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An equilibrum model of "global imbalances" and low interest rates

by Ricardo J Caballero, Emmanuel Farhi and
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Foreword

On 19–20 June 2006, the BIS held its fifth Annual Conference, on "Financial Globalisation", in Brunnen, Switzerland. The event brought together some 60 senior representatives of central banks, academic institutions and the private sector to exchange views on this topic. BIS Paper 32 contains the opening address by William White (Economic Adviser, BIS), the keynote speech by Stanley Fischer (Governor, Bank of Israel), the contributions to the panel on “Review of recent trends and issues in financial sector globalisation”, and the prepared remarks of the participants at the Policy Panel. The Policy Panel discussion was chaired by Malcolm D Knight (General Manager, BIS); the panellists were Vittorio Corbo (Banco Central de Chile), Raguram Rajan (IMF), Usha Torat (Reserve Bank of India) and Zdeněk Tůma (Czech National Bank).

The present Working Paper includes a paper presented at the Conference and the related discussant comments.

Conference programme

Monday, 19 June

09:00	Opening remarks:	William White (BIS)
09:15	Morning Chair:	Kazumasa Iwata (Bank of Japan)
	Session 1: Democracy and globalisation	
	Authors:	Barry Eichengreen (University of California, Berkeley) and David Leblang (University of Colorado, Boulder)
	Discussants:	Marc Flandreau (Institut d'Etudes Politiques de Paris) and Harold James (Princeton University)
11:15	**Session 2: Globalisation and asset prices**	
	Authors:	Geert Bekaert (Columbia University)
	Discussants:	Alan Bollard (Reserve Bank of New Zealand) and Sushil Wadhwani (Wadhwani Asset Management)
14:15	Afternoon Chair:	Lorenzo Bini Smaghi (ECB)
	Session 3: Sudden stop and recovery: lessons and policies	
	Author:	Guillermo Calvo (Inter-American Development Bank)
	Discussants:	Randall Kroszner (Board of Governors of the Federal Reserve System) and Takatoshi Ito (University of Tokyo)
16:15	**Session 4: Panel on "Review of recent trends and issues in financial sector globalisation"**	
	Lead-off presenter:	Christine Cumming (Federal Reserve Bank of New York)
	Other Panellists:	Jose Luis de Mora (Banco Santander Central Hispano), David Llewellyn (Loughborough University) and Guillermo Ortiz (Banco de México)
19:00	Dinner	
	Keynote address:	Stanley Fischer (Bank of Israel)

Tuesday, 20 June

09:00	Morning Chair:	Donald Kohn (Board of Governors of the Federal Reserve System)

Tuesday, 20 June (cont)

Session 5: Financial globalisation, governance and the evolution of home bias

Authors:	René Stulz (Ohio State University), Bong-Chan Kho (Seoul National University) and Francis E Warnock (University of Virginia)
Discussants:	Philip Lane (Institute for International Integration Studies) and José Viñals (Banco de España)

11:00 **Session 6: Global "imbalances"**

Authors:	Ricardo Caballero (Massachusetts Institute of Technology), Emmanuel Farhi (Massachusetts Institute of Technology) and Pierre-Olivier Gourinchas (University of California, Berkeley)
Discussants:	Jeffrey Frankel (Harvard University) and Michael Mussa (Institute for International Economics)

14:00 Afternoon Chair: Malcolm Knight (BIS)

Session 7: Policy panel

Panellists:	Vittorio Corbo (Banco Central de Chile), Raghuram Rajan (IMF), Usha Thorat (Reserve Bank of India) and Zdeněk Tůma (Czech National Bank)

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An Equilibrium Model of "Global Imbalances" and Low Interest Rates

Ricardo J. Caballero Emmanuel Farhi Pierre-Olivier Gourinchas*

Abstract

Three of the most important recent facts in global macroeconomics — the sustained rise in the US current account deficit, the stubborn decline in long run real rates, and the rise in the share of US assets in global portfolio — appear as anomalies from the perspective of conventional wisdom and models. Instead, in this paper we provide a model that rationalizes these facts as an equilibrium outcome of two observed forces: a) potential growth differentials among different regions of the world and, b) heterogeneity in these regions' capacity to generate financial assets from real investments. In extensions of the basic model, we also generate exchange rate and FDI excess returns which are broadly consistent with the recent trends in these variables. More generally, the framework is flexible enough to shed light on a range of scenarios in a global equilibrium environment.

JEL Codes: E0, F3, F4, G1

Keywords: Current account deficits, capital flows, interest rates, global portfolios and equilibrium, growth and financial development asymmetries, exchange rates, FDI, intermediation rents.

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1 Introduction

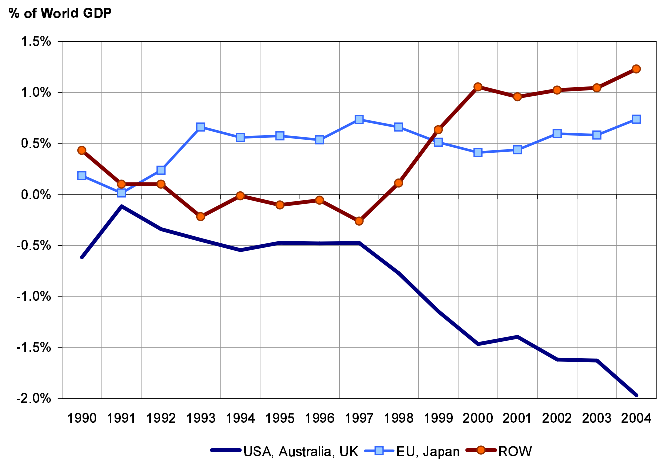
Three facts have dominated the discussion in global macroeconomics in recent times:
Fact 1: The US has run a persistent current account deficit since the early 1990s, which has accelerated dramatically since the late 1990s. Today, it exceeds US$600 billions a year. The solid dark line in Figure 1(a) illustrates this path, as a ratio of World's GDP (this line also includes the deficits of the U.K. and Australia, for reasons that will be apparent below, but it is overwhelmingly dominated by the U.S. pattern). The counterpart of these deficits has been driven by the surpluses in Japan and Continental Europe throughout the period and, starting at the end of the 1990s, by the large surpluses in Asia ex-Japan, commodity producers, and the turnaround of the current account deficits in most non-European emerging market economies.
Fact 2: The long run real interest rate has been steadily declining over the last decade, despite recent efforts from central banks to raise interest rates (the "Greenspan's Conundrum"). See Figure 1(b).
Fact 3: The importance of US assets in global portfolios has increased throughout the period and now amounts to over 17 percent of the rest of the world's financial wealth, which is equivalent to 43 percent of their annual output. See Figure 1(c).

Despite extensive debates on the factors behind and sustainability of this environment, there are very few formal structures to analyze these joint phenomena. The conventional view and their recent formalizations, attempt mostly to explain (the first half of) fact 1, largely ignore fact 2, and take 3 as an exogenous anomaly. The analysis about the future then consists of telling the story that follows once this "anomaly" goes away. However, capital flows are primarily an asset market phenomenon and hence the paths of interest rates and portfolios must be made an integral part of the analysis if we are to conjecture on what got the world into the current situation and how it is likely to get out of it.[1]

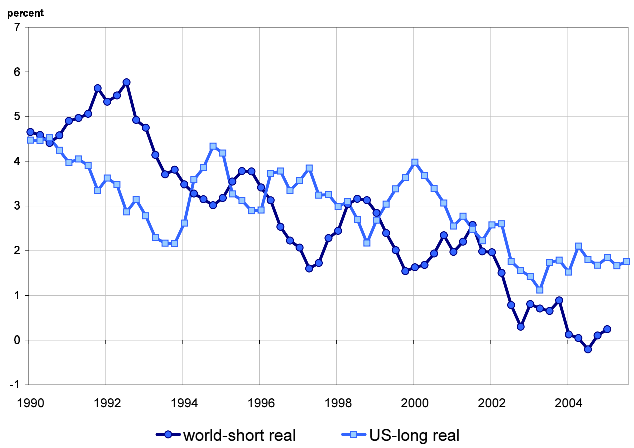
The main purpose of this paper is to provide a framework to analyze global equilibrium and, as an important side product, shed some light on the above facts. The model is fairly standard in its ingredients and provides a simple asset-demand and (most importantly) -supply framework to characterize the impact of different shocks on global capital flows, interest rates and portfolios. We use this model to show that the patterns in Figure 1 (together with observed exchange rate and gross flows patterns) can arise naturally from observed growth and financial market shocks, which interact with heterogeneous degrees of financial market development in different regions of the world.

We divide the world into three groups: The US (and "similar" economies such as Australia and the U.K.) (U); the EuroZone/Japan (E); and the rest (R). The latter include emerging markets, oil producing countries, and high saving newly industrialized economies, such as Hong-Kong, Singapore and Korea. Both U and E produce good quality financial instruments. R, on the other hand, has high growth potential but

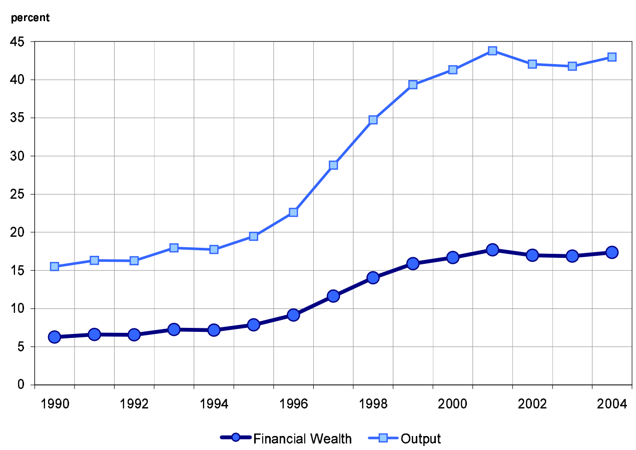
[1]Recently, some of the debate in policy circles also has began to highlight the role of equilibrium in global capital markets for US current account deficits. See especially Bernanke (2005) and IMF (2005). We will revisit the "saving glut" view after we have developed our framework.



(a) Current Account by Region (percent of world output)



(b) World and US Real Interest Rates



(c) Share of US Assets in Rest of the World's Output and Financial Wealth

Figure 1: Three Stylized Facts. Sources: (a) WDI and Deutsche Bank. (b) International Financial Statistics and Survey of Professional Forecasters. (c) World Development Indicators, Bureau of Economic Analysis, European Central Bank, Bank of Japan and Authors' calculations (see appendix)

has episodes when it cannot generate "enough" reliable savings instruments.[2]

In this world, we investigate the implication of a growth slowdown in E and, primarily, a collapse in asset markets in R. We show that both shocks point in the same direction, in terms of generating a rise in capital flows toward U, a decline in real interest rates, and an increase in the importance of U's assets in global portfolios. Importantly, while there are natural forces that undo some of the initial trade deficits in U, these are tenuous, as U's current account never needs to turn into surplus and capital flows indefinitely toward U.

The key feature of the model is that it focuses on the regions' ability to *supply* financial assets to savers. Regions U and E compete on asset production. Region R demands financial assets. Thus, fast growth in R coupled with their inability to generate local store of value instruments increases their demand for saving instruments from U and E. More growth potential in U than in E means that a larger share of global saving flows to U.

In the basic model productive assets are fixed and (implicitly) run by local agents, and there is a single good. We relax these assumptions in extensions. In the first one we allow for an investment margin and a reason for foreign direct investment (FDI). These additions enrich the framework along two important dimensions in matching the facts: First, the collapse in asset markets in R can lead to an investment slump in R (as opposed to just an increase in saving rates) which exacerbates the results from the basic model. Second, the intermediation rents from FDI, whose main reason is to transfer "corporate governance" from one country to another, reduce the trade surpluses that U needs to generate to repay for its persistent early deficits. In some instances, these rents allow U to finance permanent trade deficits.

In the second extension we allow for heterogeneous goods and discuss (real) exchange rate determination. The exchange rate patterns generated by the expanded model in response to the shocks highlighted above are broadly consistent with those observed in the data —in particular, U appreciates vis a vis both, R and E— and anticipate a very limited and slow depreciation of U's exchange rate in the absence of further shocks.

There are several recent articles related to the $U - E$ analysis in our paper. For instance, Blanchard, Giavazzi and Sa (2005) analyzes US external imbalances from the point of view of portfolio balance theory à la Kouri (1982). Their approach takes world interest rates as given and focuses on the dual role of the exchange rate in allocating portfolios between imperfectly substitutable domestic and foreign assets and relative demand through the terms of trade. In their model, the large recent US current account imbalances result from exogenous increases in U.S. demand for foreign goods and in foreign demand for U.S. assets. Their model predicts a substantial future depreciation of the US dollar since the exchange rate is the only equilibrating variable and current account deficits must be reversed. Obstfeld and Rogoff (2004) and (2005)

[2]See Caballero and Krishnamurthy (2006) for a model of bubbles in emerging markets as a result of their inability to generate reliable financial assets. When local bubbles crash, countries need to seek store of value abroad. This pattern also could arise from a fundamental shock due to a change in public perception of the soundness of the financial system and local conglomerates, degree of "cronysm," and so on.

consider an adjustment process through the global reallocation of demand for traded versus non traded and domestic versus foreign goods. Their analysis takes as given that a current account reversal needs to occur in the US, as well as the levels of relative supply of traded and non-traded goods in each country. Because the current account deficits represents a large share of traded output, they too, predict a large real depreciation of the dollar. These papers differ from ours in terms of the shocks leading to the current "imbalances", our emphasis on equilibrium in global financial markets and, most importantly, on the connection between this equilibrium and the countries' ability to produce sound financial assets.

For the $U - E$ part, the closest paper in terms of themes and some of the implications is Caballero, Farhi and Hammour (forthcoming 2006), who present several models of speculative investments booms in U and low global interest rates. One of the mechanisms they discuss is triggered by a slowdown in investment opportunities in E. However the emphasis in that paper is on the investment side of the problem and ignores the role of R and asset supply, which are central to our analysis in this paper. Kraay and Ventura (forthcoming 2006) analyze an environment similar to that in Caballero et al.. Their emphasis is on the allocation of excess global savings to a US bubble but it does not connect capital flows to growth and domestic financial markets fundamentals as we do here. Finally, Cooper (2005) presents a view about the U-E region similar to ours in terms of substantive conclusions.

For the $U - R$ part, Dooley, Folkerts-Landau and Garber (2003) and Dooley and Garber (forthcoming 2006) have argued that the current pattern of US external imbalances does not represent a threat to the global macroeconomic environment. Their "Bretton Woods II" analysis states that the structure of capital flows is optimal from the point of view of developing countries trying to maintain a competitive exchange rate, to develop a productive traded good sector, or to absorb large amounts of rural workers in the industrial sector. Unlike theirs, our analysis emphasizes the role of private sector capital flows and argues that the exchange rate is mostly a sideshow.[3]

Section 2 is the core of the paper and presents the main model and mechanisms. Section 3 introduces an investment margin and a reason for FDI, while Section 4 analyzes exchange rate determination. Section 5 discusses the impact of reversals in growth and financial development differentials. Section 6 concludes and is followed by several appendices.

[3]We do not deny the existence of large reserves accumulation by China and others. Nonetheless, we make three observations. First, most of these reserves are indirectly held by their local private sectors through (quasi-collateralized) low-return sterilization bonds in a context with only limited capital account openness. Second, US gross flows are an order of magnitude larger than official flows – rather than imputing Chinese reserves accumulation to financing the US current account deficit, one could equally well (or poorly) argue that they are financing FDI flows to emerging markets, including China. Third, the role of official interventions was most important at a time when the US was experiencing a temporary slowdown, while our analysis refers to more persistent trends.

2 A Model with Explicit Asset Supply Constraints

In this section we develop a stylized model that endogenizes and captures the broad patterns of capital flows, interest rates and global portfolios shown in Figure 1. The model highlights the supply side of the market for global saving instruments. We slice the world into three groups: U-countries have deep financial markets and good growth conditions; E-countries have deep financial markets but (perhaps temporarily) bad growth conditions; finally, R-countries (perhaps temporarily) do not have deep financial markets but have exceptional growth conditions.

In this context we show that both the depressed growth conditions in E and the depressed financial markets in R compound to generate large and persistent capital flows to U. Moreover, the exceptional growth conditions in R exacerbate rather than offset this pattern.[4]

After a series of preliminaries explaining the essence of our framework, we split the argument into three parts. In the first one, we study global equilibrium in a world with U and E countries only. This is the closest to the conventional analysis and has the dual role of showing the workings of our model and studying the equilibrium impact of a persistent decline in E's growth conditions, as experienced by Japan from the early 1990s and Continental Europe more recently. This decline raises capital flows from E to U and lowers global interest rates almost indefinitely. That is, the automatic rebalancing forces, regardless of the extent of home-bias, are tenuous in the absence of a reversal in the factors that led to the original imbalances, namely depressed growth conditions in E.

In the second part we study global equilibrium in a world with U and R countries only. This is the core of our model. We first show that if R's capacity to generate reliable financial assets crashes, global interest rates drop and capital flows from R to U permanently. Moreover, if growth potential in R is above that of the rest of the world, both effects are exacerbated. In particular, long run rates decline by more than short rates, and U can finance very significant current account deficits indefinitely. That is, if the initial asymmetry in financial development is not undone, the automatic rebalancing forces are even more tenuous than in the $U - E$ world. This part primarily captures the events following the Asian and Russian crises, as well as the fast growth and (favorably) high commodity prices experienced by much of the R region shortly afterwards. It also captures some of the elements following the crash of the Japanese bubble in the early 1990s.

We close this section by integrating the three regions. Aside from adding the effects of the previous two parts, we show that the shock in R has a larger (favorable) impact on U than on E. The reason is that the lower interest rates resulting from the asset markets collapse in R has a larger positive effect on asset values in the region with better growth prospects.

[4]Thus, the view that growth of US trading partners is on average similar to that of the US, so that differential growth cannot be a factor in explaining the large capital flows to the US, is misguided from our perspective. It matters a great deal who is growing faster and who is growing slower than the US. If those that compete with the US in asset production grow slower and those that demand assets grow faster, then both factors play in the same direction.

2.1 Preliminaries

2.1.1 A closed economy

Time evolves continuously. Infinitesimal agents (traders) are born at a rate θ per unit time and die at the same rate; population mass is constant and equal to one. At birth, agents receive a perishable endowment of $(1-\delta)X_t$ which they save in its entirety until they die (exit). Agents consume all their accumulated resources at the time of death. The term $(1-\delta)X_t$ should be interpreted as the share of national output that is not capitalizable.

The only saving vehicles are identical "trees" producing in aggregate a dividend of δX_t per unit time. Agents can save only in these trees.

By arbitrage, the instantaneous return from hoarding a unit of a tree, r_t, satisfies:

$$r_t V_t = \delta X_t + \dot{V}_t \tag{1}$$

where V_t is the value of the trees at time t. As is standard, the return on the tree equals the dividend price ratio $\delta X_t / V_t$ plus the capital gain $\dot{V}_t / V_t$.

Let W_t denote the savings accumulated by active agents at date t. Savings decrease with withdrawals (deaths), and increase with the endowment allocated to new generations and the return on accumulated savings:

$$\dot{W}_t = -\theta W_t + (1-\delta)X_t + r_t W_t. \tag{2}$$

In equilibrium, savings must be equal to the value of the trees:

$$W_t = V_t. \tag{3}$$

Replacing (3) into (1), and the result into (2), yields a relation between savings and production:[5]

$$W_t = \frac{X_t}{\theta}. \tag{4}$$

Replacing this expression back into (1), using (3), we obtain an expression for the instantaneous equilibrium interest rate:

$$r_t = \frac{\dot{X}_t}{X_t} + \delta\theta, \tag{5}$$

Conditional on exogenous output X_t, the interest rate rises with growth because the latter lifts the rate of growth of financial wealth demand (W), and hence the expected capital gains from holding a tree; it rises with δ because this increases the share of income that is capitalizable and hence it raises the supply of assets; and it rises with θ because this lowers financial wealth demand and hence asset prices.

[5] By Walras' Law, noticing that θW_t corresponds to consumption, we can re-write this relation as a goods-market equilibrium condition:

$$\theta W_t = X_t.$$

We assume that the total endowment in the economy, X_t, grows at rate g. Hence r_t is given by r_{aut} where

$$r_{aut} = g + \delta\theta.$$

We will only consider the case where $0 < \delta < 1$. Note that $\delta > 0$ guarantees that the interest rate is higher than the growth rate of dividends ($r_{aut} > g$). This in turn implies that there can be no bubbles: assets prices are given by the net present value of dividends.

2.1.2 Discussion of our setup

This minimalist model has two ingredients that need further discussion: The parameter δ and the consumption function corresponding to our particular specification of preferences and demographics.

Let us start with the former. At any time t, let PV_t denote the present value of the economy's future output:

$$PV_t = \int_t^{\infty} X_s e^{-\int_t^s r_\tau d\tau} ds.$$

The parameter δ represents the share of PV_t that can be capitalized today and transformed into a tradable asset:

$$V_t = \delta PV_t.$$

Since the asset is traded, it belongs to the current generation.

In practice, δ captures many factors behind pledgeability of future revenues. At the most basic level, one can think of δ as the share of capital in production. But in reality only a fraction of this share can be committed to asset holders, as the government, managers, and other insiders can dilute and divert much of profits. It is for this reason that we refer to δ as an index of financial development, by which we mean an index of the extent to which property rights over earning are well defined and tradable in financial markets.

For given output and interest rate paths, as δ rises the share of tradeable PV_t rises and that of its complement, N_t:

$$N_t = (1 - \delta) PV_t$$

falls one for one.[6]

This takes us to the second key ingredient, our specification of preferences and demographics. For a change in δ to have any effect, it must have an impact on prices in the closed endowment economy presented above. In the open economy environment we consider below, allocations will be impacted as well.In particular, δ must affect the total resources perceived by consumers (and hence by savers). If not, the economy is characterized by a situation akin to Ricardian equivalence: A rise in δ increases the supply of assets but it also raises the demand for assets one for one since non-capitalizable future income N_t falls by the same amount as V_t rises; as a result prices are left unchanged.

[6]Of course, in reality limited financial development affects not only the distribution of revenues but also output and growth. Adding this dimension would exacerbate our results but make them less transparent.

Thus, our choices are designed to provide the simplest model with non-Ricardian features. This is all that matters. Of course there is a large number of alternatives to achieve the same goal, at the cost of additional complexity. For example, we could assume a perpetual youth model à la Blanchard (1985) with log preferences throughout. In fact, such a model converges to ours if instead of giving agents a flow of labor income though life, we give them a lump sum at birth (see Appendix B). Moreover, our assumption of consumption in the last day of life does the same for the aggregate as Blanchard's annuity market, in that the agent does not need to worry about longevity risk. Similarly, Weil (1987)'s model of population growth with infinitely lived agents converges to ours if newly born agents receive the present value of their wages at birth. In both of these models, and their extensions to include ours, the consumption function of current agents takes the form (see Appendix B):

$$C_t = \theta(W_t + \beta N_t); \qquad \beta < 1.$$

The key point in these model as in ours is that current consumers do not have full rights over N_t while they do over V_t (and hence W_t).[7]

Finally, note that there is no need for an overlapping generations structure to have a role for asset supply. What is needed is some demand for liquidity and that changing the supply of assets has allocational consequence. For example, Woodford (1990)'s model of infinitely lived agents with alternating liquidity demand also creates an environment where a change in the availability of financial assets affects allocations and interest rates.

2.1.3 A Small Open Economy

Let us now open the (small) economy, which faces a given world interest rate, r, such that:

Assumption 1 $g < r < g + \theta$

Definition 1 *(Trade Balance and Current Account): Let us denote the trade balance and current account at time t as TB_t and CA_t, respectively, with:*

$$\begin{aligned} TB_t &\equiv X_t - \theta W_t \\ CA_t &\equiv \dot{W}_t - \dot{V}_t \end{aligned}$$

The definition of the trade balance is standard. The current account is also standard; it is the dual of the financial account and is defined as the increase in the economy's net asset demand.

[7] In Blanchard's model, the consumption function is $C_t = (p + \tilde{\theta})(W_t + H_t)$ where p is the probability of death and $\tilde{\theta}$ is the discount factor. H_t represents the aggregate value of the non-tradable asset and is strictly smaller than N_t as long as $p > 0$.

In Weil's model, and with the same notation, the consumption function is $C_t = \tilde{\theta}(W_t + H_t)$ and $H_t < N_t$ as long as the growth rate of population $n > 0$.

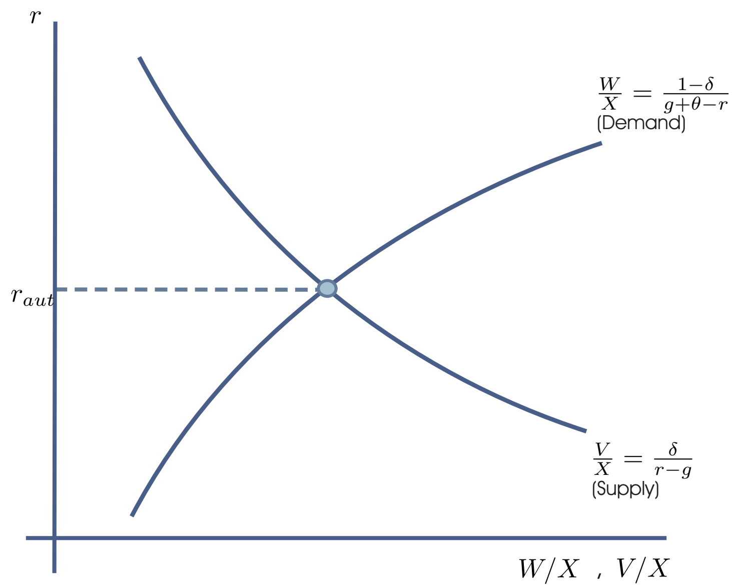


Figure 2: The Metzler diagram.

To find the steady state of this economy, we integrate (1) forward and (2) backward:

$$\begin{aligned} V_t &= \int_t^{\infty} \delta X_s e^{-r(s-t)} ds \\ W_t &= W_0 e^{(r-\theta)t} + \int_0^t (1-\delta) X_s e^{(r-\theta)(t-s)} \end{aligned}$$

Assumption 1 implies that asymptotically

$$\frac{V_t}{X_t} \underset{t\to\infty}{\to} \frac{\delta}{r-g} \tag{6}$$

$$\frac{W_t}{X_t} \underset{t\to\infty}{\to} \frac{1-\delta}{g+\theta-r} \tag{7}$$

Equation (6) is just Gordon's formula. It shows that the asymptotic supply of assets, normalized by the size of the economy, is a decreasing function of r. Equation (7) describes the asymptotic demand for assets which, normalized by the size of the economy, is an increasing function of r. Figure 2 represents the equilibrium in a supply and demand diagram, a variation on the Metzler diagram. The supply curve and demand curve cross at $r = r_{aut}$.

If $r < r_{aut}$

$$\frac{\delta}{r-g} > \frac{1-\delta}{g+\theta-r}$$

and domestic asset supply exceeds demand. Since along the balanced growth path $\dot{W}_t = gW_t$ and $\dot{V}_t = gV_t$, the above inequality implies that the small country runs an asymptotic current account deficit (financed by an asymptotic capital account surplus):

$$\frac{CA_t}{X_t} \underset{t\to\infty}{\to} g\left(\frac{1-\delta}{g+\theta-r} - \frac{\delta}{r-g}\right) = -g\frac{(r_{aut}-r)}{(g+\theta-r)(r-g)}. \tag{8}$$

Note also that, asymptotically, the trade balance is in surplus: The lower rate of return on savings depresses wealth accumulation and, eventually, consumption

$$\frac{TB_t}{X_t} \underset{t\to\infty}{\to} \frac{r_{aut}-r}{g+\theta-r} \tag{9}$$

Importantly, however, this asymptotic trade surplus is *not* enough to service the accumulated net external liabilities of the country, which is why the current account remains in deficit forever.

