The U.S. Current Account and the Dollar

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Abstract

There are two main forces behind the large U.S. current account deficits. First, an increase in the U.S. demand for foreign goods. Second, an increase in the foreign demand for U.S. assets.

Both forces have contributed to steadily increasing current account deficits since the mid–1990s. This increase has been accompanied by a real dollar appreciation until late 2001, and a real depreciation since. The depreciation accelerated in late 2004, raising the questions of whether and how much more is to come, and if so, against which currencies, the euro, the yen, or the renminbi.

Our purpose in this paper is to explore these issues. Our theoretical contribution is to develop a simple model of exchange rate and current account determination based on imperfect substitutability in both goods and asset markets, and to use it to interpret the past and explore alternative scenarios for the future. Our practical conclusions are that substantially more depreciation is to come, surely against the yen and the renminbi, and probably against the euro.

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There are two main forces behind the large U.S. current account deficits:

First, an increase in the U.S. demand for foreign goods, partly because of relatively higher U.S. growth, partly because of shifts in demand away from U.S. goods towards foreign goods.

Second, an increase in the foreign demand for U.S. assets, starting with high foreign private demand for U.S. equities in the second half of the 1990s, shifting to foreign private and then central bank demands for U.S. bonds in the 2000s.

Both forces have contributed to steadily increasing current account deficits since the mid–1990s. This increase has been accompanied by a real dollar appreciation until late 2001, and a real depreciation since. The depreciation accelerated in late 2004, raising the issues of whether and how much more is to come, and if so, against which currencies, the euro, the yen, or the renminbi.

These are the issues we take up in this paper. We do so by developing a simple model of exchange rate and current account determination, and using it to interpret the past and explore the future.

We start by developing the model. Its central assumption is of imperfect substitutability not only between U.S. and foreign goods, but also between U.S. and foreign assets. This allows us to discuss not only the effects of shifts in the relative demand for goods, but also of shifts in the relative demand for assets. We show that increases in U.S. demand for foreign goods lead to an initial depreciation, followed by further depreciation over time. Increases in foreign demand for U.S. assets lead instead to an initial appreciation, followed by depreciation over time, to a level lower than before the shift.

The model provides a natural interpretation of the past. Increases in U.S. demand for foreign goods and increases in foreign demand for U.S. assets have combined to increase the current account deficit. While the initial net effect of the two shifts was to lead to a dollar appreciation, they both imply an eventual depreciation. The United States appears to have entered this depreciation phase.

The model also provides a way of examining the future. How much depreciation is to come, and at what rate, depends on where we are, and on the future evolution of shifts in the demand for goods and the demand for assets. This raises two main issues. Can we expect the trade deficit to largely reverse itself—at a given exchange rate? If it does, the needed depreciation will obviously be smaller. Can we expect the foreign demand for U.S. assets to continue to increase? If it does, the depreciation will be delayed—although it will still have to come eventually. While there is substantial uncertainty about the answers, we conclude that neither scenario is likely. This leads us to anticipate, absent surprises, more dollar depreciation to come, at a small but steady rate.

Surprises will however take place; only their sign is unknown... We again use the model as a guide to discuss a number of alternative scenarios, from the abandonment of the peg of the renminbi to changes in the composition of reserves by Asian Central Banks, to changes in U.S. interest rates.

This leads us to the last part of the paper, where we ask how much of the depreciation is likely to take place against the Euro, how much against Asian currencies. We extend our model to allow for more than two countries. We conclude that, absent surprises, the path of adjustment is likely to be associated primarily with an appreciation of Asian currencies, but also with a further appreciation of the euro vis a vis the dollar.

1 A Model of the Exchange Rate and the Current Account

Much of the economists' intuition about joint movements in the exchange rate and the current account is based on the assumption of perfect substitutability between domestic and foreign assets. As we shall show, introducing imperfect substitutability substantially changes the scene. Obviously, it allows us to think about the dynamic effects of shifts in asset preferences. But it also modifies the dynamic effects of shifts in preferences with respect to goods.

A note on the relation of our model to the literature: We are not the first to insist on the potential importance of imperfect substitutability. Indeed the model we present below builds on two old (largely and unjustly forgotten) papers, by Henderson and Rogoff [1982], and, especially, Kouri [1983].[1] Both papers relax the interest parity condition and assume instead imperfect substitutability of domestic and foreign assets. Henderson and Rogoff focus mainly on issues of stability. Kouri focuses on the effects of changes in portfolio preferences and the implications of imperfect substitutability between assets for shocks to the current account.

Our value added is in allowing for a richer description of gross asset positions. By doing this, we are able to incorporate in the analysis the "valuation effects" which have been at the center of recent empirical research on gross financial flows—in particular by Gourinchas and Rey [2004] and Lane and Milesi–Ferretti [2002], [2004]—, and play an important role in the context of U.S. current account deficits. Many of the themes we develop, from the role of imperfect substitutability and valuation effects, have also been recently emphasized by Obstfeld [2004].

1. The working paper version of the paper by Kouri dates from 1976. One could argue that there were two fundamental papers written that year on this issue, one by Dornbusch [1976], who explored the implications of perfect substitutability, the other by Kouri, who explored the implications of imperfect substitutability. The Dornbusch approach, and its powerful implications, has dominated research since then. But imperfect substitutability seems central to the issues we face today.

The Case of Perfect Substitutability

To see how imperfect substitutability of assets matters, it is best to start from the well understood case of perfect substitutability.

Think of two countries, domestic (say the United States) and foreign (the rest of the world). We can think of the current account and the exchange rate as being determined by two relations.

The first is the uncovered interest parity condition:

$$(1+r) = (1+r^*)\frac{E}{E^e_{+1}}$$

where r and r^* are U.S. and foreign real interest rates respectively (stars denote foreign variables), E is the real exchange rate, defined as the relative price of U.S. goods in terms of foreign goods (so an appreciation is an increase in the exchange rate), and E^e_{+1} is the expected real exchange rate next period. The condition states that expected returns on US and foreign assets must be equal.

The second is the equation giving net debt accumulation:

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

$D(E,z)$ is the trade deficit. It is an increasing function of the real exchange rate (so $D_E > 0$). All other factors—changes in U.S. or foreign levels of spending, or shifts in U.S. or foreign relative demands at a given exchange rate and given activity levels—are captured by the shift variable z. By convention, an increase in z is assumed to worsen the trade balance, so $D_z > 0$. F is the net debt of the United States, denominated in terms of U.S. goods. The condition states that net debt next period is equal to net debt this period times one plus the interest rate, plus the trade deficit next period.

Assume that the trade deficit is linear in E and z, so $D(E,z) = \theta E + z$. Assume also, for convenience, that U.S. and foreign interest rates are equal, so $r^* = r$, and constant. From the interest parity condition, it follows that the expected exchange rate is constant and equal to the current exchange rate. The value of the exchange rate is obtained in turn by solving out the net debt accumulation forward and imposing the condition that net debt does not explode faster than the interest rate. Doing this gives:

$$E = -\frac{r}{\theta}\,[F_{-1} + \frac{1}{1+r}\sum_0^\infty (1+r)^{-i}\; z^e_{+i}\,]$$

The exchange rate depends negatively on the initial net debt position and on the sequence of current and expected shifts to the trade balance.

Replacing the exchange rate in the net debt accumulation equation gives in turn:

$$F_{+1} - F = [z - \frac{r}{1+r}\;\sum_0^\infty (1+r)^{-i}\; z^e_{+i}\,]$$

The change in the net debt position depends on the difference between the current shift and the present value of future shifts to the trade balance.

For our purposes, these two equations have one main implication. Consider an unexpected, permanent, increase in z at time t by Δz—say an increase in the U.S. demand for Chinese goods (at a given exchange rate). Then, from the two equations above:

$$E - E_{-1} = -\frac{\Delta z}{\theta}; \qquad F_{+1} - F = 0$$

In words: Permanent shifts lead to a depreciation large enough to maintain current account balance. By a similar argument, shifts that are expected to be long lasting lead to a large depreciation, and only a small current account deficit. As we shall argue later, this is not what has happened in the United States over the last 10 years. The shift in z appears to be, if not permanent, at least long lasting. Yet, it has not been offset by a large depreciation, but has been reflected instead in a large current account deficit. This we shall argue, is the result of two factors, both closely linked to imperfect substitutability. The first is that, under imperfect substitutability, the initial depreciation in response to increases in z is more limited, leading initially to a current account deficit. The second is that, under imperfect substitutability, there can be shocks to asset preferences. These shocks lead to an initial appreciation and a current account deficit. And they have indeed played an important role since the mid 1990s.

Imperfect Substitutability and Portfolio Balance

We now introduce imperfect substitutability between assets. Let W denote the wealth of U.S. investors, measured in units of U.S. goods. W is equal to the stock of U.S. assets, X, minus the net debt position of the United States, F:

$$W = X - F$$

Similarly, let W^* denote foreign wealth, and X^* foreign assets, both in terms of foreign goods. Then, the wealth of foreign investors, expressed in terms of U.S. goods, is given by:

$$\frac{W^*}{E} = \frac{X^*}{E} + F$$

Let R be the relative expected gross real rate of return on holding U.S. assets versus foreign assets:

$$R \equiv \frac{1+r}{1+r^*}\frac{E^e_{+1}}{E} \tag{1}$$

U.S. investors allocate their wealth W between U.S. and foreign assets. They allocate a share α to U.S. assets, and by implication a share $(1-\alpha)$ to foreign assets. Symmetrically, foreign investors invest a share α^* of their

wealth W^* in foreign assets, and a share $(1-\alpha^*)$ in U.S. assets. Assume that these shares are functions of the relative rate of return, so

$$\alpha = \alpha(R, s),\;\; \alpha_R > 0,\; \alpha_s > 0 \qquad \alpha^* = \alpha^*(R, s),\;\; \alpha^*_R < 0\; \alpha^*_s < 0$$

A higher rate of return on U.S. assets increases the U.S. share in U.S. assets, and decreases the foreign share in foreign assets. s is a shift factor, standing for all the factors which shift portfolio shares for a given relative return. By convention, an increase in s leads both U.S. and foreign investors to increase the share of their portfolio in U.S. assets for a given relative rate of return.

An important parameter in the model is the degree of home bias in U.S. and foreign portfolios. We assume that there is indeed home bias, and capture it by assuming that the sum of portfolio shares falling on own-country assets exceeds one:

$$\alpha(R, s) + \alpha^*(R, s) > 1$$

Equilibrium in the market for U.S. assets (and by implication, in the market for foreign assets) implies

$$X = \alpha(R, s)\, W + (1 - \alpha^*(R, s))\, \frac{W^*}{E}$$

The supply of U.S. assets must be equal to U.S. demand plus foreign demand. Given the definition of F introduced earlier, this condition can be rewritten as

$$X = \alpha(R, s)(X - F) \;+\; (1 - \alpha^*(R, s))\, (\frac{X^*}{E} + F) \tag{2}$$

where R is given in turn by equation (1), and depends in particular on E and E^e_{+1}.

This gives us the first relation, which we shall refer to as the **portfolio balance** relation, between net debt, F, and the exchange rate, E. The slope of the relation between net debt and the exchange rate, evaluated at $r = r^*$ and $E^e_{+1} = E$ so $R = 1$, is given by

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

So, in the presence of home bias, higher net debt is associated with a lower exchange rate. The reason is that, as wealth is transfered from the United States to the rest of the world, home bias leads to a decrease in the demand for U.S. assets, which in turn requires a decrease in the exchange rate.

