetrically, α^* is decreasing in those two factors. If home biases dominate the asset market, then $\alpha + \alpha^* > 1$. But whether they do or not is left open: it is not an condition imposed in this paper.

Equilibium in the market for home's assets, and hence foreign's assets, is then given by

$$X = \alpha W + (1-\alpha^*)W^*/E = \alpha(X - F) + (1-\alpha^*)(X^*/E + F) \tag{7}$$

where α and α^* may vary with R^e and s as stated. This is the portfolio balance equation. Unlike the perfect substitutability case, the distribution of wealth holdings between home and foreign is independent of shifts in the trade or current account balances (ie z). Instead the real exchange rate E (and relative rates of return R^e and asset preferences s, which affect α) determines and is determined by the world distribution of wealth holdings. Nevertheless, trade and current account balances do lead to changes in F, and hence to changes in the exchange rate. This we represent by the slope of the portfolio balance relationship:

$$\frac{dE}{dF} = -\frac{\alpha + \alpha^* - 1}{(1-\alpha^*)X^*/E^2} < 0 \quad \text{iff} \quad \alpha + \alpha^* > 1. \qquad (8)^{14}$$

[14] Both (8) and (11) are derived assuming that the variations in α and α^* are small and may be ignored. This is correct up to a *local* first order approximation, for the reasons that are set out in section 3.1 below.

Notice that: (i) the portfolio balance relation is by definition nonlinear in E-F space, and will be downward sloping as long as some home biases persist; (ii) under these conditions higher net debt at home requires a lower exchange rate (because the demand for home assets has fallen); (iii) portfolio balances in fact imply a relation between net debt, the exchange rate *and* future expected exchange rates (through α and R^e); (iv) the exchange rate will respond rather little to current account or trade imbalances, but rather more to changes in portfolio preferences and the distribution of wealth holdings.

2.3 Current account balances under imperfect substitutability

If home and foreign goods are imperfect substitutes, and the trade balance *D* behaves as in (3), then home net debt in the next period will be:

$$F_{+1} = (1-\alpha^*)(1+r)W^*/E - (1-\alpha)(1+r^*)W.E/E^e_{+1} + D(E_{+1}, z_{+1}) \qquad (9);$$

That is foreign ownership of home assets (plus interest)[15], less the value of home owned foreign assets (plus interest), plus the next trade deficit. Rewriting with (4), (5) and (6):

$$F_{+1} = (1+r)F + (1-\alpha)(1+r)(1-1/R^e)(X-F) + D_{+1} \qquad (10)$$

which is the current account balance equation since $CA_{+1} = D_{+1} - rF$. Notice that the term in the middle reflects the changing evaluation effects for home owned foreign assets (depending on relative rates of return and expected exchange rate movements). Notice also that (10) contains not only the current account balance, but also the cumulative effect of "discretionary" trade balance choices – analogous to the primary deficit in the budget constraint, although policymakers often have little *direct* influence over *D*. However, in different policy setting, policymakers may affect *D* via import controls or exchange rate manipulation. As a specific form of the latter, a government may decide to hold (invest) its excess foreign currency in the form of reserves – either held directly, or as sterilized domestic currency bonds. This, as we shall show, plays a important role in the specific policy regimes highlighted in this paper and amounts to a form of currency intervention aimed at creating comparative advantage and a trade surplus for the recipient.

The slope of this current account balance relation in *E*-*F* space, in the current period, is:

$$\frac{dE}{dF} = \frac{-E_{+1}}{(1-\alpha)(1+r^*)(X-F)} < 0 \qquad (11)$$

where again the sign depends on the existence of a large domestic asset base: $X > F$. This might appear to be the normal state of affairs since, if *F* rises, it requires *E* to fall to create a move towards a trade surplus in home sufficient to generate the extra revenues to pay for the higher net debt. That implies (11) will have to be negative.

3. Current Account and Portfolio Adjustments: Stability and Dynamics

Now we develop a more general version of the model. We examine potential equilibria in the trade and financial sectors for our two economies, together with the dynamics of the adjustment process toward, or away from, those possible equilibria. Do they represent stable and feasible steady states?

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[15]The foreign share of domestic assets is the share of foreign wealth allocated to home assets plus interest paid on home assets, all evaluated in home currency. Similarly, with roles reversed, for the second term.

In this section we work with a *local* linearization about each possible equilibrium point. This is for illustration only. The linearizations will be relaxed in section 5 where we deal with the general case.

3.1 Critical values where net foreign liabilities rise: the primary fiscal surplus analogy

Also for illustration, we will make another simplifying assumption: that any variations in α and α^* with respect to s or R^e are small and can be ignored. Since α and α^* are themselves small, this is a reasonable starting point; and it would be guaranteed if national interest rates were approximately equal and the exchange rate is not expected to adjust much ($r \approx r^*$ and $E^e_{+1} \approx E$, so $R^e \approx 1$), implying there is no reason to expect a change in asset preferences or the home biases *s*. These assumptions are for convenience and temporary; they will be relaxed below and in section 5.

Given these simplifications, the portfolio balance equation is:

$$X = \alpha(X - F) + (1-\alpha^*)(X^*/E + F) \tag{12}$$

from (7). And the current account balance equation is a simplified version of (3); in this case, since $F = F_{+1}$,

$$0 = rF + D(E,z) \tag{13}$$

where the approximation $D(E,z) = \theta E + z$, $\theta > 0$, can be inserted on the right. Both equations imply a negative relation between net debt and the exchange rate because of the need for the home currency to depreciate to generate more of a surplus to service net debt if net debt increases.

How does net debt change in this world? Eliminating F between (12) and (13), we see that net debt does not increase (because the current account remains balanced) if

$$D(1-\alpha-\alpha^*)/r = (1-\alpha^*)X^*/E - (1-\alpha)X\ ;$$

that is if

$$\bar{D} = r\{(1-\alpha^*)X^*/E - (1-\alpha)X\}/(1-\alpha-\alpha^*) \tag{14}.$$

This defines a critical value for the trade deficit. If $D > \bar{D}$, home's net debt F will rise [see (3)]. But if $D < \bar{D}$, home's net debt will fall; and if $D = \bar{D}$, F remains unchanged. This provides the counterpart to the condition for public sector debt not to rise: that the primary fiscal deficit shall not exceed (growth less interest rates) times the existing debt.

3.2 Zones of stability and instability

Having got the building blocks in place, do these economies represent a stable trading and financial system? Figure 1 shows that they are stable so long as the portfolio balance line has a steeper downward slope than the current account balance line. In that case, a stable steady state will be achieved at the intersection of the two.

Figure 1

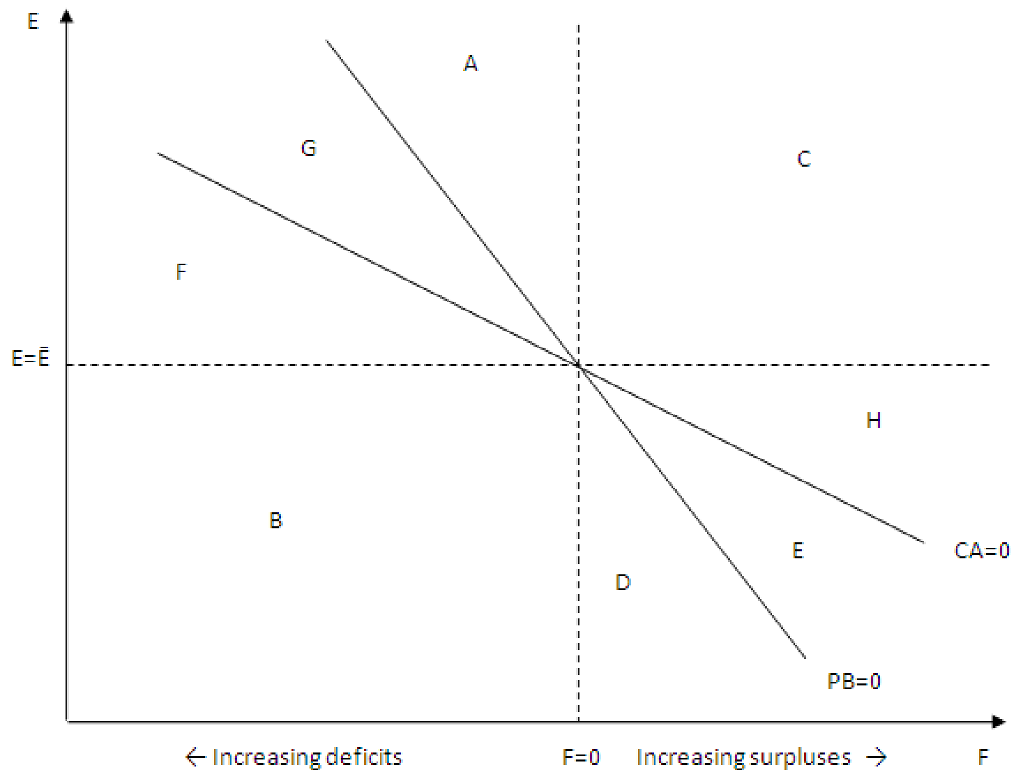


Figure 1 is divided into 8 different zones. For convenience it has been drawn with the steady state (intersection) point, where both asset holdings and current accounts are in balance at the same time, to reflect a FEER exchange rate value (which leaves the current account balanced at zero) and $F = 0$. But that is just convenience: the economies may actually achieve equilibrium/steady state at other values for *E* and *F* – for example at an *E* value that generates a trade surplus sufficient to service home's net debt exactly. In fact trade will be balanced ($D = 0$) wherever $F = 0$ lies on the current account line, whether it corresponds to a steady state on not. In addition, in this conventional case, there is a trade surplus ($D < 0$) to the right of that point on the $CA=0$ line, but a trade deficit to the left, as a result of the exchange depreciation or appreciation. Similarly *F* switches from home having net foreign assets ($F<0$) to home having net foreign liabilities ($F>0$).