Conversely, note that when $r > r_{aut}$, (8) and (9) still hold, but now the economy runs an asymptotic current account surplus.

We can prove a stronger result that will be useful later on.

Lemma 1 *Consider a path for the interest rate* $\{r_t\}_{t\geq 0}$ *such that* $\lim_{t\to\infty} r_t = r$ *with* $g < r < g+\theta$. *Then*

$$\frac{V_t}{X_t} \underset{t\to\infty}{\to} \frac{\delta}{r-g}, \qquad \frac{W_t}{X_t} \underset{t\to\infty}{\to} \frac{1-\delta}{g+\theta-r}$$
$$\frac{CA_t}{X_t} \underset{t\to\infty}{\to} -g\frac{(r_{aut}-r)}{(g+\theta-r)(r-g)}, \qquad \frac{TB_t}{X_t} \underset{t\to\infty}{\to} \frac{r_{aut}-r}{g+\theta-r}$$

Proof. See the appendix. ■

2.2 A World with Symmetric (and Developed) Financial Markets (A $U-E$ World)

Let us now study global equilibrium with two large regions, $i = \{U, E\}$. Each of them is described by the same setup as in the closed economy, with an instantaneous return from hoarding a unit of either tree, r_t, which is common across both regions and satisfies:

$$r_t V_t^i = \delta X_t^i + \dot{V}_t^i \tag{10}$$

where V_t^i is the value of country i's tree at time t. Let W_t^i denote the savings accumulated by active agents in country i at date t:

$$\dot{W}_t^i = -\theta W_t^i + (1-\delta)X_t^i + r_t W_t^i. \tag{11}$$

Adding (10) and (11) across both regions, yields:

$$r_t V_t = \delta X_t + \dot{V}_t \tag{12}$$

$$\dot{W}_t = -\theta W_t + (1-\delta)X_t + r_t W_t \tag{13}$$

with

$$W_t = W_t^U + W_t^E, \qquad V_t = V_t^U + V_t^E, \qquad X_t = X_t^U + X_t^E.$$

From now on, the solution for global equilibrium proceeds exactly as in the closed economy above, with

$$\theta W_t = X_t. \tag{14}$$

and

$$r_t = \frac{\dot{X}_t}{X_t} + \delta\theta. \tag{15}$$

Let us now specify the initial conditions and follow with our first shock.

Assumption 2 *(Initial Conditions): The world is initially symmetric, with equal levels of X_t^i and a constant rate of growth, common to both countries, g. There are no (net) capital flows across the economies and $W_t^U = V_t^U = V_t^E = W_t^E$.*

Suppose now that, unexpectedly, at $t = 0$, the rate of growth of E drops permanently to

$$g^E < g.$$

Lemma 2 *(Continuity): At impact, r absorbs the shock while V and W remain unchanged.*

Proof. At any point in time, it must be true that

$$W_t = \frac{X_t}{\theta}$$

It follows that W_t does not jump at $t = 0 : W_{0-} = W_{0+} = X_0/\theta$. Since $W_t = V_t$ must hold at all times, we conclude that V_t does not jump either: $V_{0-} = V_{0+} = X_0/\theta$. But for this absence of a decline in V at impact to be consistent with the asset pricing equation, the growth slowdown in E must be offset by a drop in r:

$$r_{0+} = \frac{g + g^E}{2} + \delta\theta < r_{0-} = g + \delta\theta$$

that reflects a decline in world output growth.[8] ■

While global wealth and capitalization values do not change at impact, the allocation of these across economies does. On one hand, it stands to reason that the lower growth in X_t^E implies that V_0^U/V_0^E must rise since both dividend streams are discounted at the common global interest rate. On the other, whether W_0^U/W_0^E rises or not depends on the agents' initial portfolio allocations. However, as long as there is some home bias in these portfolios, W_0^U/W_0^E rises as well. Because the conventional view has taken the well established fact of home bias as a key force bringing about rebalancing of portfolios, we shall assume it as well, as this isolates the contribution of our mechanisms more starkly. Moreover, for clarity, in the main propositions we assume an extreme form of home bias, but then extend the simulations and figures to more realistic scenarios.

Assumption 3 *(Home Bias). Agents first satisfy their saving needs with local assets and only hold foreign assets once they run out of local assets.*

[8] According to the World Development Indicators, average output growth for U, E and R was 3.41% in the 1980s, 2.77% in the 1990s and 2.75% since 2000.

This assumption implies that, at impact, local wealths' changes match the changes in the value of local trees one-for-one:

$$\begin{aligned} W_{0+}^E - \frac{W_0}{2} &= V_{0+}^E - \frac{V_0}{2} \\ W_{0+}^U - \frac{W_0}{2} &= V_{0+}^U - \frac{V_0}{2} \end{aligned}$$

These changes in wealth have a direct impact on consumption, which are reflected immediately in the trade balance and current account.

Before describing these effects, let us digress momentarily. At times, it will be convenient for exposition to note that the current account can also be written as the sum of trade balance and net income from global holdings:

Lemma 3 *(Alternative Formulation of the Current Account)*

$$\begin{aligned} CA_t^i &= X_t^i - \theta W_t^i + r_t(\alpha_t^{i,j} V_t^j - \alpha_t^{j,i} V_t^i) \\ &= TB_t^i + r_t(\alpha_t^{i,j} V_t^j - \alpha_t^{j,i} V_t^i) \end{aligned}$$

where $i \neq j$, $\alpha_t^{i,j}$ is the share of country j's trees held by agents in country i, $\alpha_t^{j,i}$ is the share of country i's trees held by agents in country j.

Proof. See the appendix. ■

Note that our current account definition excludes, as does national accounts, unexpected valuation effects (unexpected capital gains and losses from international positions). This is not a relevant issue for now since the only surprise takes place at date 0, when agents are not holding international assets. We shall return to this issue when relevant.

Also note that since $CA_t^E + CA_t^U = 0$, we only need to describe one of the current accounts to characterize both. Henceforth, we shall describe the behavior of CA_t^U, with the understanding that this concept describes features of the global equilibrium rather than U-specific features.

Finally, without any substantive implication (see the Appendix for the general case), we make an assumption to narrow the asymptotic cases we need to analyze:

Assumption 4 *(Bounded Growth Decline): $(g - g^E) < (1 - \delta)\theta$.*

Proposition 1 *(Persistent Current Account Deficits in U): Under assumptions 1 to 4, an unexpected and persistent decline in E's rate of growth from g to $g^E < g$, turns CA_t^U into a deficit at impact and remains in deficit in the long run (although vanishing asymptotically relative to X_t^U).*

Proof. At impact, we have

$$W_{0+}^U = V_{0+}^U$$

$$CA_0^U = TB_0^U = X_0^U - \theta V_{0+}^U < 0$$

For $t > 0$, using $\theta W_t = X_t$ and $\theta V_t = X_t$ we have

$$CA_t^U = \dot{W}_t^U - \dot{V}_t^U = \dot{V}_t^E - \dot{W}_t^E$$

From equation (15) and $g > g^E$, $\lim_{t\to\infty} r_t = r_{aut}^U$. Lemma 1 shows that

$$\frac{V_t^E}{X_t^E} \underset{t\to\infty}{\to} \frac{\delta}{r_{aut}^U - g^E}$$
$$\frac{W_t^E}{X_t^E} \underset{t\to\infty}{\to} \frac{(1-\delta)}{g^E + \theta - r_{aut}^U}$$

and

$$\frac{CA_t^U}{X_t^E} = -\frac{CA_t^E}{X_t^E} \underset{t\to\infty}{\to} -\frac{g^E(r_{aut}^U - r_{aut}^E)}{(g^E + \theta - r_{aut}^U)(r_{aut}^U - g^E)} < 0.$$

Finally, it follows immediately from $g > g^E$ that CA_t^U / X_t^U vanishes asymptotically. ■

The impact effect of a decline in E's rate of growth is a decline in the value of E's assets which drags down E's wealth one for one given the extreme home bias assumption. This leads to an immediate drop in E's consumption which is not matched by a drop in E's current income. Thus E's trade balance, which is equal to the current account in the symmetric initial equilibrium, goes into surplus. In equilibrium, U has to absorb this surplus by running a trade deficit. The latter is achieved by an increase in U's consumption, which results from an increase in U's wealth following the appreciation of U's assets. This appreciation does not stem from any increase in U's growth prospects, but from the fall in interest rates brought about by E's slowdown.

Suddenly U's assets look relatively more attractive, and hence a share of E's saving begins to flow to these assets. Over time, the return on these assets raises E's wealth and consumption (relative to output), eventually overturning the initial trade surplus, and hence U' s trade deficit.

However, U's eventual trade surpluses are never enough to service the accumulated net-foreign liabilities in full, and hence U's current account remains in deficit forever. The counterpart of this persistent deficit is a sustained accumulation of U's assets by E. This accumulation is very fast early on, as the relative importance of U assets in E's portfolio rises until it converges (asymptotically) to:

$$\frac{g - g^E}{((1-\delta)\theta - (g - g^E))\,((g - g^E) + \delta\theta)} > 0.$$

Thus, in the limit, E continuously accumulates U's assets at a rate g^E.

Of course, this does not mean that our model violates the intertemporal approach to the current account. Integrating forward the equation:

$$\dot{W}_t^U - \dot{V}_t^U = X_t^U - \theta W_t^U + r_t(W_t^U - V_t^U)$$

we find the usual expression:

$$\begin{aligned} W_t^U - V_t^U &= -\int_t^\infty \left(X_s^U - \theta W_s^U\right) e^{-\int_t^s r_u du} ds \\ &= -\int_t^\infty TB_s^U e^{-\int_t^s r_u du} ds. \end{aligned}$$

In particular

$$0 = W_{0^+}^U - V_{0^+}^U = -\int_0^\infty TB_t^U e^{-\int_0^t r_s ds} dt.$$

Since the initial net asset position is balanced in our basic scenario, the net present value of trade balance surpluses is zero. The trade balance TB_t^U is initially in deficit and eventually turns into surplus since:

$$\frac{TB_t^U}{X_t^E} = -\frac{TB_t^E}{X_t^E} \underset{t\to\infty}{\rightarrow} \frac{g - g^E}{g^E + \theta - r_{aut}^U} > 0.$$

Importantly, however, increased net interest payments to E due to U's accumulation of net foreign liabilities exceed the trade balance surpluses and generate a chronic current account deficit in U.

We can understand the asymptotic result in the proposition with reference to the simple small open economy in Section 2.1, and its Figure 2. First, since in the long run U dominates the global economy, the equilibrium interest rate converges to the Autarky interest rate for U:

$$r_\infty = r_{aut}^U = g + \delta\theta.$$

Thus the gap between W_t^U/X_t^U and V_t^U/X_t^U is asymptotically vanishing. However, note that the limit interest rate exceeds the new Autarky rate in E:

$$r_\infty = g + \delta\theta > g^E + \delta\theta = r_{aut}^E.$$

Thus the asymptotic gap between W_t^E/X_t^E and V_t^E/X_t^E is strictly positive. Moreover, by global equilibrium this means that the asymptotic gap between W_t^U/X_t^E and V_t^U/X_t^E is strictly *negative.*

Let us now turn to a characterization of the entire path. Figure 3 portrays an example of the impact of a growth slowdown for parameters calibrated to match some key aspects of the data.[9] Our only goal here is to consolidate the insights from the proposition and to argue that the effects we describe are quantitatively significant. We do not attempt to match the exact paths in the data, as that would require additional smoothing mechanisms, such as gradual globalization, and other adjustment costs. Absent these, adjustments are too large at impact and too fast. Still, note that even in this frictionless environment, adjustments are gradual and capital flows remain large many years after the shock. Also note that the cumulative results, which are more robust to the absence of frictions, are large.

Panel A of Figure 3 shows that U's current account/GDP exhibits large initial deficits of 17 percent of output, which converge to zero only gradually. Panel B reports U's net external position. The growth shock lowers V^E relative to V^U. Since in order to match Figure 1(c), we calibrated U's assets share in initial global portfolio to 5% (rather than the 0% in the proposition), U suffers a small initial valuation loss.[10] More centrally, the large initial current account deficits worsen rapidly U's net foreign asset position from zero to -75 percent in 15 years. Eventually, the net foreign asset position converges to zero (relative to

[9]See the appendix for a discussion of the calibration. The drop in E's growth rate is about one percent.

[10]That is, the initial jump at $t = 0^+$ reflects the unexpected valuation effect from U's holdings of E's asset. Recall that our convention, similar to NIPA or BoP accounting, excludes these valuation effects from the current account.

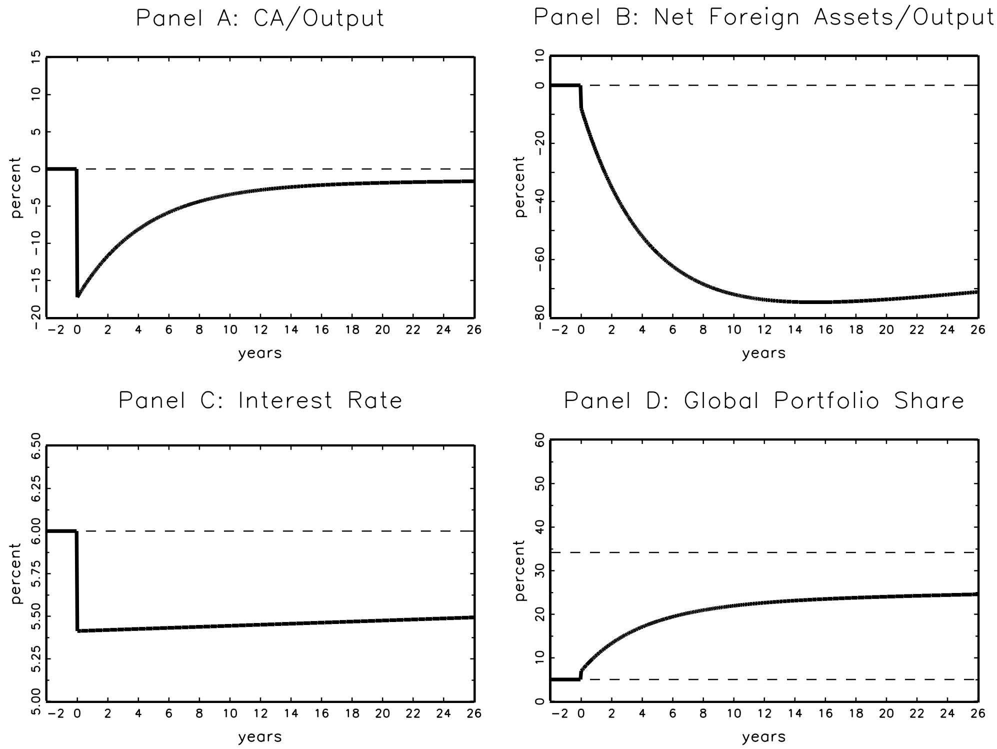


Figure 3: A Collapse in g^E

domestic output), but panel B illustrates that this convergence is slow, and in fact comes entirely from the denominator (output growth) since U never runs a current account surplus. Given our parameter values, the initial real interest rate equals 6 percent. Panel C shows that it drops by about 60 basis points at impact, then climbs back very slowly to pre-shock levels. Finally, the last panel shows the share of U's assets in E's wealth, under the assumption that U maintains its initial holdings. This portfolio share increases rapidly from 5 percent to 25 percent, and asymptotes to 34 percent.

The model is thus able to generate simultaneously large and long lasting current account deficits in U (Fact 1); a decline in real interest rates (Fact 2) and an increase in U's share in the global portfolio (Fact 3).

Up to now, differential growth limited the aggregate ability to create valuable assets in E relative to U. But there are other factors that create comparative advantage in asset creation, such as institutional differences, ranging from corporate governance to transparency of the financial system and policymaking. We turn to this analysis next, which is at the core of our explanation for recent global imbalances.

2.3 A World with Asymmetric Financial Markets (a $U-\ R$ World)

Let us now turn to the interaction between U and R. For clarity, we shall remove E from the analysis for now. The key element of this part of the model is that R is able to grow and generate income for savers but is limited in its ability to generate sound financial assets for these savers.

In this section we develop our argument in two steps: First, at date 0 we let R's δ drop from δ to $\delta^R < \delta$, in an environment where R and U are growing at the same rate g. Second, we repeat the experiment but now in an environment where R is growing faster than U, $g^R > g$.

How should we interpret a drop in δ^R? In general, as the realization that local financial instruments are less sound than they were once perceived to be. This could result from, *inter alia*, a crash in a bubble; the realization that corporate governance is less benign than once thought; a significant loss of informed and intermediation capital; the sudden perception —justified or not— of "crony capitalism"; a sharp decline in property rights protection, and so on. All of these factors -and more- were mentioned in the events surrounding the Asian/Russian crises (e.g. Fischer (1998)).

The formulae are very similar to that in the $U-E$ model, but there are some differences that need to be highlighted. Let quantities without superscript denote world aggregates (now made of U and R, rather than U and E), then:

$$r_t V_t^R \quad = \quad \delta^R X_t^R + \dot{V}_t^R$$

and

$$r_t V_t = \delta X_t - \left(1 - x_t^U\right)(\delta - \delta^R) X_t + \dot{V}_t$$

with $x_t^U \equiv X_t^U / X_t$. Similarly, we have that:

$$\dot{W}_t^R = (1-\delta^R) X_t^R + (r_t - \theta) W_t^R$$

and

$$\dot{W}_t = \left[1 - \delta + (\delta - \delta^R)(1 - x_t^U)\right] X_t + (r_t - \theta) W_t$$

Finally, using the equilibrium conditions $W = V = X/\theta$, and the arbitrage equation for V, we can solve for the equilibrium interest rate as before:

$$r_t \quad = \quad x_t^U (g + \delta\theta) + (1 - x_t^U)(g + \delta^R \theta) \tag{16}$$

$$\quad = \quad r_{aut}^U - (1 - x_t^U)(\delta - \delta^R)\theta. \tag{17}$$

Proposition 2 *(Crash in R's Financial Markets with Symmetric Growth): Assume R and U grow at the same rate g. Under Assumption 3, if δ drops in R to $\delta^R < \delta$, then the current account of U turns into a deficit at impact and remains in deficit thereafter, with CA_t^U / X_t^U converging to a strictly negative constant. The interest rate falls permanently below r_{aut}^U.*

Proof. Note first that since both regions are growing at the same rate, $x_t^U = x_0^U$ for all $t > 0$, and the interest rate remains constant after dropping at date 0:

$$r_t = r^+ = r_{aut}^U - (1 - x_0^U)(\delta - \delta^R)\theta < r_{aut}^U. \tag{18}$$

Next, because the interest rate is constant, the values of the trees change immediately to their new balanced growth path:

$$V_t^R = \frac{\delta^R X_t^R}{r^+ - g}, \qquad V_t^U = \frac{\delta X_t^U}{r^+ - g}.$$

Let us now describe the balanced growth path and then return to describe transitory dynamics. In the balanced growth path, we know from Lemma 1 that

$$W_t^R = \frac{(1-\delta^R)X_t^R}{\theta + g - r^+} \qquad W_t^U = \frac{(1-\delta)X_t^U}{\theta + g - r^+}$$

and

$$\frac{CA_t^U}{X_t^U} = -g\frac{r_{aut}^U - r^+}{(g+\theta-r^+)(r^+-g)} < 0.$$

For transitory dynamics, define $w_t^R = W_t^R/X_t^R$ so that

$$\dot{w}_t^R = (r^+ - g - \theta)w_t^R + (1-\delta^R).$$

with a balanced growth equilibrium value of $(1-\delta^R)/\left(\theta + g - r^+\right)$.

From home-bias Assumption 3 we have that

$$w_{0+}^R = \frac{V_{0+}^R}{X_0^R} < \frac{1-\delta^R}{\theta + g - r^+}$$

since $r^+ < r_{aut}^U$. That is, w_t^R is below its balanced growth path at $t = 0^+$.

Since $r^+ < r_{aut}^U < g + \theta$, we must have $\dot{w}_t^R > 0$ when w_t^R is below its steady state, or equivalently:

$$\dot{W}_t^R > gW_t^R$$

Thus we also have that U's current account $CA_t^U = \dot{V}_t^R - \dot{W}_t^R$ is in deficit – in fact, a larger deficit– before converging to its new balanced growth path. ∎

That is, now even if both regions have similar rates of growth, U runs a permanent current account deficit. The latter is the counterpart of the increasing flow of resources from R-savers, who have few reliable local assets to store value and hence must resort to U-assets. In balanced growth, R-savings grow at the rate of growth of income. If R-savings are below (output-detrended) steady state, then the rate of accumulation exceeds the rate of growth of the economy and capital flows toward U grow at a fast rate (faster than g).

The collapse in δ^R decreases the global supply of assets by reducing the share of R's income that can be capitalized. As before, the shock is entirely absorbed via a decline in world interest rates, reflecting a decline in the global dividend rate from δ to $\delta - (1-x_0)\left(\delta - \delta^R\right)$. While global wealth and capitalization do not change at impact, the allocation of wealth and assets across countries does. The collapse in δ^R implies that V_0^U/V_0^R must rise as an unchanged stream of U's dividends is now discounted at a lower interest rate. Correspondingly, under our home bias assumption, the ratio W_0^U/W_0^R must also rise.[11]

Again, we can resort to the analysis of a small open economy in Section 2.1, and its Figure 2, to understand the asymptotic result. For this, note that the equilibrium interest rate falls to a level in between the two ex-post Autarky rates:

$$r_{aut}^U = g + \delta\theta > r^+ = g + \delta\theta - (1-x_0^U)(\delta - \delta^R)\theta > g + \delta^R\theta = r_{aut}^R$$

[11] It is easy to show that if δ^R crashes to zero, then a bubble must arise in U-trees. While that drop in δ^R is extreme, it captures the flavor of the behavior of U's asset markets in recent years. In the less extreme version we have highlighted, we still capture this flavor through the rise in the value of U's fundamentals following the decline in equilibrium interest rates.

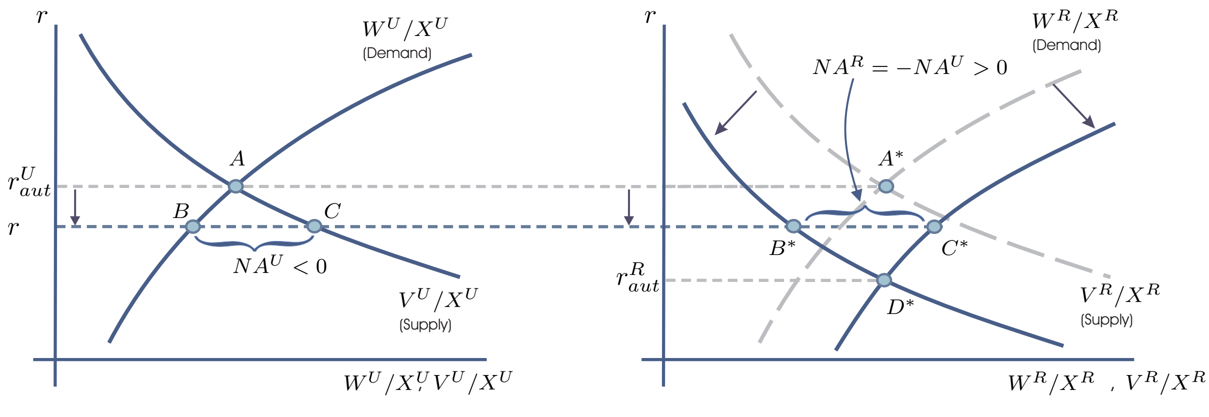


Figure 4: The Metzler diagram for a permanent drop in δ^R.

Thus the gap between W_t^U/X_t^U and V_t^U/X_t^U is negative and *non*-vanishing (see Lemma 1). Or, from the other region's perspective, the gap between W_t^R/X_t^R and V_t^R/X_t^R is positive and non-vanishing. Figure 4 presents the asymptotic result. Starting from a symmetric equilibrium at A and A^* with a world interest rate r^U_{aut}, the decline in δ^R shifts the V^R/X^R curve to the left (decline in asset supply) and the W^R/X^R curve to the right (increase in asset demand). The world interest rate declines just enough so that the net foreign assets in U ($NA^U \equiv W^U - V^U < 0$) and the net foreign assets in R ($NA^R \equiv W^R - V^R > 0$) sum to zero.

Figure 5 characterizes the entire path following a collapse of δ^R calibrated so that R's asset prices drop by 50% on impact (see the appendix for a discussion). Again, our objective is not to match the precise trajectory of the US current account following the Asian crisis, but to argue that the effects we describe are quantitatively significant. Panel A of Figure 5 shows that U's current accounts exhibit large initial deficits of 20 percent. The current account remains negative and asymptotes at -2.8 percent of output. As in the $U-E$ case, the large initial current account deficits worsen rapidly the net foreign asset position from -6 percent at impact to -95 percent (panel B). The real interest rate drops by slightly more than 50 basis points and remains permanently lower. Finally, U's share in R's portfolio increases gradually from 11 percent (immediately after the shock) to 55 percent.[12]

Once again, the model is able to generate, simultaneously, large and long lasting current account deficits in U (Fact 1); a decline in real interest rates (Fact 2) and an increase in the share of U's assets in global portfolios (Fact 3).

Importantly, now CA_t^U/X_t^U does not vanish asymptotically as it converges to:

$$\frac{CA_t^U}{X_t^U} = -g\frac{(\delta-\delta^R)(1-x_0^U)\theta}{(\theta+g-r^+)\,(r^+-g)} < 0.$$

The reason is that excess savings needs in R grow with R's output, which grows in tandem with U's output.

[12]The initial jump from 5 to 11 percent reflects the drop in R's wealth and jump in V^U at $t = 0^+$.

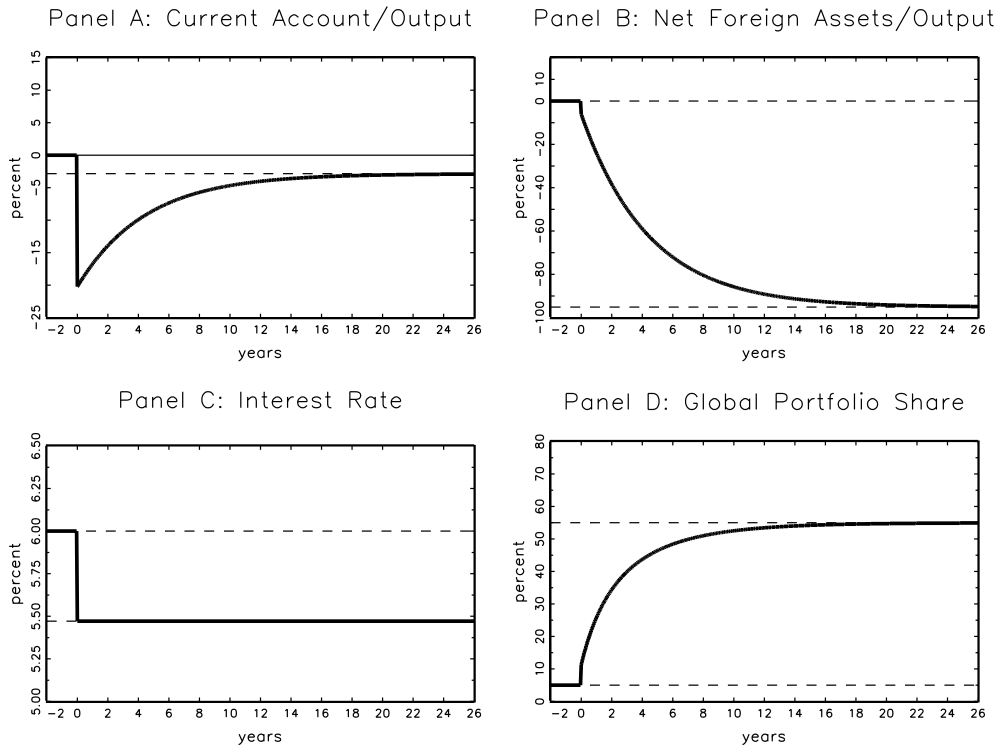


Figure 5: A Collapse in δ^R

Note also that the size of the permanent current account deficit in U (relative to output) is increasing in the relative size of R (equal to $(1 - x_0^U)$). This observation hints at an important additional source of large and persistent deficits in U. In practice, R's rate of growth exceeds that of U, and hence the relative importance of this source of funding of U-deficits rises over time — both, because of differential growth and because many R countries are gradually globalizing.