Imperfect Substitutability and Current Account Balance

Assume, as before, that U.S. and foreign goods are imperfect substitutes, and the U.S. trade deficit, in terms of U.S. goods, is given by:

$$D = D(E, z),\ D_E > 0,\ D_z > 0$$

Turn now to the equation giving the dynamics of the U.S. net debt position. Given our assumptions, U.S. net debt is given by:

$$F_{+1} = (1 - \alpha^*(R, s))\ \frac{W^*}{E}\ (1+r) - (1 - \alpha(R, s))\ W\ (1+r^*)\frac{E}{E_{+1}} + D(E_{+1}, z_{+1})$$

Net debt next period is equal to the value of U.S. assets held by foreign investors next period, minus the value of foreign assets held by U.S. investors next period, plus the trade deficit next period:

- The value of U.S. assets held by foreign investors next period is equal to their wealth in terms of U.S. goods this period, times the share they invest in U.S. assets this period, times the gross rate of return on U.S. assets in terms of U.S. goods.
- The value of foreign assets held by U.S. investors next period is equal to U.S. wealth this period, times the share they invest in foreign assets this period, times the realized gross rate of return on foreign assets in terms of U.S. goods.

The previous equation can be rewritten as

$$F_{+1} = (1+r)F + (1 - \alpha(R, z))(1+r)(1 - \frac{1+r^*}{1+r}\frac{E}{E_{+1}})(X - F) + D(E_{+1}, z_{+1}) \tag{3}$$

We shall call this the **current account balance** relation.

The first and last terms on the right are standard: Next period net debt is equal to this period net debt times the gross rate of return, plus the trade deficit next period.

The term in the middle reflects valuation effects, recently stressed by Gourinchas and Rey [2004], and Lane and Milesi–Ferretti [2004].[2] Consider for example an unexpected decrease in the price of U.S. goods, an unexpected decrease in E^e_{+1} relative to E—a dollar depreciation for short.

This depreciation increases the dollar value of U.S. holdings of foreign assets, decreasing the net debt U.S. position. Put another way, a depreciation improves the U.S. net debt position in two ways, the conventional one through the improvement in the trade balance, the second through asset

2. So long as the net debt position is the result of partly offsetting gross positions, valuation effects are present whether or not domestic and foreign assets are perfect substitutes. (Following standard practice, we ignored them in the model presented earlier by implicitly assuming that, if net debt was positive, U.S. investors did not hold foreign assets and net debt was therefore equal to the foreign holdings of U.S. assets.) Under perfect substitutability however, there is no guide as to what determines the alphas, and therefore what determines the gross positions of U.S. and foreign investors.

revaluation. Note that:

- The strength of the valuation effects depends on gross rather than net positions, and so on the share of the U.S. portfolio in foreign assets, $(1-\alpha)$, and on the size of U.S. wealth, $X-F$. It is present even if $F=0$.
- The strength of valuation effects depends on our assumption that U.S. gross liabilities are denoted in dollars, and so their value in dollars are unaffected by a dollar depreciation. Valuation effects would obviously be very different when, as is typically the case for emerging countries, gross positions were smaller, and liabilities were denominated in foreign currency.

Steady State and Dynamics

Assume the stocks of assets X, X^*, and the shift variables z and s, to be constant. Assume also r and r^* to be constant and equal to each other. In this case, the steady state values of net debt F and E are characterized by two relations:

The first is the portfolio balance equation (2). Given the equality of interest rates and the constant exchange rate, $R=1$ and the relation takes the form:

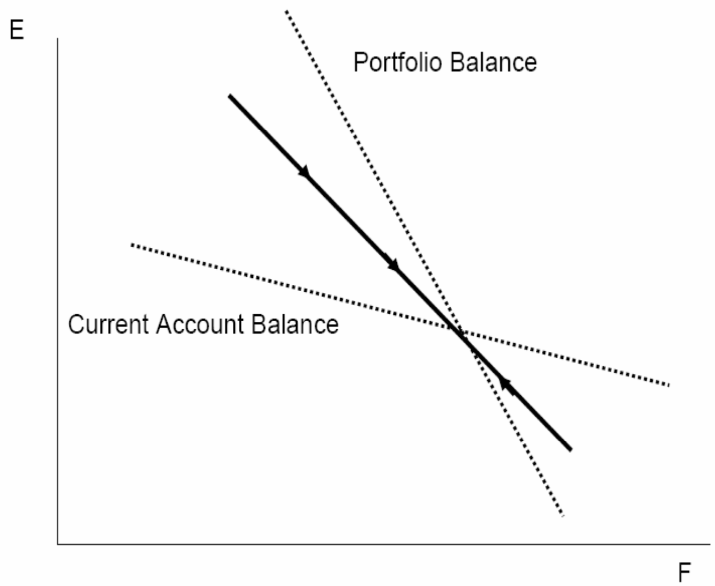
$$X = \alpha(1,s)(X-F) \;+\; (1-\alpha^*(1,s))\,(\frac{X^*}{E}+F)$$

The second is the current account balance equation (3). Given the equality of interest rates and the constant exchange rate and net debt levels, the relation takes the form:

$$0 = rF + D(E,z)$$

The first relation implies a negative relation between net debt and the exchange rate: As we saw earlier, in the presence of home bias, higher U.S. net debt, which transfers wealth to foreign investors, shifts demand away

Figure 1. Steady State Exchange Rate and Net Debt, and Saddle Path



from U.S. assets, and thus lowers the exchange rate.

The second relation also implies a negative relation between net debt and the exchange rate. The higher the net debt, the higher the trade surplus required in steady state to finance interest payments on the debt, thus the lower the exchange rate.[3]

This raises the question of the stability of the system. The system is (locally saddle point) stable if, as drawn in Figure 1, the portfolio balance relation is steeper than the current account balance equation.[4] To understand this condition, consider an increase in U.S. net debt. This increase has two effects on the current account deficit, and thus on the change in net debt: It increases interest payments. It leads, through portfolio balance, to a lower exchange rate, and thus a decrease in the trade deficit. For stability, the net effect must be that the increase in net debt reduces the current account deficit. This condition appears to be satisfied for plausible parameter values (more in the next section), and we shall assume that it is satisfied here. In that case, the path of adjustment—the saddle path—is downward sloping, as drawn in Figure 1.

We can now characterize the effects of shifts in preferences for goods or for assets.

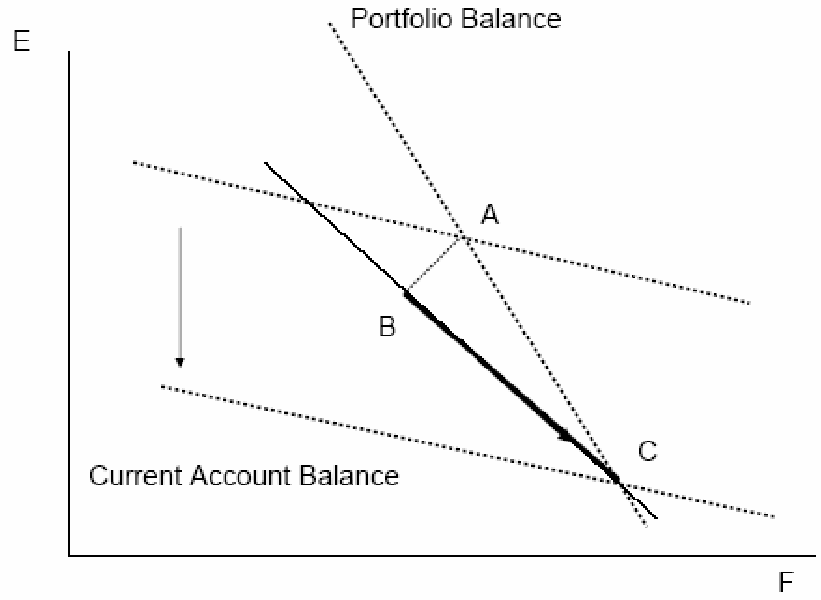
The Effects of a Shift Towards Foreign Goods

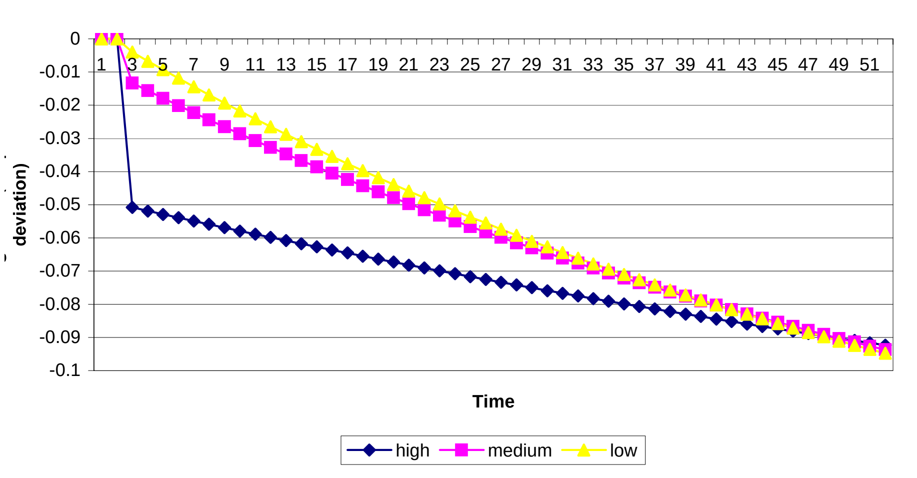
Figure 2a shows the effect of an (unexpected and permanent) increase in z. One can think of z as coming either from increases in U.S. activity relative to foreign activity, or from a shift in exports or imports at a given level of

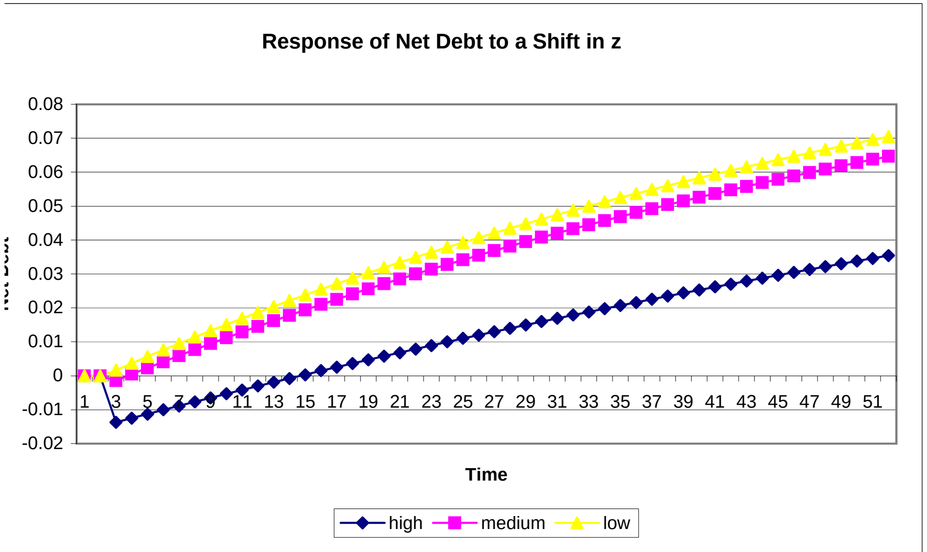
3. If we had allowed r and r^* to differ, the relation would have an additional term and take the form: $0 = rF + (1 - \alpha(R))(r - r^*)(X - F) + D(E, z)$. This additional term implies that if, for example, a country pays a lower rate of return on its liabilities than it receives on its assets, it may be able to combine positive net debt with positive net income payments from abroad—the situation the United States was in until very recently.

4. A characterization of the dynamics is given in the appendix.

Figure 2a. Adjustment of the Exchange Rate and the Net Debt Position to a Shift in the Trade Deficit.







activity and a given exchange rate; we defer a discussion of the sources of the actual shift in z over the past decade in the United States to later.

For a given level of net debt, current account balance requires a lower exchange rate: The current account balance locus shifts down. The new steady state is at point C, associated with a lower exchange rate and a higher level of net debt.