The logic here is that, going to the right of that point, $F > 0$ becomes larger which means larger trade surpluses are needed to pay the interest on the larger net debt if the current account is to remain balanced; and to generate those surpluses E must fall. Likewise, to the left of that point, $F < 0$ becomes smaller which means larger deficits are possible with the same current account, and E rises to create those deficits. Thus, above the $CA=0$ line, trade deficits are larger/surpluses smaller than those at points vertically below, on the line or below that line. Conversely, below that line trade deficits are smaller (surpluses larger) that at points vertically above, whether on or off the line. But on the line, since the current account is balanced ($CA=0$), there is no change in home's net debt position: $\dot{F} = 0$. But above the line, $CA<0$ and $\dot{F} > 0$; and below it, $CA<0$ with $\dot{F} > 0$.

With these facts in mind, we can trace the movements in *E* and *F* at different points.

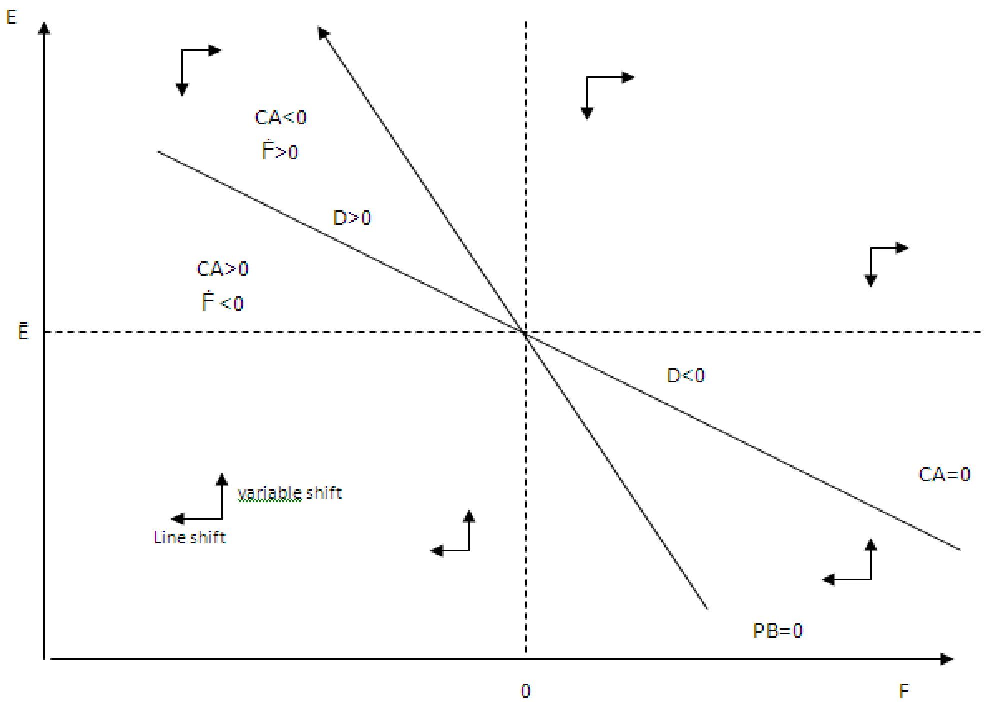
- In zone A, *F* is negative but *D* large and positive. So $rF+D > 0$, implying $CA < 0$ and hence $\dot{F} > 0$. The explanation is that *E* is too high, meaning the trade deficit is too large to be balanced by the net inflow of investment earnings ($F<0$ implies home has net foreign assets, but they are diminishing in this zone);
- Zone B has $F < 0$, but the trade balance is a large surplus ($D < 0$). So $rF+D < 0$; $CA >0$ and $\dot{F} < 0$. The explanation is the reverse of that in zone A; E is low so the trade surplus and investment income both add to home's net foreign assets.
- Zone F has $F < 0$; and $D < 0$ but small. Hence $rF+D < 0$, $CA > 0$ and $\dot{F} < 0$. The explanation is the same as for zone B, but home's foreign assets grow slower.
- Zone G is the same as zone A (i.e $F < 0$ but $D > 0$) except that the trade deficit is now smaller, but still large enough to imply $CA < 0$ and hence $\dot{F} > 0$.

The remaining zones are the mirror image of those four:

- Zone C is the opposite of zone B: $F > 0$ and $D > 0$ is large. Hence $rF+D > 0$ and $CA < 0$, so $\dot{F} > 0$. The trade deficit is reinforced by a investment income outflow.
- Zone H is the same; although the trade deficit is smaller, it still reinforces the net outflow of investment income.
- Zone D has $F > 0$ but $D < 0$ is large; so $rF+D < 0$, $CA > 0$ and $\dot{F} < 0$.
- Zone E has F > 0 and D < 0 smaller, but large enough to imply CA > 0 and $\dot{F} < 0$.

Hence zones A, C, G and H all have $\dot{F} > 0$, which means that if we arrive at any point in those zones the portfolio balance line will shift to the right (for any given exchange rate value). Similarly, zones B, D, E and F all have $\dot{F} < 0$ which means the portfolio line will move to the left. In other words, the current account balance line depicts a set of unstable equilibria in the sense that, once off it, portfolios start to adjust and the portfolio balance positions shift. The portfolio line, by contrast, does not show unstable equilibria; once off it, exchange rates adjust to rebalance both trade and the asset distribution. Thus, we arrive at the inequalities, shifts and dynamic adjustments displayed in figure 2.

Figure 2

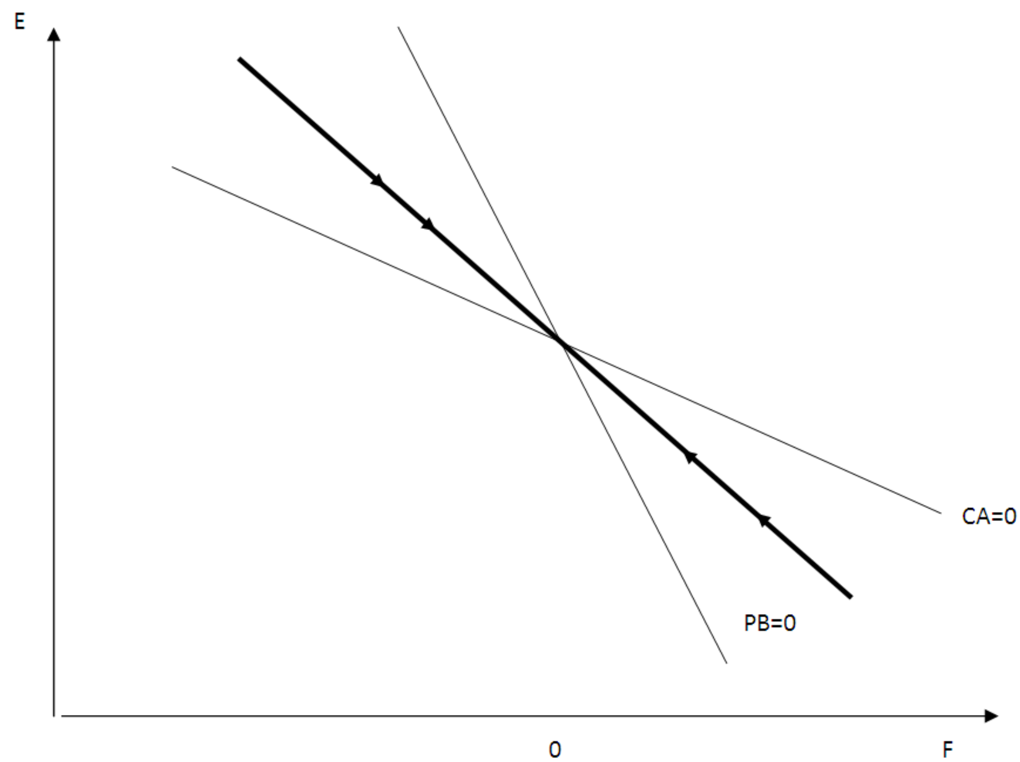


3.3 Stability of the adjustment process

Suppose now that, for some reason, our two economies had arrived at a position in zone G of Figure 1 [that is on the upper side between the two balance lines], but there has been no change in asset preferences or home biases. This could have happened because of a deterioration in home's real exchange rate (rising costs); or because of a change of policy (home runs a fiscal deficit, causing a trade deficit); or because of a shift in the relative preference for home goods (opening up to cheap imports, discovery of new technologies).