Let us now turn to our second experiment and explore the effect of a crash in δ^R that takes place in an environment where:

$$g^R > g.$$

The instantaneous interest rate in this case is:

$$r_t = x_t^U \, (g + \delta\theta) + (1 - x_t^U)(g^R + \delta^R\theta). \tag{19}$$

Let us assume that the additional growth in R is not enough to offset the effect of a lower δ^R on interest rates:

Assumption 5 *(Lower ex-post autarky rate in R)* $\quad r_{aut}^R = g^R + \theta\delta^R < r_{aut}^U - \theta(1 - x_0^U)(\delta - \delta^R) < r_{aut}^U$

Proposition 3 *(Crash in R's Financial Markets with High Growth in R) Suppose that Assumptions 3 and 5 hold, but that $g^R > g$. If at date 0 δ drops to δ^R in R, then:*

$$r_{aut}^U = r_{0-} > r_{0+} > r_\infty = r_{aut}^R$$

and the asymptotic current account deficit in U relative to its output is larger when $g^R > g$ than when $g^R = g$:

$$\lim_{\substack{t \to \infty \\ g^R > g}} \frac{CA_t^U}{X_t^U} < \lim_{\substack{t \to \infty \\ g^R = g}} \frac{CA_t^U}{X_t^U} < 0$$

Proof. See the appendix. ■

The result in this proposition is intuitive given the previous proposition: As R's growth rises, so does its demand for financial assets. Since this rise is not matched by an increase in R's ability to generate financial assets, these assets must be found in U and interest rates drop as the price of U-assets rise. The corresponding increase in capital flows finances the larger current account deficit in U. Long run interest rates fall more than the short term interest rates because the relative importance of the country with excess demand for assets, R, rises over time.

As before, let us now describe the asymptotic result in terms of Figure 2, from Section 2.1. First, since in the long run R dominates the global economy when $g^R > g$, the equilibrium interest rate converges to the Autarky interest rate for R:

$$r_\infty = r_{aut}^R = g^R + \delta^R \theta.$$

Thus, relative to X_t^R, the gap between W_t^R and V_t^R is vanishing, and so is that between W_t^U and V_t^U.

However, note that this limit interest rate is below the Autarky rate in U:

$$r_\infty = g^R + \delta^R \theta < g + \delta \theta = r_{aut}^U.$$

Thus, relative to X_t^U, the gap between W_t^U and V_t^U is negative and *not* vanishing. Moreover, since

$$r_\infty < r^+ < r_{aut}^U,$$

that gap is larger when $g^R > g$ than when $g^R = g$.

2.4 The Three Regions World ($U - E - R$)

In this section, we consider a $U - E - R$ environment. Much of this world is simply the sum of the two sub-worlds described above, but there is one additional insight: If the crash in δ^R takes place when $g^U > g^E$, then the asset appreciation in U is (much) larger than that in E, and the bulk of the capital flows from R are directed to U rather than to E.

Since the dynamic equations follow directly from those discussed above, we relegate them to the appendix and state the main proposition directly, after making an assumption on the parameter region under consideration:

Assumption 6 $r_{aut}^R \equiv g^R + \delta^R \theta < r_{aut}^U \equiv g + \delta \theta$, $r_{aut}^R < g^E + \theta$, $g^E < g$.

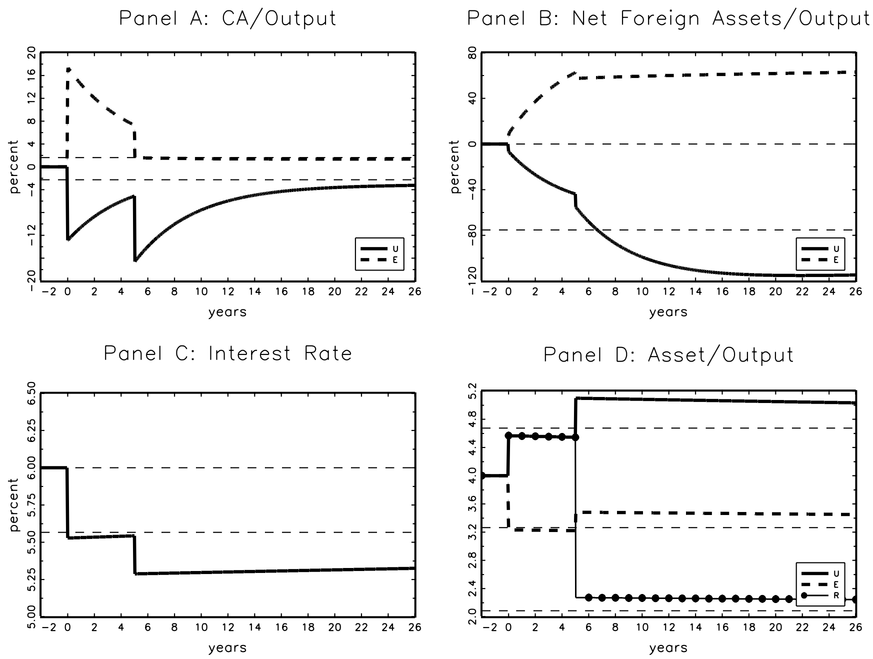


Figure 6: A Collapse in g^E followed by a collapse in δ^R in the U-E-R model

Proposition 4 *(Disproportionate Flows toward U) If Assumption 6 holds, then a crash in δ^R leads to an increase in V^U/V^E and a "disproportionate" (to relative output) allocation of R's capital outflows to U over E. Asymptotically*

$$\frac{\frac{\delta^R}{V_t^U}\frac{\partial V_t^U}{\partial \delta^R}}{\frac{\delta^R}{V_t^E}\frac{\partial V_t^E}{\partial \delta^R}} = \frac{r_\infty - g^E}{r_\infty - g} = 1 + \frac{g - g^E}{r_\infty - g} > 1.$$

Proof. See the appendix. ■

In words, the reduction in world interest rates stemming from the crash in δ^R has a larger impact on U-assets since these are more leveraged than E-assets when $g > g^E$. This difference can be quite large. For a decline in δ^R calibrated so that V^R collapses by 50 percent on impact, with $g = g^R$ and a 1.1 percent growth differential $g - g^E$, the ratio of asset price elasticities equals 1.43.

Figure 6 traces the entire path in the case where $g = g^R$. We start the economy in a symmetric equilibrium ($g^i = g$ and $\delta^i = \delta$), with $x_0^U = x_0^E = 0.425$ and $x_0^R = 0.15$. We then reduce E's growth at $t = 0$. This reduces world interest rates to 5.5 % and increases asset values in R and U as both regions receive capital inflows (panel D). Then, at $t = 5$, we decrease δ^R. Panel D illustrates that the collapse in δ^R and V^R disproportionately affects V^U relative to V^E: V^U increases by 12 percent at $t = 5$, compared to 8 percent for V^E. This results in much larger current account deficits in U relative to E and an additional build-up in net liabilities in U (panel A).

3 Investment Slumps and Foreign Direct Investment

Let us now add an investment margin to the $U - R$ model and a reason for foreign direct investment (FDI). We capture the former with the emergence of options to plant new trees over time, and the latter with U's ability to convert new R trees into δ (rather than δ^R) trees.[13] These additions enrich the framework along two important dimensions in matching the facts: First, the collapse in δ^R can lead to an investment slump in R which exacerbates our results in the previous section. Second, the intermediation rents from FDI reduce the trade surpluses that U needs to generate to repay for its persistent early deficits.[14]

3.1 An Investment Margin and Slump

Let us split aggregate output in each region into the number of trees, N, and the output per tree, Z:

$$X_t^i = N_t^i Z_t^i$$

At each point in time, $g^n N_t^i$ options to plant new trees arise. At the same time, the output of each planted tree grows at the rate g^z. Planting the $g^n N_t^i$ new trees consumes resources I_t^i:

$$I_t^i = \kappa X_t^i.$$

Let us assume first that κ is low enough so that all investment options are exercised (see below), and hence aggregate output grows at rate g, with (equal for both regions):

$$g = g^n + g^z.$$

Suppose for now that δ^i is specific to the region where the tree is planted, not to who planted it. Then

$$r_t V_t^i = \delta^i X_t^i + \dot{V}_t^i - g^n V_t^i \tag{20}$$

where V_t^i represents the value of all (new and old) trees planted at time t in region i, and $\dot{V}_t^i - g^n V_t^i$ represents the expected capital gains from those trees.

[13] Note that in a three regions version of the model E also could convert R trees. Although in this case, a good question is which rate of growth would the output of those trees have.

[14] The view here is not unrelated to that in Despres, Kindleberger and Salant (1966) and Kindleberger (1965), who during the Bretton Woods era argued that the US had a unique role as a provider of international currency liquidity. More recently, Gourinchas and Rey (forthcoming 2006) have documented that the total return on US gross assets (mostly equity and FDI) consistently exceeded the total return on gross liabilities (mostly safe instruments) by an average of 3.32 percent per year since 1973. Of course part of this excess return is due to the risk-premium differential associated to the leveraged nature of US investments. Our analysis omits this risk dimension and focus on the "intermediation" rent obtained by the US.

Everything suggests that this "intermediation" role of the US has only grown in importance as total gross capital flows to/from the US have risen from \$222 billion in 1990 to \$2.3 trillion in 2004 (see BEA, US International Transactions Accounts, Table 1). See also Lane and Milesi-Ferretti (forthcoming 2006) for a systematic analysis of cross border flows and positions for a large sample of countries.

The options to invest are allocated to all those alive at time t within each region, who immediately exercise them by investing I_t^i.[15] Thus,

$$\dot{W}_t^i = (r_t - \theta)W_t^i + (1 - \delta^i)X_t^i + g^n V_t^i - I_t^i.$$

As usual, aggregating across both regions to find the equilibrium interest rate, yields:

$$r_t V_t = \delta X_t - (\delta - \delta^R)X_t^R + \dot{V}_t - g^n V_t \tag{21}$$

$$\dot{W}_t = (r_t - \theta)W_t + (1 - \delta)X_t + (\delta - \delta^R)X_t^R + g^n V_t - I_t \tag{22}$$

so that:

$$W_t = V_t = (1 - \kappa)\frac{X_t}{\theta}.$$

and

$$r = g^z + \frac{\theta}{1-\kappa}(\delta - (\delta - \delta^R)\ x^R) < r^U_{aut} = g^z + \frac{\theta\delta}{1-\kappa}, \tag{23}$$

which amounts to the same model as in the previous section, with the exceptions that only the rate of growth of output per-tree enters, and that the investment cost reduces wealth accumulation and hence raises the interest rate (since it lowers the price of trees).

Let us now assume that the drop in δ^R is large enough that investment is not privately profitable in R (κ is large relative to $g^n V_t^R / X_t^R$). This immediately delivers an (extreme) investment slump in R.[16] Moreover, the equations for R change to:

$$g^R = g^z < g.$$

$$r_t V_t^R = \delta^R X_t^R + \dot{V}_t^R \tag{24}$$

$$\dot{W}_t^R = (r_t - \theta)W_t^R + (1 - \delta^R)X_t^R. \tag{25}$$

Solving for global equilibrium, yields:

$$V_t = W_t = (1 - \kappa x_t^U)\frac{X_t}{\theta}.$$

Note that now at the time of the crash in δ^R there is an *increase* in the value of global assets equal to:

$$\Delta V_0 = \kappa\frac{X_t^R}{\theta} > 0.$$

[15] Note that the share of options that are allocated to existing owners of trees are subsumed within the Z component. In fact, we can reinterpret the model in Section 2 as an investment model where all the options are allocated to the owners of existing trees. The only reason we modified the allocation of options in this section is to spread the excess returns from FDI over time in a more realistic manner (otherwise the entire capitalized excess returns accrues to the first generation in U).

[16] See Caballero and Krishnamurthy (2006) for a more detailed emerging markets model where the collapse in the "bubble" component of (something like) δ^R leads to an investment slowdown in R.

The mechanism behind this increase in asset value —made of a milder decline in asset values in R and a sharper appreciation in U— is a further drop in interest rates at impact following the investment collapse in R.[17] Moreover, the latter exacerbates the initial current and trade deficit in U.

The following proposition summarizes these results more precisely and is proved in the appendix. It compares two situations when $g^n V_t^R / X_t^R < \kappa$. In situation 1, R agents make the optimal decision not to invest. In situation 2, which is intended only to serve as a benchmark, R agents are forced to exercise their investment options.

Proposition 5 *(Investment slump) At impact, the drop in interest rate is larger under situation* 1 *than under situation* 2*. Also, the initial current account and trade balance deficits in* U *are larger in situation* 1 *than in situation* 2.

3.2 An Intermediation Margin: Foreign Direct Investment

Let us now assume that R residents can sell the options to the news trees to U residents at price, P:

$$P_t = \kappa_P X_t^{Rn}.$$

where X_t^{Rn} denotes the output from the trees sold to U. We think of this price as the result of some bargaining process but its particular value is not central for our substantive message as long as it leaves some surplus to U.

There are gains from trade: If U residents plant the new R trees, the share of output from the new trees that can be capitalized rises from δ^R to δ. Suppose that P_t is such that all new R trees are planted by U residents. In fact, the following assumption ensures that U investors and R sellers gain from foreign direct investment along the entire path.

Assumption 7 (Asymptotic Bilateral Private Gains from FDI) *Let* κ_P *and* $(\delta - \delta^R)$ *be such that:*

$$g^n \frac{\delta}{r_{aut} - g^z} > \kappa + \kappa_P > g^n \frac{\delta^R}{r_{aut} - g^z}$$

Proposition 6 *If Assumption 7 holds, then* U *runs an asymptotic trade deficit financed by its intermediation rents.*

Proof. Let us assume that enough time has passed so that the output of the old R trees is negligible relative to the total output produced by trees planted in R by U. We have:

$$(r_t + g^n)V_t^i = \delta X_t^i + \dot{V}_t^i$$

$$(r_t + g^n)V_t = \delta X_t + \dot{V}_t$$

[17]Note that in the long run the interest rate converges to r_{aut} since now U is growing faster than R. However this long run rise is not enough to offset the sharp decline in interest rates in the short (and medium) run.

$$\dot{W}_t^U = (r_t - \theta)W_t^U + (1-\delta)X_t^U + g^n V_t - (I_t^U + I_t^R) - P_t.$$

$$\dot{W}_t^R = (r_t - \theta)W_t^R + (1-\delta)X_t^R + P_t.$$

$$\dot{W}_t = (r_t - \theta)W_t + (1-\delta)X_t + g^n V_t - I_t \tag{26}$$

so that:

$$W_t = V_t = (1-\kappa)\frac{X_t}{\theta}.$$

and

$$r = r_{aut} = g^z + \frac{\delta\theta}{1-\kappa} \tag{27}$$

It follows from derivations analogous to those in previous sections that:

$$\frac{W_t^U}{X_t^U} \to \frac{(1-\delta-\kappa) + g^n \frac{\delta}{r_{aut}-g^z} + g^n \frac{\delta x^R/x^U}{r_{aut}-g^z} - (\kappa+\kappa_P)\, x^R/x^U}{\theta + g - r_{aut}}$$

and since $TB_t^U = -\theta W_t^U - I_t^U + X_t^U$, we have that:

$$\begin{aligned} \frac{TB_t^U}{X_t^U} &\to -\theta\frac{(1-\delta-\kappa) + g^n \frac{\delta}{r_{aut}-g^z} + g^n \frac{\delta x^R/x^U}{r_{aut}-g^z} - (\kappa+\kappa_P)\, x^R/x^U}{\theta + g - r^{U,aut}} + (1-\kappa) \\ &= -\theta\frac{x^R}{x^U}\frac{g^n \frac{\delta}{r_{aut}-g^z} - (\kappa+\kappa_P)}{\theta + g - r_{aut}} < 0. \end{aligned}$$

That is, the trade balance is in deficit in the long run as long as there is an intermediation rent, which is ensured by Assumption 7. ■

Does this mean that the intertemporal approach of the current account has been violated? Certainly not. It simply means that the intermediation rents rather than future trade surpluses pay for the initial (and now permanent) trade deficits. Alternatively, one could account for these intermediation services as "non-traditional" net exports and imports for U and R, respectively. In which case, we have:

$$\widehat{TB}_t^U = TB_t^U + g^n V_t^R - (\kappa+\kappa_P)X_t^R$$

and, assuming $r_{aut} > g$ so the integral converges, it follows that:

$$W_t^U - V_t^U = -\int_t^{+\infty} \widehat{TB}_s^U e^{-\int_t^s r_u du} ds$$

Figure 7 reports the path of U's trade balance following a collapse in δ^R.[18] We consider three cases: first, when κ_P is sufficiently high that no FDI takes place. Second, when all the rents asymptotically go to R (i.e. when the second inequality of Assumption 7 holds exactly) and lastly when all the rents from FDI asymptotically go to U (i.e. when the first inequality of Assumption 7 holds exactly).[19] We assume

[18] We calibrate the decline in δ^R as before, to a drop in V^R of 50%. See the appendix for details of the simulation.

[19] For this simulation, we assume $\kappa = 0$, $g^n = g = 0.03$, $g^z = 0$ and we vary κ_P between 5% and 12%. For comparability, we also choose δ so that $r_{aut} = 6\%$. We obtain $\delta = 0.24$.

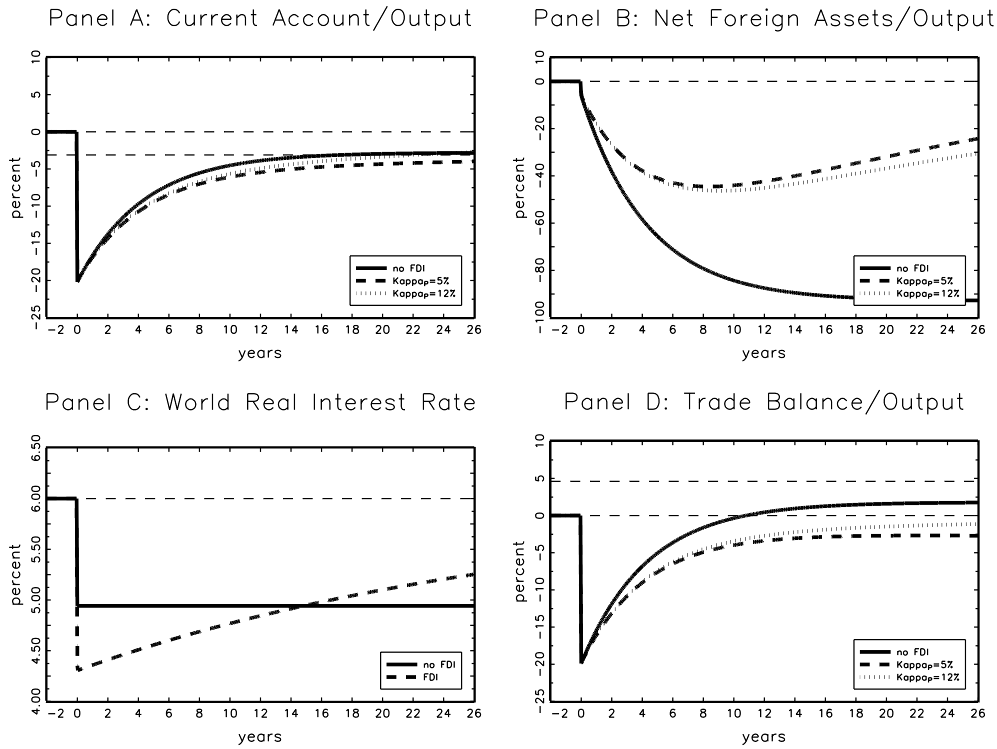


Figure 7: A Collapse in δ^R with and without FDI

parameters such that in all cases the investment options are exercised. The model without FDI is very similar to the model of section 2.3: following a collapse in δ^R, the interest rate falls permanently from r_{aut} to $\bar{r} = g^z + \bar{\delta}\theta/(1-\kappa)$ where $\bar{\delta}$ is the fraction of world income that can be capitalized. By now, the consequences are well known: the wealth transfer to U generates a trade deficit, an accumulation of foreign debt, eventually followed by trade surpluses (panel D).

In the presence of FDI, the results are starkly different. Let's start with the long run. The asymptotic effect of FDI is to increase the supply of U-like assets sufficiently to offset the initial shock. This has a strong implication for the path of net foreign assets (panel B): since r_t converges to r_{aut} as long as FDI takes place (Panel C), the Metzler diagram tells us that long run external imbalances disappear asymptotically. This is independent of the cost of ownership of the R trees (κ_P) as long as Assumption 7 is satisfied. The reason is that κ_P controls the distribution of wealth between U and R, leaving total wealth unchanged.

Consider the short run now. The interest rate satisfies:[20]

$$r_t = g^z + \theta\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right] - \theta g^n \frac{N_0^R\left[v_t^{Rn} - v_t^{Ro}\right]}{X_t} \tag{28}$$

where x_t^{Rn} (resp. x_t^{Ro}) denote the new (resp. old) R's trees share of world output and v_t^{Rn} (resp. v_t^{Ro}) represent the value of one new (resp. old) R tree. The last term of this equation makes clear that initially $r_t < \bar{r}$ since $v_0^{Rn} > v_0^{Ro}$ and $x_0^{Rn} = 0$. The reason for this last term is the initial increase in asset demand arising from the total flow of financial savings generated by $FDI: g^n\left(V_t^U + N_t^R v_t^{Rn}\right) > g^n V_t$.[21]

[20]See the appendix for a derivation.

[21]In other words, when there is FDI, savings decline less in U and increase more in R. The precise allocation depends upon

In the short run, FDI increases asset demand -which lowers further interest rates; in the long run, it increases asset supply, which brings interest rates back to r_{aut}.

From (20) and (28) we note also that the dynamics of interest rates and asset values are independent of κ_P (as long as FDI takes place). Hence, the initial increase in U's wealth is also independent of the cost of FDI. It follows that U's initial trade imbalance (equal to $X_0^U - \theta W_0^U - I_0^U$) is also independent of κ_P. Indeed, we observe on Panels A and D that U's initial current accounts and trade deficits are the same for different realizations of κ_P.

A lower value of κ_P (higher rents for U) implies a permanently larger trade deficit in U, ranging from 0 to 4% of output (Panel D).

To understand why U runs asymptotic trade deficits as soon as it has strictly positive asymptotic surpluses, consider first the case where U has no FDI rents asymptotically. In that case, U has no asymptotic trade deficit either. Yet, Panel D indicates that U never runs a trade surplus. The reason is that U earns rents on its FDI investment along the path, which allow it to run trade deficits in every period. In fact, we can define these rents (over total wealth W^U) as:

$$\chi_t = \frac{g^n N_t^R v_t^{Rn} - (\kappa_p + \kappa) X_t^{Rn} - \kappa X_t^{Ro}}{W_t^U}$$

Asymptotically, these rents converge (from above) to

$$\chi_\infty = \left[g^n \frac{\delta}{r_\infty - g^z} - (\kappa_p + \kappa) \right] \frac{X_t^R}{W_t^U} \tag{29}$$

which is equal to zero when the first inequality of Assumption 7 holds exactly.

We can now understand why U can run permanent trade deficits: When Assumption 7 holds strictly, intermediation rents remain positive and provide the resources to finance permanent trade deficits.

4 Multiple Goods and Exchange Rates

Up to now, our conclusions have abstracted from (real) exchange rate considerations. However, the main point of this section is to show that adding such dimension to the model does not alter the qualitative (and in some cases quantitative) features of the results. While adding multiple goods allows us to generate exchange rate patterns from our shocks that resemble those observed in recent data —in particular, U appreciates vis a vis both, R and (to a lesser extent) E, when asset markets collapse in R— the behavior of capital flows and interest rates remain largely unchanged with the exception of some attenuation in the $U-E$ context and amplification in some $U-R$ cases.

the value of κ_P. The reason for the additional savings is the future rise in interest rates which depresses current asset values (and hence short run rates have to fall to restore these values).

4.1 Preliminaries

Let us return to the framework in Section 2, without an investment margin, but extend it to consider differentiated goods. Each country i produces one type of good X^i, while its consumers have the following constant elasticity preferences (CES):

$$C^i = \left(\sum_j \gamma_{ij}^{\frac{1}{\sigma}} x^{j\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{30}$$

where σ represents the –constant– elasticity of substitution between the goods from any two countries. The coefficients γ_{ij} measure the strength of preferences for the various goods and satisfy $\sum_j \gamma_{ij} = 1$. Assumption 8 below imposes that agents have a preference for their home good. This assumption is well-established empirically. It also generates relative demand effects that will be important for exchange rate dynamics.

Assumption 8 *(Consumption Home Bias) Each agent has a preference for the home good:* $\gamma_{ii} \equiv \gamma > 0.5$.

Let X^U be the numeraire good and define q^j as the price of good j in terms of good U (with the convention $q^U = 1$). Given (30), the Fisher-ideal price indices are:

$$P^i = \left(\sum_j \gamma_{ij} q^{j(1-\sigma)} \right)^{1/(1-\sigma)}$$

and the real exchange rate between countries i and k is

$$\lambda^{ik} = \frac{P^k}{P^i} = \left(\frac{\sum_j \gamma_{kj} q^{j(1-\sigma)}}{\sum_j \gamma_{ij} q^{j(1-\sigma)}} \right)^{1/(1-\sigma)}$$

This expression highlights the importance of consumption home bias for exchange rate movements: if $\gamma_{ij} = \gamma_{kj}$ for all j, then purchasing power parity obtains and the real exchange rate is equal to 1.

Given CES preferences, the demand for good j by residents of country i satisfy:

$$x^{ij} = \gamma_{ij} C^i \left(\frac{q^j}{P^i} \right)^{-\sigma}, \ \forall i, j$$

and equilibrium in the goods market imposes

$$\sum_i x_{ij} = X_j, \ \forall j.$$

Substituting $P^i C^i = \theta W^i$ (where domestic wealth is now measured in terms of U's good), the equilibrium condition for good i can be rewritten as:

$$\theta \sum_i \gamma_{ij} \frac{W^i}{P^i} \left(\frac{q^j}{P^i} \right)^{-\sigma} = X^j, \ \forall j.$$

4.2 A $U-E$ World

We now specialize the model to a symmetric $U-E$ world, and denote by r_t the instantaneous return in terms of the numeraire. By arbitrage, r_t satisfies

$$r_t V_t^i = \delta q_t^i X_t^i + \dot{V}_t^i$$

while wealth dynamics follow

$$\dot{W}_t^i = (1-\delta)\, q_t^i X_t^i + (r_t - \theta)\, W_t^i.$$

As before, adding across countries and using the equality between global wealth and global asset values, one obtains:

$$W_t = V_t = \frac{X_t}{\theta}$$

where $X_t = X_t^U + q_t^E X_t^E$.

Following the same steps as before, the instantaneous interest rate satisfies:

$$r_t = \frac{\dot{X}_t}{X_t} + \delta\theta.$$

The only notable difference is that the (inverse of the) terms of trade q_t^E –and hence the real exchange rate– enters into the determination of global wealth and of the equilibrium interest rate via X_t.