Valuation effects imply that any unexpected depreciation leads to an unexpected decrease in the net debt position. Denoting by ΔE the unexpected change in the exchange rate at the time of the shift, it follows from equation (3) that the relation between the two at the time of the shift is given by:

$$\Delta F = (1-\alpha)(1+r^*)(X-F)\frac{\Delta E}{E} \tag{4}$$

The economy jumps initially from A to B, and then converges over time along the saddle point path, from B to C. The shift in the trade deficit leads to an initial, unexpected, depreciation, followed by further depreciation and net debt accumulation over time until the new steady state is reached.

Note that the degree of substitutability between assets does not affect the steady state (more formally: note that the steady state depends on $\alpha(1,s)$ and $\alpha^*(1,s)$, so changes in α_R and α_R^* which leave $\alpha(1,s)$ and $\alpha^*(1,s)$ unchanged do not affect the steady state.) In other words, the eventual depreciation is the same no matter how close substitutes U.S. and foreign assets are. But the degree of substitutability plays a central role in the dynamics of adjustment, and in the respective roles of the initial unexpected depreciation and the anticipated depreciation thereafter. This is shown in Figure 2b, which shows the effects of three different values of α_R and α_R^*, on the path of adjustment (The three simulations are based on values for the parameters discussed and introduced in the next section. The purpose here is just to show qualitative properties of the paths. We shall return to the quantitative implications later.)

The less substitutable U.S. and foreign assets are—the smaller α_R and α_R^*—the smaller the initial depreciation, and the larger the anticipated rate of depreciation thereafter. To understand why, consider the extreme case where the shares do not depend on rates of return: U.S. and foreign investors want to maintain constant shares, no matter what the relative rate of return is. In this case, the portfolio balance equation (2) implies that there will be no response of the exchange rate to the unexpected change in z at the time it happens: Any movement in the exchange rate would be inconsistent with equilibrium in the market for U.S. assets. Only, over time, as the deficit leads to an increase in net debt, will the exchange rate decline.

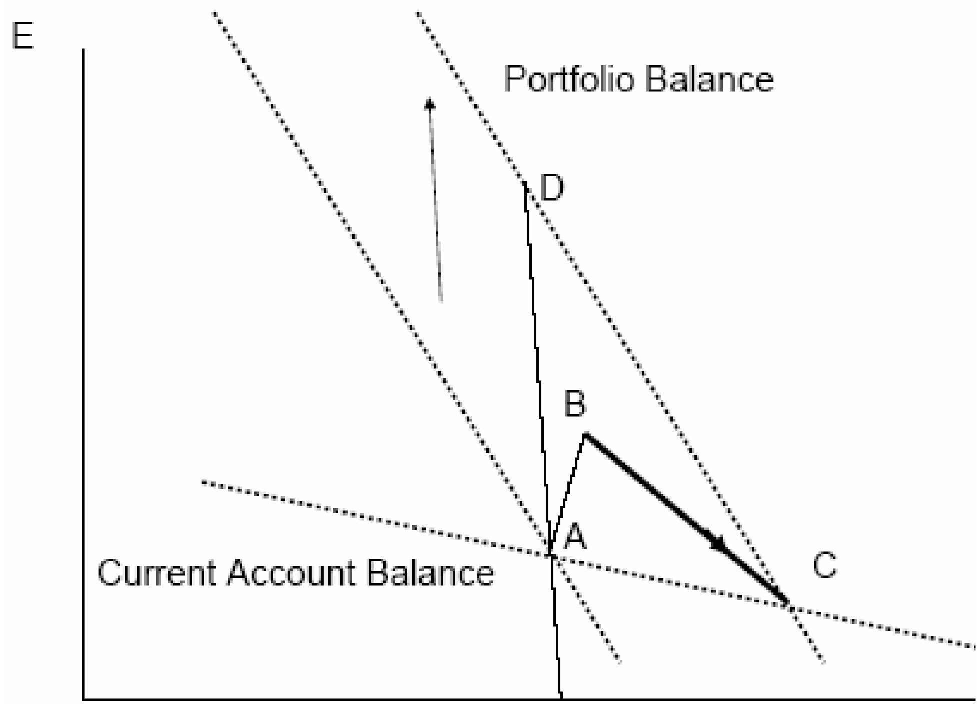
Conversely, the more substitutable U.S. and foreign assets are, the larger will be the initial depreciation, and the smaller the anticipated rate of depreciation thereafter, the longer the time to reach the new steady state. The limit of perfect substitutability—corresponding to the model we saw at the start—is actually degenerate: The initial depreciation is such as to maintain current account balance, and the economy does not move from there on, never reaching the new steady state (and so, the anticipated rate of depreciation is equal to zero.)

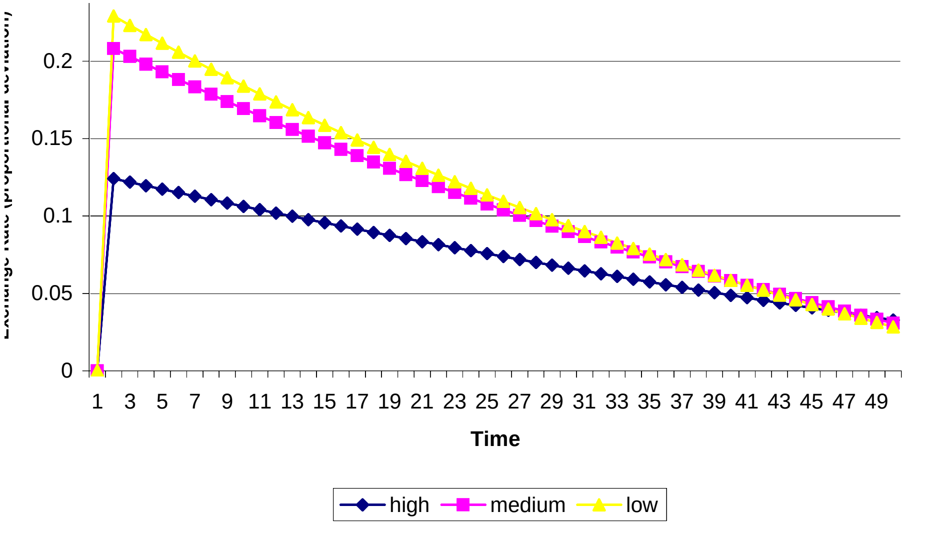
To summarize, in contrast to the case of perfect substitutability between assets we saw earlier, an increase in the U.S. demand for foreign goods leads to a limited depreciation initially, a potentially large and long lasting current account deficit, and a steady depreciation over time.

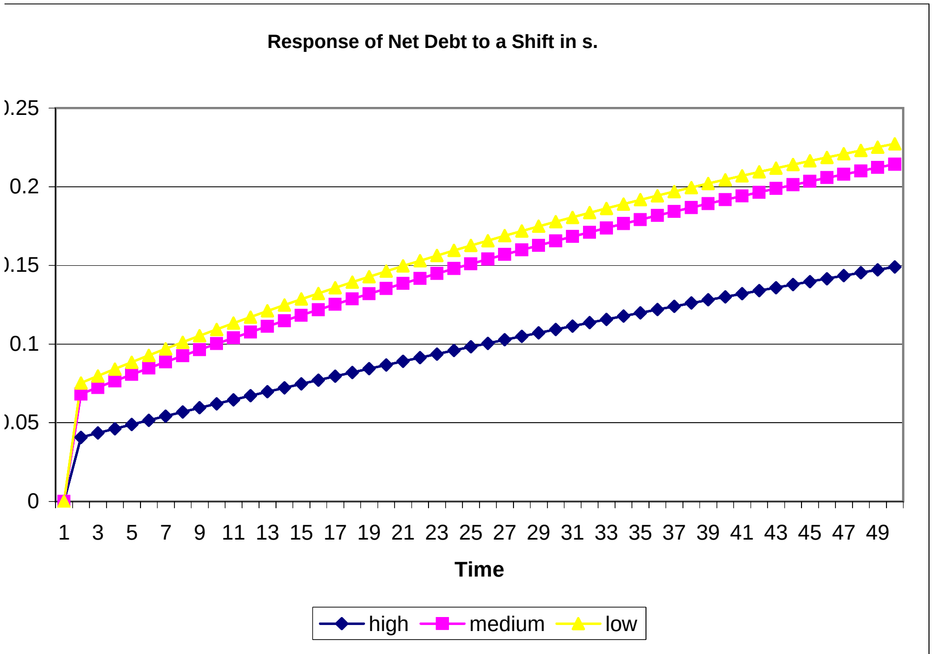
The Effects of a Shift Towards U.S. Assets

Figure 3a shows the effect of an (unexpected and permanent) increase in s, an increase in the demand for U.S. assets. Again, we defer a discussion of the potential factors behind such an increase in demand to later.

By assumption, the increase in s leads to an increase in $\alpha(1, s)$ and a







decrease in $\alpha^*(1, s)$. At a given level of net debt, portfolio balance requires an increase in the exchange rate. The portfolio balance locus shifts up. The new steady state is at point C, associated with a lower exchange rate and higher net debt.

The dynamics are given by the path ABC. The initial adjustment of E and F must again satisfy condition (4). So, the economy jumps from A to B, and then converges over time from B to C. The dollar initially appreciates, triggering an increase in the trade deficit and a deterioration of the net debt position. Over time, net debt increases, and the dollar depreciates. In the new equilibrium, the exchange rate is necessarily lower than before the shift: This reflects the need for a larger trade surplus to offset the interest payments on the now larger U.S. net debt. In the long run, the favorable portfolio shift leads to a depreciation.

Again, the degree of substitutability between assets plays an important role in the adjustment. This is shown in Figure 3b, which shows the path of adjustment for three different values of α_R and α_R^*. The less substitutable U.S. and foreign assets, the higher the initial appreciation, and the larger the anticipated rate of depreciation thereafter. The more substitutable the assets, the smaller the initial appreciation, and the smaller the anticipated rate of depreciation thereafter. While the depreciation is eventually the same (the steady state is invariant to the values of α_R and α_R^*), the effect of portfolio shifts is more muted but longer lasting, when the degree of substitutability is high.

An Interpretation of the Past

Looking at the effects of shifts in preferences for goods and for assets when both goods and assets are imperfect substitutes suggests three main conclusions:

Shifts in preferences towards foreign goods lead to an initial depreciation, followed by further anticipated depreciation. Shifts in preferences towards U.S. assets lead to an initial appreciation, followed by an anticipated depreciation.

The empirical evidence suggests that both types of shifts have been at work in the recent past in the United States. The first shift, by itself, would have implied a steady depreciation in line with increased trade deficits, while we observed an initial appreciation. The second shift can explain why the initial appreciation has been followed by a depreciation. But it attributes the increase in the trade deficit fully to the initial appreciation, whereas the evidence is of a large adverse shift in the trade balance even after controlling for the effects of the exchange rate. (This does not do justice to an alternative, and more conventional, monetary policy explanation, high U.S. interest rates relative to foreign interest rates at the end of the 1990s, leading to an appreciation, followed since by a depreciation. Relative interest rate differentials seem too small however to explain the movement in exchange rates.)

Both shifts lead eventually to a steady depreciation, a lower exchange rate than before the shift. This follows from the simple condition that higher net debt, no matter its origin, requires larger interest payments in steady state, and thus a larger trade surplus. The lower the degree of substitutability between U.S. and foreign assets, the higher the expected rate of depreciation along the path of adjustment. We appear to have indeed entered this depreciation phase in the United States.

2 How Large a Depreciation? A Look at the Numbers

The model is simple enough that one can put in some values for the parameters, and draw the implications for the future. More generally, the model provides a way of looking at the data, and this is what we do in this section.