How do the economies adjust from here? Home's trade deficit outweighs her net investment earnings. This implies a current account deficit, and hence a decrease in home's foreign assets or an increase in her net debt. In a world of floating exchange rates, this leads to two effects: an increase in foreign's holdings of home's assets as foreign recycles her surplus earnings of home's currency or stockpiles them in her reserves; and to a depreciation of the exchange rate which reduces the trade deficit if foreign sells that surplus home currency. The two economies therefore move down the saddle path in a south-easterly direction, indicated in Figure 3, until the equilibrium (steady state) point, where the *PB=0* and *CA=0* lines cross, is reached.

Figure 3

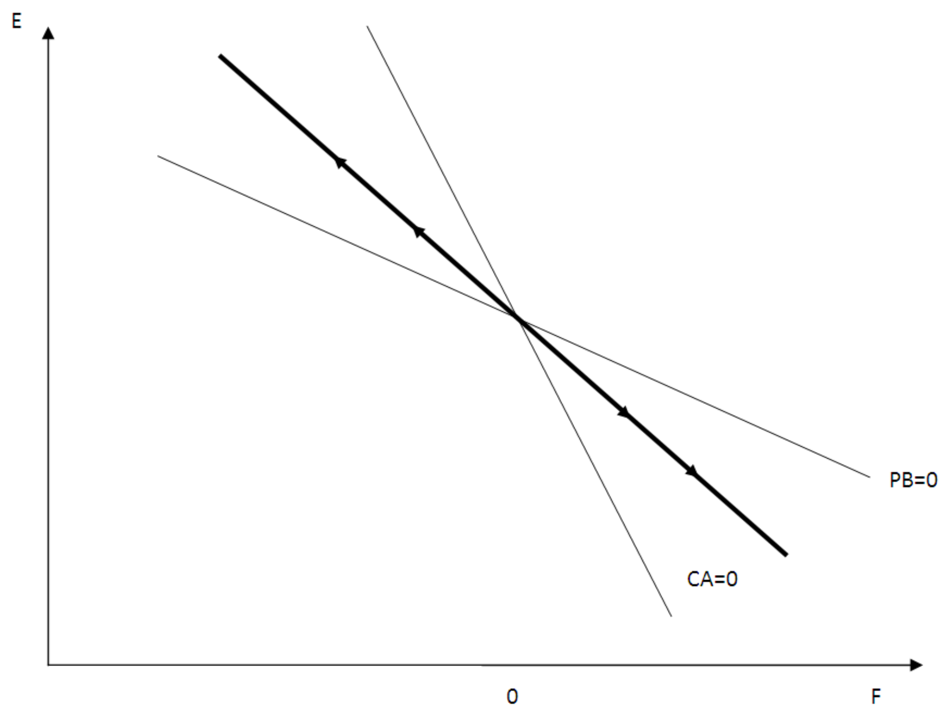


Stability, however, not only requires movements to the south-east; it must also be that the increased interest payments on home's (now higher) net debt exactly match the decreases in her trade deficit to stop the movements. This will happen automatically at the intersection point. But, if the exchange rate is sticky or there are attempts to keep it fixed, it may come about through an adjustment path that moves more east than south and therefore hits the portfolio balance line before the intersection point. This means the early adjustments take place through net debt accumulation (recycling/stockpiling), and the later ones through exchange rate changes caused by portfolio adjustments in response to valuation changes as the expected real rate of return on home assets falls (see (6), and then (10)). Thus, once we reach the *PB=0* line we slide down it. Of course, it may happen the other way. If the exchange is flexible and sensitive, the adjustments are mostly south not east as foreign sells surplus foreign currency reserves till the *CA=0* line is reached. The trade deficit has been reduced enough to balance current interest payments on net debt, but needs to fall further to make space for interest payments on extra debt since valuation changes will have made home's assets look increasingly attractive. Hence, this time we slide down the *CA=0* line. But, either way, the adjustment process is stable.

We can tell exactly the same story in reverse if we start from a point in zone E, between the lines on the lower side in Figure 1. But starting from any other position, stability is not assured. It depends on the exchange rate being more sensitive and flexible than the net debt accumulation process: see Figure 2. This cannot be guaranteed for all parameter values; but if it is true, then the adjustments will either hit the *PB=0* line, if we start from above, or the *CA=0* line if we start from below, and the adjustments will then move along the relevant line through valuation effects just as in the previous paragraph. In all other cases, stability will be lost.

Finally, it is easy to see that if the relative slopes of the *PB=0* and *CA=0* lines become reversed (the *CA=0* line is steeper), then stability is also lost. The potential equilibria are always unstable in this case. Figure 4, which is derived from the same information as Figure 2, shows this directly.

Figure 4



There are two qualifying remarks to make before we go on to the specific policy regimes. First, this analysis has all been conducted with local linearizations about one particular equilibrium point. In a non-linear world it is possible to have multiple steady states, some stable like Figure 3 and some unstable like Figure 4. In section 5 we find that this will in fact be the standard outcome (figures 6 and 7).

3.4 Necessary and sufficient conditions for stability

Thus to ensure stability in both trade and international capital markets, we need the slope of the portfolio balance line to exceed that of the current account line. Using (8) and (11), this amounts to requiring:

$$\frac{(1-\alpha)(1-\alpha^*)}{\alpha+\alpha^*-1} > \frac{E_{+1}E^2}{(1+r^*)X^*(X-F)} \qquad (15)$$

It is easy to satisfy (15), and thus guarantee stability in the international markets, if:

- *F > X*, or *X >> F*. The first represents an economy heavily dependent on foreign investment (typical of developing or early emerging economies; *F* represents net foreign liabilities, not net liabilities); the second, an economy that is self-sufficient in investment and funding (most large developed economies).

- If E is low, and expected to remain low, or X^* large, or r^* high. This is generally a matter of policy stance, as in China for example.
- If $\alpha + \alpha^* \approx 1$, i.e. total home biases or safe haven effects are not strong (assets are regarded as largely substitutable; investors are indifferent as to their source), but $\alpha\alpha^*$ is large.[16]

But it becomes difficult to satisfy this stability condition if both α and α^* fall such that $\alpha + \alpha^* < 1$; **or** if $X \approx F$. This may be the typical case in the smaller developed economies – particularly those in the Euro-zone, those who peg to the Euro or dollar, or those who rely on holdings of foreign assets for risk sharing and diversification purposes. If $\alpha + \alpha^* < 1$, the system will remain stable if $X << F$ (as might be the case in Hungary, the Czech Republic, or the Baltics which depend on FDI from the Euro economies). But it would become unstable if $X \geq F$; or if $X < F$, but not by enough to prevent (15) being violated. That is more likely to be the case in Italy, Spain or Japan, where much of the assets are held at home; or in Greece, Portugal and Ireland where they more widely held by other Euro-zone economies than at home.

The lessons from this section are therefore:

1) The adjustment process described in earlier sections is going to work more effectively in some bilateral comparisons than others.

2) Adjustments in the foreign sector become easier if home has a large asset base and few foreign liabilities but wishes to diversify; and if foreign has a home bias and high rates of return on a small asset base.

3) Policies that increase stability: home should reduce its home bias, reduce its foreign debt (run a more balanced trade account) and increase its asset base. Foreign can help by raising r^* (allowing the real exchange rate to rise) without raising its home bias, and by increasing its asset base.

4) That said, E has to be free to adjust as much as required. Since E is a real exchange rate, this will have strong implications for economies with different degrees of inflation control and managed or inflexible nominal exchange rates.

4. Fixed Exchange Rates and Current Account Limits

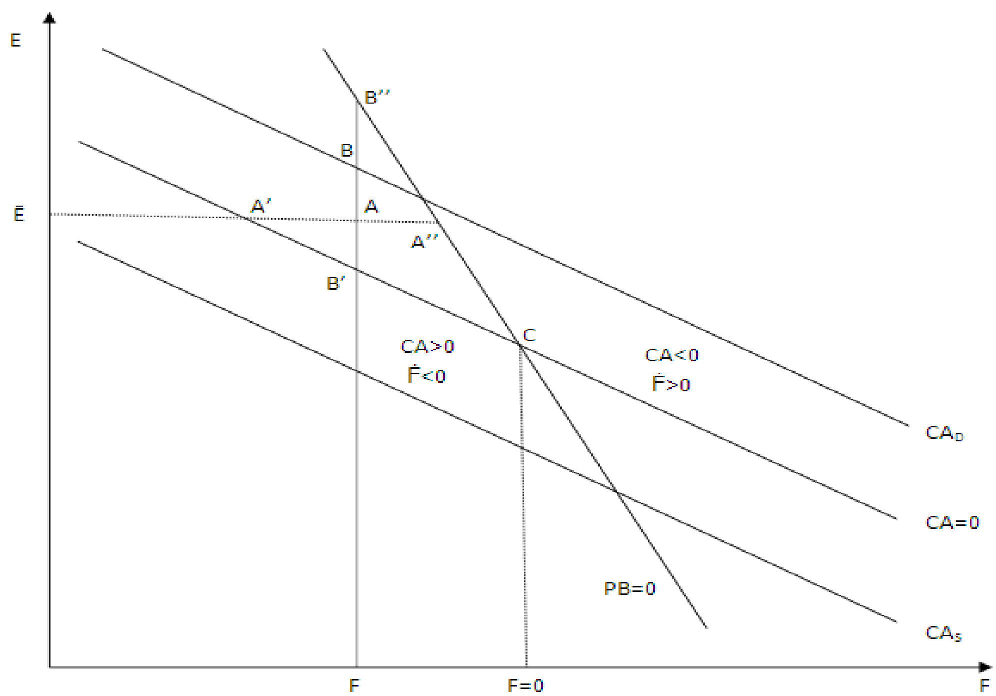
Now we come to the two specific policy regimes that have been proposed in the name of guaranteeing stability in the foreign exchange and international capital markets: first, fixed exchange rates (as in the Euro-zone economies; de facto between the US and China; or for any country that dollarizes or pegs its currency); and, second, the US Treasury suggestion that trading economies should be required to restrict their current account surpluses or deficits to no more than a certain limit, defined in terms of national income – say 4% of GDP.