In turn, the terms of trade are determined by the equilibrium on the market for X^U (by Walras' Law, the market for X^E is also in equilibrium):

$$\theta\gamma W_t^U P_t^{U(\sigma-1)} + \theta\,(1-\gamma)\, W_t^E P_t^{E(\sigma-1)} = X_t^U.$$

Let Assumptions 2 and 3 hold, so that the world is initially symmetric with a common rate of growth g, and there is extreme portfolio home bias. Given the symmetry assumption, it is immediate that $q^E = 1$, so that the interest rate satisfies:

$$r = g + \delta\theta$$

while asset values and wealth satisfy

$$V^i = W^i = \frac{X^i}{\theta}.$$

As before, suppose that at $t = 0$ the growth rate of E drops unexpectedly and permanently to:

$$g^E < g.$$

The main initial difference with Section 2 is that now both the interest rate *and* the real exchange rate absorb the shock at impact. To see this, observe that the decline in g^E decreases E's asset values. With Assumption 3 (extreme home portfolio bias), this impoverishes E's residents. Given the consumption-home-bias assumption (Assumption 8), the associated decline in E's consumption falls mostly on the demand for E goods. Equilibrium in the goods markets then requires that q^E falls. This *relative demand effect* implies that U's real exchange rate *appreciates at impact*. It is a direct consequence of both home consumption and portfolio biases. Over time, however, the increase in the *relative supply* of U's good requires that its real exchange rate *depreciates*.

How large is the initial fall and eventual increase in q^E depends on the elasticity of substitution σ. To see this, observe that the relative demands satisfy

$$\frac{x^{iE}}{x^{iU}} \propto (q^E)^{-\sigma}$$

Asymptotically, the ratio of relative demands for at least one country must equal the ratio of relative supply, X^E/X^U. From this, we infer that:

$$\frac{\dot{q}_t^E}{q_t^E} \underset{t\to\infty}{=} \frac{1}{\sigma}(g - g^E).$$

Let us rule out the region $\sigma < 1$ since it implies immiserizing growth. In the feasible region, consider first the $\sigma = 1$ case which yields the starkest departure from the previous section. Given the initial symmetry between E and U, one can show that now terms of trade satisfy

$$q_t^E = \frac{X_t^U}{X_t^E}$$

which implies,

$$x_t^U = \frac{1}{2}.$$

In this extreme case, when growth slows down in E there is no change in the exchange rate at impact, and a gradual increase in q at rate $(g - g^E)$ thereafter. Since the output share is constant, the instantaneous return in terms of X^U is also constant and equal to

$$r = \frac{1}{2}g + \frac{1}{2}\left(g^E + \frac{\dot{q}^E}{q^E}\right) + \delta\theta = g + \delta\theta.$$

One can also check that

$$V_t^i = W_t^i = \frac{q^i X_t^i}{\theta}.$$

Hence neither country needs to run current account imbalances in response to the collapse in g^E. The reason is that the terms of trade offset perfectly the relative decline in output growth, leaving relative wealth and relative output unchanged (when measured in the same units). Log preferences eliminate the model's dynamics.[22]

Consider now the more realistic case where $\sigma > 1$. From the previous discussion, we infer that q^E increases at a smaller rate than the growth differential. For instance, with $\sigma = 4$ —not an unreasonable value[23]— and a growth differential of 1 percent per year, the model implies that U's terms of trade would worsen at 0.25 percent per year. This implies an even slower real exchange rate depreciation, which eventually converges to a steady state value of $((1-\gamma)/\gamma)^{1/(1-\sigma)}$.

[22]This well-known result was first shown by Cole and Obstfeld (1991).

[23]See later in this section for a discussion of the calibration of σ.

We can prove a result similar to Proposition 1 and the associated Metzler diagram in presence of exchange rates. From $r_t = \dot{X}_t/X_t + \delta\theta$, we have

$$r_t = gx_t^U + \left(g^E + \dot{q}_t/q_t\right)\left(1 - x_t^U\right) + \delta\theta.$$

Since x_t^U tends to 1, we obtain:

$$\lim_{t\to\infty} r_t = g + \delta\theta = r_{aut}^U.$$

From

$$\begin{aligned}
\dot{W}_t^E &= (r_t - \theta)\, W_t^E + (1-\delta)\, q_t^E X_t^E \\
r_t V_t^E &= \delta q_t X_t^E + \dot{V}_t^E
\end{aligned}$$

it is apparent that

$$\begin{aligned}
\frac{W_t^E}{q_t^E X_t^E} &\underset{t\to\infty}{\to} \frac{(1-\delta)}{\theta + \left(g^E + \frac{1}{\sigma}(g - g^E)\right) - r_{aut}^U} \\
\frac{V_t^E}{q_t^E X_t^E} &\underset{t\to\infty}{\to} \frac{\delta}{r_{aut}^U - \left(g^E + \frac{1}{\sigma}(g - g^E)\right)}
\end{aligned}$$

Thus, the asymptotic wealth and asset values are similar to those of Proposition 1, the only difference being that g^E has to be replaced by $g^E + \frac{1}{\sigma}(g - g^E) < g^U$.

By a reasoning analogous to that in Lemma 1, we obtain:

$$\frac{CA_t^U}{q_t^E X_t^E} = -\frac{CA_t^E}{q_t^E X_t^E} \underset{t\to\infty}{\to} \left(g^E + \frac{1}{\sigma}(g - g^E)\right)\left[\frac{\delta}{r_{aut}^U - \left(g^E + \frac{1}{\sigma}(g - g^E)\right)} - \frac{(1-\delta)}{\theta + \left(g^E + \frac{1}{\sigma}(g - g^E)\right) - r_{aut}^U}\right] \leq 0$$

As we discussed above, when $\sigma = 1$ there is no current account deficit. At the other extreme, when σ tends to infinity we recover the deficits from Proposition 1 since there is no offsetting long-run exchange rate movement. While there can be non-monotonicities in the intermediate region, the general message is apparent: The possibility of *long-run* exchange rate movements attenuates rather than exacerbates the wealth effects associated with differential growth and hence attenuates asymptotic current account deficits. The main reason behind the latter is that the reduced wealth effects at impact when $\sigma < \infty$ leads to smaller initial trade deficits in U and hence smaller accumulated net external liabilities.

Figure 8 presents a simulation of a decline in g^E in the two-goods model when $\sigma = 4$ and $\gamma = 0.9$.[24] It confirms our conclusions from the one-good model –see Figure 3.

Comparing panels A-D in both figures, we observe that relative price movements limit the size of the current account deficit (Panel A, 8.2 percent versus 17 percent in the single good model) and limit accordingly

[24] Feenstra (1994) finds a value of 4 for σ while Broda and Weinstein (2004) report estimates ranging from 17 at 7-digit between 1972-1988 to 4 for 3-digit goods in 1990-2001. Obstfeld and Rogoff (2004) use an elasticity of 2 while Obstfeld and Rogoff (2000) used a value of 6. Obstfeld and Rogoff (2004) use a weight on domestic tradeable of 0.7. But they also assume a share of expenditure on non-tradeable equal to 0.75. This corresponds to a share of domestic consumption on domestic goods γ of 0.925, not far from our 0.9.

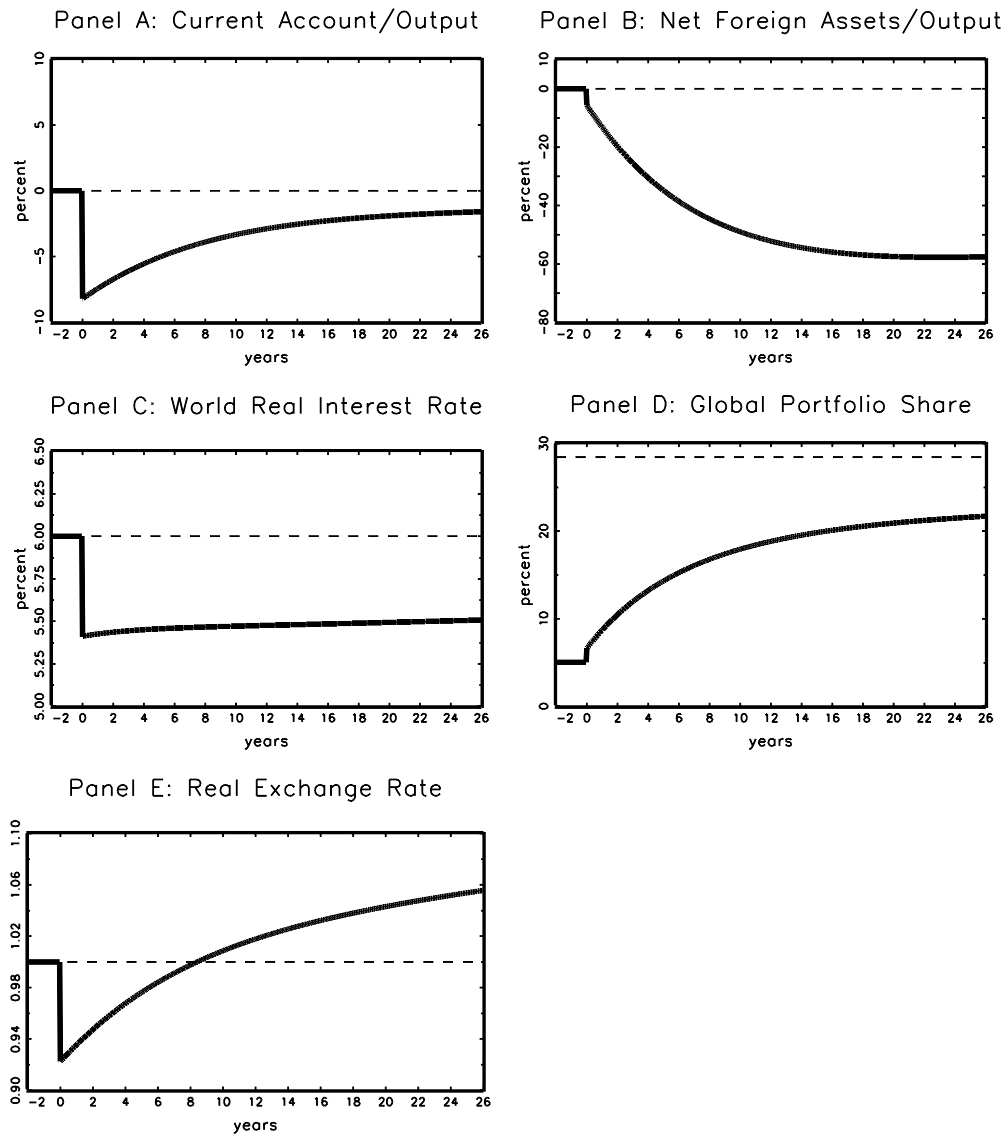


Figure 8: A Collapse in g^E in the two-good model

the build-up in net foreign debt (Panel B, -57 percent after 24 years versus -75 percent of output after 15 years in the single good model). Accordingly, the increase in the share of U in global portfolios is more muted (Panel D). Panel C reports the world's real instantaneous rates of return, defined as the output-weighted average of both countries real returns. The trajectory of the world real interest rates is very similar to the one obtained in panel C in figure 3: from 6 percent, the world interest rate drops to 5.41 percent on impact, then climbs very slowly back toward 6 percent. Finally, Panel E reports the real exchange rate $\lambda = P^E/P^U$. On impact λ appreciates by about 7.8 percent, then gradually but persistently depreciates. Importantly, in our model it is the latter effect that dominates (dampens) wealth effects and hence limits the initial current account deficits in U.

4.3 A $U-R$ World

Consider now the interaction between U and R. As before, let's consider a scenario where R's ability to capitalize financial assets drops from δ to $\delta^R<\delta$ while $g^R=g$.

Following the same steps as before, we obtain:

$$V_t=W_t=\frac{X_t}{\theta}$$

where $X_t=X_t^U+q_t^RX_t^R$, $V_t=V_t^U+V_t^R$ and $W_t=W_t^U+W_t^R$. The instantaneous rate of return now satisfies:

$$r_t=r_{aut}^U+\left(1-x_t^U\right)\left(\frac{\dot{q}_t^R}{q_t^R}-\theta(\delta-\delta^R)\right)$$

which is similar to equation (16), except for the rate of change of the terms of trade.

Since output growth is the same in both countries, a reasoning similar to the previous section implies that $\dot{q}_t^R/q_t^R=0$ asymptotically. The absence of relative supply effect implies that the long run terms of trade are stable. On impact, however, the relative demand effect is still present: the decline in δ^R reduces the value of R's financial assets which, under portfolio home bias, reduces R's financial wealth. Finally, due to consumption home bias, the decline in financial wealth in R reduces disproportionately the relative demand for R's good and induces a decline in q^R.

Asymptotically, substituting $\dot{q}_t^R/q_t^R=0$ into the expression for r_t, we see that the interest rate reaches the value:

$$\lim_{t\to\infty}r_t=r_\infty^+=r_{aut}^U-\left(1-x_\infty^U\right)(\delta-\delta^R)\theta<r_{aut}^U$$

where x_∞^U represents the asymptotic share of U's output. Now Lemma 1 applies, so that

$$\frac{V_t^R}{q_t^RX_t^R}\underset{t\to\infty}{\to}\frac{\delta^R}{r_\infty^+-g};\qquad\frac{V_t^U}{X_t^U}\underset{t\to\infty}{\to}\frac{\delta}{r_\infty^+-g},$$

$$\frac{W_t^R}{q_t^RX_t^R}\underset{t\to\infty}{\to}\frac{1-\delta^R}{\theta+g-r_\infty^+};\qquad\frac{W_t^U}{X_t^U}\underset{t\to\infty}{\to}\frac{1-\delta}{\theta+g-r_\infty^+}$$

and the asymptotic current account satisfies

$$\frac{CA_t^U}{X_t^U}\underset{t\to\infty}{\to}g\left(\frac{1-\delta}{\theta+g-r_\infty^+}-\frac{\delta}{r_\infty^+-g}\right)<0.$$

Since $r_{aut}^U>r_\infty^+$, U runs a permanent current account deficit.

The results of Proposition 2 carry through with one exception: the asymptotic output share x_∞^U may differ from the initial output share x_0^U. It is immediate that the current account deficit will be larger if $r_\infty^+<r^+$, or, from the formula for r_∞^+, if

$$x_\infty^U<x_0^U.$$

Since $x_t^U=X_0^U/\left(q_t^RX_0^R+X_0^U\right)$, this is equivalent to $q_\infty^R>q_0^R$ or $\lambda_\infty>\lambda_0$. If the real exchange rate depreciates asymptotically, which it does in our simulations, the asymptotic current account worsens, compared to the single good case.

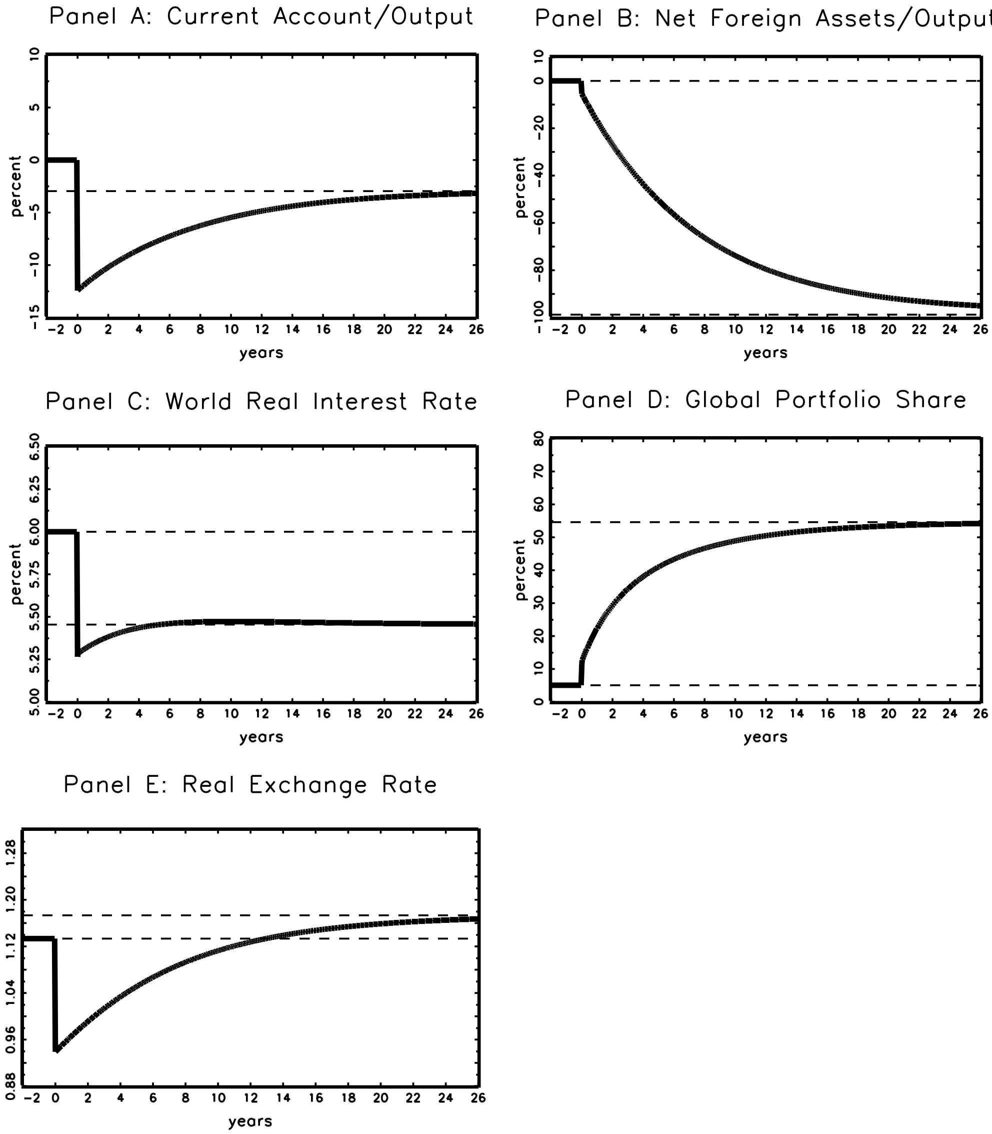


Figure 9: A Collapse in δ^R in the two-good model

The conventional rebalancing channel has implications for exchange rate movements but does not affect the core story for capital flows, which lies somewhere else in global asset markets.[25] In fact, although small for our calibrated parameters, adding the exchange rate dimension allows U to run larger asymptotic current account deficits and hold larger net foreign liabilities. The reason is that the long run depreciation reduces U's share of output (x^U_∞). This is equivalent to a further reduction in the global supply of assets and pushes world interest rates lower (Panel C), reducing U's borrowing costs.

Finally, figure 9 presents the results of a simulation similar to Figure 5. Panel E demonstrates that the real exchange rate appreciates on impact by 17 percent, then depreciates slowly, returning to λ_{0^-} in 12 years, then depreciating by another 3.5 percent. Given the previous discussion, the long run depreciation

[25]The rebalancing channel refers to the mechanism whereby the rapid accumulation of claims on U by R residents, together with the consumption home bias assumption requires a future a depreciation of the real exchange rate.

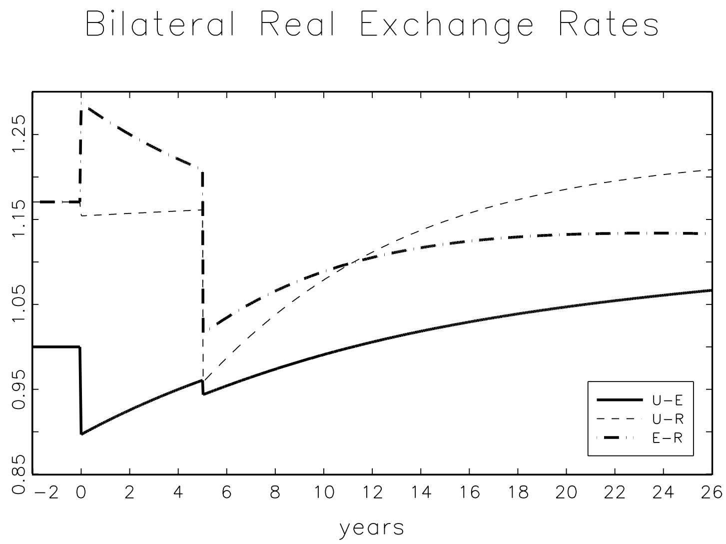


Figure 10: Bilateral Real Exchange Rates in the U-E-R model. Collapse in g^E at $t = 0$ followed by a collapse in δ^R at $t = 5$

of the real exchange rate implies that the asymptotic current account deficits are (slightly) larger than in the single good model (-2.96 percent versus -2.85 percent in the single good model) with a correspondingly higher permanent accumulation of net foreign liabilities (99% of output versus 95%). Panel C shows that our conclusion with respect to the decline in interest rates from the single good model remains largely unchanged.

4.4 The Three Regions World

For completeness, we conclude this section by integrating the three regions. The results are as expected, with the additional insight that since a crash in δ^R has a disproportionate effect on V^U relative to V^E when $g^E < g$, and, given financial home bias, on W^U, at impact U's currency appreciates not only vis-a-vis R's currency but also vis-a-vis E's currency (due to consumption-home-bias). However, this effect is small relative to the depreciation of R exchange vis-a-vis both U and E.

Figure 10 reports the bilateral real exchange rates between U, E and R. We start the economy in a symmetric equilibrium ($g^i = g$ and $\delta^i = \delta$), with $x_0^U = x_0^E = 0.425$ and $x_0^R = 0.15$.[26] We then reduce E's growth at $t = 0$. This leads to an immediate appreciation of $U's$ real exchange rate, as in section 4.2. Then, at $t = 5$, we decrease δ^R so that V^R decreases by 50%. The figure confirms our intuition: the crash in δ^R increases V^U/V^E, which increases the relative demand for good U and appreciates $U's$ real exchange rate relative to E by 2%.

[26] We also assume that the home good preferences are such that $\gamma_{ii} = 0.9$, $\gamma_{ij} = 0.05$ for $i \neq j$.

5 Reversals

Until now, we have only considered the effect of permanent shocks to growth and financial development on global allocations. While indeed many of the factors behind growth and financial development differential seem structural, it is not unconceivable —and is certainly desirable— that they dissipate over time. Convergence forces may prevent E from growing at a permanently lower rate than U. Similarly, R countries are likely to develop financially and eventually increase their domestic supply of financial assets (section 3 shows how this can occur through direct investment). This section considers the effects of reversals in the forces behind 'global imbalances.' Specifically, we study the consequences of an increase in δ^R in a $U - R$ world.[27] We consider two scenarios. In the first one, financial development in R *unexpectedly* reverts to δ twenty years after the initial shock (Figure 11). For the first twenty years, the shock is perceived as permanent, so the dynamics coincide with Figure 5. The increase in δ^R at $t = 20$ is now associated with a sharp reversal in the current account deficit in U, as interest rates increase back to r_{aut}, and R residents rapidly decumulate their financial claims on U. Importantly, this reversal generates a substantial positive valuation effect for U residents, equal to about 22% of U's output (panel B).

This figure highlights that our setup can accommodate a sharp reversal in the current account, but this reversal would stem from a reversal of the fundamental causes that triggered the initial shift (here a sudden increase in δ^R), and not from a spontaneous correction of an "anomaly", as the conventional view would have it.

A more likely scenario is that R (or E) turns the corner gradually. This is our second experiment: the reversal is now *expected* as of time $t = 0$ (Figure 12). Expectations of a reversal lead to a smaller decline in asset values in R relative to U, hence a smaller decline in relative wealth and smaller current account deficits in U (from -20 % of GDP in Figures 5 and 11 to -8 %). Further, these deficits are *gradually* eliminated as asset values in R and U converge back up to their pre-shock level. U eventually runs current account surpluses (after 10 years) as R residents start decumulating U's assets in anticipation of the reversal in δ^R. Yet these surpluses remain small relative to the initial current account deficits.

The message is clear: expectations of future financial development (or growth in E) increase asset values in R (or in E) and sustain a gradual rebalancing.

6 Final Remarks

In this paper we have proposed a framework to analyze the effects of different structural shocks on global capital flows, portfolio shares and interest rates. The framework highlights the connection between a region's relative fundamentals – in particular, its growth potential and the quality (or acceptance) of its financial assets – and its ability to produce financial assets for global savers.

We used the framework to discuss two shocks that we view as particularly relevant in explaining recent

[27] The case of a growth reversal in a $U - E$ world is similar.

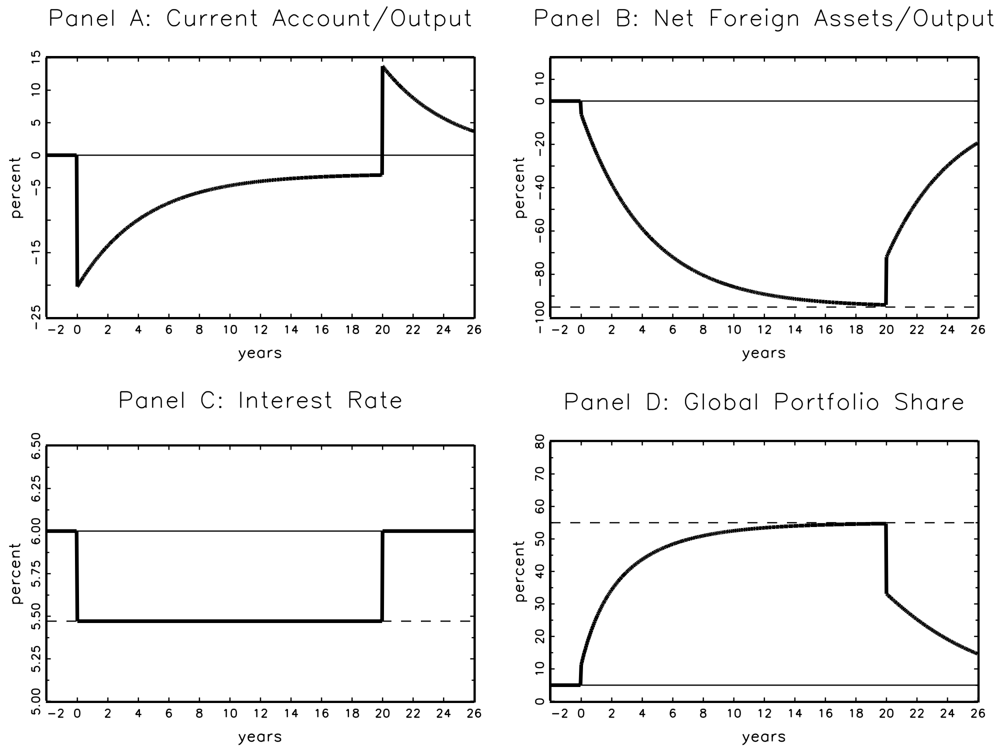


Figure 11: A Collapse in δ^R, followed by an *unexpected* reversal at $t = 20$

"global imbalances" and the "interest rate conundrum." The first one is a sustained growth slowdown in E; The second one is a collapse in the capacity to generate assets in R. The former captures well the effect of a relative slowdown in the Euro area and Japan. The second captures aspects of the Japanese bubble crash in the early 1990s and the developments in much of emerging markets and newly industrialized economies of Asia in the aftermath of the Asian and Russian crises at the end of the 1990s. We also explored the global effects of the interaction between R's limited financial markets and its fast potential growth. All these effects point in the same direction: To a sustained reallocation of savings toward U and to lower interest rates.