Parameter Values

Consider first what we know about portfolio shares: In 2003, U.S. financial wealth, W, was equal to \$35 trillion, or about three times U.S. GDP (\$11 trillion).[5] Non–U.S. world financial wealth is harder to assess. Based on a ratio of financial assets to GDP of about 2 for Japan and for Europe, and a GDP for the non–U.S. world of approximately \$18 trillion in 2003, a reasonable estimate for W^*/E is \$36 trillion—so roughly the same as for the United States.[6]

The net U.S. debt position, F measured at market value, was equal to \$2.7 trillion in 2003, up from approximate balance in the early 1990s.[7] By implication, U.S. assets, X, were equal to $W + F =$ \$37.7 trillion (35+2.7), and foreign assets, X^*/E, were equal to $W^*/E - F =$ \$33.3 trillion (36-2.7). Put another way, the ratio of U.S. net debt to U.S. assets, F/X, was 7.1% (2.7/37.7); the ratio of U.S. net debt to U.S. GDP was equal to 25% (2.7/11).

In 2003, gross U.S. holdings of foreign assets, at market value, were equal to \$8.0 trillion. Together with the value for W, this implies that the share of U.S. wealth in U.S. assets, α, was equal to 0.77 (1 - 8.0/35). Gross foreign holdings of U.S. assets, at market value, were equal to \$10.7 trillion. Together with the value of W^*/E, this implies that the share of foreign wealth in foreign assets, α^*, was equal to 0.70 (1 - 10.7/36).

To get a sense of the implications of these values for α and α^*, note, from equation (2) that a transfer of one dollar from U.S. wealth to foreign wealth

5. Source for financial wealth: Flow of Funds Accounts of the United States 1995-2003, Table L100, Board of Governors of the Federal Reserve Board, December 2004
6. For the Euro Area, financial wealth was about 16 trillion euros in 2003, with a GDP of 7.5 trillion (Source: Europe: ECB Bulletin, February 2005, Table 3.1). For Japan, financial wealth was about 900 trillion yen in 2004, with a GDP of 500 trillion. (Source: Flow of Funds, Bank of Japan website, http://www.boj.or.jp/en/stat/sj/sj.html).
7. Source for the numbers in this and the next paragraph: BEA, International Transactions, Table 2, International Investment Position of the United States at Year End, 1976-2003, October 2004

implies a decrease in the demand for U.S. assets of $(\alpha + \alpha^* - 1)$ dollars, or 47 cents.[8]

We would like to know not only the values of these shares, but also their dependence on the relative rate of return—the value of the derivatives α_R and α_R^* . Little is known about these values. Gourinchas and Rey [2004] provide indirect evidence of the relevance of imperfect substitutability by showing that a combination of the trade deficit and the net debt position help predict a depreciation of the exchange rate (we shall return to their results later); this would not be the case under perfect substitutability. It is however difficult to go from their results to estimates of α_R and α_R^*. Thus, when needed below, we shall derive results under alternative assumptions about these derivatives.

Table 1 summarizes the relevant numbers.

W	W^*/E	X	X^*/E	F	α	α^*
\$35	\$36	\$37.5	\$33.3	\$2.7	0.77	0.70

W, W^*/E, X, X^*/E, F are in trillions of dollars

The next important parameter in our model is θ, the effect of the exchange rate on the trade balance. The natural starting point here is the Marshall Lerner relation:

$$\frac{dD}{d\text{Exports}} = [\eta_{\text{im}} - \eta_{\text{exp}} - 1] \frac{dE}{E}$$

where η_{im} and η_{exp} are respectively the elasticities of imports and exports with respect to the real exchange rate.

8. Note that this conclusion is dependent on the assumption we make in our model that marginal and average shares are equal. This may not be the case.

Estimates of the η's based on estimated U.S. import and export equations range quite widely (see the survey by Chinn [2004]). In some cases, the estimates imply that the Marshall–Lerner condition (the condition that the term in brackets be positive, so a depreciation improves the trade balance) is barely satisfied. Estimates used in macroeconometric models imply a value for the term in brackets between 0.5 and 0.9. Put another way, together with the assumption that the ratio of U.S. exports to U.S. GDP is equal to 10%, they imply that a reduction of the ratio of the trade deficit to GDP of 1% requires a depreciation somewhere between 11 and 20%.

One may believe however that measurement error, complex lag structures, and mispecification all bias these estimates downwards. An alternative approach is to derive the elasticities from plausible specifications about utility, and the pass-through behavior of firms. Using such an approach, and a model with non tradable goods, tradable domestic goods, and foreign tradable goods, Obstfeld and Rogoff [2004] find that a decrease in the trade deficit to GDP of 1% requires a decrease in the real exchange rate somewhere between 7% and 10%—thus, a smaller depreciation than implied by macroeconometric models.

Which value to use is obviously crucial to assess the scope of the required exchange rate adjustment. We choose an estimate for the term in brackets of 0.7—towards the high range of empirical estimates, but lower than the Obstfeld Rogoff elasticities. This estimate, together with an export ratio of 10%, implies that a reduction of the ratio of the trade deficit to GDP of 1% requires a depreciation of 15%.

A Simple Exercise

We have argued that a depreciation of the dollar has two effects, a conventional one through the trade balance, and the other through valuation effects. To get a sense of the relative magnitudes of the two, consider the effects of an unexpected depreciation in our model. More specifically, consider the effects of an unexpected 15% decrease in E_{+1} relative to E on net debt, F_{+1}, in equation (3).

The first effect of the depreciation is to improve the trade balance. Given our earlier discussion and assumptions, such a depreciation reduces the trade deficit by 1% of GDP (which is why we chose to look at a depreciation of 15%).

The second effect is to increase the dollar value of U.S. holdings of foreign assets (equivalently, reduce the foreign currency value of foreign holdings of U.S. assets), and thus reduce the U.S. net debt position. From equation (3) (with both sides divided by U.S. output Y, to make the interpretation of the magnitudes easier), this effect is given by:

$$\frac{dF_{+1}}{Y} = -(1-\alpha)(1+r^*)\frac{X-F}{Y}\,\frac{dE}{E}$$

From above, $(1-\alpha)$ is equal to 0.23, $(X-F)/Y$ to 3. Assume that r^* is equal to 4%. The effect of the 15% depreciation is then to reduce the ratio of net debt to GDP by 10 percentage points (0.23 x 1.04 x 3 x 0.15).

This implies that, after the unexpected depreciation, interest payments are lower by 4% times 10%, or 0.4% of GDP. Putting things together, a 15% depreciation improves the current account balance by 1.4% of GDP, roughly one third of it due to valuation effects.[9]

It is then tempting at this point to ask what size unexpected depreciation would lead to a sustainable current account deficit **today**? Take the actual current account deficit to be about 6%. What the "sustainable" current account deficit is depends on the ratio of net debt to GDP the United States is willing to sustain and on the growth rate of GDP: If the growth rate of U.S. GDP is equal to g, the U.S. can sustain a current account deficit of gF/Y. Assuming for example a growth rate of 3%, and a ratio of net debt to GDP of 25% (the current ratio, but one which has no particular claim to being the right one for this computation) implies that the United States can run a current account deficit of 0.75% while maintaining a constant ratio of net debt to GDP. In this case, the depreciation required to shift from the actual to the sustainable current account deficit would be equal to roughly 56% ((6% -0.75%) times (15%/1.4%)).

This is a large number, and despite the uncertainty attached to the underlying values of many of the parameters, it is a useful number to keep in mind. But one should be clear about the limitations of the computation:

First, the United States surely does not need to shift to sustainable current account balance right away. The rest of the world is still willing to lend to it, if perhaps not at the current rate. The longer the United States waits however, the higher the ratio of net debt to GDP, and thus the higher the eventual required depreciation. In this sense, our computation gives a lower bound on the eventual depreciation.

Second, the computation is based on the assumption that, at a current exchange rate, the trade deficit will remain as large as it is today. If, for example, we believed that part of the current trade deficit reflected the combined effect of recent depreciations and J-curve effects, then the computation above would clearly overestimate the required depreciation.

The rest of the section deals with these issues. First, by returning to dynamics, to have a sense of the eventual depreciation, and of the rate at which it may be achieved. Second, by looking at the evidence on the origins of the shifts in z and s.

9. A similar computation is given by Lane and Milesi-Ferretti [2004] for a number of countries, although not for the United States.

Returning to Dynamics

How large is the effect of a given shift in z (or in s) on the accumulation of net debt and on the eventual exchange rate? And how long does it take to get there?

The natural way to answer these questions is to simulate our model using the values of the parameters we derived earlier. This is indeed what the simulations presented in Figure 2b and 3b the previous section did; we look now more closely at their quantitative implications.

Both sets of simulations are based on the values of the parameters given above. Recognizing the presence of output growth (which we did not allow for in the model), and rewriting the equation for net debt as an equation for the ratio of net debt to output, we take the term in front of F in the current account balance relation (3) to stand for the interest rate minus the growth rate. We choose the interest rate to be 4%, the growth rate to be 3%, so the interest rate minus the growth rate is equal to 1%. We write the portfolio shares as:

$$\alpha(R, s) = a + bR + s, \quad \alpha^*(R, s) = a^* - bR - s$$

The simulations show the results for three values of the parameter b, $b = 10$, $b = 1.0$, and $b = 0.1$. A value of b of 1 implies that an increase in the expected relative return on U.S. assets of 100 basis points increases the desired shares in U.S. assets by one percentage point.

Figure 2b shows the effects of an increase in z of 1% of U.S. GDP. Figure 3b shows the effects of an increase in s of 5%, leading to an increase in α and a decrease in α^* of 5% at a given relative rate of return. Time is measured in years.

Figure 2b leads to two main conclusions. First, the effect of a permanent increase in z by 1% is to eventually increase the ratio of net debt to GDP

by 17%, and require an eventual depreciation of 12.5% (Recall that the long run effects are independent of the degree of substitutability between assets, independent of the value of b). Second, it takes a long time to get there: The figure is truncated at 50 years; by then the adjustment is not yet complete.

Figure 3b leads to similar conclusions. The initial effect of the increase in s is to lead to an appreciation of the dollar, from 23% if $b = 0.1$, to 12% if $b = 10$. The long run effect of the increase in s is to eventually lead to an increase in the ratio of U.S. net debt to GDP of 35%, and a depreciation of 15%. But, even after 50 years, the adjustment is far from complete, and the exchange rate is still above its initial level.

What should one conclude from these exercises? That, under the assumptions that (1) there are no anticipated changes in z, and in α and α^*, (2) that investors have been and will be rational (the simulations are carried out under rational expectations), and (3) that there are no surprises, the dollar will depreciate by a large amount, but at a steady and slow rate. There are good reasons to question each of these assumptions, and this is where we go next.

A Closer Look at the Trade Deficit

To think about the likely path of z, and thus the path of the trade deficit at a given exchange rate, it is useful to write the trade deficit as the difference between exports and the value of imports (in terms of domestic goods):

$$D(E, z) \equiv \exp(E, Z^*, \widetilde{z^*}) - E \, \mathrm{imp}(E, Z, \tilde{z})$$

We have decomposed z into two components, total U.S. spending Z, and $\tilde{z}$, shifts in the relative demand for U.S versus foreign goods, at a given level of spending and a given exchange rate. z^* is similarly decomposed between Z^*, and shifts in the relative demand for U.S. versus foreign goods, $\tilde{z}^*$.

Most of the large current account fluctuations in developed countries of the last decades have come from relative fluctuations in activity, from fluctuations in Z relative to Z^*.[10] It has indeed been argued that the deterioration of the U.S. trade balance has come mostly from faster growth in the United States relative to its trade partners, leading imports to the United States to increase faster than exports to the rest of the world. This appears however to have played a limited role. Europe and Japan indeed have had lower growth than the United States (45% cumulative growth for the United States from 1990 to 2004, versus 29% for the Euro Area and 25% for Japan), but they account for only 35% of U.S. exports, and other U.S. trade partners have grown as fast or faster as the United States. A study by the IMF [2004] finds nearly identical output growth rates for the United States and its export–weighted partners since the early 1990s.[11]

Some have argued that the deterioration in the trade balance reflects instead a combination of high growth both in the United States and abroad, combined with a high U.S. import elasticity to domestic spending (1.5 or higher), higher than the export elasticity with respect to foreign spending. Under this view, high U.S. growth has led to a more than proportional increase in imports, and an increasing trade deficit. The debate about the correct value of the U.S. import elasticity is an old one, dating back to the estimates by Houthakker and Magee [1969]; we tend to side with the recent conclusion by Marquez [2000] that the elasticity is close to one. For our purposes however, this discussion is not relevant. Whether the evolution of the trade deficit is the result of a high import elasticity or the result of shifts in the $\tilde{z}$'s there are no obvious reasons to expect either the shift to reverse, or growth in the United States to drastically decrease in the future.