Figure 5 shows the implications of imposing regimes such as these. This diagram is figure 2 from section 3.2 above, with either a fixed exchange rate $\bar{E}$ imposed or a limit for current account imbalances. For the latter, we show both the deficit limit case (the upper line marked CA_D), and the surplus limit case (the lower line marked CA_S), for a given or pre-existing value of F. For ease of exposition, we will assume that whichever constraint

[16] If $\alpha+\alpha^* \approx 1$, then $\alpha\alpha^* \approx \alpha(1-\alpha)$ is maximized at $\alpha=½$. So both conditions imply that stability follows from substitutability.

applies is binding. That puts us at a point such as A for the fixed exchange rate regime; or at a point such as B for current account deficit imbalances. Finally, if capital controls are imposed, we will be restricted to a point on the vertical line at F for as long as they are complete and effective; or a point on a steeper PB=0 that shifts only slowly right or left if they are partial or partially effective. We will approximate this situation in what follows with complete capital controls; that is, by setting $\alpha = \alpha^* = 1$ (no investor can buy assets in the other economy).

Figure 5



In terms of outcomes and performance, the implications are as follows:

1) At a point such as A, in the fixed exchange rate regime, home's current account is in deficit and her net foreign debt is increasing. So the *PB=0* line will shift right, and will continue to do so for as long as the fixed exchange rate value remains in place without any revaluations. The process of adjustment is exactly that described in section 3.3 where the early stage movements involve adjustments in the net debt/assets position, before the valuation and exchange rate effects that cause us to slide down the *PB=0* line kick in. But the difference is that we never quite get to A'' because exchange rate depreciations are not allowed. So the *PB=0* line moves out, and the adjustments to *F* follow without ever fully catching up. This regime is not sustainable because home's foreign debt increases without limit. That cannot be sustained; default will break the exchange rate peg when the level of debt can no longer be serviced. When that happens, the economy will adjust down the *PB=0* line till we reach C. The longer the peg is maintained, the further the

PB=0 line will have shifted, and the greater the increase in debt and eventual currency depreciation. If we wish to avoid those outcomes, home or foreign must introduce capital controls to overcome the impossible trinity[17]; or they must let the exchange rate peg go. In other words, the ultimate control has to be placed on the capital account, not the current account – until we are forced to accept a change in the exchange rate.

2) Similarly, at point B on the current account deficit limit, home's current account is in deficit and net foreign debt is increasing. Superficially this looks like the situation in figure 3. But it is different: first because we got to point B by constraint, not as a result of a jump in E caused by the market expectations of agents who foresee adjustments down a saddle path to a new equilibrium at C. Second, we are off the portfolio balance line even at the start, which means investors are adjusting their holdings of home's net debt, F, before as well as during the transition to the new equilibrium. Hence F adjusts further and faster than in figure 3, implying that $PB=0$ moves to the right.

Whether the combination of these two differences will allow us to reach, and start down, a saddle path to a new, non-stationary equilibrium largely depends on timing: that is, on the interplay of differences between the faster adjustments in the net debt position (hence upward pressure on the current account deficit), vs. the slower short run adjustments of the trade component (downward pressure on the current account deficit). If the former dominates, as we might expect, we will not get off the CA_D constraint – moving down it instead until we get close to the portfolio balance line; that is, if the slower moving trade adjustments nevertheless allow us to catch up with the movements in portfolio balances. Eventually at $PB=0$, should we ever get there, F will be moving slower than the trade balance and it becomes possible to slide down the portfolio balance line to a new equilibrium at C. But there is no guarantee that such a catch up will be possible: it depends on the precise timing and sizes of the changes; on the import/export price elasticities, and the Marshall-Lerner conditions vs. the evaluation effects, capital gains and relative rates of return on the different assets. And there is no expectations jump to start us off. So there is no guarantee that a new equilibrium can ever be reached.

On the other hand, if the trade account changes dominate, then we will leave CA_D and start down a saddle path in the normal way.

Hence, an equilibrium in this regime is certainly possible. But whether we actually reach it from a current account constraint is an empirical matter. If the trade balance is sensitive to movements in the exchange rate (i.e the Marshall-Lerner conditions are well satisfied), then the pressure to move down the current account constraint would be large relative to the changes in debt and we would catch up with the shifts in C. However, if that was the case in a flexible exchange rate world, we would almost certainly not have been at the current account constraint in the first place: the trade deficit would already have improved with a depreciating exchange rate and taken us off that constraint. Moreover evidence is against the proposition. The Marshall-Lerner conditions are often not satisfied, especially in the short run when the J-curve effect applies. In that case we will stay on the current account constraint as we move to the right. Reaching a new equilibrium then becomes a matter of timing. In the short term, rising interest payments

[17] Or build up sterilized foreign currency reserves (as in China) to preserve an independent monetary policy while keeping E fixed. The crucial role of these unused currency reserves is emphasized again at point 6 below.

and the short term insensitivity of the trade deficit to exchange rate variations mean we will move down the current account constraint chasing the *PB=0* line. In the longer term, the trade deficit may become sensitive enough, and the cumulative depreciations large enough, for the economy to leave the constraint. If so, *E* will jump to the saddle path, as in figure 3, because there is now a genuine expectation of reaching an equilibrium at C (where $\dot{F} = 0,$ and the *PB=0* line stops moving). However, the danger is that the corrections in the trade balance may never be never large enough, or rapid enough, to get us off the current account constraint and trigger the larger exchange rate adjustments needed to overcome the escalating debt.

3) Thus, a regime of current account limits can be sustainable. But it is risky because of the danger that debt liabilities build up faster than trade balance improvements; and it can only lead to a new steady state if exchange rates are allowed to be flexible. That would probably rule it out as a regime for restraining the trade imbalances between the US and China, or for reducing Germany's trade imbalances with her Euro partners; but it could work between China and the Euro.

4) The adjustments are no different for a surplus limit. A surplus limit would imply a position on CA_s, below *CA=0*, but a starting point to the right of C in figure 5 (assuming a trade surplus has created the need for the current account constraint). The adjustment process would then just be the reverse of the deficit case, involving a rising exchange rate, sluggish trade deficit reductions, left-ward shifts in the *PB=0* line, and the danger that the trade surplus reductions/exchange rate adjustments are never fast enough.

5) Notice also that a dual exchange rate regime is required, either explicitly or implicitly, to sustain[18] these current account limits while they are in operation: higher for asset transactions, and lower for trade, for a deficit limit; but lower for asset transactions and higher for trade in a surplus limit. The same holds for *capital controls* which hold us on the line marked F (if they are fully effective), or limit the rightward movement along the F axis if they are only partially effective. The latter, like current account limits, are really a device to slow down the accumulation of net foreign debt.

Three further observations are useful:

6) The movements described above apply to any points on the fixed exchange rate line between A" and A', including A" but excluding A'; and to any point on the current account constraint between B and B'' (but not B'). This is because at A" and B" the asset portfolios are temporarily balanced, but $\dot{F} > 0$ in either case so the portfolio balance line will be moving. This is not a temporary equilibrium. At A' for example, we have an unstable equilibrium because although $D > 0$ and $F < 0$ the trade deficit is matched by the revenues from home's net foreign assets, implying $\dot{F} = 0.$ That is an unstable point because, in order to sustain it, your trading partner has to sterilize *all* further foreign exchange earnings, or hold them as reserves, but not convert them into assets. If they are converted, the exchange rate will fall and the portfolio balance line shift, the moment shocks hit the system; or when the trade deficit changes; or when interest rates or relative prices change. In other words that position won't survive shocks or changes without

[18] That is, to prevent the current account limits being breached while in operation: either because of "excess" asset flows or because of "excess" (that is, unrestrained) exports or imports.

extensive sterilization or careful management of the currency reserves. The same point applies to the unstable equilibrium at B'. In either case, because there will be increasing amounts in unused currency reserves, it is debt management, capital controls, unrestricted reserves that sustain the regime; not current account limits or fixed exchange rates.

7) Current account limits can only work with flexible real exchange rates. The two regimes cannot be combined.