The framework is flexible enough to explore a variety of experiments and issues that have been postulated in the "global imbalances" debate. For example, a dimension we did not develop in the main text but is trivial to analyze is that of an increase in a regions' saving propensity (for example, a decline in θ^R). The implications would be similar in terms of the path of capital flows, measured saving rates, interest rates and the interaction with fast growth in R, as those following a crash in δ^R. However the implications would be entirely different for V^R: While a drop in δ^R comes with an initial crash in R's asset prices, an increase in the propensity to save does the opposite. This distinction is important since the dramatic acceleration in capital flows toward the US in the late 1990s from R came with a crash rather a rise in asset values in R. This is not to say that a drop in θ^R is not part of the story, as it is a convenient short-cut to represent the more recent increase in saving rates by commodity producing economies (which have come with high local asset prices) or even to capture demographic factors. Moreover, such drop further strengthens the downward pressure on long rates when combined with fast growth in R. However, in terms of timing it is the crash in

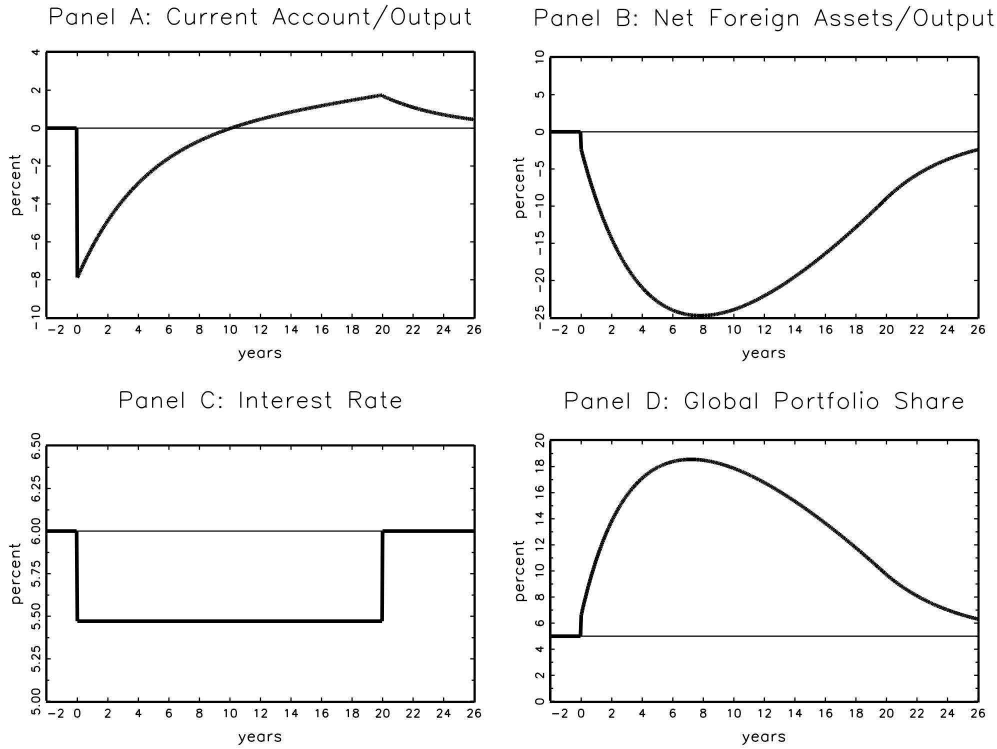


Figure 12: A Collapse in δ^R, followed by an *expected* reversal at $t = 20$

δ^R that most likely started the massive flows from R to U.

One could also model some of the aspects of fiscal deficits in the US as an increase in θ^U. This would indeed lead to current account deficits in U but it would increase rather than reduce interest rates, and hence it is probably not the main factor behind current "global imbalances." Instead, this angle offers a better representation of the current account deficits of the US during the 1980s.

Similarly, one could model the process of globalization as one in which regions are gradually allowed to participate in global capital markets. In that case, one could generate a downward trend in global interest rates as low δ^R economies are integrated. This probably accounts for some of the downward pressure observed on rates since the 1990s.

Finally, a word of caution. Our framework also highlights that the current configuration of global asymmetries is likely to continue building the already large net external liabilities of U. Leverage always comes with risks. We have already illustrated within our framework how an unexpected reversal in the relative growth advantage of U vis-a-vis E, or in R's financial underdevelopment (perhaps the most likely reversal channel), would lead to a sharp reversal in capital flows, interest rates and exchange rates. One could also go outside the model and add a credit-risk concern with U's liabilities and generate a more harmful reversal. Our model has little to say about the latter possibility, although it seems remote. Moreover, one of our main points has been that such risk does *not* follow as an unavoidable outcome of the current scenario, as the latter is consistent with current global asymmetries in growth potential and financial development.

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A Proofs

A.1 Proof of Lemma 1

We have

$$\begin{aligned} V_t &= \int_t^{\infty} \delta X_s e^{-\int_t^s r_u du} ds = \delta X_t \int_t^{\infty} e^{-\int_t^s (r_u - g) du} ds \\ W_t &= W_0 e^{\int_0^t (r_s - \theta) ds} + \int_0^t (1-\delta) X_s e^{\int_s^t (r_u - \theta) du} ds \\ &= (1-\delta) X_t \left[\frac{W_0}{(1-\delta) X_t} e^{\int_0^t (r_s - \theta) ds} + \int_0^t e^{\int_s^t (r_u - \theta - g) du} ds \right] \end{aligned}$$

The Lemma follows from the fact that

$$\begin{aligned} \lim_{t \to \infty} \int_t^{\infty} e^{-\int_t^s (r_u - g) du} ds &= \frac{1}{r - g} \\ \lim_{t \to \infty} \int_0^t e^{\int_s^t (r_u - \theta - g) du} ds &= \frac{1}{g + \theta - r} \end{aligned}$$

and

$$\lim_{t \to \infty} \frac{W_0}{(1-\delta) X_t} e^{\int_0^t (r_s - \theta) ds} = 0$$

when $g < r < g + \theta$.

A.2 Proof of Lemma 3

By definition, we can write:

$$W_t^j = \alpha_t^{j,i} V_t^i + (1 - \alpha_t^{i,j}) V_t^j$$

and the net asset demand as:

$$W_t^j - V_t^j = \alpha_t^{j,i} V_t^i - \alpha_t^{i,j} V_t^j$$

so that:

$$\begin{aligned} CA_t^i &= \dot{W}_t^i - \dot{V}_t^i \\ &= (1-\delta) X_t^i - \theta W_t^i + r_t W_t^i - \dot{V}_t^i \\ &= (1-\delta) X_t^i - \theta W_t^i + r_t (W_t^i - V_t^i) + \delta X_t^i \\ &= X_t^i - \theta W_t^i + r_t (\alpha_t^{i,j} V_t^j - \alpha_t^{j,i} V_t^i) \end{aligned}$$

A.3 The role of assumption 4

Suppose that assumption 4 does not hold. This appendix shows that the essence of our analysis is not affected by this change, although the expressions are less friendly, if we are willing to make the minimal assumption that $g^E > 0$, so that $g > (1-\delta)\theta$ if Assumption 4 does not hold.

Let $x_t^u \equiv X_t^U / X_t$be the relative size of country U's endowment. Since $X_0^U = X_0^E$, we have

$$x_t^u = \frac{X_0^U e^{gt}}{X_0^U e^{gt} + X_0^E e^{g^E t}} = \frac{1}{1 + e^{-(g-g^E)t}}$$

It will prove useful to compute $\int_0^t x_s^u ds$ in closed form

$$\begin{aligned}
\int_0^t x_s^u ds &= \int_0^t \frac{1}{1 + e^{-(g-g^E)x}} dx = \frac{1}{g - g^E} \int_{e^{-(g-g^E)t}}^1 \frac{1}{u(1+u)} du \\
&= \frac{1}{g - g^E} \left[\ln \left(\frac{u}{1+u} \right) \right]_{e^{-(g-g^E)t}}^1 = \frac{1}{g - g^E} \ln \left(\frac{1 + e^{(g-g^E)t}}{2} \right)
\end{aligned}$$

Note that we can express $r_t = \frac{\dot{X}_t}{X_t} + \delta\theta$ as

$$r_t = \delta\theta + g^E + x_t^U \left(g - g^E \right)$$

Solving forward the differential equation for V_t^E, we get

$$\begin{aligned}
V_t^E &= \int_t^\infty \delta X_s^E e^{-\int_t^s r_u du} ds \\
&= \int_t^\infty e^{-\delta\theta(s-t) - g^E(s-t) - (g-g^E)\int_t^s x_h^u dh} \delta X_t^E e^{g^E(s-t)} ds \\
&= \delta X_t^E \int_t^\infty e^{-\delta\theta(s-t) - (g-g^E)\int_t^s x_h^u dh} ds \\
&= \delta X_t^E \int_t^\infty \frac{1 + e^{-(g-g^E)t}}{1 + e^{-(g-g^E)s}} e^{-(g-g^E+\delta\theta)(s-t)} ds
\end{aligned}$$

Similarly, we can solve forward the differential equation for V_t^U

$$\begin{aligned}
V_t^U &= \int_t^\infty \delta X_s^U e^{-\int_t^s r_u du} ds \\
&= \int_t^\infty e^{-\delta\theta(s-t) - g^E(s-t) - (g-g^E)\int_t^s x_h^u dh} \delta X_t^U e^{g(s-t)} ds \\
&= \delta X_t^U \int_t^\infty e^{-\delta\theta(s-t) + (g-g^E)(s-t) - (g-g^E)\int_t^s x_h^u dh} ds \\
&= \delta X_t^U \int_t^\infty \frac{1 + e^{-(g-g^E)t}}{1 + e^{-(g-g^E)s}} e^{-\delta\theta(s-t)} ds
\end{aligned}$$

We can also solve the differential equation for W_t^E and W_t^U, with initial conditions $W_{0^+}^E$ and $W_{0^+}^U$

$$
\begin{aligned}
W_t^E &= W_{0^+}^E e^{\int_0^t (r_s-\theta)ds} + \int_0^t (1-\delta) X_s^E e^{\int_s^t (r_u-\theta)du} \\
&= W_{0^+}^E \exp\left[-(1-\delta)\theta t + g^E t + (g-g^E)\int_0^t x_s^u ds\right] \\
&\quad +(1-\delta)X_t^E \int_0^t \exp\left[-(1-\delta)\theta(t-s) + (g-g^E)\int_s^t x_h^u dh\right] ds \\
&= W_{0^+}^E \frac{e^{g^E t}+e^{gt}}{2} e^{-(1-\delta)\theta t} + (1-\delta)X_t^E \int_0^t \frac{1+e^{-(g-g^E)t}}{1+e^{-(g-g^E)s}} e^{(g-g^E-(1-\delta)\theta)(t-s)} ds \\
W_t^U &= W_{0^+}^U e^{\int_0^t (r_s-\theta)ds} + \int_0^t (1-\delta) X_s^U e^{\int_s^t (r_u-\theta)du} \\
&= W_{0^+}^U \exp\left[-(1-\delta)\theta t + g^E t + (g-g^E)\int_0^t x_s^u ds\right] \\
&\quad +(1-\delta)X_t^U \int_0^t \exp\left[-(1-\delta)\theta(t-s) - (g-g^E)(t-s) + (g-g^E)\int_s^t x_h^u dh\right] ds \\
&= W_{0^+}^U \frac{e^{g^E t}+e^{gt}}{2} e^{-(1-\delta)\theta t} + (1-\delta)X_t^U \int_0^t \frac{1+e^{-(g-g^E)t}}{1+e^{-(g-g^E)s}} e^{-(1-\delta)\theta(t-s)} ds
\end{aligned}
$$

Hence

$$
\begin{aligned}
V_t^E &= \delta X_t^E \int_t^\infty \frac{1+e^{-(g-g^E)t}}{1+e^{-(g-g^E)s}} e^{-(g-g^E+\delta\theta)(s-t)} ds \\
&\underset{t\to\infty}{\sim} \frac{\delta X_t^E}{g-g^E+\delta\theta} \\
W_t^E &= W_{0^+}^E \frac{e^{g^E t}+e^{gt}}{2} e^{-(1-\delta)\theta t} + (1-\delta)X_t^E \int_0^t \frac{1+e^{-(g-g^E)t}}{1+e^{-(g-g^E)s}} e^{(g-g^E-(1-\delta)\theta)(t-s)} ds \\
&\underset{t\to\infty}{\sim} W_{0^+}^E \frac{e^{(g-(1-\delta)\theta)t}}{2} + (1-\delta)X_0^E e^{(g-(1-\delta)\theta)t} \int_0^t \frac{1+e^{-(g-g^E)t}}{1+e^{-(g-g^E)s}} e^{-(g-g^E-(1-\delta)\theta)s} ds \\
&\underset{t\to\infty}{\sim} W_{0^+}^E \frac{e^{(g-(1-\delta)\theta)t}}{2} + (1-\delta)X_0^E e^{(g-(1-\delta)\theta)t} \int_0^\infty \frac{1}{1+e^{-(g-g^E)s}} e^{-(g-g^E-(1-\delta)\theta)s} ds
\end{aligned}
$$

Therefore, it is easy to see that

$$
\begin{aligned}
&V_t^E \underset{t\to\infty}{\sim} \frac{\delta X_t^E}{g-g^E+\delta\theta} \\
&\dot{V}_t^E \underset{t\to\infty}{\sim} \frac{\delta g^E X_t^E}{g-g^E+\delta\theta} \\
&W_t^E \underset{t\to\infty}{\sim} e^{(g-(1-\delta)\theta)t}\left(W_{0^+}^E + (1-\delta)X_0^E\right)\left(\frac{1}{2} + \int_0^\infty \frac{1}{1+e^{-(g-g^E)s}} e^{-(g-g^E-(1-\delta)\theta)s} ds\right) \\
&\dot{W}_t^E \underset{t\to\infty}{\sim} (g-(1-\delta)\theta)e^{(g-(1-\delta)\theta)t}\left(W_{0^+}^E + (1-\delta)X_0^E\right)\left(\frac{1}{2} + \int_0^\infty \frac{1}{1+e^{-(g-g^E)s}} e^{-(g-g^E-(1-\delta)\theta)s} ds\right)
\end{aligned}
$$

Hence

$$
\begin{aligned}
&CA_t^U \underset{t\to\infty}{\sim} -\dot{W}_t^E \\
&CA_t^U \underset{t\to\infty}{\sim} -(g-(1-\delta)\theta)e^{(g-(1-\delta)\theta)t}\left(W_{0^+}^E + (1-\delta)X_0^E\right)\left(\frac{1}{2} + \int_0^\infty \frac{1}{1+e^{-(g-g^E)s}} e^{-(g-g^E-(1-\delta)\theta)s} ds\right)
\end{aligned}
$$

Now the decomposition is:

$$\theta W_t^E - X_t^E \underset{t\to\infty}{\sim} \theta W_t^E$$
$$r_t(V_t^E - W_t^E) \underset{t\to\infty}{\sim} -(g+\delta\theta)W_t^E$$

Therefore, the trade balance is positive while income flows are negative (and larger in absolute value than the trade balance), as in the main text.

A.4 Proof of proposition 3

The first inequality of the first statement follows directly from $(\delta - \delta^R) > 0$, as in Proposition 2. The second inequality follows from the fact that x_t^U declines over time. Asymptotically, r_t converges to r_{aut}^R.

From Lemma 1, we know that

$$\frac{CA_t^U}{X_t^U} \underset{\substack{t\to\infty \\ g^R > g}}{\rightarrow} -g\frac{r_{aut}^U - r_{aut}^R}{\left(g+\theta-r_{aut}^R\right)\left(r_{aut}^R - g\right)} < 0$$

On the other hand, from Proposition 2 we have that

$$\frac{CA_t^U}{X_t^U} \underset{\substack{t\to\infty \\ g^R = g}}{\rightarrow} -g\frac{r_{aut}^U - r^+}{\left(g+\theta-r^+\right)\left(r^+ - g\right)} < 0$$

where $r^+ = r_{aut}^U - \theta\left(1 - x_0^U\right)\left(\delta - \delta^R\right)$ (see (18)). From assumption 5, $r^+ > r_{aut}^R$ and the second statement in the proposition now follows since

$$\frac{r - r_{aut}^U}{\left(g+\theta-r\right)\left(r-g\right)} = \frac{1-\delta}{g+\theta-r} - \frac{\delta}{r-g}$$

is increasing with respect to r.

A.5 The $U - E - R$ model

In this case the equations describing the dynamics of each country's wealth are

$$\begin{aligned}
\dot{W}_t^U &= -\theta W_t^U + (1-\delta)X_t^U + r_t W_t^U \\
\dot{W}_t^E &= -\theta W_t^E + (1-\delta)X_t^E + r_t W_t^E \\
\dot{W}_t^R &= -\theta W^R + (1-\delta^R)X_t^R + r_t W_t^R
\end{aligned}$$

which aggregate to the following differential equation for global wealth

$$\dot{W}_t = \left(1 - \delta + \left(\delta - \delta^R\right)x_t^R\right)X_t + (r_t - \theta)W_t \tag{31}$$

Similarly, the asset pricing equations for each country's tree are

$$\begin{aligned} r_t V_t^U &= \delta X_t^U + \dot{V}_t^U \\ r_t V_t^E &= \delta X_t^E + \dot{V}_t^E \\ r_t V_t^R &= \delta^R X_t^R + \dot{V}_t^R \end{aligned}$$

which imply the following equation for the total value of world assets

$$r_t V_t = \left(\delta - \left(\delta - \delta^R\right) x_t^R\right) X_t + \dot{V}_t \tag{32}$$

As usual, investment equals savings in the world market:

$$W_t = V_t \tag{33}$$

which implies a goods market clearing condition

$$W_t = \frac{X_t}{\theta} \tag{34}$$

The equilibrium interest rate can be solved for

$$\begin{aligned} r_t &= \frac{\dot{X}_t}{X_t} + \theta\left(\delta(1 - x_t^R) + \delta^R x_t^R\right) \\ &= x_t^U g^U + x_t^E g^E + x_t^R g^R + \theta\left(\delta(1 - x_t^R) + \delta^R x_t^R\right) \\ &= x_t^U (g^U + \delta\theta) + x_t^E \left(g^E + \delta\theta\right) + x_t^R (g^R + \delta^R\theta) \end{aligned}$$

Hence the world interest rate is a average of $g^U + \delta\theta$, $g^E + \delta\theta$ and $g^R + \delta^R\theta$ with weights given by the relative size of the endowment of each country.

A.6 Proof of proposition 4

Define r_∞ the asymptotic interest rate. $r_{aut}^R \leq r_\infty < r_{aut}^U$ with equality when $g^R > g$. Note that:

$$\begin{aligned} W_t^E &\underset{t\to\infty}{\sim} \frac{(1-\delta)X_t^E}{g^E + \theta - r_\infty} \\ W_t^U &\underset{t\to\infty}{\sim} \frac{(1-\delta)X_t^U}{g + \theta - r_\infty} \\ W_t^R &\underset{t\to\infty}{\sim} \frac{(1-\delta^R)X_t^R}{g^R + \theta - r_\infty} \end{aligned}$$

and

$$\begin{aligned} V_t^E &\underset{t\to\infty}{\sim} \frac{\delta X_t^E}{r_\infty - g^E} \\ V_t^U &\underset{t\to\infty}{\sim} \frac{\delta X_t^U}{r_\infty - g} \\ V_t^R &\underset{t\to\infty}{\sim} \frac{\delta^R X_t^R}{r_\infty - g^R} \end{aligned}$$

Hence

$$\begin{aligned}\frac{\delta^R}{V_t^E}\frac{\partial V_t^E}{\partial \delta^R} &= \frac{\delta^R}{r_\infty - g^E}\cdot\frac{\partial r_\infty}{\partial \delta^R}\\ \frac{\delta^R}{V_t^U}\frac{\partial V_t^U}{\partial \delta^R} &= \frac{\delta^R}{r_\infty - g}\cdot\frac{\partial r_\infty}{\partial \delta^R}\end{aligned}$$

which implies

$$\frac{\frac{\delta^R}{V_t^U}\frac{\partial V_t^U}{\partial \delta^R}}{\frac{\delta^R}{V_t^E}\frac{\partial V_t^E}{\partial \delta^R}} = \frac{r_\infty - g^E}{r_\infty - g} = 1 + \frac{g - g^E}{r_\infty - g}$$

That is, the long run proportional increase in the value of assets following a collapse in δ^R is larger in U than in E. The results on the current account follow immediately from its definition and the fact that asymptotic wealths are less sensitive than initial wealth to interest rate changes.

A.7 Proof of proposition 5

Let us first focus on the first claim in the proposition. In situation 1, we have

$$\begin{aligned}\dot{W}_t &= \left(1-\kappa x_t^U\right)\frac{\dot{X}_t}{\theta} - \kappa \dot{x}_t^U\frac{X_t}{\theta}\\ &= \frac{X_t}{\theta}\left[g^n x_t^U + g^z - \kappa x_t^U g\right]\end{aligned}$$

Substituting into the asset equation we solve for the interest rate:

$$r_t = g^z + \frac{\theta\bar{\delta}_t}{1-\kappa x_t^U} + \frac{g^n x_t^U}{1-\kappa x_t^U}\left[1-\kappa-\theta\frac{V_t^U}{X_t^U}\right]$$

where $\bar{\delta}_t = \delta x_t^U + \delta^R x_t^R$. Comparing the interest rate at time 0 when there is no investment collapse ($r_0 = g^z + \theta\bar{\delta}_0/\left(1-\kappa\right)$) and where there is an investment collapse, the difference in interest rates is

$$\Delta r_0 = -\kappa\theta\bar{\delta}_0\frac{1-x_0^U}{\left(1-\kappa x_0^U\right)\left(1-\kappa\right)} + \frac{g^n x_0^U}{1-\kappa x_0^U}\left[1-\kappa-\theta\frac{V_0^U}{X_0^U}\right]$$

and this is negative because each term is negative (since U is a borrower, we know that $\kappa X_0^U + \theta W_0^U = I_0^U + C_0^U > X_t^U$). This proves the first claim in the proposition.

Let us now prove the second claim in the proposition. To distinguish variables under our counterfactual situation 2, we adopt the convention to underline those variables. We have

$$\begin{aligned}V_{0^+} &= (1-\kappa\frac{X_0^U}{X_0})\frac{X_0}{\theta} \text{ and}\\ V_{0^+}^R &= \frac{\delta^R X_0^R}{\delta^R X_0^R + \delta X_0^U}V_{0^+}.\end{aligned}$$

Similarly

$$\begin{aligned}\underline{V}_{0^+} &= (1-\kappa)\frac{X_0}{\theta} = V_{0^+} - \kappa\frac{X_t^R}{\theta} \text{ and}\\ \underline{V}_{0^+}^R &= \frac{\delta^R X_0^R}{\delta^R X_0^R + \delta X_0^U}\underline{V}_{0^+}.\end{aligned}$$

Hence

$$\begin{aligned} V^R_{0^+} - \underline{V}^R_{0^+} &= \frac{\delta^R X^R_0}{\delta^R X^R_0 + \delta X^U_0}(\underline{V}_{0^+} - V_{0^+}) = \frac{\delta^R X^R_0}{\delta^R X^R_0 + \delta X^U_0}\kappa\frac{X^R_0}{\theta} \\ &= \frac{V^R_{0^+}}{V_{0^+}}\kappa\frac{X^R_0}{\theta} \end{aligned}$$

Let us first consider situation 1. Assuming extreme home bias, at $t = 0^+$, we have,

$$TB^U_{0^+} = CA^U_{0^+} = \theta W^R_{0^+} - X^R_0 = \theta V^R_{0^+} - X^R_0$$

Let us now analyze situation 2.

$$\begin{aligned} \underline{TB}^U_{0^+} &= \underline{CA}^U_{0^+} = \theta\underline{W}^R_{0^+} - (1-\kappa)X^R_0 = \theta\underline{V}^R_{0^+} - (1-\kappa)X^R_0 \\ &= \theta(V^R_{0^+} - \kappa\frac{X^R_0}{\theta}\frac{V^R_{0^+}}{V_{0^+}}) - (1-\kappa)X^R_0 \\ &= \theta V^R_{0^+} - X^R_0(1 - \kappa(1 - \frac{V^R_{0^+}}{V_{0^+}})) \end{aligned}$$

Hence

$$CA^U_{0^+} < \underline{CA}^U_{0^+}$$

and

$$TB^U_{0^+} < \underline{TB}^U_{0^+}$$

This proves the second claim in the proposition.

A.8 Investment and gross flows

We need to distinguish between the old trees (with δ^R) and the new trees. Define v^{Ro}_t the value of an old R tree, v^{Rn}_t the value of a new R tree and v^U_t the value of a U tree. We have

$$\begin{aligned} r_t v^{Ro}_t &= \delta^R Z^R_t + \dot{v}^{Ro}_t \\ r_t v^{Rn}_t &= \delta Z^R_t + \dot{v}^{Rn}_t \\ r_t v^U_t &= \delta Z^U_t + \dot{v}^U_t \end{aligned}$$

The aggregate value of U trees is $V^U_t = N^U_t v^U_t$ and satisfies

$$r_t V^U_t = \delta X^U_t + \dot{V}^U_t - g^n V^U_t$$

The aggregate value of new trees in R is $V^{Rn}_t = \left(N^R_t - N^R_0\right) v^{Rn}_t$ and satisfies

$$\begin{aligned} r_t V^{Rn}_t &= \delta\left(N^R_t - N^R_0\right) Z^R_t + \left(N^R_t - N^R_0\right)\dot{v}^{Rn}_t \\ &= \delta X^{Rn}_t + \dot{V}^{Rn}_t - g^n N^R_t v^{Rn}_t \end{aligned}$$

Finally, define the aggregate value of the old trees in R as $V^{Ro}_t = N^R_0 v^{Ro}_t$. It satisfies:

$$r_t V^{Ro}_t = \delta^R X^{Ro}_t + \dot{V}^{Ro}_t$$

Aggregate wealth then evolves according to

$$r_t V_t = \delta\left(X_t^U + X_t^{Rn}\right) + \delta^R X_t^{Ro} + \dot{V}_t - g^n V_t^U - g^n N_t^R v_t^{Rn}$$

Let's now consider wealth accumulation equations:

$$\begin{aligned}
\dot{W}_t^U &= (r_t - \theta) W_t^U + (1-\delta) X_t^U + g^n V_t^U + g^n N_t^R v_t^{Rn} - P_t - I_t \\
\dot{W}_t^R &= (r_t - \theta) W_t^R + (1-\delta) X_t^{Rn} + \left(1 - \delta^R\right) X_t^{Ro} + P_t
\end{aligned}$$

Aggregating, we obtain:

$$\dot{W}_t = (r_t - \theta) W_t + (1-\delta)\left(X_t^U + X_t^{Rn}\right) + \left(1-\delta^R\right) X_t^{Ro} + g^n V_t^U + g^n N_t^R v_t^{Rn} - I_t$$

Now equate $W = V$ and infer

$$\theta W_t = X_t (1-\kappa)$$

and the interest rate satisfies

$$\begin{aligned}
r_t &= \frac{\dot{X}_t}{X_t} + \theta\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right]/(1-\kappa) - \frac{\theta}{1-\kappa} g^n \frac{V_t^U + N_t^R v_t^{Rn}}{X_t} \\
&= \frac{\dot{X}_t}{X_t} + \theta\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right]/(1-\kappa) - \frac{\theta}{1-\kappa} g^n \frac{X_t (1-\kappa)/\theta + N_0^R\left[v_t^{Rn} - v_t^{Ro}\right]}{X_t} \\
&= \frac{\dot{X}_t}{X_t} - g^n + \theta\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right]/(1-\kappa) - \frac{\theta}{1-\kappa} g^n \frac{N_0^R\left[v_t^{Rn} - v_t^{Ro}\right]}{X_t}
\end{aligned}$$

As for aggregate output growth, we have

$$\frac{\dot{X}_t}{X_t} = g^n + g^z$$

so that:

$$r_t = g^z + \theta\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right]/(1-\kappa) - \frac{\theta}{1-\kappa} g^n \frac{N_0^R\left[v_t^{Rn} - v_t^{Ro}\right]}{X_t} \tag{35}$$

The last term makes clear that the interest rate will initially be lower with FDI.

The reason is that $g^n\left(V^U + N_t^R v_t^{Rn}\right) > g^n V_t$ so the asset demand in U increases more when there is FDI. This depresses even more interest rates.