10. For a review of current account deficits and adjustments for 21 countries over the last 30 years, and for references to the literature, see for example [Debelle and Galati 2005].

11. As the case of the United States indeed reminds us, output is not the same as domestic spending, but the differences in growth rates between the two over a decade are small.

One way of assessing the relative role of spending, the exchange rate, and other shifts, is to look at the performance of import and export equations in detailed macroeconometric models. The numbers, using the macroeconometric model of Global Insight (formerly the DRI model) are as follows:[12] The U.S. trade deficit in goods increased from \$221 billion in 1998:1 to \$674 billion in 2004:4. Of this \$453 billion increase, \$126 billion was due to the increase in the value of oil imports, leaving \$327 billion to be explained. Using the export and import equations of the model, activity variables and exchange rates explain \$202 billion, so about 60% of the increase. Unexplained time trends and residuals account for the remaining 40%, a substantial amount.[13]

Looking to the future, whether growth rate differentials, or Houthakker-Magee effects, or unexplained shifts, are behind the increase in the trade deficit is probably not essential. Lower growth in Europe or in Japan reflects in large part structural factors, and neither Europe nor Japan are likely to make up much of the cumulative growth difference since 1995 over the next few years. One can still ask how much an increase in growth in Europe would reduce the U.S. trade deficit. A simple computation is as follows. Suppose that Europe and Japan made up the roughly 20% growth gap they have accumulated since 1990 vis a vis the United States—an unlikely scenario in the near future—and so U.S. exports to Western Europe and

12. We thank Nigel Gault for communicating these results to us.

13. The model has a set of disaggregated export and import equations. Most of the elasticities of the different components with respect to domestic or foreign spending are close to one, so Houthakker-Magee effects play a limited role (except for imports and exports of consumption goods, where the elasticity of imports with respect to consumption is 1.5 for the United States, but the elasticity of exports with respect to foreign GDP is an even higher 1.9).

Japan increased by 20%. Given that U.S. exports to these countries account for about 350 billion, the improvement would be 0.7% of U.S. GDP—not negligible, but not major either.

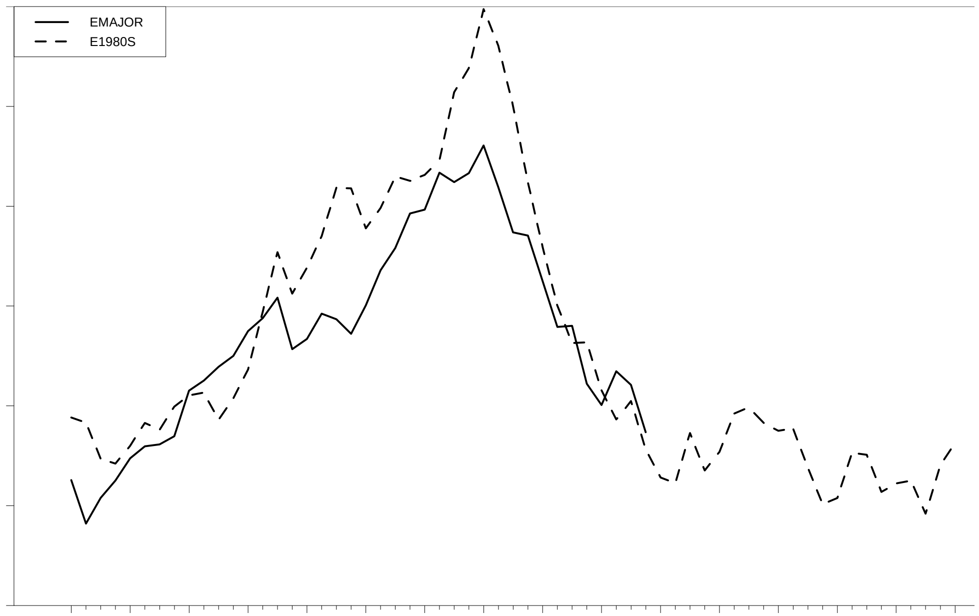
There is however one place where one may hold more hope for a reduction in the trade deficit, namely the working out of the J- curve. Nominal depreciations increase import prices, but these decrease imports only with a lag. Thus, for a while, depreciations can increase the value of imports and worsen the trade balance, before improving it later. The reason to think this may be important is the “dance of the dollar”, and the joint movement of the dollar and the current account during the 1980s:

From the first quarter of 1979 to the first quarter of 1985, the real exchange rate of the United States (measured by the trade weighted major currencies index constructed by the Federal Reserve Board) increased by 41%. This appreciation was then followed by a sharp depreciation, with the dollar falling by 44% from the first quarter of 1985 to the first quarter of 1988.

The appreciation was accompanied by a steady deterioration in the current account deficit, from rough balance in the early 1980s to a deficit of about 2.5% when the dollar reached its peak in early 1985. The current account continued to worsen however for more than two years, reaching a peak of 3.5% in 1987. The divergent evolutions of the exchange rate and the current account led a number of economists to explore the idea of hysteresis in trade (in particular [Baldwin and Krugman 1987]), the notion that once appreciation had led to a loss of market shares, an equal depreciation may not be sufficient to reestablish trade balance. Just as the idea was taking hold, the current account position rapidly improved, and trade was roughly in balance by the end of the decade.[14]

14. These issues were discussed at length in the Brookings Papers then. (For example Cooper [1986], Baldwin and Krugman [1987], Dornbusch [1987], Sachs and Lawrence [1988], with post-mortems by Lawrence [1990] and Krugman [1991].) Another much discussed issue was the respective roles of deficit reduction and exchange rate adjustment. We return to it below.

U.S. Multilateral Real Exchange Rate, 1995:1 to 2004:3



The parallels with current evolutions are clear. They are made even clearer in Figure 4, which plots the evolution of the exchange rate and the current account both during the 1980s and today. The two episodes are aligned so that the dollar peak of 1985:1 coincides with the dollar peak of 2001:2. The figure suggests two conclusions:

If that episode in history is a reliable guide, and the lags similar to those which prevailed in the 1980s, the current account deficit may start to turn around soon. The deficit is however much larger than it was at its peak in 1987 (6% versus 3.5%) and the depreciation so far has been more limited than in the 1980s (26% from 2001:2 to 2004:4, compared to 39% over the equivalent period of time from 1985:1 to 1988:3). So one can surely not conclude that the depreciation so far is enough to get back to a sustainable current account deficit. But it may be that in the computation we went through earlier, one can start from a "J-curve" adjusted current account deficit of 4-5% instead of 6%. If we choose 4%—a very optimistic assumption—then the remaining required depreciation (following the same steps as we did earlier) is 34% ((4%-0.75%) times (15%/1.4%)).

A Closer Look at Portfolio Shares

One of the striking aspects of the simulations we presented above is how slow the depreciation was along the path of adjustment. This is in contrast with predictions of much more abrupt falls in the dollar in the near future (for example [Roubini and Setser 2005]). This raises two issues: Can the anticipated depreciation be higher than in the simulations? Are there surprises under which the depreciation might be much faster (slower), and if so which ones? We take both questions in turn.

To answer the first, we go back to the model. We noted earlier that the anticipated rate of depreciation is higher, the lower the degree of substitutability between assets. So, by assuming zero substitutability—i.e. constant shares, except for changes coming from shifts in s—we can derive an upper bound on the anticipated rate of depreciation. Differentiating equation (2) gives:

$$\frac{dE}{E} = -\frac{(\alpha + \alpha^* - 1)X}{(1-\alpha^*)X^*/E}\ d\,(\frac{F}{X}) + \frac{(X-F)\ d\alpha + (X^*/E + F)\ d\alpha^*}{(1-\alpha^*)X^*/E}$$

In the absence of anticipated shifts in shares—so the second term is equal to zero—the anticipated rate of depreciation depends on the change in the ratio of U.S. net debt to U.S. assets: The faster the increase in net debt, the faster the decrease in the relative demand for U.S. assets, therefore the higher the rate of depreciation needed to maintain portfolio balance. Using the parameters we constructed earlier, this equation implies:

$$\frac{dE}{E} = -1.6\ d\,(\frac{F}{X}) + 3.0\ (d\alpha - d\alpha^*)$$

Suppose shares remain constant. If we take the annual increase in the ratio of net debt to U.S. GDP to be 5%, and the ratio of U.S. GDP to U.S. assets to be one third, this gives an anticipated annual rate of depreciation of 2.7% a year (1.6 times .05 divided by 3).[15]

If, however, shares in U.S. assets in the portfolios of either domestic or foreign investors are expected to decline, the anticipated depreciation can clearly be much larger. If for example, we anticipate the shares of U.S. assets in foreign portfolios to decline by 2% over the coming year, then the anticipated depreciation is 8.7% (2.7% from above, plus 3.0 times 2%). This is obviously an upper bound, as it assumes that the remaining in-

15. While a comparison is difficult, this rate appears lower than the rate of depreciation implied by the estimates of Gourinchas and Rey [2004]. Their results imply that a combination of net debt and trade deficits two standard deviations from the mean—a situation which would appear to characterize well the United States today—implies an anticipated annual rate of depreciation of about 5% over the following two years.

vestors are willing to keep a constant share of their wealth in U.S. assets despite a large negative expected rate of return. Still, it implies that, under imperfect substitutability, and under the assumption that desired shares in U.S. assets will decrease, it is a logically acceptable statement to predict a substantial depreciation of the dollar in the near future.

Are there good reasons to anticipate these desired shares to decrease in the near future? This is the subject of a contentious debate:

Some argue that the United States can continue to finance current account deficits at the current level for a long time to come, at the same exchange rate. They argue that poor development of financial markets in Asia and elsewhere, and the need to accumulate international collateral, implies a steadily increasing relative demand for U.S. assets. They point to the latent demand by Chinese private investors, currently limited by capital controls. In short, they argue that foreign investors will be willing to further increase $(1-\alpha^*(R))$, and/or that domestic investors will be willing to further increase $\alpha(R)$ for many years to come (for example, Dooley et al [2004], Caballero et al [2004]).

Following this argument, we can ask what increase in shares—say, what increase in $(1-\alpha^*)$, the foreign share falling on U.S. assets—would be needed to absorb the current increase in net debt at a given exchange rate. From the relation derived above, putting dE/E and $d\alpha$ equal to zero gives:

$$d\alpha^* = -\frac{(\alpha^* + \alpha - 1)X}{X^*/E + F}\, d\,(\frac{F}{X})$$

For the parameters we have constructed, this implies an increase in the share of U.S. assets in foreign portfolios of about 2.5% a year (0.47 times 5%), a large increase by historical standards.[16]

16. A related argument is that, to the extent that the rest of the world is growing faster than the United States, an increase in the ratio of net debt to GDP in the United States

We find more plausible the arguments that the relative demand for U.S. assets may actually decrease rather than increase in the future. This is based in particular on the fact that much of the recent accumulation of U.S. assets has taken the form of accumulation of reserves by the Japanese and the Chinese central banks. Many worry that this will not last, that the pegging of the renminbi will come to an end, or that both central banks will want to change the composition of their reserves away from U.S. assets, leading to further depreciation of the dollar. Our model provides a simple way of discussing the issue and thinking about the numbers.