8) In practice we cannot actually fix *E*, as BGS do, unless strict price stability rules are in place at the same time since it represents a real exchange rate, not a nominal one. That is to say, inflation control has to be very similar in both economies for a fixed (nominal) exchange rate regime to work. Similarly, for current account limits to be sustainable, they have to be combined with sufficiently flexible nominal exchange rates; or coordinated with precisely calibrated changes in relative costs and prices. Thus fixed exchange rates are an option within a full currency union like the Euro-zone or the UK; but not between economies with different inflation controls, such as between China and the US or Europe. Similarly, current account limits could work between flexible exchange rate economies (China and Europe); but not where exchange rates are de facto fixed (at least not without extensive agreements on how to adjust relative prices), and not within a currency union that lacks a precise mechanism (a competitiveness pact?) that guarantees both parties adjust their relative costs exactly as required.

5. The Complete System: Nonlinear Portfolio and Trade Adjustments

The last step is to recreate the general problem, but without imposing linearizations that restrict us to analyzing only parts of it. However, rather than assuming a specific functional form for the trade deficit term *D*, which would inevitably introduce additional arbitrariness to a problem where slopes (hence precise functional forms) matter, we work with implicit functions. We already have expressions for the slopes of the portfolio and current account equations. This will allow us to give a global representation of those two relationships, even if the numerical evaluations we use are a series of state dependent approximations to the underlying (unspecified) generic functions.

We start with the portfolio balance equation with imperfectly substitutable assets at (7):

$$X = \alpha W + (1-\alpha^*)W^*/E = \alpha(X-F) + (1-\alpha^*)(X^*/E + F)$$

This expression is non-linear: its slope is a quadratic function of the real exchange rate *E*:

$$\frac{dE}{dF} = -\frac{\alpha + \alpha^* - 1}{(1-\alpha^*)X^*/E^2} < 0,$$

Hence (9) is downward sloping iff $\alpha + \alpha^* > 1$, but decreasingly so as *E* falls.

The current account balance is given by equation (10), with slope given by the expression at (11) and $F = F_{+1}$ to ensure balance. This implies a current account balance relationship:

$$0 = rF + \theta E + z \qquad (16)$$

where $\theta = [r(1-\alpha)(1+r^*)(X-F)]/E_{+1}$ is the state dependent coefficient implied by the underlying relation's slope given at (13). Note that $\theta > 0$ if $X > F$, but decreasingly so as *F* increases. So even if (16) looks like a linear approximation used, it is quite different. It provides a state dependent representation of the original equation; or, put differently, a piecewise sequence of linearisations that allows us to give a global representation of (10).

Now, if we rearrange the terms in (7) and (16), we get the system:

$$E = \frac{X^*(1-\alpha^*)}{(1-\alpha)X-(1-\alpha-\alpha^*)\mathrm{F}} \tag{17}$$

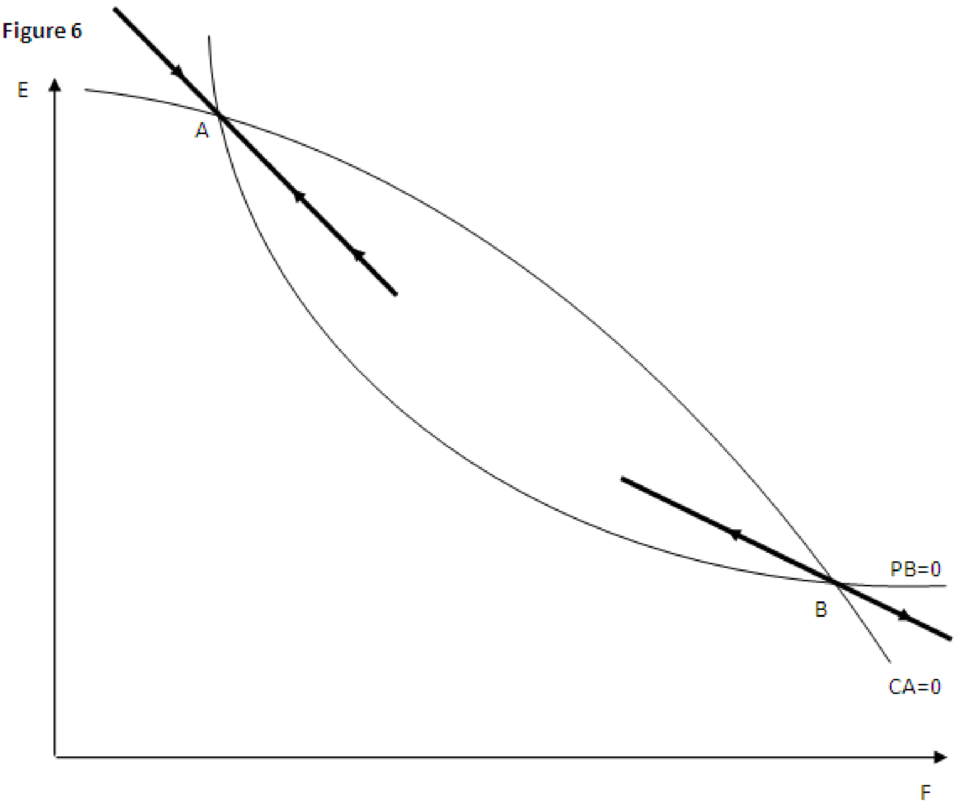
$$E = -\frac{r}{\theta}F - \frac{z}{\theta} \tag{18}$$

where the slope of (17) is given by (8); and the slope of (18) is negative given θ, itself a function of F now, and increasingly negative as F expands. Equations (17) and (18) can there-fore be drawn in (E, F) space as in Figure 6.

Figure 6 shows here are now two intersection points, corresponding to two equilibria: A and B. Following the results in section 3, it is obvious that only A is a dynamically stable equilibrium. It conforms to the local analysis of Figure 3. Point B, by contrast, is unstable and places the system on an explosive path. That follows from the analysis of Figure 4. In particular, to the right of B, a rise in net external debt F raises interest payments and contributes to an increase in the current account deficit. It also forces a decline of the real value of the home currency E, which improves the trade balance and thus contributing to a reduction in the current account deficit. To the right of B, the former effect prevails over the latter: the net effect on current account would be an increase in deficit, and a corresponding increase in F. This process of exchange rate depreciations and increases in net debt will therefore continue without limit.

To the left of point B, the adjustments go the other way. A decrease in F contributes to an improvement in the current account deficit by reducing interest payments (recall Figure 2 showed the current account improves and net debt falls below the *CA=0* line). That permits some deterioration in the trade deficit itself and a rise in the exchange rate. In other words, the net debt effect outweighs the currency effect here, and we move off to the stable equilibrium at A.

Figure 6



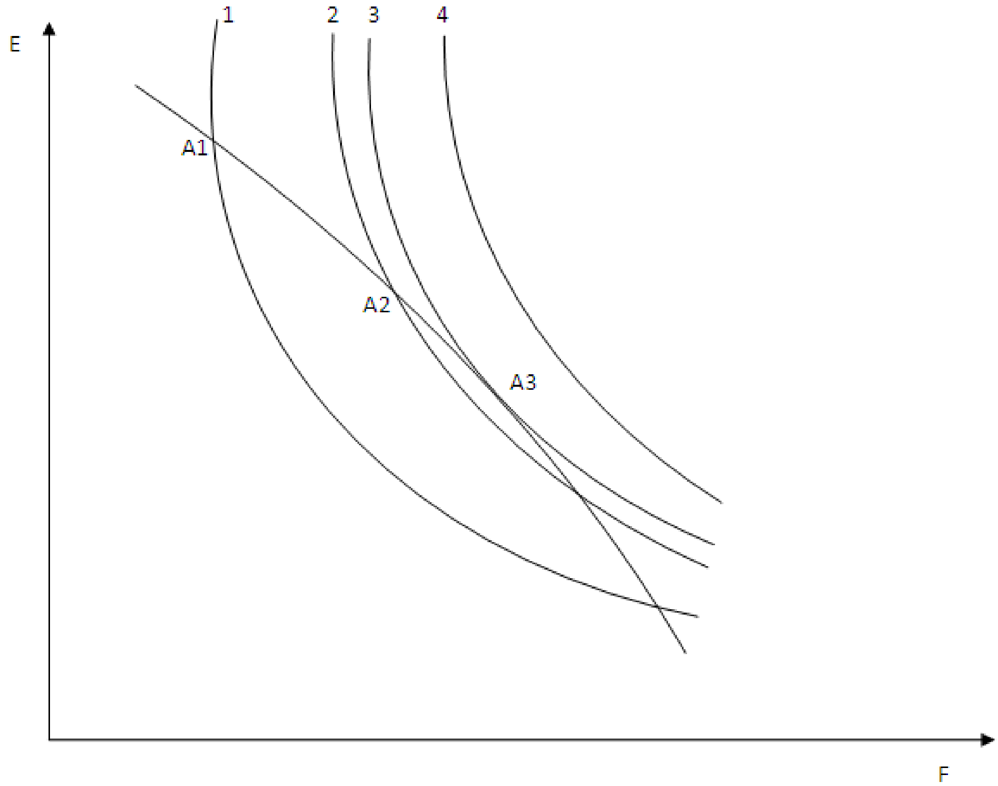
At A, the story is reversed: movements to the right of A improve the current account, movements to the left worsen it. In that sense, A represents the optimal debt position; and B the net debt limit – beyond which the domestic economy will collapse as debt escalates and the domestic currency collapses. Thus if A represents the optimal foreign debt level, AB is a measure of "trade space" equivalent to the IMF's concept of "fiscal space" in the management of public sector finances (Ghosh et al, 2011; Hughes Hallett and Jensen, 2011). Policy therefore needs to be directed to keeping net foreign debt in the interval around A, where trade and portfolio balances are self stabilizing, and away from point B where shocks, information errors or policy mistakes could easily drive economies into the unstable region beyond B and cause a breakdown.[19]