Asymptotically, the last term disappears (since v_t^{Rn} and v_t^{Ro} grow at rate g^z while X grows at rate g) and x_t^{Ro} tends to 0, so that

$$r_\infty = g^z + \frac{\theta\delta}{1-\kappa} = r_{aut}$$

Since $v_t^{Rn} > v_t^{Ro}$ and $\delta^R x_t^{Ro} \leq \delta x_t^{Ro}$, we have:

$$r_t \leq r_\infty$$

The solution for the interest rate requires that we feed in a solution for the asset values v_t^{Rn} and v_t^{Ro}. Integrating forward, they satisfy:

$$\begin{aligned}
v_t^{Ro} &= \delta^R Z_t^R \int_t^\infty e^{-\int_t^s (r_u - g^z) du} ds \\
v_t^{Rn} &= \delta Z_t^R \int_t^\infty e^{-\int_t^s (r_u - g^z) du} ds
\end{aligned}$$

so that $v_t^{Ro}/v_t^{Rn} = \delta^R/\delta$ and we obtain:

$$r_t = g^z + \frac{\theta}{1-\kappa}\left[\delta\left(x_t^U + x_t^{Rn}\right) + \delta^R x_t^{Ro}\right] - \frac{\theta}{1-\kappa} g^n \frac{V_t^{Ro}}{X_t^{Ro}} x_t^{Ro}\left(\delta/\delta^R - 1\right) \tag{36}$$

where

$$V_t^{Ro} = \delta^R X_t^{Ro} \int_t^{\infty} e^{-\int_t^s (r_u - g^z)du} ds \tag{37}$$

$$\dot{V}_t^{Ro} = -\delta^R X_t^{Ro} + r_t V_t^{Ro} \tag{38}$$

What complicates the problem is that the equilibrium interest rate depends upon the current value of V_t^{Ro}/X_t^{Ro} which in turn depends upon the entire sequence of future interest rates.

To solve this problem, define $\hat{v}_t^{Ro} = V_t^{Ro}/X_t^{Ro} = v_t^{Ro}/Z_t^R$. It satisfies

$$\frac{d\hat{v}_t^{Ro}}{dt} = (r_t - g^z)\,\hat{v}_t^{Ro} - \delta^R$$

and the interest rate can be expressed in terms of $\hat{v}_t^{Ro}$ and x_t^{Ro} as:

$$r_t = g^z + \frac{\theta}{1-\kappa}\left[\delta\left(1 - x_t^{Ro}\right) + \delta^R x_t^{Ro}\right] - \frac{\theta}{1-\kappa} g^n \hat{v}_t^{Ro} x_t^{Ro}\left(\delta/\delta^R - 1\right)$$

If we note further that x_t^{Ro} follows simple dynamics:

$$\dot{x}_t^{Ro} = -g^n x_t^{Ro}$$

we obtain a single equation for $\frac{d\hat{v}_t^{Ro}}{dt}$ with a forcing term x_t^{Ro} :

$$\frac{d\hat{v}_t^{Ro}}{dt} = \frac{\theta}{1-\kappa}\left[\delta\left(1 - x_t^{Ro}\right) + \delta^R x_t^{Ro} - g^n \hat{v}_t^{Ro} x_t^{Ro}\left(\delta/\delta^R - 1\right)\right]\hat{v}_t^{Ro} - \delta^R$$

We can solve this differential equation by '*reversing time*'. Since $r_t \to r_{aut}$, $\hat{v}_t^{Ro}$ settles to:

$$\hat{v}_\infty^{Ro} = \frac{\delta^R}{\delta}\frac{1}{\theta}$$

We start at $t = \infty$ with x^{Ro} very close to 0 and $\hat{v}^{Ro} = \hat{v}_\infty^{Ro}$ then move 'back' in time until $x^{Ro} = x_0^{Ro}$.

Finally, after we find the solution, we integrate backward the budget constraint to obtain wealth using $w_t^U = W_t^U/X_t^U$ and

$$\begin{aligned}
\dot{w}_t^U &= \frac{\dot{W}_t^U}{X_t^U} - g\, w_t^U \\
&= \frac{(r_t - \theta)\, W_t^U + (1-\delta)\, X_t^U + g^n V_t^U + g^n N_t^R v_t^{Rn} - P_t - I_t}{X_t^U} - g w_t^U \\
&= (r_t - \theta - g)\, w_t^U + \left(1 - \delta - \frac{\kappa}{x_t^U}\right) + g^n\left(\hat{v}_t^U + \frac{N_t^R v_t^{Rn}}{X_t^{Rn}}\frac{x_t^{Rn}}{x_t^U} - \kappa_p \frac{x_t^{Rn}}{x_t^U}\right) \\
&= (r_t - \theta - g)\, w_t^U + \left(1 - \delta - \frac{\kappa}{x_t^U}\right) + g^n\left(\frac{1-\kappa}{\theta}\frac{1}{x_t^U} - \hat{v}_t^{Ro}\frac{x_t^{Ro}}{x_t^U}\left(1 - \frac{\delta}{\delta^R}\right) - \kappa_p \frac{x_t^{Rn}}{x_t^U}\right)
\end{aligned}$$

where the last line uses:

$$V_t = \frac{1-\kappa}{\theta}\cdot X_t = V_t^U + N_t^R v_t^{Rn} + N_0^R v_t^{Ro}\left(1 - \frac{\delta}{\delta^R}\right)$$

A.9 Solving the Model with Exchange Rates

We use a shooting algorithm to solve for the initial terms of trade q^i_{0+} and asset values V^i_{0+} after the shock. Define $w_t = W^U_t/X^U_t$ and $x_t = X^U_t/\sum_i q^i_t X^i_t$. The system (w_t, x_t, q^i_t) satisfies:

$$\dot{w}_t = (r_t - \theta - g)w_t + (1-\delta) \tag{39}$$

$$1 = \theta\gamma w_t P_t^{U(\sigma-1)} + (1-\gamma)\left(\frac{1}{x_t} - \theta w_t\right) P_t^{i(\sigma-1)} \tag{40}$$

$$\dot{x}_t = x_t\,(1-x_t)\left(g - g^i - \frac{\dot{q}^i_t}{q^i_t}\right) \tag{41}$$

$$r_t = x_t\,(g+\delta\theta) + (1-x_t)\left(g^i + \frac{\dot{q}^i_t}{q^i_t} + \delta^i\theta\right) \tag{42}$$

Equation (39) is the wealth dynamics for country i. Equation (40) is the equilibrium condition on the market for good U. Equation (41)characterizes the law of motion of relative output. Unlike the one-good model, the path for future interest rates depends upon the future sequence of terms of trade, which depends upon the current and future asset values.

We start with a guess for the asset values V^i_{0+} immediately after the shock. Given the initial portfolio allocation, we infer the initial wealth distribution W^i_{0+}. We then use (40) to solve for the initial terms of trade q_{0+}. Finally, we integrate (39)-(42) forward to construct the path of future interest rates and terms of trade r_t, q_t consistent with equilibrium on the goods markets. We then use

$$\begin{aligned} V^i_{0+} &= \delta^i \int_0^\infty q^i_t X^i_t e^{-\int_0^s r_u du} ds \\ &= q^i_0 X^i_0 \delta^i \int_0^\infty e^{-\theta \int_0^s \bar{\delta}_u du} \frac{x^i_s}{x^i_0} ds \end{aligned}$$

to update our guess for V^i_{0+}, where $\bar{\delta}_t = \sum_i x^i_t \delta^i$ is the average (time-varying) capitalization ratio.

B Non-Ricardian environments

In this appendix, we show how two standard non-Ricardian models – Blanchard's model and Weil's model – generate an aggregate consumption function of the form

$$C_t = \tilde{\theta}(W_t + H_t)$$

where W_t is aggregate tradeable financial wealth in the economy and H_t is the aggregate nontradeable wealth of agents *currently alive.* In those models, $H_t < N_t$ where N_t is the net nontradeable wealth of agents *currently alive and to be born in the future.* The quantity $N_t - H_t$ is then the net non tradeable wealth that cannot be pledged or consumed against by agents currently alive. Our model in the main text is simply one in which $H = 0$, which we show to be a special case of expanded versions of Blanchard (1985) and Weil (1987)'s models.

B.1 Blanchard's model

In this section, we modify the preferences and demographics of our model and adopt the specification in Blanchard (1985).

We keep the production side of our model unaltered: we consider a continuous-time endowment economy, where the aggregate endowment at date t is X_t and grows at rate g. There are two assets in the economy. The first asset can be traded across cohorts. It pays a dividend δX_t every period. The second asset cannot be traded *across cohorts*. It is an *annuity* that pays $z(s,t)$ at time t to an agent born at s.[28] We assume that the aggregate income from that nontraded asset equals $(1-\delta) X_t$ at time t:

$$\int_{-\infty}^{t} z(s,t)\, p e^{-p(t-s)} ds = (1-\delta) X_t$$

where p represents each agent's constant probability of death p. At any instant in time, a new cohort whose size is normalized to p is born. There is a competitive life-insurance sector: agents may contract to make or receive payments contingent on their death. In the absence of a bequest motive, and if negative bequests are prohibited, agents with *tradeable* wealth w enter in a contract which transfers their tradeable wealth to the insurance company contingent on their death. In equilibrium, contracts are actuarially fair: a contract pays w to the insurance companies if the agent dies, and pays the agent pw if he lives.

As in Blanchard, we assume that utility is logarithmic with discount factor $\tilde{\theta}$. Under these conditions, aggregate consumption is given by

$$C_t = (p+\tilde{\theta})(W_t + H_t)$$

where H_t represents the aggregate nontradeable wealth of agents *currently alive*. If we define $h(s,t)$ the time-t value of the annuity for an agent born at time $s<t$, and $R(t,z) = \exp\left[-\int_t^z (r_u + p)\, du\right]$ the discount factor between time t and time $z \geq t$, we obtain:

$$\begin{aligned} h(s,t) &= \int_t^{\infty} z(s,u)\, R(t,u)\, du \\ H_t &= \int_{-\infty}^{t} h(s,t)\, p\, e^{-p(t-s)} ds \end{aligned}$$

Aggregate (financial) wealth W_t evolves according to

$$\dot{W}_t = r_t W_t + (1-\delta) X_t - (p+\tilde{\theta})(W_t + H_t) \tag{43}$$

The value of the tradeable asset, V_t, evolves according to:

$$r_t V_t = \dot{V}_t + \delta X_t$$

and the asset market clears if and only if $W_t = V_t$.

The only difference between this model and the model in the main text is the presence of the term H_t on the right hand side of (43). The determination of nontradable wealth H_t depends on how the aggregate income from the nontradeable asset $(1-\delta) X_t$ is distributed.

[28] This is equivalent to a set-up with one asset, but where only the fraction δX_t can be capitalized and traded across cohorts.

We first consider the case where $(1-\delta)X_t$ is distributed over time, as in Blanchard (representing labor income in his case). In that case, H_t evolves according to:

$$\dot{H}_t = (r_t + p) H_t - (1-\delta) X_t$$

while the evolution of N_t is:

$$\dot{N}_t = r_t N_t - (1-\delta) X_t.$$

These two expression differ as long as $p > 0$, and it follows from them that in this case $N > H$ throughout.

Finally, we consider the case where $(1-\delta)X_t$ is given as an initial endowment to agents born at date t. In that case, nontradeable wealth H_t is zero (while N_t remains unchanged), and we recover exactly the same differential equations for aggregate wealth as in the model in the main text if we replace θ in the main text in place of $p + \tilde{\theta}$, the effective discount rate.

$$\begin{aligned} \dot{W}_t &= (r_t - \theta) W_t + (1-\delta)X_t \\ C_t &= \theta W_t \end{aligned}$$

B.2 Weil's model

It is important to realize that what matters is that $N > H$, *not* that agents have a finite horizon. This point can be highlighted with Weil (1987) model. In this model, population size grows at rate n_t. Agents of each generation are infinitely-lived log-utility consumers.

Let us keep the production side of our model unaltered: we consider a continuous-time endowment economy, where the endowment at date t is X_t. There are two assets in the economy. The first asset can be traded across cohorts. It pays a dividend δX_t every period. The second asset cannot be traded across cohorts. It is an *annuity* that pays $z(s,t)\, e^{-\int_{-\infty}^{s} n_u du}$ at time t to an agent born at time s. We assume that the aggregate income from that nontraded asset equals $(1-\delta) X_t$ at time t:

$$\int_{-\infty}^{t} z(s,t)\, ds = (1-\delta) X_t$$

Agents can trade shares in the tradable asset. The endowment grows at rate g.

Weil shows that aggregate consumption is given by

$$C_t = \tilde{\theta}(W_t + H_t)$$

where W_t is tradeable financial wealth and H_t measures non-tradeable wealth. Aggregate wealth W_t evolves according to

$$\dot{W}_t = r_t W_t + (1-\delta)X_t - \tilde{\theta}(W_t + H_t) \tag{44}$$

The value of assets V_t evolves according to

$$r_t V_t = \dot{V}_t + \delta X_t$$

and the asset market clears if and only if $W_t = V_t$.

The only difference between Weil's model and the model in the main text is the presence of non tradeable wealth H_t on the right hand side of (44). The determination of H_t depends on the way the aggregate annuity income $(1-\delta)\,X_t$ is distributed.

As Blanchard, Weil considers the case where $(1-\delta)X_t$ is split equally among agents. In that case, aggregate nontradable wealth H_t evolves according to

$$\begin{aligned} h(s,t) &= \int_t^{\infty} z(s,u)\,R(t,u)\,du \\ H_t &= \int_{-\infty}^{t} h(s,t)\,ds \end{aligned}$$

where $R(t,z) = \exp\left[-\int_t^z r_u du\right]$. We obtain:

$$\begin{aligned} H_t &= \int_t^{\infty} (1-\delta)\,X_u \exp\left[-\int_t^u n_v dv\right] R(t,u)\,du \\ \dot{H}_t &= (r_t + n_t)\,H_t - (1-\delta)\,X_t \end{aligned}$$

Again, this contrasts with the corresponding expressions for N_t:

$$\begin{aligned} N_t &= \int_t^{\infty} (1-\delta)\,X_u R(t,u)\,du \\ \dot{N}_t &= r_t N_t - (1-\delta)\,X_t \end{aligned}$$

It is apparent that $N_t > H_t$ as long as $n > 0$.

Alternatively, we can consider the case where $(1-\delta)X_t$ is given exclusively as an initial endowment to agents born at date t. In that case, non tradeable wealth H_t is zero, and we recover exactly the same differential equations for aggregate wealth as in the model in the main text (with $\tilde{\theta} = \theta$)

$$\dot{W}_t = \left(r_t - \tilde{\theta}\right) W_t + (1-\delta)X_t$$

B.3 The Meltzer Diagram

B.3.1 Blanchard's model

Consider the Blanchard model summarized above, assuming that non-tradeable asset income $(1-\delta)X_t$ is distributed across agents as a flow. Imagine a small open economy growing at rate g and facing a constant interest rate $g + p + \tilde{\theta} > r > g + \tilde{\theta}$. On the balanced growth path:

$$\lim_{t\to\infty} \frac{W_t}{X_t} = \frac{\left(r - g - \tilde{\theta}\right)(1-\delta)}{(p + r - g)\,(p + \tilde{\theta} + g - r)} \tag{45}$$

$$\frac{V_t}{X_t} = \frac{\delta}{r-g} \tag{46}$$

$$\frac{H_t}{X_t} = \frac{1-\delta}{r+p-g}$$

$$\frac{N_t}{X_t} = \frac{1-\delta}{r-g}$$

The asset demand curve (45) is increasing in r and decreasing in δ. While the expression for the interest rate has no closed form solution in this case, the conclusions are qualitatively similar to the ones we stress as long as $p > 0$.[29]

The asset supply curve (46) is decreasing in r and increasing in δ. Since for a given interest rate, V_t/X_t goes up with δ, this implies that the autarky interest rate defined implicitly in the following equation is increasing in δ :

$$\frac{(r_{aut}-g)\left(r_{aut}-g-\tilde{\theta}\right)}{(p+r_{aut}-g)\,(p+\tilde{\theta}+g-r_{aut})}=\frac{\delta}{1-\delta}$$

For $r \neq r_{aut}$, we can express the current account deficit on the balanced growth path:

$$\frac{CA_t}{X_t}=g\left[\frac{\left(r-g-\tilde{\theta}\right)(1-\delta)}{(p+r-g)\,(p+\tilde{\theta}+g-r)}-\frac{\delta}{r-g}\right]$$

Hence we can perform a Metzler diagram analysis as in the main text of the paper: the current account is increasing in r, and decreasing in δ.

What is novel is that we can now distinguish between the role of $\tilde{\theta}$ and p. The asset supply curve is invariant with respect to these parameters. The asset demand curve is decreasing in p and in $\tilde{\theta}$. Hence a shortening of the time horizon or a higher discount rate are forces for a current account deficit.

B.3.2 Weil's model

Consider the Weil model summarized above, assuming that non tradable asset income $(1-\delta)X_t$ is distributed as a flow over time. Imagine a small open economy growing at rate g and facing a constant interest rate r, such that $r+n > g+\tilde{\theta} > r > g$. Then, on the balanced growth path,

$$\begin{aligned}\lim_{t\to\infty}\frac{W_t}{X_t} &= \frac{r+n-g-\tilde{\theta}}{g+\tilde{\theta}-r}\,\frac{(1-\delta)}{r+n-g}\\ \frac{V_t}{X_t} &= \frac{\delta}{r-g}\\ \frac{H_t}{X_t} &= \frac{1-\delta}{r+n-g}\\ \frac{N_t}{X_t} &= \frac{1-\delta}{r-g}\end{aligned}$$

As above, the asset supply curve is decreasing in r and increasing in δ, while the asset demand curve is increasing in r and decreasing in δ. The latter is again a consequence of the non-Ricardian feature of this environment.

The asset market clears if and only if r is given by:

$$\frac{n-(g+\tilde{\theta}-r_{aut})}{g+\tilde{\theta}-r_{aut}}\,\frac{r_{aut}-g}{r_{aut}-g+n}=\frac{\delta}{1-\delta}$$

[29]Note that $p > 0$ captures the non-Ricardian feature of this model. When p converges to zero, r converges to $g+\tilde{\theta}$ and no longer depends on δ.

When $n = 0$, we find the usual condition $r = g + \tilde{\theta}$. With $n > 0$, r depends positively on δ.

The current account is given by:

$$\frac{CA_t}{X_t} = g\left[\frac{r+n-g-\tilde{\theta}}{g+\tilde{\theta}-r}\frac{(1-\delta)}{r+n-g} - \frac{\delta}{r-g}\right]$$

Hence we can perform a Metzler diagram analysis as in the main text of the paper: the current account is increasing in r, and decreasing in δ.

C "Calibration"

This section discusses the choice of parameters underlying Figures 3-10. The 'calibration' of the model requires parameter values for δ, θ, g, x_0, α_0^{iU}, α_0^{Ui}, $(g - g^E)$ and $(\delta - \delta^R)$. We chose to assign parameters approximately based on US aggregate data. Table 1 summarizes our parameter assumptions.

Parameter	θ	g	δ	x_0^E	x_0^R	μ_{0-}^{iU}	NA_{0-}^U/X_0^U	$\frac{\Delta V^R}{V^R}\|_{t=0}$	$(g-g^E)$	$(\delta-\delta^R)$
Value	0.25	3%	0.12	0.5	0.3	0.05	0	-0.5	1.11%	0.07

Table 1: Main Parameters

According to (4), we should think of θ as the output to financial wealth ratio, X/W. We obtain an estimate of W as the net financial worth of the household sector. According to the US Flow of Funds, it is equal to \$48.52 trillion in 2004.[30] With a US GDP of \$11.73 trillion in 2004, this implies $\theta = \frac{11.73}{48.53} \sim 0.24$. In the simulations, we round this parameter to 0.25. Average output growth in the U.S. between 1950 and 2004 equals 3.33%. We round this number and set the growth rate g to 3 percent. Finally, we assume a value of r_{aut} equal to 6%. This implies a value of δ of $(r-g)/\theta = 0.12$. [31]

We now turn to the output shares. We define U as the U.S., the U.K. and Australia. These countries are good asset suppliers, and experienced robust growth in the past decade. We identify E with developed non-oil producing countries with sound financial markets, but a lackluster growth performance. Accordingly, we define E as countries from the European Union (less the UK), Iceland, Japan, New Zealand, and Switzerland. Finally, we identify R with developing and oil producing countries with a good income growth potential, but limited asset production capacity.[32]

[30] See the Balance Sheet Table B100, line 42 of the September 2005 release.

[31] Another possible way to calibrate δ is to observe that in steady state, the P/E ratio is $V/\delta X = 1/\delta\theta$. The P/E ratio for the S&P 500 averages 18.2 for the period 1950-2005.(see Robert Shiller's webpage at http://www.econ.yale.edu/~shiller/data.htm).) This yields $\delta = 0.22$,. This value of δ would imply a risk free rate of 8% which we view as too high. Since not all assets in the economy are capitalizable, we prefer our estimate of δ.

[32] The list includes Argentina, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, Egypt, Hong-Kong, India, Indonesia, Korea, Mexico, Malaysia, Nigeria, Panama, Peru, Philippines, Poland, Russia, Singapore, Thailand and Venezuela. Output data for Poland and Russia starts in 1990.

We measure the initial output share as the average output share between 1980 and 2003.[33] We find

$$\begin{aligned} x_0^E &= \frac{X_0^E}{X_0^E + X_0^U} \approx 0.50 \\ x_0^R &= \frac{X_0^R}{X_0^R + X_0^U} \approx 0.30. \end{aligned}$$

Lastly, we assume that the initial portfolio share for U-trees equals the share of US assets in ROW financial wealth, as estimated in figure 1(c). We adopt an initial value of 0.05. Figure 1(c) is constructed as the ratio of US gross external liabilities (from the BEA's US International Investment Position) to the Rest of the World's financial wealth. To estimate the latter, we calculate the ratio of financial wealth to output for the US, the EU and Japan between 1982 and 2004.[34] We find a GDP weighted average of 2.48. We apply this ratio to the Rest of the World GDP. For 2004, we estimate a financial wealth of \$72 trillion for the ROW and \$36 trillion for the US.

We set:

$$\mu_{0-}^{iU} = \frac{\alpha_0^{iU} V_{0-}^U}{W_{0-}^i} = 0.05 \tag{47}$$

where $i \in \{E, R\}$. Furthermore, we assume that the initial net foreign asset position is 0.[35] This implies that

$$V_{0-}^i = W_{0-}^i = \frac{X_0^i}{\theta}.$$

Substituting into (47), we obtain

$$\alpha_0^{iU} = \mu_{0-}^{iU} \frac{x_0^i}{1 - x_0^i}$$

which yields:

$$\begin{aligned} \alpha_0^{EU} &= 0.05 \\ \alpha_0^{RU} &= 0.02. \end{aligned}$$

Finally, since

$$W_{0-}^U - V_{0-}^U = \alpha_0^{Ui} V_{0-}^i - \alpha_0^{iU} V_{0-}^U = 0$$

we find

$$\alpha_0^{Ui} = \mu_{0-}^{iU} = 0.05$$

We now describe the parameters for our shocks. We set the decline in E's growth rate, $(g - g^R) = 1.11\%$. According to the WDI, E's average growth rate between 1980 and 1992 was 2.73% and only 1.63% between 1992 and 2003 (ppp-adjusted).

[33] We use GDP data in current dollars from the World Development Indicators.

[34] Sources: US: Flow of Funds, Table B100 line 8, household financial assets; EU: Table 3.1 of the ECB Bulletin, financial and capital account of the non financial sector; Japan: Flow of Funds, households total financial assets, available at http://www.boj.or.jp/en/stat/stat_f.htm.

[35] According to the Bureau of Economic Analysis, the US had a zero net foreign asset position in 1988.

We calibrate the decline in δ^R so that it matches the decline in asset values around the time of the Asian crisis. From Section 2.3, R's assets price drops from $V^R_{0-} = X^R_0/\theta$ before the shock to $V^R_{0+} = \delta^R/\theta\bar{\delta}X^R_0$ where $\bar{\delta} = \left(x^U_0\delta + \left(1 - x^U_0\right)\delta^R\right)$ is the world capitalization index. Hence the drop in asset values at $t = 0$ is

$$\frac{\Delta V^R}{V^R}|_{t=0} = \delta^R/\bar{\delta} - 1 < 0.$$

Solving this expression for δ^R, we obtain

$$(\delta - \delta^R) = \delta\left(1 + \frac{x^U_0\left[1 + \frac{\Delta V^R}{V^R}|_{t=0}\right]}{\left[\frac{\Delta V^R}{V^R}|_{t=0}\left(1 - x^U_0\right) - x^U_0\right]}\right).$$

The decline in dollar asset values was 37 percent in Hong-Kong, 75 percent in Korea and 83 percent in Indonesia.[36] We conservatively consider a decline of 50 percent. This implies:

$$(\delta - \delta^R) = 0.07;\ \delta^R = 0.05$$

[36]We calculated the decline between July 1997 and January 1998 of the Hang Sen Composite Index (Hong Kong), the KOSPI (Korea) and the Jakarta Stock Index (Indonesia). All price indices were converted into dollars using daily exchange rates.

Comments on "Global Imbalances and Low Interest Rates: An Equilibrium Model vs a Disequilibrium Reality" by Ricardo Caballero, Emmanuel Farhi & Pierre-Olivier Gourinchas

Jeffrey Frankel[1]

I. Introduction

Caballero, Farhi & Gourinchas (2006) are motivated by three current properties of the world financial system:

- Fact 1: US current account deficits are large and rising.
- Fact 2: Long-term interest rates have been low since 2002.
- Fact 3: The share of US assets in world portfolios has been rising.

Fact 3 follows naturally from fact 1; Fact 2 is the real anomaly.

The C, F & G model is a tour-de-force. It shows how all three properties could be the outcome of an equilibrium situation. The model features three regions: a high-growth high-finance *"U"* zone (US, UK, Australia), a low-growth high-finance *"E"* zone (the euro area plus Japan), and a high-growth low-finance *"R"* zone (the rest of world). The model is fully developed. I like the assumption that only a certain fraction δ of future income can be capitalized into tradable financial assets, and that this varies with the quality of countries' institutions. I like too that the authors build up the model step by step:

- Small county
- 2-countries: *U & E*
- 2 countries: *U & R*
- 3 countries.

The paper allows for various other parameter shifts and extensions, including (importantly) investment slumps & FDI (part 3).

The basic idea is that "fast growth in R [essentially emerging markets] coupled with their inability to generate local store of value instruments increases their demand for saving instruments from *U* and *E*. More growth potential in *U* than in *E* means that a larger share of global saving flows to *U*" (p 4). The model would indeed account for the three facts, if true. It is driven by the combination of (i) a hypothesized collapse in capacity of *R* to generate attractive assets, and (ii) a growth slowdown in the €-zone and Japan. These disturbances fit the 1990s fairly well. My one concern, however, is that they don't fit 2003-06 as well, which is the puzzle period, that is, the period that featured the record US current account deficits coinciding with low long-term interest rates. Emerging markets *have* had a high capacity during 2003-06 to generate assets that others want (in contrast to the crises of the late 1990s). I would say δ_R today is above where it was in the 1980s, not below. Even the economies of Japan and Germany have recently recovered from their decade-long slumps.