Consider pegging first. Pegging means that the foreign central bank buys dollar assets so as keep $E = \bar{E}$.[17] Let B denote the reserves (i.e the U.S. assets) held by the foreign central bank, so

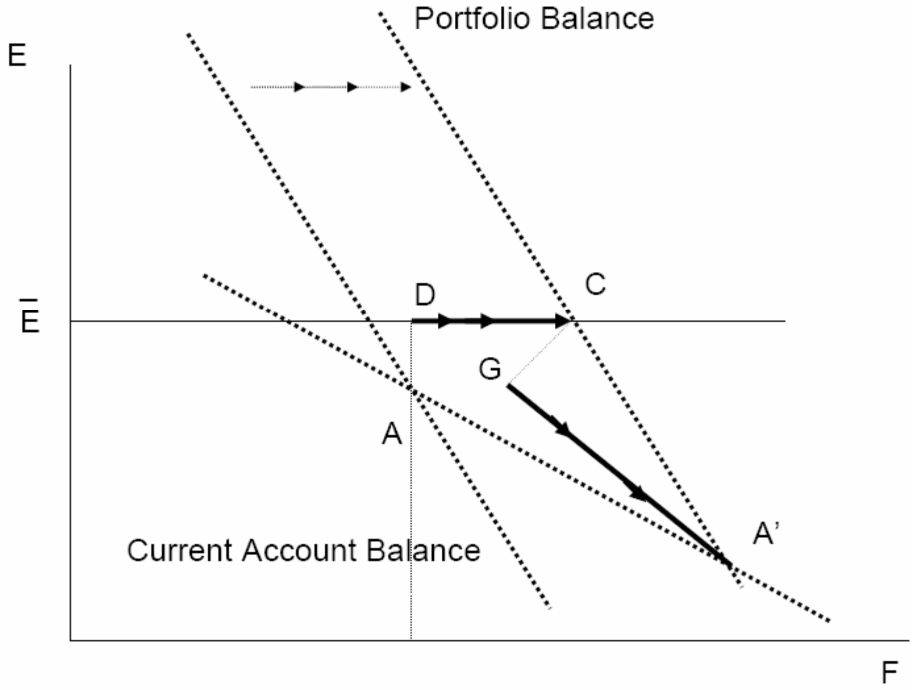
$$X = B + \alpha(1)(X - F) + (1 - \alpha^*(1))(\frac{X^*}{E} + F)$$

The dynamics under pegging are characterized in Figure 5. Suppose that, in the absence of pegging, the steady state is given by point A, and that the foreign central bank pegs the exchange rate at level $\bar{E}$. At $\bar{E}$, the U.S. current account is in deficit, and so F increases over time. Wealth gets steadily transfered to the foreign country, so the private demand for U.S. assets steadily decreases. To keep E unchanged, B must increase further over time. Pegging by the foreign central bank is thus equivalent to a continuous outward shift in the portfolio balance schedule: What the foreign central bank is effectively doing is keeping world demand for U.S. assets un-

is consistent with a constant share of its portfolio in U.S. assets. The argument falls quantitatively short. While Asian countries are growing fast, their weight and their financial wealth are still too small to absorb the U.S. current account deficit while maintaining constant shares of U.S. assets in their portfolios.

17. Our two-country model has only one foreign central bank, and so we cannot discuss what happens if one foreign bank pegs and the others do not. The issue is however relevant in thinking about the joint evolutions of the dollar–euro and the dollar–yen exchange rates. More on this in the next section.

gure 5. Adjustment of the exchange rate and the net debt position to the end of pegging.



changed by offsetting the fall in private demand. Pegging leads to a steady increase in U.S. net debt, and a steady increase in reserves offsetting the steady decrease in private demands for U.S. assets. This path is represented by the path DC in Figure 5. What happens when the foreign central bank (unexpectedly) stops pegging? The adjustment is represented in Figure 5. With the economy at point C just before the abandon of the peg, the economy jumps to G (recall that valuation effects lead to a decrease in net debt—and therefore a capital loss for the foreign central bank—when there is an unexpected depreciation), and the economy then adjusts along the saddle point path DA'. The longer the peg lasts, the larger the initial and the eventual depreciation.

In other words, an early end to the Chinese peg will obviously lead to a depreciation of the dollar (an appreciation of the renminbi). But the sooner it takes place, the smaller the required depreciation, both initially, and in the long run. Put another way, the longer the Chinese wait to abandon the peg, the larger the eventual appreciation of the renminbi.

The conclusions are very similar with respect to changes in the composition of reserves. We can think of such changes as changes in portfolio preferences, this time not by private investors but by central banks, so we can apply our earlier analysis directly. A shift away from U.S. assets will lead to an initial depreciation, leading to a lower current account deficit, a smaller increase in net debt, and thus to a smaller depreciation in the long run.

How large might these shifts be? Chinese reserves are currently equal to 500 billion, Japanese reserves to 850 billion. Assuming that these reserves are now held mostly in dollars, and the People's Bank of China (PBC for short) and the Bank of Japan (BOJ) reduced their dollar holdings to half of their portfolio, this would represent a decrease in the share of U.S. assets in foreign (private and central bank) portfolios, $(1-\alpha^*)$, from 30% to 28%. The computations we presented earlier suggest that this would be a substantial shift, leading to a decrease in the dollar possibly as large as 8.7%.

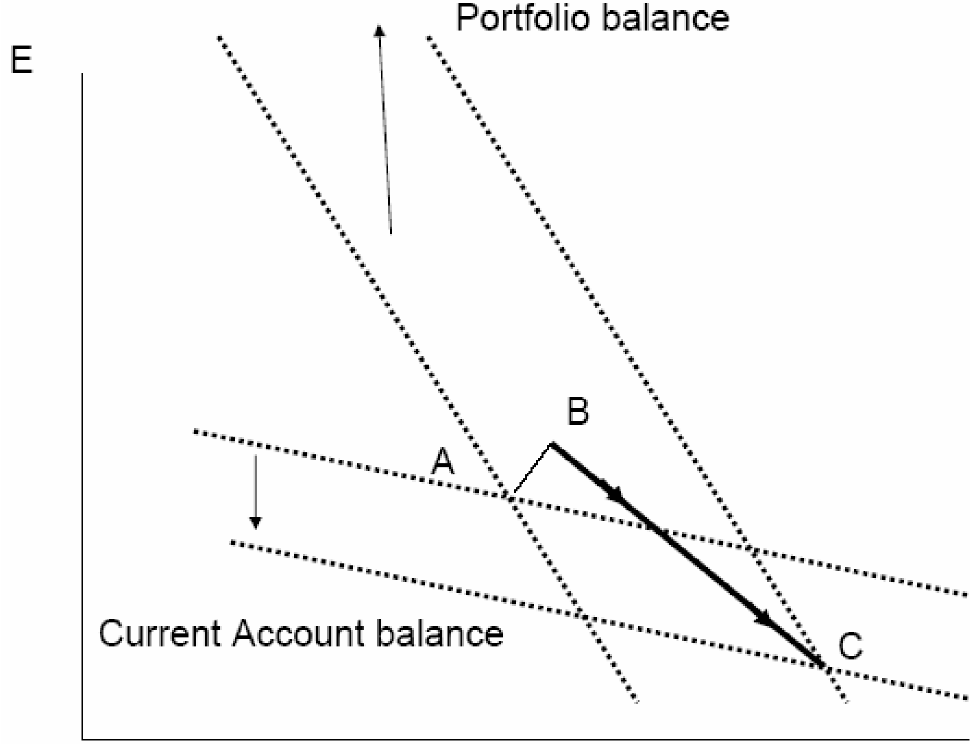
To summarize: To avoid a depreciation of the dollar would require a steady and substantial increase in shares of U.S. assets in U.S. or foreign portfolios at a given exchange rate. This seems unlikely to hold for very long. A more likely scenario is the opposite, a decrease in shares due in particular to diversification of reserves by central banks. If and when this happens, the dollar will depreciate. Note however that the larger the adverse shift, the larger initial depreciation, but the smaller the accumulation of debt thereafter, and therefore the smaller the eventual depreciation. “Bad news” on the dollar now may well be good news in the long run (and the other way around).

The Path of Interest Rates

We took interest rates as given in our model, and have taken them as constant so far in our discussion. Yield curves in the United States, Europe, and Japan indeed indicate little expected change in interest rates over the near and medium term. It is however easy to think of scenarios where interest rates may play an important role, and this takes us to an issue we have not discussed until now, the role of budget deficit reduction in the adjustment process.

Before we do so, we briefly show the effects of an increase in the U.S. interest rate in our model. This is done in Figure 6, which shows the effects of an unexpected permanent increase in r over r^* (In contrast to the case of perfect substitutability, it is possible for the two interest rates to differ even in steady state.) The portfolio balance equation shifts up: At a given level of net debt, U.S. assets are more attractive, and so the exchange rate increases. The current account balance shifts down. The higher interest rate implies larger payments on foreign holdings of U.S. assets, and thus a

6. Adjustment of the exchange rate and the net debt positi to an increase in the U.S. interest rate



larger trade surplus, a lower exchange rate. The adjustment path is given by ABC. In response to the increase in r, the economy jumps from A to B, and then moves over time from B to C. As drawn, the exchange rate initially appreciates, but, in general, the initial effect on the exchange rate is ambiguous: If gross liabilities are large for example, then the effect of higher interest payments on the current account balance may dominate the more conventional "overshooting" effects of increased attractiveness and lead to an initial depreciation rather than an appreciation. In either case, the steady state effect is higher net debt accumulation, and thus a larger depreciation than if r had not increased.

Thus, under the assumption that an increase in interest rates leads initially to an appreciation, an increase in U.S. interest rates beyond what is already implicit in the yield curve would delay the depreciation of the dollar, at the cost of higher net debt accumulation, and a larger eventual depreciation.

A more relevant scenario however may be what happens in response to other shifts, for example in response to adverse portfolio shifts leading, at given interest rates, to a large depreciation of the dollar. As the dollar depreciates, relative demand shifts towards U.S. goods, reducing the trade deficit, but also increasing the total demand for U.S. goods. Suppose also that initially output is at its natural level, i.e. the level associated with the natural rate of unemployment—which appears to be a good description of the United States today. Three outcomes are possible:

- Interest rates and fiscal policy remain unchanged. The increase in demand leads to an increase in output, and an increase in imports which partly offsets the effect of the depreciation on the trade balance. (In terms of our model, it leads to an increase in domestic spending, Z, and thus to a shift in z.)
- Interest rates remain unchanged but fiscal policy is adjusted to offset the increase in demand and leave output at its natural level; in other words, the budget deficit is reduced so as to maintain internal balance.
- Fiscal policy remains unchanged but the Fed increases interest rates so as to maintain output at its natural level. In this case, higher U.S. interest rates limit the extent of the depreciation and reduce the current account deficit reduction. In doing so, they lead however to larger net debt accumulation, and to a larger eventual depreciation.

In short, an orderly reduction of the current account deficit—that is, a decrease in the current account deficit while maintaining internal balance—requires both a decrease in the exchange rate and a reduction in budget deficits.[18] The two are not substitutes: The exchange rate depreciation is needed to achieve current account balance, and the budget deficit reduction is needed to maintain internal balance at the natural level of output.[19] (Frequently heard statements that deficit reduction would reduce the need for a dollar depreciation leave us puzzled). If the depreciation is not accompanied by a reduction in budget deficits, one of two things can happen: An increase in demand, and the risk that the U.S. economy overheats. Or, and more likely, an increase in U.S. interest rates so as to maintain internal balance. This increase would either limit or delay the depreciation of the dollar. As we have made clear, this is however a mixed blessing. Such a delay implies less depreciation in the short run, but more net debt accumulation and more depreciation in the long run.