There is one problem remaining: shifts in the relative positions of the current account and portfolio balances will change the position of the (stable and unstable) equilibrium points. As the current account line moves down, and/or the portfolio balance line moves up, the two equilibrium points move together. Ultimately the lines may fail to intersect, in which case no equilibrium exists for either economy and the outcomes will become random and potentially explosive. This is illustrated in figure 7. If we consider the stable equilibrium point A1, an upward shift will move the equilibrium to A2, where the foreign debt F is higher and the real exchange rate is lower (more depreciated); further upward movement

[19]Figure 8 may not look like the fiscal space story because we are working in levels, while the fiscal space argument is done in ratios to GDP. Yet the idea is the same: the target is the debt level (a stock), the instrument is the fiscal or trade balance (a flow) net of interest payments which cannot be changed in the current period. But because we do not work in ratios to GDP here, the trade balance as decision variable remains hidden, whereas the primary fiscal balance is centre stage in the fiscal space story. The conversion is straightforward (see section 3.1), but left for a future paper.

might bring the equilibrium to A3, where the portfolio balance curve is tangent to the current account line (stable for movements in one direction, but unstable in the other).

Figure 7



More problematic, even a very small departure in portfolio balances from A3 to the right, or current accounts to the left, will deny the system any possible equilibrium. Such cases would condemn our economies to a path of endless exchange rate depreciations and debt increases.

To see the circumstances in which this might happen, eliminate *E* from between (17) and (18), and solve the result for *F*:

$$r(1-\alpha-\alpha^*)\mathrm{F}^2-[r(1-\alpha)X-z(1-\alpha-\alpha^*)]\mathrm{F}-[z(1-\alpha)X+\theta(1-\alpha^*)X^*]=0 \qquad (19)$$

It is now comparatively easy to check if no equilibrium exists. Suppose we have the usual case where $\alpha+\alpha^*>1$. Using the conventional test for real roots, Hughes Hallett and Marinez Oliva (2011) show that this will happen if and only if there are negative trade shocks (external, or as result of policy interventions or additional costs) to the home economy in the non-empty interval: (φ_1,φ_2) where $0>\varphi_1>\varphi_2$ are defined in that paper.

Thus a foreign trade breakdown (no equilibrium, unrestrained currency depreciations, unrestrained debt increases) is always possible. But it would result from trade shocks, not from shifts in asset preferences. Such a breakdown also depends on parameters from both sides (asset bases, home biases, rates of return, expected depreciations). So it requires action or policies from both sides to minimize the chances of a breakdown.

6. Simulating the Model: the US vs. China

We have seen that the roots of the quadratic equation (19) represent the coordinates of the intersection points between current account and portfolio equilibria in (E,F) space. The existence of such points will depend on the sign, in conventional notation, of the term:

$$\Delta = b^2 - 4ac$$

A closed form analysis of Δ is complicated, and would involve a cumbersome discussion of relative sizes of different parameters. For this reason, our analysis of the properties of the nonlinear model set out in previous sections will be based on numerical simulations. The crucial parameters of the system are: $r, \alpha, \alpha^*, X, X^*, \theta, z.$

For illustration and calibration purposes, we assume that the two countries in the model are the United States and China. The rest of the world is assumed to be exogenous at this stage. Since we consider only the bilateral interplay between the two actors, the parameters need to be defined accordingly. In particular, consistent with the assumption of imperfect capital mobility, US investors can distribute their wealth between home and Chinese assets, putting a share α in home securities and $(1\text{-}\alpha)$ in Chinese assets; likewise α^* and $1\text{-}\alpha^*$ are the shares of Chinese wealth held in domestic and US assets. If home biases dominate, then $\alpha + \alpha^* > 1$. By contrast, if strict capital controls are in place, both α and α^* will equal unity since neither US nor Chinese private investors would be able to purchase the other country's assets. Since any Chinese purchases of U.S. assets will take place through the accumulation of reserves by the Peoples Bank, we can write:

$$X = S/E + \alpha(X - F) + (1 - \alpha^*)(X^*/E + F) \tag{20}$$

Equation (20) represents equilibrium in the market for US assets, where S/E denotes US currency or bonds held by foreigners. It makes explicit the effects of foreign central bank purchases of home currency denominated bonds, and/or the stockpiling of home currency reserves by the foreign central bank, done with the aim (implicit or explicit) of keeping a given exchange rate level unchanged. For $\alpha = \alpha^* = 1$, equation (20) becomes:

$$X = S/E + X - F \tag{21}$$

or:

$$F = S/E \tag{22}$$

Equation (22) shows that, with capital controls, the US net debt position vis-à-vis China is equal to the dollar denominated reserve assets held at the PBC.

For the purposes of numerical simulation, we need to make a series of assumptions about the values of $r, X, X^*, \theta, z.$ For r, we use the US average interest rate on the total interest-bearing debt, currently equal to 3 per cent[20]. US financial assets are assumed to amount to 60 trillion dollars and China's financial assets to 9 trillion dollars[21]. Given the wide range of elasticity estimates in the literature, it will be assumed for simplicity that θ is equal to

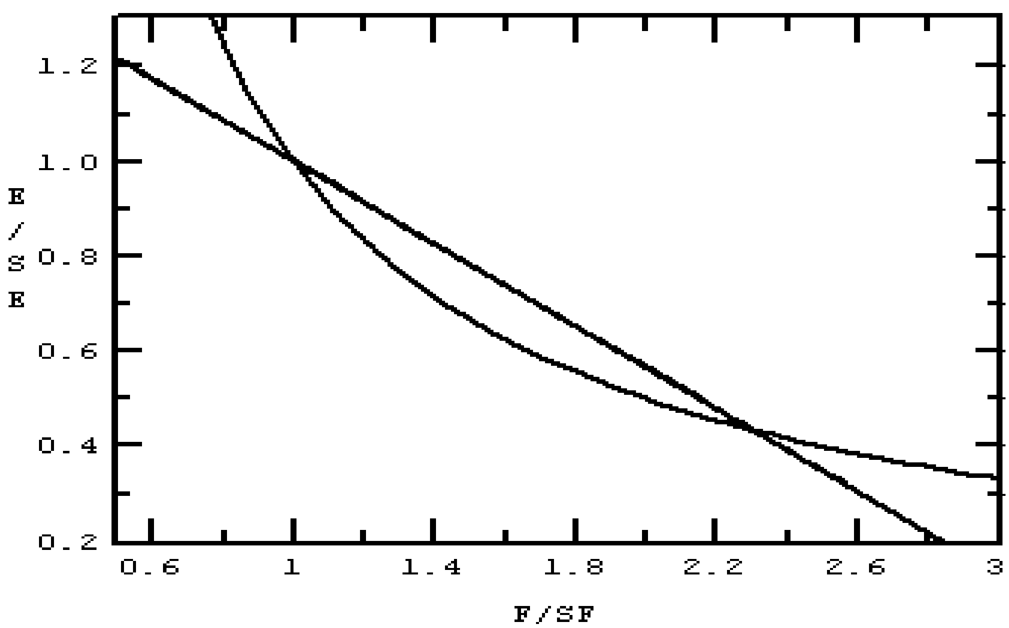
[20] As of April 2011: average interest rates for total marketable, total nonmarketable, and total interest-bearing debt not including Treasury inflation-indexed securities. See: *http://www.treasurydirect.gov/govt/rates/pd/avg/2011/2011_04.htm*

[21] Actual figures for the US at end-2010. The figure for China is estimated consistently with the assumption that the ratio between China and US assets is at the same level as2006.

0.9[22]. Finally, given all the previous parameters, we chose a *z* value of -1.6; a value that is consistent with the stability condition implied by (19). According to what was said above, we also set α and α* to be equal to one.

The simulation constructed from the numbers above will form a baseline for subsequent comparisons. It implies two equilibria, as shown in figure 8, where the values of E and F are normalized so as to be equal to (1,1) at the point of the stable equilibrium.

Figure 8: Stable and unstable equilibria in the baseline simulation



The intersection towards the top-left corner represents the stable equilibrium, and the intersection in the bottom-right corner area represents the unstable one. The vertical axis represents the exchange rate, US dollars per RMB, meaning that "home" is the US. Since relative prices are normalized to equal one at that point, the real and nominal exchange rates are normalized to be equal at the stable equilibrium. From then on we are interested only in the changes from the baseline position. The horizontal axis represents the US net external position vis-à-vis China. To the left of the *F=1* point, the US has a lower net foreign debt in bilateral terms than in the baseline. To the right, the US has a higher net foreign debt. The results of each simulation to follow are therefore deviations from the current situation; the *status quo ante* position.