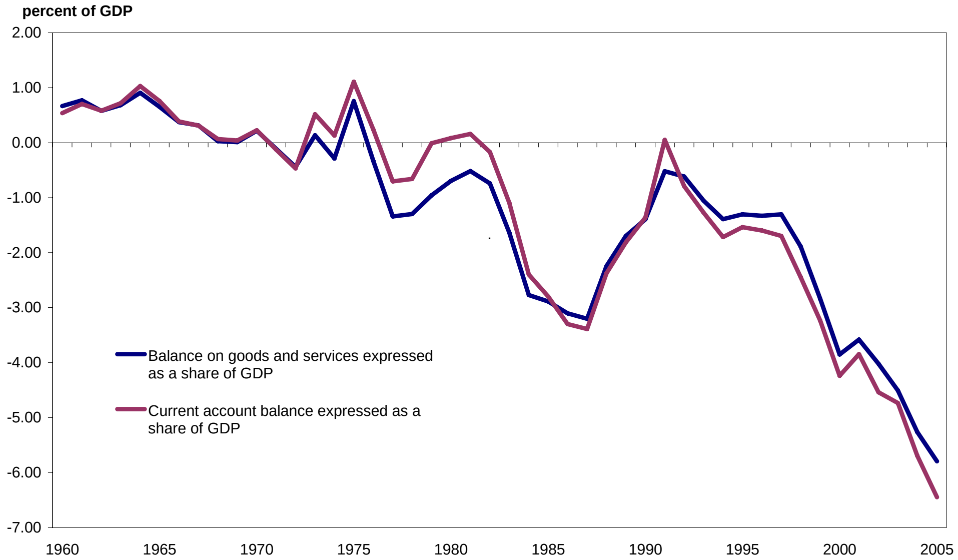
[1] Harpel Professor of Capital Formation and Growth, Harvard University

I won't try to do the model justice in the rest of my comments. Instead, I will review the topic of the global imbalances - mainstream view vs dissenters - before locating CFG in this space of viewpoints.

Figure 1 (1960-2005) illustrates the alarming rate at which the US trade and current account balances are deteriorating.

Figure 1

US Trade Balance and Current Account Balance, 1960-2005



Sources: Department of Commerce (Bureau of Economic Analysis)

The US deficits hit record levels in 2005: 6 ½ % GDP for the current account deficit. These levels would set off alarm bells if incurred in Brazil, Turkey or South Africa. There are likely harmful effects in the short, medium, and long terms: The short-term danger is protectionism in the US Congress, which has taken the form of scapegoating China for our problems. The medium-term danger is a hard landing for the dollar, stemming from the rising dependence on foreign investors to finance the deficits[2]. The long-term danger, from the viewpoint of Americans, stems from the high net debt to the rest of the world, now at about $3 trillion and still far from signs of reaching a plateau. To service this debt, America's grandchildren will suffer a reduced standard of living. Furthermore, dependence on foreign central banks may eventually bring about a loss of US global hegemony.

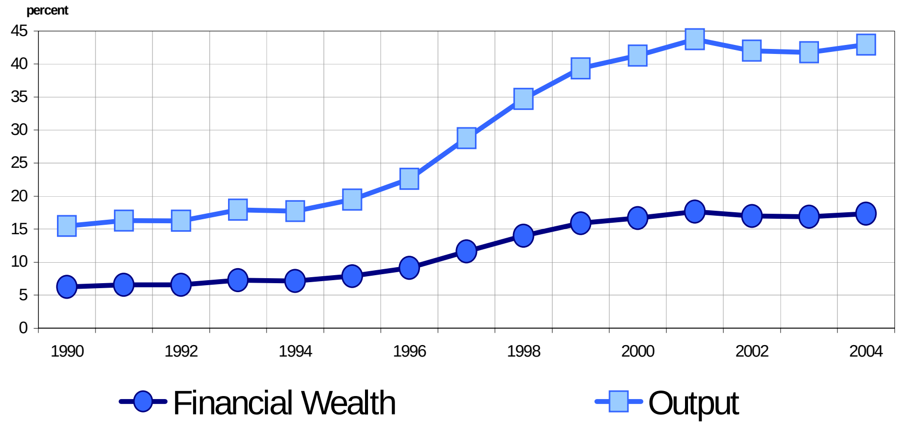
In Figure 2, reproduced here from the authors' paper, holdings of US assets by foreigners have risen, whether measured relative to the size of the world portfolio or, especially, relative to world output, both of which can be thought of as relevant for the world's ability to absorb dollar assets. If we were talking about about any other country, the denominator would be a measure of US ability to pay, such as US output or US exports or US output of tradable

[2] Obstfeld and Rogoff (2001, 2005) were perhaps the first to warn of the renewed problem of US current account sustainability. Edwards (2006), looking at other countries' deficits, finds that "major current account reversals have teneded to result in large declines in GDP." He concludes that a day of reckoning for the US is likely to arrive soon and that it will involve a fall in the dollar and in economic growth. Roubini (2004) also warns of dire consequences. Eichengreen (2006) offers another review of the conventional view and its challengers.

goods - not a measure of the rest-of-the-world's ability to absorb. Empirically, the relevant determinant of the ability to pay turns out to be a trade measure like exports plus imports, not GDP - relevant in the sense that the ratio of trade to GDP is a good statistical predictor of immunity against sudden stops and currency crashes in a broad sample of countries: Cavallo & Frankel (2005). It is not good news for the US economy, which has a low X/GDP ratio. Indeed this is the basis on which Obstfeld & Rogoff (2001, 2005) have been warning for a number of years that the US eventually faces an abrupt, disruptive, and large depreciation of the dollar. If one computes foreign indebtedness as a ratio of exports, rather than as a fraction of the world portfolio, then the current US path is explosive.

Figure 2

Share of US Assets in Rest of the World's Output and Fianancial Wealth



Source: Cabellero, Fahri and Gourinchas (2006)

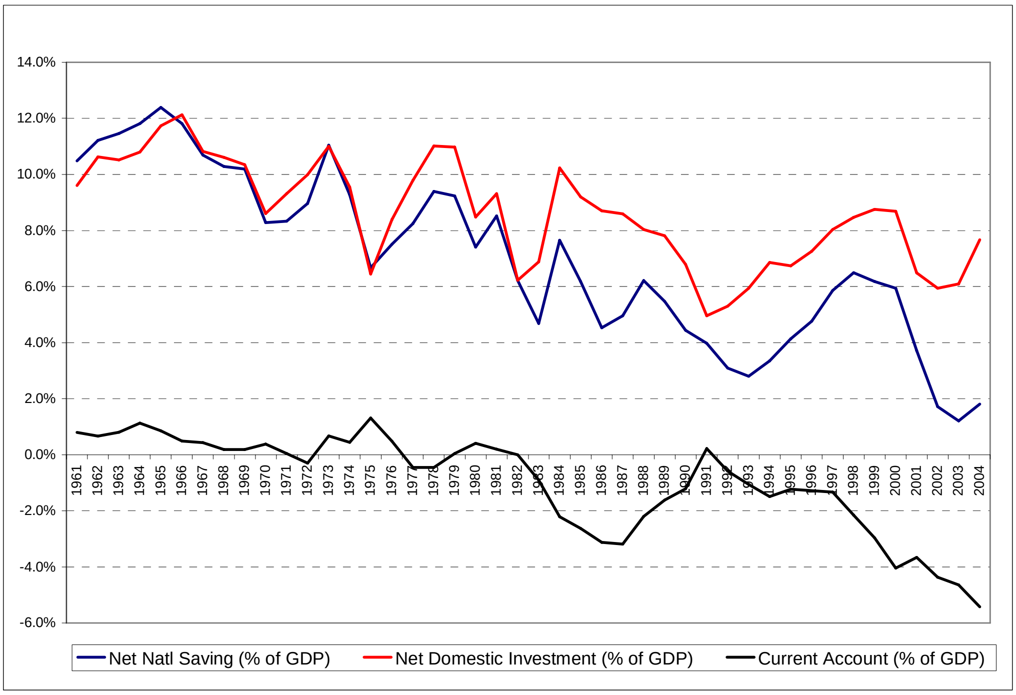
The remainder of my comments will attempt to bring some further perspective, by reviewing two sides of the debate over the global imbalances. First, I will summarize the "twin deficits" or "US saving shortfall" view of the origins of the US current account deficit, which regards it as unsustainable. I used to call this the mainstream view, but it has received so many challenges - only a few of them coming from apologists for the current US government - that I must acknowledge that the dissenters may outnumber the purveyors of the "conventional wisdom". Second, I will review the most popular challenges, most of which suggest that the US current account deficit is nothing to worry about. Caballero, Farhi and Gourinchas seem to fit in this second view.

II. The "Mainstream" View: A Shortfall of National Saving in the US

According to the "Mainstream" view, the US current account fundamentally reflects a shortfall in National Saving: the rapid widening of the US CA deficit in early 1980s, and again at an accelerated rate during 2001-05, were both associated with strong declines in National Saving as Figure 3 shows.

Figure 3

Net National Saving, Investment,
and Current Account as Shares of GDP



True, trade deficits are affected by such determinants as exchange rates and growth rates at home and abroad. But these are just the "intermediating variables". The CFG paper notes perceptively: "the view that growth of US trading partners is on average similar to that of the US, so that differential growth cannot be a factor in explaining the large capital flows to the US is misguided from our perspective.If those that compete with the US in asset production grow slower and those that demand assets grow faster, then both factors play in the same direction." (p 6).

More fundamentally, the US trade deficit reflects a shortfall in National Saving. When the US current account deficit widened rapidly in the early 1980s and again when the deterioration accelerated sharply in 2001-06, both events were associated with strong declines in National Saving.

Why did National Saving fall in these episodes? Start with the numbers. Both times, in the early 1980s and 2001-06, the federal budget balance fell abruptly. In the first episode it deteriorated from a deficit that averaged 2% of GDP in the 1970s, to a peak of 5% in 1983. In the second episode it swung from a 2000 *surplus* of 2% GDP, to deficits around 3% of GDP in 2003-04. According to some theories, pro-capitalist tax cuts were supposed to have resulted in higher household saving. But both times, saving actually *fell* after tax cuts. US household saving is now close to or less than zero! Thus both components of US National Saving fell.

What was the cause of the decline in National Saving? The Bush Administration has, since it assumed office in 2001, enacted large tax cuts, together with rapid increases in government spending. There are parallels not only with the Reagan Administration in the early 1980s, but also with the Johnson Administration in the late 1960s:

- Big rise in defense spending
- Rise in non-defense spending as well

- Unwillingness of president to raise taxes to pay for it.
- Resulting decline in the trade balance
- Eventual gradual decline in global role of the dollar.

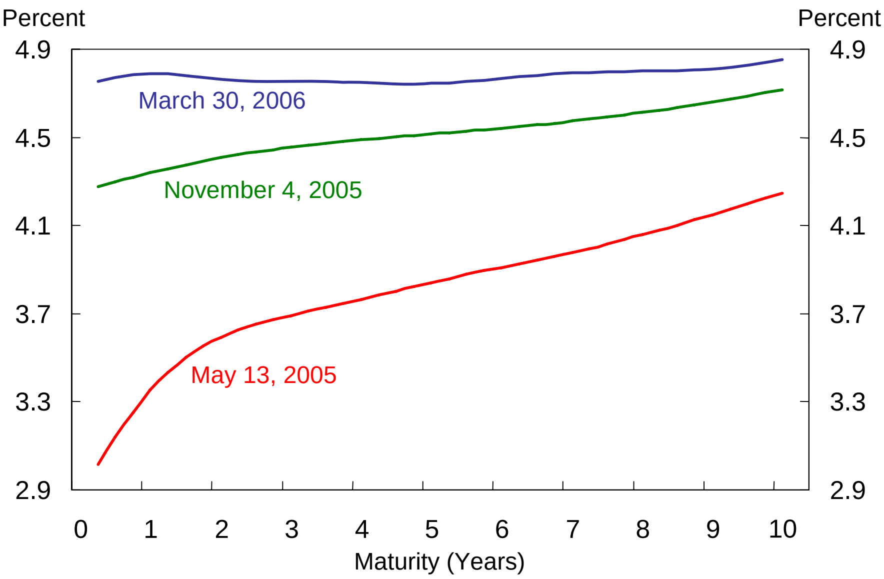
In the Johnson episode, the subsequent decline in the role of the dollar took the form of the end of the US commitment to accept dollars in exchange for gold and eventually, in 1971, the end of the Bretton Woods system under which countries pegged to the dollar. In the second episode, the twin deficits probably contributed to a continued decline throughout the 1980s in the share of central banks' reserve portfolios allocated to dollars and the rise of the share of the yen and mark. Meanwhile, efforts by German and French leaders to supply a new international currency that would be stable in value since the US seemed no longer able to do so eventually bore fruit, first in the form of the European Monetary System, and then in the form of the euro.

The current bout of American fiscal irresponsibility is actually worse than the 1980s. First, the retirement of the baby boom generation is that much closer than it was in 1981. Second, the national debt is that much higher. Third we now have other new fiscal time bombs as well, eg, phony sun-setting of tax cuts, the annual need to fix the Alternative Minimum Tax (AMT), and an exacerbated Medicare shortfall. The current administration seems to lack ability - which the Reagan Administration and the elder Bush did have - to perceive when reality diverges from the speech-writers' script, and to respond with mid-course correction. To the contrary, the White House continues to propose more tax cuts. Further, after a transitory dip, the much more serious deterioration will start after 2009 (although the 10-year window is no longer reported in White House projections). The cost of tax cuts truly explode in 2010, if they are made permanent as the Administration wants, as does the cost of fixing the AMT. The baby boom generation starts to retire in 2008; this implies soaring costs of social security and, especially, Medicare.

This "mainstream view" - that the shortfall in national saving is the primary driver - must contend with the conundrum of why long-term interest rates have been so low since 2001. (Figure 4 shows the flattening of the US yield curve.) Indeed the tension between these two phenomena was the stimulus for the Caballero, Farhis and Gourinchas paper.

Figure 4

Treasury Yield Curves



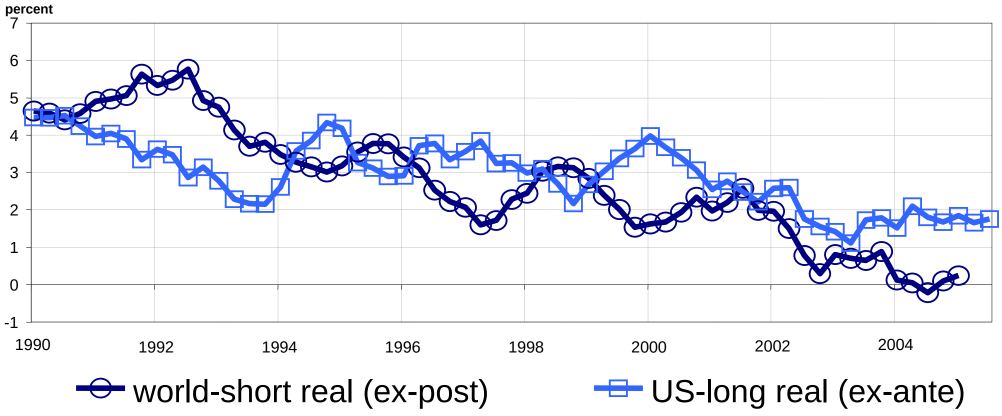
Source: Estimated using off-the-run Treasury securities, FRBNY, 6 Apr 2006

In my view, three major factors kept long-term interest rates low in the first half of this decade. The first was easy monetary policy by the Federal Reserve Board, the European Central Bank (less so), the Bank of Japan (more so), and the People's Bank of China. One can see, in the authors' figure 5, globally low short-term interest rates since 2001 pulling down the long-term real rate. Low short-term rates have led to the "carry trade": money has gone into bonds, stocks, real estate, emerging markets, and commodities - anywhere that it might earn a higher return than the very low rates that were on offer in the US and Japan. The period of easy monetary policy has been coming to an end. Indeed, in the US case, the Fed began raising short-term interest rates in mid-2004. Why was there no reversal in the bond market and other markets over the subsequent two years? Bubbles were a possible candidate explanation. Often in financial markets, for a year or two after fundamentals have turned around, prices have kept moving under the own momentum, until the markets notice the lack of support, at which point they come crashing down (the 1985 dollar, 1990 Japanese stock market, 1995 yen, and 2000 US stock market). Attributing unexplained movements to "bubbles" is not an attractive approach for an academic economist. But since many of the markets in question did indeed begin to correct in 2006, one must consider the possibility that the correction was a delayed reaction to the tightening of monetary policy, notwithstanding that the delay does some violence to our notions of well-functioning financial markets.

Figure 5

Monetary policy since 2001
has been easy everywhere

World and US real interest rates, 1990-2005



Source: Caballero, Farhi and Gourinchas (2006)

The second factor that has kept US long-term interest rates low in the first half of the decade was foreign central banks doing the same thing that the Fed was doing: buying US securities. The third factor is that investors have not yet fully understood how bad is the long run fiscal outlook in the United States (and in Europe and Japan as well).

All three factors are probably coming to an end soon. On this basis, one ventures to forecast rises in long-term interest rates, what has happened between 2005 and 2006.

III. Why We Are Not Supposed To Worry: Eight Challenges to the Mainstream View

Caballero, Farhi and Gourinchas are on a list of economists - by now rather long - who have come up with ingenious arguments why we shouldn't worry about the US deficits. Indeed the list is so long that one can probably no longer apply the label "mainstream" or "conventional wisdom" to the view that the source of the US current account deficit is an unsustainable shortage of US national saving.

I count eight distinct arguments against the twin deficits view, and in favor of the view that the current account deficit is sustainable and not a cause for worry.

1. The siblings are not twins
2. Alleged investment boom
3. Low US private savings
4. Global savings glut
5. It's a big world
6. Valuation effects will pay for it
7. "Intermediation rents…pay for the trade deficits"
8. China's development strategy entails accumulating unlimited dollars

Ultimately I don't buy these arguments. But it is well worth going through the list.

1. "The 'twin deficits' view is wrong, because the budget and current account deficits do not always move in lockstep."[3]

This is a "straw man". Use of the term "twin deficits" does not mean to claim that current account and budget deficits always move together, and nobody pretends that they do. Of course the budget deficit and current account deficit can and do at times move in opposite directions, as in the US investment boom of 1990s. The claim, however, is that *in the 1980s and the current decade, US fiscal expansion led to both the budget deficit and the current account deficit.*

2. Capital is flowing to the US due to its favorable investment climate and consequent high return to capital.

Apparently the argument of the current administration is that the capital inflows represent foreigners enthusiastically pursuing attractive investment opportunities created by the favorable business climate and high productivity growth of the United States.[4] It should be easy to dispose of this argument. In the first place, the current US business investment rate is less than it was in the 1990s IT boom (or than it was in the 60s, 70s, & 80s). In the second place, FDI is flowing out of the US not in (where is it flowing to? Developing countries like China[5]). In the third place, the money coming into the US is largely purchases of short-term

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[3] Bernanke (2005) is one of many making this point.

[4] Council of Economic Advisers (2006).

[5] The flow of FDI out of the US and into China – not directly, as it happens, but let us say indirectly, via other OECD countries – is consistent with Part 3 of the CFG paper. How does it square with inferior property rights in the non OECD world in their model? Some recent papers suggest that if one allows countries to vary not only according to the development of their financial institutions but also according to a property rights

portfolio assets, especially acquisition of dollar forex reserves. The importance of foreign official purchases of dollars rose steadily from 2001 to 2004. (See table.) Many observers have accepted at face value the official US statistics that show the rate of purchases declining somewhat in 2005 and 2006. But there are good reasons to think that central banks in Asia and now, especially, among oil-exporting countries may be adding to their dollar holdings in ways that do not show up in the US data as foreign official purchases, such as via European financial centers.

Table 6

Foreign central banks finance an increasing share of the US current account deficit

Billions of US dollars

	∆ Foreign priv assets in US	**∆ US private assets abroad**	**Net priv capital inflow**	**∆ Foreign official US assets[1]**	**Official share of inflow**
2000	1004	559	445	43	0.09
2001	755	377	378	28	0.07
2002	678	291	387	116	0.23
2003	611	330	281	278	0.5
2004	1046	860	186	395	0.68
2005	1072	513	559	221	0.28

Source: US BEA & Treasury
[1] Increasingly, foreign CBs' purchases of $ are not recorded as such.

3. A fall in US private saving has been as big a part of the fall in national saving as has been the budget deficit.

This is true. But recall that Bush tax cuts were supposedly designed to be pro-saving: abolition of the estate tax, sharp reductions in taxes on dividends & capital gains, and so forth. That was the excuse for their regressivity. As the private saving rate did not subsequently rise, this is a further indictment of our current fiscal policy. The same characterization applies to the Reagan tax cuts of 1981: they were supposed to boost saving but were instead followed by a fall in US private saving rates (let alone national saving rates).

4. "The problem is a global savings glut, not a US saving shortfall."[6]

True, foreign net lending to US is determined by conditions among foreign lenders as much as in US. But the term "savings glut" is highly misleading: Global saving is not really up.[7] The

parameter, one can explain the pattern of FDI flowing in at the same time that portfolio capital is flowing out. See Ju and Wei (2006) and the papers cited there.

6 Again, Bernanke (2005)

7 True, overall saving/GDP outside US had by 2004 climbed to a level slightly greater that of 1990s. But it is still less than the 1980s, the reference period in the CFG paper. More importantly, investment is down.

case of Japan, which was not long ago feared for its super-human saving rate, is striking: the household saving rate has lately been 7% of disposable income, down from 23% in 1975. Nor is there a saving glut in developing Asia. [8]Rather than a rise in foreign saving being the driver, it is global investment that is way down. One could call this an *R* investment slump, as in CFG. But in any case the pattern is inconsistent with the hypothesis that the exogenous change underlying the flow of capital to the US is an increase in saving abroad: that would have shown up as an international rise in investment. The observed pattern is consistent, rather, with the hypothesis that the US shortfall is sucking in capital from the rest the of world.

5. "It's a big world."

The argument here is that world financial markets are big, relative even to the $3 trillion of US debt, and are increasingly integrated.[9] As a consequence, foreign investors can bail us out for decades. If foreign investors keep moving, even slowly, toward fully diversified international portfolios (away from "home country bias" in their investments), they can absorb US current account deficits for a long time. Once again, this much is true. But, as already noted, when it comes to default or country risk, GDP or exports may be more relevant denominators for debt than is global portfolio size. Debt dynamics suggest that the US Debt/Export ratio is currently on an explosive path.

6. The US current account deficit does not imply rising debt & debt-service

Lane & Milesi-Feretti (2005) compute valuation effects. As a result of gains in the dollar value of foreign assets held by Americans, particularly via dollar depreciation, US net debt has risen "only" to $3 trillion, despite a much larger increase in liabilities to foreigners. The question then becomes *how many times can the US fool foreign investors?* Foreign investors will at some point start demanding higher interest rates on dollar assets if they are to hold a currency that cannot be expected to hold its value.

7. Despite years of deficits, net investment income is still in surplus

As is well-known, the US earns a higher rate of return on its assets abroad (especially FDI) than it pays on its obligations (especially treasury bills). In the 1960s, Kindleberger (1965) characterized the United States as playing the role of World Banker, taking short-term deposits and investing long-term. Today, Gourinchas and Rey (2005) call the US a global "venture capitalist". Their chart, which is reproduced here as Figure 6, shows that the composition of US holdings abroad is tilted toward high-return FDI and equity, and away from low-return debt. Hausmann and Sturzenegger (2006) speak of "dark matter", by which they mean US hidden assets of know-how that are not properly reflected in service export numbers. Cline (2005) calls the US an economic net creditor, though a net international debtor in an accounting sense. But Daniel Gros (2006) figures that the accounting errors are going the other direction, that foreign companies are understating profits of US subsidiaries, probably to avoid taxes. The implication would be that the true situation is worse than the current account numbers indicate, not better.

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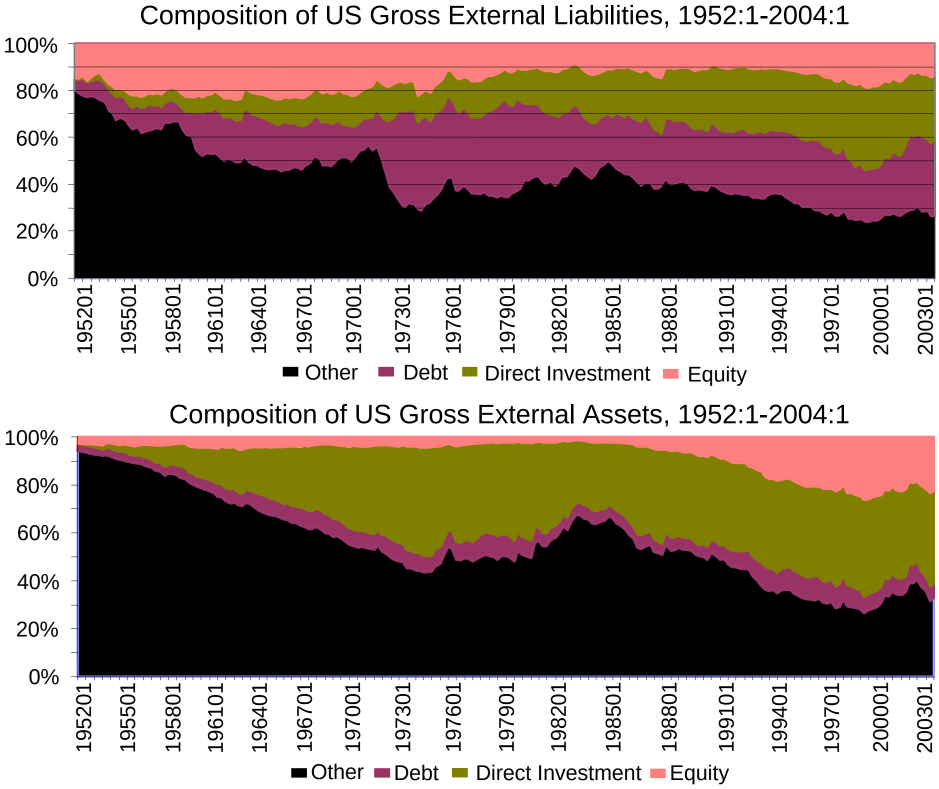
[8] Chinn and Ito (2005).

[9] This view can be attributed to Richard Cooper (2005) and Alan Greenspan, among others.

Figure 6

US assets give more weight to high-return equity & FDI than do US liabilities



Source: Gourinchas and Rey (forthcoming. 2006)

Some of these arguments rely on the dollar retaining its unique role in the world monetary system forever. The French in the 1960s called it the “exorbitant privilege”: the rest of the world gives up real goods and companies in exchange for pieces of paper (dollars). The arguments assume that the dollar stays the premier international reserve currency held by central banks, and that the US treasury security market will continue to be the preferred liquid asset for private investors as well. This has been true since World War II, but one can no longer assume that it will necessarily always be true: the euro now exists as a plausible rival over the longer term.

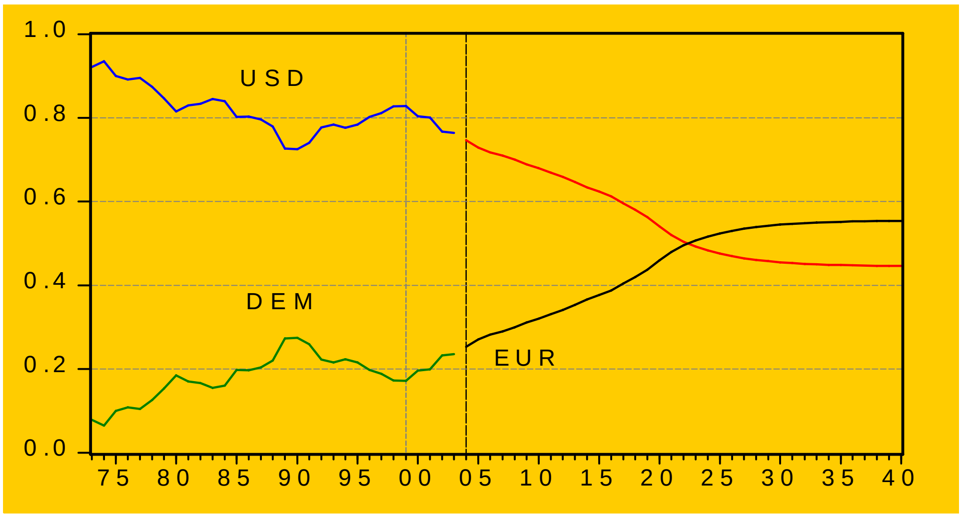
In a recent paper, Menzie Chinn and I econometrically estimate determinants of reserve currency status: size of home economy, size of its financial markets, inflation rates, exchange rate volatility, trend depreciation, lagged adjustment, and a tipping phenomenon. We conclude that under certain scenarios - roughly *either* the United Kingdom joining the euro *or*, more likely, the dollar continuing to lose value in the future at the same rate as it has during 2001-04 - the euro could surpass the dollar as leading international reserve currency by 2022. Figure 7 shows the share of the dollar versus the euro in such a simulation. If this tipping took place, the cost to the US would probably extend beyond the simple loss of seignorage narrowly defined. We would lose the exorbitant privilege of playing banker to the world, accepting short-term deposits at low interest rates in return for long-term investments at high average rates of return. Global monetary hegemony is a century-long advantage that is not to be cast away lightly.