18. Many of the discussions at Brookings in the late 1980s were about the respective roles of budget deficit reduction and exchange rate adjustment. To take two examples: Sachs [1988] argued "the budget deficit is the most important source of the trade deficit. Reducing the budget deficit would help reduce the trade deficit [while] an attempt to reduce the trade deficit by a depreciating exchange rate induced by easier monetary policy would produce inflation with little benefit on the current account", a view consistent with the third scenario above. Cooper [1986] in a discussion of the policy package better suited to eliminate the U.S. imbalances stated: "The drop in the dollar is an essential part of the policy package. The dollar's decline will help offset the fiscal contraction through expansion of net exports and help maintain overall U.S. economic activity at a satisfactory level", a view consistent with the second scenario.

19. A similar point is emphasized by Obstfeld and Rogoff [2004].

3 The Euro, the Yen, and the Renminbi

So far, the real depreciation of the dollar since the peak of 2002, has been very unevenly distributed: 45 per cent against the Euro, 25 per cent against the Yen, zero against the Renminbi. In this section we return to the questions asked in the introduction: If substantially more depreciation is to come, against which currencies will the dollar fall? If China abandons the peg, or if Asian banks diversify their reserves, how will the euro and the yen be affected?

The basic answer is simple. Along the adjustment path, what matters—because of home bias in asset preferences—is the reallocation of wealth across countries, and thus the bilateral current account balances of the United States vis a vis its partners. Wealth transfers modify the relative world demands for assets, thus requiring corresponding exchange rate movements. Other things equal, countries with larger trade surpluses vis a vis the United States will see a larger appreciation of their currency.

Other things may not be equal however. Depending on portfolio preferences, a transfer of wealth from the United States to Japan for example may change the relative demand for Euro assets, and thus the euro exchange rate. In that context, one can think of central banks as investors with different asset preferences. For example, a central bank that holds most of its reserves in dollars can be thought of as an investor with strong dollar preferences. Any increase in its reserves is likely to lead to an increase in the relative demand for dollar assets, and thus an appreciation of the dollar. Any diversification of its reserves is likely to lead to a depreciation of the dollar.

There is no way we can construct and simulate a realistic multi-country portfolio model in this paper. But we can make some progress in thinking about mechanisms and magnitudes. The first step is to extend our model to allow for more countries.

Extending the Portfolio Model to Four Regions

In 2004, the U.S. trade deficit in goods (the only category for which a decomposition of the deficit by country is available) was \$652 billion. Of this, \$160 was with China, \$75 billion with Japan, \$71 with the Euro area, and the remainder with the rest of the world.

We shall ignore the rest of the world here, and think of the world as composed of four countries (regions), the United States (indexed 1), Europe (indexed 2), Japan (indexed 3), and China (indexed 4). We shall therefore think of China as accounting for roughly one half of the U.S. current account deficit, and Europe and Japan as accounting each for roughly one fourth.

We extend our portfolio model as follows. We assume that the share of asset j in the portfolio of country i is given by

$$\alpha_{ij}(.) = a_{ij} + \beta_j(\{R_i\})$$

where the R_is is the expected gross real rate of return, in dollars, from holding assets of country i (so R_i denotes a rate of return, not a relative rate of return as in our two-country model). Note that this specification implies that differences in portfolio preferences across countries show up only as different constant terms, while derivatives with respect to rates of return are the same across countries.

The following restrictions apply: From the budget constraint, it follows that $\sum_j a_{ij} = 1$ and $\sum_j \beta_j(.) = 0$. The home bias assumption takes the form: $\sum_i a_{ii} > 1$. The $\beta_j(.)$ functions are assumed to be homogenous of degree zero in expected gross rates of return.

Domestic interest rates, in domestic currency, are assumed to be equal and constant, all equal to $(1 + r)$. Exchange rates, E_i, are defined as the price of U.S. goods in terms of foreign goods (so $E_1 = 1$). It follows that the expected gross real rate of return, in dollars, from holding assets of country i is given by $R_i = (1+r)E_i/E^e_{i,+1}$.

In steady state, $R_i = (1+r)E_i/E^e_{i,+1} = (1+r)$, so $\beta_j(\{R_i\}_i) = 0$ and we can concentrate on the a_{ij} s. The portfolio balance conditions, absent central bank intervention, are given by:

$$\frac{X_j}{E_j} = \sum_i a_{ij}\,(\frac{X_i}{E_i} - F_i)$$

where F_i denotes the net foreign debt position of country i, so $\sum_i F_i = 0$.

So far, we have treated all four countries symmetrically. China is however special in two dimensions: It enforces strict capital controls, and pegs the exchange rate between the renminbi and the dollar. We capture these two features as follows:

- We formalize capital controls as the assumption that $a_{4i} = a_{i4} = 0$ for all $i \neq 4$, *i.e.* capital controls prevent Chinese residents from investing in foreign assets, but also prevent investors outside China from acquiring Chinese assets.[20]
- To peg the exchange rate ($E_4 = 1$), the PBC passively acquires all the dollars flowing into China: the wealth transfer from the U.S. to the Euro area and Japan is thus the U.S. current account minus the fraction that is financed by the PBC: $dF_1 + dF_4 = -dF_2 - dF_3$.

Some Simple Computations

Assume that a share γ of the U.S. net debt is held by China. Assume the remaining portion is held by the Euro area and Japan according to shares x and$(1-x)$, so

20. This ignores FDI inflows into China, but since we are considering the financing of the U.S. current account deficit, this assumption is inconsequential for our analysis.

$$dF_2 = -x(1-\gamma)dF_1,\ dF_3 = -(1-x)(1-\gamma)dF_1,\ dF_4 = -\gamma dF_1$$

Assume that China imposes capital controls and pegs the renminbi. Assume that the remaining three countries are of the same size, and that the matrix of a_{ij} is symmetric in the following way. $a_{ii} = a$ and $a_{ij} = b = (1-a)/2 < a$ for $i \neq j$. In other words, investors want to put more than one third of their portfolio into domestic assets (the conditions above imply $a > 1/3$) and allocates the rest of their portfolio equally among foreign assets.[21]

Under these assumptions, $dE_4 = 0$ (because of pegging) and dE_2 and dE_3 are given by:

$$\begin{aligned}
\frac{dE_2}{dF} &= -\frac{(a-b)(1-\gamma)[x(1-a)+b(1-x)]}{(1-a)^2-b^2} + \frac{b\gamma}{1-a-b} \\
\frac{dE_3}{dF} &= -\frac{(a-b)(1-\gamma)[xb+(1-a)(1-x)]}{(1-a)^2-b^2} + \frac{b\gamma}{1-a-b}
\end{aligned}$$

Consider first the effects of γ. The higher γ, the smaller the appreciation of the euro and the yen vis a vis the dollar. This is hardly surprising: the higher γ, the smaller the transfer of wealth from the United States to Europe and to Japan, thus the smaller the pressure on the euro or the yen to appreciate. The interesting term however is the first. To see why, consider the case where $\gamma = 1$, so net debt accumulation is only vis a vis China. In this case, the euro and the yen depreciate vis a vis the dollar! This result is surprising but the explanation is straightforward, and is found in portfolio preferences. The transfer of wealth from the United States to China is a transfer of wealth from U.S. investors, who are willing to hold dollar, euro and yen assets, to the PBC, who only holds dollars. This transfer to an

21. The assumption of equal size countries allows us to specify the matrix in a simple way. Allowing countries to differ in size—as they obviously do—would lead to a more complex size adjusted matrix; but the results we derive below would be unaffected.

investor with extreme dollar preferences leads to a relative increase in the demand for dollars, an appreciation of the dollar vis a vis the euro and the yen.

Consider now the effects of x. For simplicity, put γ equal to zero. Consider first the case where $x = 0$, so the trade deficit is entirely vis a vis Japan. In this case, it follows that $dE_3 = 2\ dE_2$. Both the yen and the euro appreciate vis a vis the dollar, with the yen appreciating twice as much as the euro. This result might again be surprising: Why should a transfer of wealth from the United States to Japan lead to a change in the relative demand for euros? The answer is that it does not. The euro goes up vis a vis the dollar, but down vis a vis the yen. The real effective exchange rate of the euro remains unchanged. If $x = 1/2$, which seems to correspond roughly the ratio of trade deficits today, then obviously the euro and the yen appreciate in the same proportion vis a vis the dollar.

This simple framework also allows us to think what would happen if China stopped pegging, and/or diversified its reserves away from dollars, and/or relaxed capital controls on Chinese and foreign investors.

Suppose China stopped pegging, while maintaining capital controls. Given capital controls, the renminbi would have to appreciate vis a vis the dollar in order to eliminate the trade deficit vis a vis the United States. From then on, reserves of the PBC would remain constant. So as the United States continued to accumulate net debt vis a vis Japan and Europe, relative net debt vis a vis China would decrease. In terms of our model, γ—the proportion of U.S. net debt held by China—would decrease.[22] Building on our results, this would lead to a decrease in the role of an investor with extreme preferences, namely the PBC, and would lead to an appreciation of the euro and the yen. Suppose instead that China diversified its reserves away from dollars. Then, again, the demand for euros and for yens would

22. Marginal γ, the proportion of the increase in U.S. net debt falling on China, would be equal to zero.

increase, leading to an appreciation of the euro and the yen vis a vis the dollar.

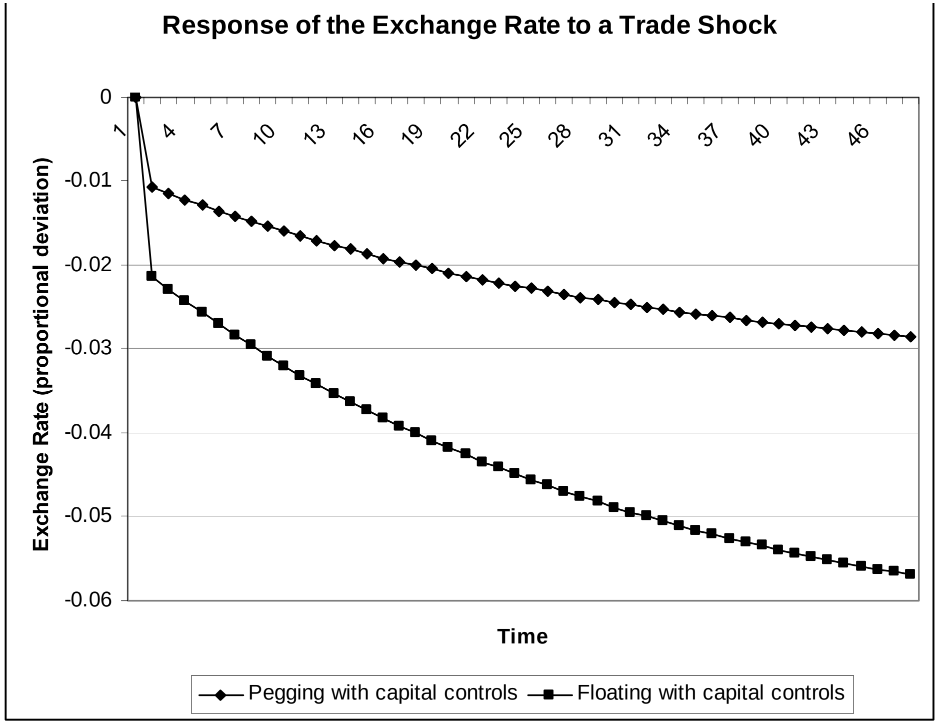
To summarize: The trade deficits vis a vis Japan and the Euro area imply an appreciation of both currencies vis a vis the dollar. This effect is partially offset by the Chinese policies of pegging and keeping most of its reserves in dollars. If China were to give up its peg, or diversify its reserves, the euro and the yen would appreciate further vis a vis the dollar. This last argument is at odds with an often heard statement that the Chinese peg has "increased the pressure on the euro" and that therefore, the abandon of the peg would remove some of the pressure, leading to a depreciation of the euro. We do not understand the logic behind that statement.

Two Simulations and a Look at Portfolios

We have looked so far at equilibrium for a given distribution of Fs. This distribution is endogenous in our model, determined by trade deficits and portfolio preferences. We now show the result of a simulation of our extended model.