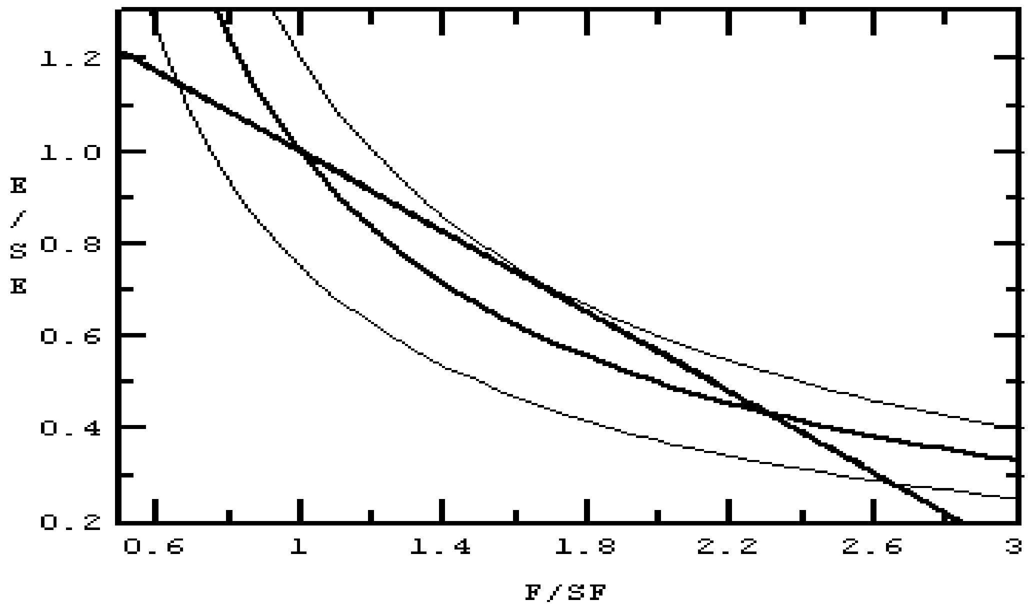
Pegging the Exchange Rate: Consistent with the analysis of section 4, equation (20) represents the equilibrium in the market for US assets, and takes into account the effects of the PBC's purchases of dollar denominated bonds and/or stockpiling of dollar reserves with the aim of keeping a given exchange rate unchanged. The baseline exchange rate level in figure 8 is where the exchange rate would jump to following the abandoning of

[22] See Blanchard, Giavazzi, Sa (2005). This assumption is consistent with the results found in the survey by Chinn (2003). See also Cline (2005) for a similar figure.

the exchange rate peg. If the authorities reduce the stock of reserves, though, the (stable) equilibrium exchange rate will move up, thus making the adjustment smaller than implied in the baseline. Figure 9 shows this change. The lower thinner line corresponds to a level of China's dollar reserves equivalent to 15 trillion RMB, which compares with the solid line where reserves are equal to 20 trillion RMB (US$3.1 trillion). The difference between the FEER (fundamental equilibrium exchange rate) that is the level of exchange rate in the absence of intervention and the baseline exchange rate, where the actual exchange rate would eventually converge after moving along the saddle path when the peg is abandoned can be estimated to be of 23.5 per cent, according to recent calculations[23]. This means that the actual equilibrium is found in the space north-west of the stable equilibrium point corresponding to the upper intersection of the two solid curves in figure 9. There the exchange rate is 23.5 higher than the baseline by assumption, and the US net foreign debt is equivalent to China's dollar reserves, consistent with assumption (22). It means that the baseline value of F can be estimated to be around 60-80 per cent of 3.1 trillion, that is around 1.9-2.5 trillion dollars. If the reserves are reduced by 25 per cent, though, the portfolio equilibrium shifts downwards, as in figure 9. This implies that the depreciation following the abandonment of the currency peg will be much smaller, around 10 per cent (the difference between the intersection point where E is 1.13 and the FEER at 1.235). By contrast, if the reserves continue to accumulate, the equilibrium could easily become unstable; any shock moving the solid line to the right of the point of tangency with the current account equilibrium (a shock of only 4 trillion RMB (US$624bn), or just 20%, at an exchange rate of 0.1565 US$/RMB would suffice) would lead to the system falling into a spiral of continuing depreciations and increasing US debt unless drastic action, such as trade restrictions or capital controls, is taken to stop the process and reestablish equilibrium.

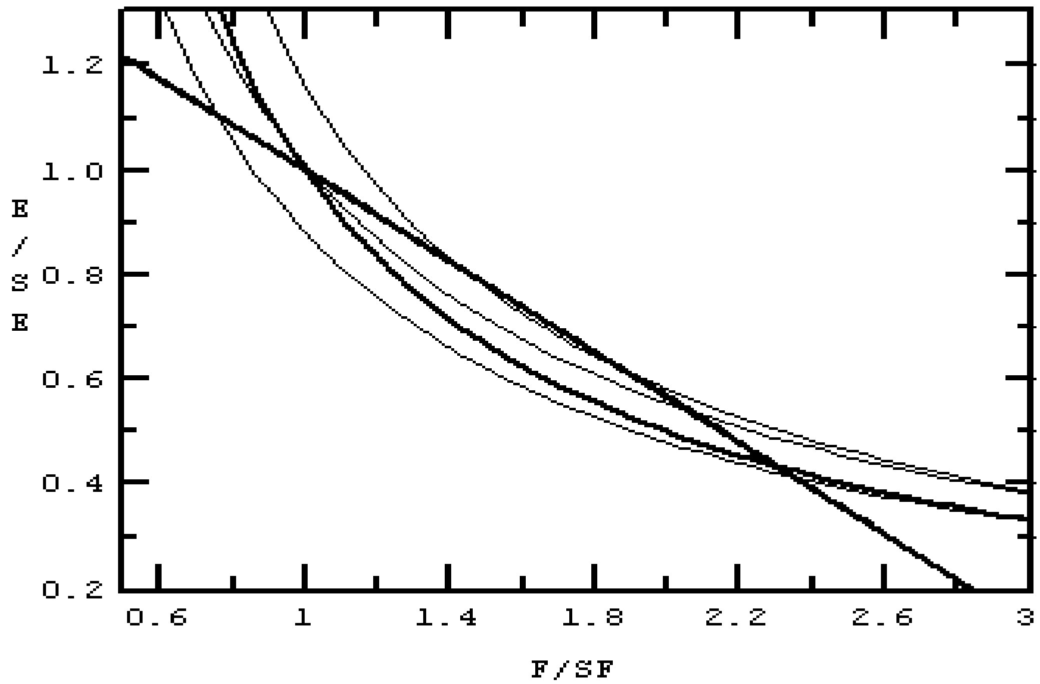
Figure 9: Equilibria when policymakers stockpile foreign reserves or bonds

[23] See Cline and Williamson (2011), p. 5 Table 3.



Capital Liberalization: Next we evaluate the effect of a gradual shift away from capital controls. It is reasonable to suppose that, as China's capital liberalization moves ahead, Chinese households and companies will be free to convert their bank deposits between local and foreign currencies and move their funds cross-borders as they wish. The same freedom will apply to foreign investors willing to buy RMB-denominated assets. We simulate the effect of such shifts by assuming that the parameter α increases as a result of the purchases by the US investors of Chinese bonds. Equally, the parameter α^* increases reflect purchases of US bonds by Chinese investors. We consider the effects of these changes in α and α^* separately. A decrease in α, say to 0.95, shifts the portfolio equilibrium to the left (lower thinner line). The implication is that the US foreign debt would be lower and the dollar exchange rate higher/stronger by 10 per cent because, in order to maintain the portfolio balance at (7) with a reduced demand for US assets, the exchange rate will need to appreciate so as to generate smaller trade surpluses to cover the smaller interest payments. Conversely, a further decrease in α^*, say to 0.90, will *ceteris paribus* shift the portfolio equilibrium to the right (the higher thinner line) and, according to condition (7), the exchange rate will depreciate (by around 15 per cent) These movements are shown in figure 10. Interestingly enough however, the responses of US and Chinese investors following capital liberalization have offsetting effects on the real exchange rate, so that the final equilibrium values are not actually altered very much (thinner line in the middle). But the net debt imbalances accumulated in the interim, if the two actions are not pursued simultaneously, are distinctly worse from the US point of view.