Figure 7

Chinn & Frankel (2006)
Simulation of shares in central bank reserve holdings

Case 2, Scenario D:

Assumes continued depreciation of $ at 2001-04 rate,
but no entry of UK, Sweden, or Denmark into the euro



8. "China's development strategy entails accumulating unlimited dollars."

The view of Dooley, Folkerts-Landau, and Garber (2003) has received a lot of attention and has come to be associated in the US with their employer Deutsche Bank. They begin, perceptively enough, with the observation that today's system is a new Bretton Woods, with Asia playing the role that Europe played in the 1960s - buying up lots of dollars to prevent their own currencies from appreciating. Then the authors go on to some more original and provocative ideas: China is piling up dollars not because of myopic mercantilism, but as part of an export-led development strategy that is rational given China's need to import workable systems of finance and corporate governance.

Initially, they were understood to be saying that this system could continue indefinitely. More recently, they have been pinned down as claiming only that it can go on for ten or 15 years, comparable to the life of the Bretton Woods system.[10] My own view is that the Bretton Woods analogy is apt, but we are closer to 1971 (the date of the collapse of the Bretton Woods system) than to 1944 (the date of the actual meeting at Bretton Woods, N H) or 1958 (when currency convertibility was first restored in Europe). The current situation is more like the 1960s than Dooley, Folkerts-Landau and Garber had in mind. It might have taken decades after 1958 for the Triffin dilemma to work itself out. But the Johnson and Nixon administrations greatly accelerated the process by expansionary fiscal and monetary policies (driven by the Vietnam War and Arthur Burns, respectively). These policies led rapidly to the declining trade balance and overall balance of payments, and the collapse of the Bretton Woods system in 1971 and the failure of the attempted patch in 1973. There is no reason to

[10] Dooley and Garber (2005).

expect better today. First, capital mobility is much higher now than in the 1960s. Second the US can no longer necessarily rely on support of the foreign creditor central banks - neither on economic grounds (they are not now as they were then organized into a cooperative framework where each agrees explicitly to hold dollars if the others do), nor on political grounds (the US is not as popular internationally as it once was). This is all reason to fear that the current imbalances cannot be sustained for very many years.

9. Caballero, Farhi and Gourinchas

Where do Caballero, Farhi and Gourinchas fit in? They take as given US comparative advantage in the ability to generate financial assets that others want to hold. This assumption is similar to arguments, under challenge #7 above, about America's unique good fortune in the form of its ability to serve as World Banker, supplier of intermediation services, owner of #1 international currency, beneficiary of exorbitant privilege, or recipient of flight to quality. In the words of the authors, "Intermediation rents…pay for the trade deficits." Why is one on firmer ground taking any of these exceptionalisms as exogenously and eternally given, as opposed to considering that the willingness of foreigners to hold dollars may be an unsustainable disequilibrium?

This brings up a question of modeling philosophy or methodology: what to do when the desire to build an Equilibrium Model conflicts with what appears to be a Disequilibrium Reality? When events depart from conventional economics, do you revise the theory, or predict that events will soon fall in line? Sometimes there is a temptation to revise the theory too quickly. I have already mentioned examples of overvalued currencies and stock markets in the United States and Japan that fell back into line a year or two after the fundamentals had turned around. Similarly, the euro was predictably undervalued relative to fundamentals in 2002, and emerging market spreads were too low repeatedly in 1981, 1996, and 2005.[11] In each case new theories - both academic and popular - were invented to rationalize the anomaly, but reality re-asserted itself within a few years.

Perhaps bond markets were simply "too high" (long-term interest rates too low) in 2006. After all, speculators, investors, business economists, talking heads, journalists, politicians, and voters are all adept at thinking up rationalizations for extrapolating whatever has been the current trend. It does not leave much for us academic economists to do if we aren't prepared to stick to our guns - the longer-term perspective of theory, history, and statistics - when markets wander away. Caballero, Farhi and Gourinchas do an elegant job of showing that theory can be adapted to match a conundrum exhibited by the markets over the past few years. But I prefer to continue waiting for the markets to come to me instead.

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Comments on "An equilibrium model of "global imbalances" and low interest rates" by Caballero, Farhi and Gourinchas

Michael Mussa[12]

The growth of the US external payments deficit to over 6½ percent of US GDP by 2005 and the questions of whether this huge international payments imbalance is sustainable and/or how it may be corrected are at the forefront of the issues that concern the international economy. In their paper, Ricardo Caballero, Emmanuel Farhi and Pierre-Olivier Gourinchas (henceforth, C-F-G) provide us with a theoretical analysis that helps to illuminate these important issues.

With nearly three hundred equations in the main text and appendix, it is probably fair to say that the analysis in C-F-G will not be immediately appealing to most policy makers. Applying the inverse square rule that the readership of a paper among policy officials tends to decline with the square of the number of equations, one suspects that readership beyond the range of well-tooled, theoretically oriented, international macro-economists will be quite limited. Nevertheless, as a former practitioner of general equilibrium international macroeconomics, I have sympathy for the author's endeavours, including the choice of one of Lloyd Metzler's models as the inspiration for their theoretical analysis.

Indeed, for proper analysis of the phenomenon of the US external payments deficit (and the corresponding payments surplus of the rest of the world), it is essential to understand that this is a general equilibrium phenomenon involving complex interactions over time in goods and asset markets all around the world. Use of a logically rigorous, dynamic, general equilibrium framework is important - even if it is in the background - in order to avoid significant errors of analysis and policy prescription. For example, it is correct to emphasise - as was done in the 2006 Economic Report of the President - that the United States is running an enormous capital account surplus because it is attracting huge net inflows of foreign capital. However, viewing the massive US current account deficit in terms of the corresponding capital account surplus should not be allowed to obscure the essential role that the excess of spending over income in the United States plays in this phenomenon. Nor does it obviate the concern that large and growing US current account deficits, implying ever widening US net external indebtedness, may not be forever met with a willing flow of foreign financing.

The analysis developed by C-F-G avoids these pitfalls while also eschewing the hysteria that a substantial further build-up in US net foreign indebtedness is necessarily unsustainable and will ultimately lead us down the path to disaster. Indeed, the C-F-G model embodies the key elements that enable us to understand how and why, in view of the special circumstances of the United States in the world economy, a substantial-but-not-unlimited further increase in the net foreign indebtedness (relative to US GDP) may be sustainable in the longer term. This, however, does not remove all concerns about the adjustments, including further depreciation of the dollar, that will be needed to insure that the US external payments deficit does not proceed along a fundamentally unsustainable path.

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The story about the growth of the US external payments deficit over the past decade that is embodied in C-F-G's formal analysis is, in fact, very similar to the story that I have previously told-in words that should be understandable to most policy officials - about this phenomenon.[13] It is worthwhile to tell that story again (in abbreviated form) and relate it to C-F-G's formal analysis.

The rise of the US external deficit

After a brief return to overall balance at the time of the first Gulf War and the US recession of 1990-91, the US current account moved back to a deficit of 1½ percent of US GDP by 1995. This scale of US current account deficit appeared to be sustainable in the longer term. Specifically, if the current account deficit was stabilised at 1½ percent of US GDP and GDP grew at a 5 percent annual rate in nominal terms, then the ratio of US net external indebtedness to GDP would stabilise in the long-run at about 30 percent - a substantial but not outrageously high level for a country that appears to provide a safe and happy home for foreign investment. (Taking account of the fact that the US earns a higher rate of return on its foreign investments than foreigners earn on their US investments complicates this picture somewhat but does not alter the basic conclusion.)

Starting around 1995, the US economy began to enjoy an unanticipated acceleration of productivity growth that lifted the potential growth rate of US real GDP from a little more than 2 percent per year to somewhat more than 3 percent per year. This acceleration of productivity growth and of potential GDP growth was not shared by other industrial countries (or developing countries). In C-F-G's formal analysis, g for the United States rose while g for Europe (and Japan) did not. As a result of the acceleration in potential and actual US GDP growth, US consumers began to feel better off and increased their spending. Also, investment in the United States began to appear more profitable, and this contributed to a pick-up in business investment. Indeed, private consumption and investment spending rose by more than the acceleration in potential and actual real GDP growth. (And this happened despite the fact that the government budget moved sharply from deficit toward surplus.) The excess of the growth of US national spending over US real GDP amounted to about one-half of one percent per year. This was necessarily reflected in a widening of the US current account deficit by that amount each year.

Meanwhile, in the other industrial countries (on average) output growth was relatively sluggish, especially in Japan; and growth of aggregate demand in these countries generally fell somewhat short of actual (and potential) output growth. Many developing countries suffered financial difficulties in the period 1995 through 2002 that required sharp improvements in their current accounts and were associated with recessions or severe growth slowdowns and even more severe reductions in domestic demand.

These developments in the rest of the world interacted with what was happening in the United States. The increased attractiveness of investment in the United States and the difficulties with investment in the rest of the world encouraged an increased flow of (mainly private) foreign capital to the United States. This capital inflow financed the excess of US spending growth over US income growth which otherwise would have been choked off by rising US capital costs. The capital inflow also contributed importantly to the appreciation in the foreign exchange value of the US dollar which, in turn, helped to transform a general

[13] See Michael Mussa, "Sustaining Global Growth while Reducing External Imbalances", in C Fred Bergsten, *The United States and the World Economy*. Institute for International Economics, Washington, DC, January 2005, pp 175-207.

excess of US spending over US output into a growing trade deficit. The absorption of the excess of US spending growth over US output growth into a widening trade deficit and the favourable impact of a strong dollar on US inflation allowed US monetary policy to avoid the sharp tightening that would otherwise have been required to contain US output within its potential. At the same time, for the rest of the world the additional stimulus to output growth from rising net exports to the United States was quite welcome in view of levels of slack and, in some cases, the urgent need to improve current account positions. Thus, in the period 1995 through 2000, the rising US current account deficit, the increasing net flow of foreign capital to the United States, the strengthening US dollar, and the corresponding balance of payments and exchange rate developments in the rest of the world were both understandable and, given the other economic forces at work, generally desirable.

The story changes somewhat since 2000. US productivity growth has remained relatively strong, and this part of the earlier story remains largely intact. In 2001, however, the recession in the US economy led to a significantly greater slowdown in US output and spending growth than (on average) in other industrial countries or in most developing countries. Not surprisingly, in that year the US current account registered a modest improvement.

Since 2001, the US economy has again expanded more rapidly than the economies of other industrial countries (on average), and growth of US spending has again exceeded US output growth (by about one-half percentage point in 2002-2004 but by less in 2005). In contrast with the 1990s, policy stimulus has played an important role in kicking up US spending growth. Monetary policy became highly accommodative in 2001-02 and remained generally accommodative through the summer of 2004. Significant tax cuts enacted in 2001 and 2003 and rapid growth in most categories of federal spending from 2001 through 2005 provided further important stimulus to growth of US domestic demand. Thus, the further substantial deterioration of the US current account in 2002-05 was associated with a sharp deterioration in the public sector's net saving - in contrast with 1995 to 2000 when substantial improvements in public sector net saving were overwhelmed by deterioration in the private sector saving/investment balance.

At the same time, private foreign capital flows to the United States have provided a smaller share of the needed financing for the increasing US current account deficit than in the late 1990s, and the foreign exchange value of the US dollar has depreciated significantly since early 2002 against the currencies of other industrial countries, except Japan. (The maintenance of an extraordinarily accommodative monetary policy helps to explain the Japanese exception.) Massive official exchange market intervention by several Asian countries, most notably China, directed at resisting significant appreciation of their currencies against the US dollar has helped to fill in the external financing gap associated with the rising US current account deficit. Over the past three years, especially for the past 18 months, accumulation of massive reserve holdings by oil exporting countries, including Russia, has also helped to finance the US current account deficit.

Long run sustainability

The formal analysis developed by C-F-G does not entirely account for how some of these recent developments have helped to drive the evolution of the US current account deficit and its financing over the past five years. To remain manageable, a formal model like that of C-F-G must inevitably abstract from some things that are practically important in the real world. The virtue of C-F-G's theoretical framework is that it sheds light on some key issues that may be lost in excessive focus on the complexities of the real world. In particular, there is the key issue of whether the large and still growing US current account deficit is plausibly sustainable in the longer term.

Following in the tradition of Lloyd Metzler, C-F-G usefully distinguish between the very broad measure of national wealth, PV, that corresponds to the expected present discounted value of net national product (NNP) and the much narrower measure of the market value, V, of claims to income streams that may be relatively easily exchanged among domestic residents and, at least potentially, between domestic and foreign residents. This distinction is not absolute; for example, individuals can borrow to some extent against their expected labour income and foreigners can hold some of these claims (for instance, by investing in Sally Mae obligations). But, the vast bulk of U.S. national wealth that is embodied in human capital, in the value of sole proprietorships, partnerships, and small corporations, and in US real estate and other real assets is not something in which foreigners can hold a meaningful and reliable ownership interest.

Quantitatively, the distinction between PV and V is very important. Even allowing for the cost of upkeep on human capital, PV must be at least on the order of 25 to 30 times annual NNP or roughly \$300 trillion. In contrast, the value of US based marketable assets, V, is only about four times annual NNP or roughly \$50 trillion. At present, foreigners own claims on the United States that are estimated to be worth around \$13 trillion and US residents own claims on foreigners that are estimated to be worth about \$10 trillion. This leaves the United States with a negative net foreign asset position of about \$3 trillion - equivalent to about 25 percent of US NNP.

Relative to US national wealth, PV, the current negative US net foreign asset position does not seem very worrying at barely 1 percent. Even if the net foreign asset position deteriorated to - 100 percent of NNP, it might not appear very worrying as that would be equivalent to only about 4 percent of national wealth. Richard Cooper's very sanguine view of the long-run sustainability of very large US current account deficits can be related to this observation (see "Living with Global Imbalances: A Contrarian View", IIE Policy Brief, October 2005).

However, following the analysis of C-F-G, if we recognise that the practical limit on foreign gross holdings of US assets is the value of US marketable assets and that US residents will undoubtedly want to hold some significant fraction of US based marketable assets, then the situation changes. Present foreign gross holdings of about 25 percent of US marketable assets and net holdings of about 10 percent are not apparently a problem. But, increasing foreign net holdings to 100 percent of annual NNP would raise net holdings to about 25 percent of marketable US based assets and would probably mean foreign gross holdings of something like 50 percent of all US based marketable assets. At such levels, US residents might become concerned that so much of "their country" was owned and controlled by foreigners, and foreign investors might become concerned about the political reaction of the US authorities to this situation. Both of these concerns would presumably become more intense as foreign holdings of US based marketable assets rose beyond 100 percent of NNP.

Another phenomenon explicitly modelled in the C-F-G framework ameliorates but does not remove this concern. Consistent with the observable facts, the United States and other industrial countries are assumed to have an advantage relative to developing countries in making streams of national income into marketable assets. Formally in the C-F-G analysis, the "delta" for the United States is larger than the "delta" for developing countries. Assuming that the demand to hold wealth in the form of marketable assets is similar across countries, this implies that the United States (and other industrial countries) can earn income from this comparative advantage in creating marketable assets. Empirically, we may be seeing this phenomenon in the fact that the United States is able to earn a higher rate of return on its foreign assets than foreigners earn on their investments in US based assets. This helps the United States maintain a larger negative net foreign asset position without suffering adverse consequences for its flow of current account transactions. Presumably this increases the size of the negative net foreign asset position of the US that is sustainable in the longer term.

I would not, however, emphasise too much the longer-run significance of the "lower delta effect" for developing countries. In particular, much of the massive recent accumulation of foreign exchange reserves by Asian emerging market economies and by oil exporters is not, in my judgement, plausibly attributable to the comparative disadvantage of these countries in creating marketable assets. Asian emerging market economies are accumulating reserves because they are resisting appreciations of their currencies - policies that are unsustainable and undesirable in the long term. As with past surges in world oil prices, some oil exporting countries invest substantial fractions of their sudden income gains in marketable foreign assets, but this will tend to wane over time.

Quite rightly, C-F-G are cautious in drawing explicit conclusions concerning how much longer the United States could continue to run substantial (and possibly still growing) current account deficits. The formal analysis indicates that the growth of the US current account deficit over the past decade can reasonably be viewed as a sustainable, general equilibrium phenomenon and probably can go on somewhat longer without disastrous consequences. However, as emphasised by many analysts (including my colleagues William Cline, *The United States as a Debtor Nation*, Institute for International Economics, September 2005; Catherine Mann, *Is the US Trade Deficit Sustainable*?, IIE, September 1999; and C Fred Bergsten and John Williamson (eds), *Dollar Overvaluation and the World Economy*, IIE, February 2003, and *Dollar Adjustment: How Far? Against What?*, IIE, November 2004), there is some limit to the net foreign liability position that the United States can run up as the cumulative consequence of large and growing current account deficits. This limit is presumably well below the marketable value of US based assets. Indeed, recognizing that gross foreign investment in US based assets is limited by the value of marketable US assets and that net foreign investment will probably need to remain no more than about half of gross foreign investment would suggest that net foreign investment ratios of 100 percent or more of annual NNP are problematical.

Specifically, suppose that the US current account deficit stabilises at its present ratio of 6½ percent of US GDP (or about 7 percent of US NNP). With an annual average growth rate of (nominal) GDP of 5 percent, this would imply that the net foreign liability position of the United States would ultimately stabilise at 130 percent of GDP and would rise above 100 percent of GDP within less than 20 years. Even this would require significant dollar depreciation in order for reductions in the trade deficit as a share of GDP to offset deteriorating net foreign investment income associated with rising US net international liabilities. If the foreign exchange value of the US dollar stabilised at its present level, many estimates suggest that the U.S. current account deficit would expand to over 10 percent of US GDP within a decade; and the net foreign liability position of the United States would be on a path to exceed 200 percent of GDP. It is unreasonable to believe that this is sustainable. (Looking at the US external deficit from a somewhat different perspective, recent empirical work by Sebastian Edwards also raises serious questions about long-run sustainability. Most analysts, including the IMF, the OECD, and the BIS, share this scepticism.)

Reducing the US external deficit to sustainable proportions

The formal analysis of C-F-G and my less formal treatment both indicate that the widening of the US current account deficit over the past decade can be understood as a global general equilibrium phenomenon in which market forces have played a dominant role. Symmetrically, we should assume that the general equilibrium processes at work in the global economy will impose relevant limits on how much the US current account deficit can further expand and for how long it can continue at a high level. Market forces will presumably induce adjustments in behaviour in the United States and in the rest of the world to ensure an outcome that is sustainable in the longer term.

These adjustments will surely include a substantial further real depreciation of the US dollar, as well as a slowing of US spending growth below US output growth and an acceleration of foreign spending growth relative to foreign output growth. These adjustments will not all be painless and will not all come smoothly. However, there is no necessary reason to presume that the necessary adjustments involve a high likelihood of a cataclysmic crisis similar to the “sudden stops” that have recently afflicted several emerging market economies (and are the subject of a paper by Guillermo Calvo in this conference). The United States does not have the economic and financial characteristics where a sudden massive run by foreign investors out of US based assets is a high probability event.

That said, it must also be recognised that the scenario of a “dollar crash” is not a zero risk event. To induce a “dollar crash” it is not necessary that foreign investors dump (or try to dump) substantial amounts of the existing US based assets, it is only necessary that they suddenly decide to stop accumulating more US based assets or perhaps even cut their rate of accumulation suddenly in half. With a sudden drop in foreign financing, the US current account deficit would need to contract with equal speed - induced by a sharp drop in the foreign exchange value of the dollar and fall in US expenditure (and hence imports) associated with an upsurge in US interest rates (reflecting the scarcity of investment finance). It seems reasonable to worry that the larger the US current account deficit becomes and the longer it goes on, the greater is the risk of such a dollar crash. Global financial markets may awaken some day with the fear that the huge US external payments deficit cannot continue to be financed - and then adjustment will come suddenly.

The role of policy

Economic policy has an important role to play in limiting the risk of such a dollar crash and, more generally, in helping to insure that the global adjustment process operates in a manner that avoids undue harm to world economic growth. In this regard, many analysts emphasise the desirability (or even necessity) of substantial fiscal consolidation by the United States as a means for reducing the growth of U.S. spending and contributing to a reduction in the US current account deficit. (The analysis of C-F-G does not explicitly treat this issue, but it is suggested that it could be modelled in terms a change in “theta,” the exogenous saving rate for the United States.) Some even adhere to the old, discredited notion from the 1980s of the “twin deficits” - the idea that rise of the U.S. current account deficit under President George W Bush (and earlier under President Ronald Reagan) is largely, although not entirely, attributable to the deterioration of the US government’s fiscal position under these two Presidents.

My view of this matter is that sound public policy calls for the structural (or cyclically adjusted) US budget position, measured on a cash basis, to move from a deficit of about 2½ percent of GDP today to a surplus of 1 to 2 percent of GDP, re-establishing the situation that existed in 2000. This would mean that (on a cyclically adjusted basis) the ratio of US government debt to GDP would decline about 3 percentage points of GDP per year over the next few years. This decline in the ratio of visible government debt to GDP is appropriate and desirable because the US government (like governments of most industrial countries) faces massive and growing obligations to pay for pension and health benefits for aging populations. Measured on an accrual basis, taking account of these growing implicit liabilities, the US government is now running a massive deficit; and it is building up massive needs for future government revenues to pay for these benefits. Putting the cash budget into modest surplus now (while pension and health care costs are much lower than they will be in the decades ahead) is the responsible way to manage the US government’s overall budget position.

It should be expected that efforts to reduce the federal budget deficit will, other things equal, contribute to improvement in the US current account. Fiscal consolidation, whether through restraint on spending or increased taxes, tends to slow the growth of spending in the US economy; and a fraction of a reduction in general spending (probably about 20 percent) falls on imports. In addition, when the US economy is operating near potential, as it is today, fiscal consolidation substitutes for monetary policy tightening as a means for containing inflationary pressures. In theory at least, tighter fiscal policy and easier monetary policy implies a lower course for US interest rates and a somewhat weaker US dollar in foreign exchange markets. Over time, a weaker dollar ought to curtail the growth of demand for imports in the United States and stimulate US exports, thereby enhancing considerably the direct effect of tighter fiscal policy on the US current account. But, significant correction of the US current account deficit could come over the next few years even if there is not a more vigorous effort for US fiscal consolidation; in particular, US monetary tightening together with a natural recovery in household saving rates could do much to slow demand growth in the United States.

Moreover, it is misleading to argue, that US fiscal consolidation is the only key policy that would be useful to achieve a non-disruptive, growth-friendly correction of the US external payments deficit. And, it is even more misleading to suggest - as the twin-deficits theory does - that one should anticipate a tight, virtually one-for-one, linkage between US fiscal consolidation and reduction of the US current account deficit. Notably, after the twin-deficits theory was advanced in the early 1980s, we saw in the late 1980s the US current account deficit disappear while the US fiscal deficit shot up. Subsequently in the 1990s, we saw the US current account deficit expand to 4 percent of GDP (by 2000) as the US budget moved from substantial deficit to significant surplus. Most recently, for the past three years we have seen the US current account deficit resume its expansion (after a pause in 2001) at the same time that the US budget deficit has been shrinking as a share of GDP.

Looking at these facts, reasonable people (including some senior officials in the Bush Administration) conclude that advocates of the twin-deficits theory are talking bunk and are perhaps more motivated by a political desire to criticise Bush Administration policies than by an effort to seek the truth. Such a conclusion is not entirely fair, but neither is it entirely unjustified. There is a solid case to be made for more vigorous US fiscal consolidation (including increased taxes) over the next few years on the basis of the requirements for sound public finance in the longer term. Ceteris paribus, more vigorous US fiscal consolidation should help to address one of the key requirements for gradual correction of the US current account deficit - namely, the need to slow spending growth in the US below the rates of growth of actual and potential output.

While US fiscal consolidation can reasonably be recommended as a policy to aid in the necessary slowing of US spending growth, there is not, unfortunately, a symmetric policy that can generally be recommended for the necessary task of stimulating an increase in spending growth in the rest of the world to a pace that modestly exceeds actual and potential output growth. (For the world as a whole, one would want to see the reduction of spending growth in the United States offset by an increase of spending growth in the rest of the world so that world spending growth would match potential world output growth.) In particular, other industrial countries generally face both short-run budget problems and longer-term fiscal challenges that preclude expansionary fiscal policies as desirable means for stimulating growth of aggregate demand. Also, monetary policies in other industrial countries cannot ignore indications that inflationary pressures may now be picking up in the world economy and that the very accommodative stances of industrial country monetary policies that have prevailed in recent years are no longer appropriate. The best that can be advised is that monetary authorities should take careful account of the need for demand growth to exceed modestly potential output growth in an environment where current accounts need to move toward deficit as the counterpart to improvement in the US current account.

Regarding the real effective exchange rate of the US dollar, most estimates suggest that just to keep the US current account from deteriorating further (as a share of GDP), the dollar will need to depreciate by a couple of percent per year, on average, in the long run. (This assumes that the US economy and the economy of the rest of the world continue to grow in line with their respective potential growth rates.) In addition, to reduce the current account deficit to approximately one-half of its present share of GDP (which is widely suggested as a sustainable ratio), it is generally estimated that a 20 to 30 percent depreciation of the US dollar would be required (together with a cut in the ratio of US spending to US GDP of perhaps 5 percent and an offsetting rise of spending in the rest of the world).

Since its peak in early 2002, the real effective foreign exchange value of the dollar has depreciated about 12 percent. This reflects large depreciations of the US dollar against the currencies of other industrial countries, excluding Japan. In contrast, the currencies of most Asian emerging market countries and Japan fallen in real terms against the US dollar since early 2002; and the real effective depreciations of some Asian currencies have been quite significant.

Looking forward from a policy perspective, I see no clear case to interfere with market processes underlying exchange rate adjustments for those currencies where these processes are allowed to operate with reasonable freedom. For the euro, this will probably mean some further appreciation against the dollar, but along an erratic course that will involve many shorter-run ups and downs. For the Japanese yen, substantial appreciation against the dollar should be anticipated in the longer term. Market forces should be expected to drive this process once the Japanese economy has firmly re-established self-sustaining growth. Policy actions to promote yen appreciation do not appear warranted; but a return to the old Japanese policy of massive intervention to resist yen appreciation would be inappropriate.

For the exchange rates of several key Asian emerging market economies, market forces are not the primary determinants and cannot be relied upon to promote appropriate appreciation against the US dollar. Most importantly for the Chinese yuan, it is clear that massive, persistent official intervention has been used over the past three years to maintain a substantially undervalued exchange rate. This policy needs to be changed to allow a 25 to 30 percent appreciation of the yuan against the dollar within the next five years. This appreciation should not come all at once, but there should be a significant initial step to provide a clear signal to re-orient Chinese economic growth toward less dependence on export expansion. Some coordination of exchange rate adjustments among Asian economies would also be useful.