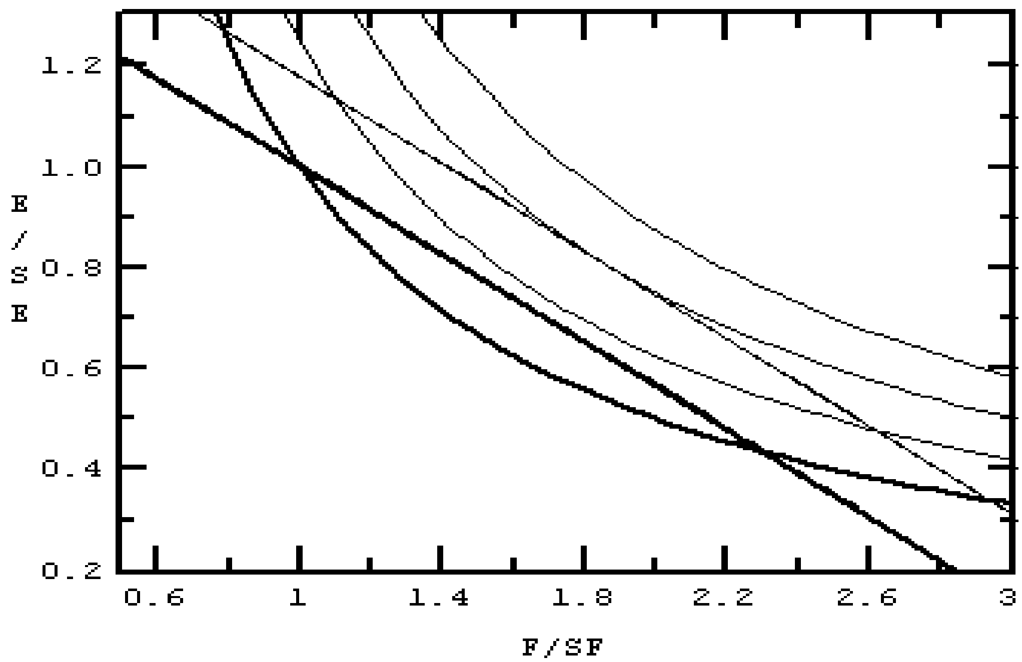
Figure 10: Equilibria generated by portfolio shifts in US and in China following capital account liberalization



Current Account Caps: The last case we consider is where it is desired to limit the size of the current account imbalances. This corresponds to the situation described in section 4 where current account imbalances are allowed to persist within certain limits: a current account cap. In this simulation the new line for a current account deficit is higher than the CA=0 line in figure 11, giving a larger trade space and an exchange rate appreciation [around 25%]. As a result, the portfolio balance starts to shift upward, gradually reducing trade space as the accumulating current account imbalances increase the foreign debt position. When the tangency point is approached, the exchange rate will have depreciated back to a position not far from its initial level to pay for the extra debt, but leaves US foreign debt higher by about 80 per cent higher than in the baseline. If the equilibrium continues to shift rightwards, after the tangency point is passed, such as we see in the portfolio line at the extreme right, the system falls into a spiral of continuing devaluations brought about by the accumulating additions to foreign debt. So current account limits may give us a breathing space to reduce imbalances. But the cost is instability in foreign debt, and a likelihood that the exchange rate eventually collapses.

The basic lesson that can be drawn from this simulation is that the stricter are the limits to the current account imbalances, the slower will be the process that eventually brings the system to instability. Even if the quantitative results of this last exercise are no more than illustrative, the basic implication is that further efforts need to be devoted to the analysis of the long-run sustainability of global imbalances, and to examining the level of current account imbalances that can be tolerated before the trade space is eliminated entirely and the system becomes ungovernable. To do that requires, inter alia, an explicit model of the *speed* of portfolio adjustments (in addition to just their direction of change) relative to the speed of adjustment in current account balances and real exchange rates.

Figure 11: Potential instability from a current account cap



Trade Space Evaluations: What is the size or degree of available trade space in each of these policy regimes? Which offers the greatest degree of stability in the sense of being able to absorb shocks, changes of investor sentiment or expectations, or changes in policy by the policymakers without causing an unstable sequence of adjustments; spiraling increases in F or a collapse in the real exchange rate E, for example? We evaluate the trade space available in each of the regimes above from the distance (in percentage changes) from stable to unstable equilibrium in each case.

1) *Baseline case, Fig. 8:* F can rise by up to 130% from the stable equilibrium (A in Figure 6) to the unstable equilibrium (B, Figure 6) before an unstable sequence of US foreign debt increases and an exchange rate collapse sets in. Similarly, the real US$/RMB exchange rate may fall by as much as 60% before that happens. These numbers are quite large and comfortably exceed the kinds of adjustments regarded as necessary to rebalance the US-China trade and net debt/foreign reserve imbalances. But that observation is correct only if we were starting from the good equilibrium. Since US-China trade and net debt/asset positions have been out of balance for quite a long time, the two economies are currently at some point between the good and bad equilibria. To evaluate exactly where will require accurate estimates of the bilateral real exchange rate and net bilateral debts in levels, which we do not have, and which are not required for the regime comparisons that are the focus of this paper. But the outside estimates offered by others, that the RMB exchange rate may need a revaluation of 20%-40% and foreign exchange reserves halved or more[24], suggest that we may be about half way between the stable and unstable equilibria and that half the available trade space has been used up already.

[24] References...

Second, there is more trade space in asset/debt accumulations than in exchange rate flexibility. If adjustment is to be done, it is more important to make those adjustments in the (real) exchange rate than in asset positions. That said, sticky exchange rates would push these economies in the direction of areas A and C in Figure 1 which is to invite unstable accumulations of foreign assets. Policymakers may want to slow that process down by imposing current account limits or capital controls to slow down the changes in F and allow the exchange rate adjustments time to catch up and steer the system to a new, stable equilibrium. [Recall the discussion in section 4, points 1) to 3) where we discuss the relative speeds of adjustment in current accounts and portfolio balances].

2) *Pegged exchange rates, Fig. 9:* On the upper thin line, where no attempt is made to reduce the accumulation of foreign exchange reserves, there is no trade space available at all. Whether we have reached that point yet is not clear because it depends on the (real) exchange rate fix. With small nominal appreciations of the RMB, and larger relative price (real) appreciations, we may have come close, but now be moving away. That case contrasts sharply with the lower thin line, where the stock of foreign reserves is reduced by 25%. Here *F* may rise by up to 270%, and *E* fall by as much as 77%, without setting in train an unstable spiral of adjustments. Again there is more "space" on the net debt/asset side than in exchange rates in this scenario, though both show more space than in the baseline.

3) *Capital liberalization, Fig 10:* The uppermost line shows *F* has room to increase by up to 21% and *E* fall by as much as 25%. Thus decreases in US home bias leaves little room for adjustment, and distinctly less than in our base case. By contrast, a decrease in Chinese home bias (US assets become more attractive; lower thin line) provides much more room for a stable system: *F* could now rise by as much as 236%, and *E* fall by 175%. Moreover, there is a larger increase in the space for *E* to vary, than for *F,* in this case.

4) *Current account limits, Fig 11:* In this regime, it is easy for the trading system to go unstable. The top line shows no equilibrium exists at all. The second, an equilibrium but zero trade space. The third line is more policy friendly: F may rise by up to 136%, and E fall by up to 54%, before instability sets in. These simulations represent a sequence of steadily tighter current account caps.

7. Policy Conclusions

We have used an established, but often neglected, model of the current account balances, internationally held assets, and the interactions between them, to examine the stability of trade, currency markets and international portfolio balances. Using this model, we have established conditions for equilibrium in the foreign sector as a whole (trade and asset balances together); for whether those equilibria are stable or not; and examined whether those equilibria continue to exist, and are reachable, if the markets are distorted by the common policy prescriptions of fixed exchange rates or defined limits to the size of current account surpluses and deficits allowed.

The most important conclusion is that foreign trade and asset markets will, in general, display multiple equilibria: at least two, one stable and one unstable. This gives rise to the idea of a "trade space" defining the areas in which it is safe to allow trade deficits and net foreign assets or debt operate; and the areas in which it is not safe because, lacking an equilibrium position, debt burdens will explode and asset values collapse.

This theoretical finding is applied to the case of the economic and financial relations between the US and China with the help of a simulation framework. Albeit illustrative rather than definitive, the simulation results suggest that stockpiling of foreign (dollar) reserves by the PBC may lead the system towards an unstable equilibrium. Letting the currency float following a currency peg may involve a sudden exchange rate adjustment of a sizeable amount. Reducing the stock of reserves is likely to reduce the size of that adjustment. Capital liberalization may also be conducive to exchange rate instability, depending on the direction of the flows of capital. A coordinated action, by offsetting the effects of portfolio shifts in the two countries can play a stabilizing role.

A summary of the model's simulation results:

a) *Current account limits* pose some danger in terms of instability; it is too easy for them to limit trade space and the room for adjustment, and may remove the possibility of an eventual equilibrium altogether. At best, they offer a breathing space by slowing down the rate of accumulation of foreign assets in order to allow the adjustment of the current account and (real) exchange rate to catch up by enough to prevent a financial collapse in the deficit economy. That is valuable; but it requires carefully calibrated and adjusted current account caps to be effective.

b) *Capital liberalization* does the most to increase trade space and hence the chances of long run stability. It does this most strongly if rates of return increase in US asset markets, so that Chinese (foreign) investors markets attractive compared to their own and are free to exploit those rates of return. It is less effective if Chinese home bias is reduced/rates of return increase to attract US investors. This option allows more room for exchange rate adjustments.

c) *Pegged exchange rates* is a relatively poor option, but it does create almost as much trade space as capital liberalization if holdings of foreign exchange reserves are reduced. That is marked where China's stocks are reduced by 25%. But if those stocks accumulate without any attempt to reduce them, then it is easy for the system to slip into an unstable sequence of adjustments and financial collapse.

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