The assumptions are as follows. We consider a shift in the U.S. trade deficit, falling for one half on China, for one fourth on Japan, and for one fourth on the Euro area. We assume that each country only trades with the United States, so we can focus on the bilateral balances with the United States. The parameters are the same for all countries. We do the simulation under two alternative assumptions about China. In both, we assume capital controls. In the first, we assume that China pegs the renminbi. In the second, we assume that the renminbi floats; together with the assumption of capital controls, this implies a zero Chinese trade deficit.

The results are shown in Figure 7. Because of symmetry, the response of the euro and the yen are identical, and thus represented by the same line. The bottom line shows the depreciation of the dollar vis a vis the euro



and the yen, when the renminbi floats. The higher locus shows the more limited depreciation of the dollar—the more limited appreciation of the euro and the yen—when the renminbi is pegged, and the Chinese central bank accumulates and keeps dollars.

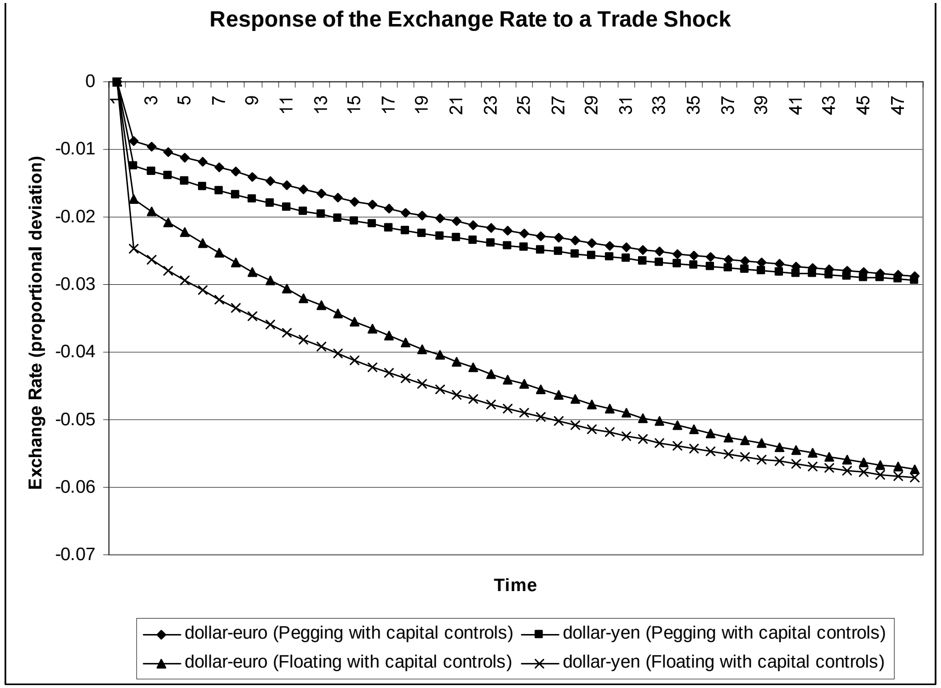
One may wonder whether the preferences of private investors are really symmetric. Constructing portfolio shares for Japanese, European, and U.S. investors requires rather heroic assumptions. We have nevertheless given it a try. The details of construction are given in the appendix.

Table 2: Portfolio shares (includes Portfolio Investment and FDI)

Investing country	United States	Euro area	Japan
Destination of Investment			
United States	0.77	0.19	0.17
Euro area	0.08	0.53	0.12
Japan	0.04	0.02	0.63
Rest of the world	0.11	0.27	0.08

Note a number of features of the table. Note in particular that the home bias of the United States is higher than that of the Euro area (an economy of roughly the same size). Note also the small share of Japanese assets held by Euro area investors relative to the share of Euro area assets held by Japanese investors (the difference is much larger than the difference in the relative size of the two economies.) Portfolio preferences appear indeed to be asymmetric.

To see what difference this asymmetry makes, Figure 8 gives the results of the same simulation as Figure 7, but using the shares in Table 2, and taking into account the relative size of the three countries. The differences are small (the slightly larger appreciation of the yen is related to the lower share of dollar assets in Japanese portfolios).



Summary and Conclusions

We have argued that there have been two main forces behind the large U.S. current account deficits which have developed over the past 10 years: an increase in the U.S. demand for foreign goods and an increase in the foreign demand for U.S. assets. The path of the dollar since the late 1990's can be explained as the reaction to these shocks.

The shift in portfolio preferences towards U.S. assets came first (in the late 1990s) in the form of a high private demand for U.S. equities, more recently in the form of high central bank demands for U.S. bonds.

The shift in demand away from U.S. goods is often related to higher growth in the U.S. relative to its trading partners. This appears however to have played only a limited role: the performance of import and export equations in macroeconometric models shows that activity variables and exchange rates explain only about 60% of the increase in the U.S. trade deficit: Unexplained time trends and residuals account for the remaining 40%. We interpret this as evidence of a shift in the U.S. trade balance.

Either shift could only have induced the path of the dollar and the U.S. current account that we have experienced in a world where financial assets are imperfect substitutes. The shift in asset preferences, because it would be meaningless in a world where assets are perfect substitutes. The shift in the U.S. trade balance, because with perfect substitutability such a shift—provided it were perceived as long lasting—would have induced a quicker and stronger depreciation of the exchange rate, and a smaller increase in the current account.

To organize thoughts about the U.S. current account deficit and the dollar we have thus studied a simple model characterized by imperfect substitutability both among goods and among assets. The model allows for valuation effects, whose relevance has recently been emphasized in a number of papers: The explicit integration of valuation effects in a model of imperfect substitutability is, we believe, novel.

We find that the degree of substitutability between assets does not affect the steady state. In other words, the eventual dollar depreciation induced by either shift is the same no matter how close substitutes U.S. and foreign assets are. But the degree of substitutability plays a central role in the dynamics of adjustment.

In contrast to the case of perfect substitutability between assets, an increase in the U.S. demand for foreign goods leads to a limited depreciation initially, a potentially large and long lasting current account deficit, and a slow and steady depreciation over time. An increase in the foreign demand for U.S. assets leads to an initial appreciation, followed by a slow and steady depreciation thereafter.

The slow rate of dollar depreciation implied by imperfect substitutability is in contrast with many predictions of much more abrupt falls in the dollar in the near future. We show that in the absence of anticipated portfolio shifts, the anticipated rate of depreciation depends on the change in the ratio of U.S. net debt to U.S. assets: The faster the increase in net debt, the faster the decrease in the relative demand for U.S. assets, therefore the higher the rate of depreciation needed to maintain portfolio balance. If we take the annual increase in the ratio of net debt to U.S. GDP to be 5%, we derive an upper bound on the anticipated annual rate of depreciation of 2.7% a year.

If shares in U.S. assets in the portfolios of either U.S. or foreign investors are instead expected to decline, the anticipated depreciation can be much larger. If for example, we anticipate the shares of U.S. assets in foreign portfolios to decline by 2% over the coming year, then the upper bound on the anticipated depreciation is 8.7%. This is obviously only an upper bound, derived by assuming that the remaining investors are willing to keep a constant share of their wealth in U.S. assets despite a large negative

rate of return. Still, it implies that, under imperfect substitutability, and under the assumption that desired shares in U.S. assets will decrease, it is a logically acceptable statement to predict a substantial depreciation of the dollar in the near future.

On the contrary, a further shift in investors' preferences towards dollar assets would slow down, or even reverse, the path of dollar depreciation. The relief, however, would only be temporary. It would lead to an initial appreciation, but the accompanying loss of competitiveness would speed up the accumulation of foreign debt. The long run value of the dollar would be even lower. Thus the argument that the United States, thanks to the attractiveness of its assets, can keep running large current account deficits with no effect on the dollar, appears to overlook the long run consequences of a large accumulation of external liabilities.

For basically the same reason, an increase in interest rates would be self defeating. It might temporarily strengthen the dollar, but the depreciation eventually needed to restore equilibrium in the current account would be even larger—both because (as in the case of a shift in portfolio preferences) the accumulation of foreign liabilities would accelerate, and because eventually the U.S. would need to finance a larger flow of interest payments abroad. A better mix would be a decrease in interest rates, and a reduction in budget deficits to avoid overheating. (To state the obvious: Tighter fiscal policy is needed to reduce the current account deficit, but is not a substitute for the dollar depreciation. Both are needed.)

The same will happen so long as China keeps pegging the exchange rate. One should think of the PBC as a special investor whose presence has the effect of raising the portfolio share that the rest of the world invests in dollar assets. The longer the PBC intervenes, the higher the share of rest-of-world wealth invested in U.S. assets. Sooner or later, however—as in the case of Korea in the late 1980's—the PBC will find it increasingly difficult to sterilize the accumulation of reserves. Eventually, when the peg is abandoned, the depreciation of the dollar will be larger the longer the peg will have lasted, because in the process the U.S. will have accumulated larger quantities of foreign liabilities. Thus, if China is worried by a loss of competitiveness, pegging may be a myopic choice.

What would an abandonment of the peg imply for the Euro and the Yen? Contrary to a common argument, when the Renminbi is left to float, both currencies are likely to appreciate further relative to the dollar. The reason is that, when the PBC stops intervening, the market effectively loses an investor with extreme dollar preferences, who will be replaced by private investors with less extreme preferences. A similar argument holds if the PBC diversifies its reserves away from dollar assets.

For Europe and Japan, however, what matters are effective exchange rates and these may well depreciate even if the bilateral dollar exchange rate appreciates.

We end with one more general remark. A large fall in the dollar is not by itself a catastrophe for the United States. It leads to higher demand and higher output, and it offers the opportunity to reduce budget deficits without triggering a recession. The danger is much more serious for Japan and Western Europe, although it would be alleviated by an abandonment of the Chinese peg.

Appendix 1. Dynamics of the Model

The dynamics of the system composed of equations (2) and (3) are more easily characterized by taking the continuous time limit. In continuous time, the portfolio and current account balance equations become:

$$X = \alpha(1 + r - r^* + \frac{\dot{E}^e}{E}, s)\ (X - F) + (1 - \alpha^*(1 + r - r^* + \frac{\dot{E}^e}{E}), s)\ (\frac{X^*}{E} + F)$$

$$\dot{F} = rF + (1 - \alpha(1 + r + r^* + \frac{\dot{E}^e}{E}), s)\ \frac{\dot{E}}{E}\ (X - F) + D(E, z)$$

Note the presence of both expected and actual depreciation in the current account balance relation. Expected appreciation determines the share of the U.S. portfolio put in foreign assets; actual appreciation determines the change in the value of that portfolio, and in turn the change in the U.S. net debt position.

We limit ourselves to a characterization of the equilibrium and local dynamics, using a phase diagram. (Global dynamics are more complex. The non linearities imbedded in the equations imply that the economy is likely to have two equilibria, only one of them potentially saddle point stable. This is the equilibrium we focus on.) We do so here under the additional assumption that $r = r^*$. The extension to different interest rates, which we use to construct Figure 6 in the text, is straightforward.

The locus ($\dot{E} = \dot{E}^e = 0$) is obtained from the portfolio balance equation, and is downward sloping: In the presence of home bias, an increase in net debt shifts wealth abroad, decreasing the demand for U.S. assets, and requiring a depreciation.

The locus ($\dot{F} = 0$) is obtained by assuming ($\dot{E}^e = \dot{E}$) in the current account balance relation and replacing ($\dot{E}^e$) by its implied value from the portfolio balance equation. This locus is also downward sloping: A depreciation leads to a smaller trade deficit, and thus allows for a larger net debt position consistent with current account balance.

Note that the locus ($\dot{F} = 0$) is not the same as the current account balance locus in Figure 1 in the text; that locus is derived under the assumption that both the $\dot{F}$ and $\dot{E}$ are equal to zero.

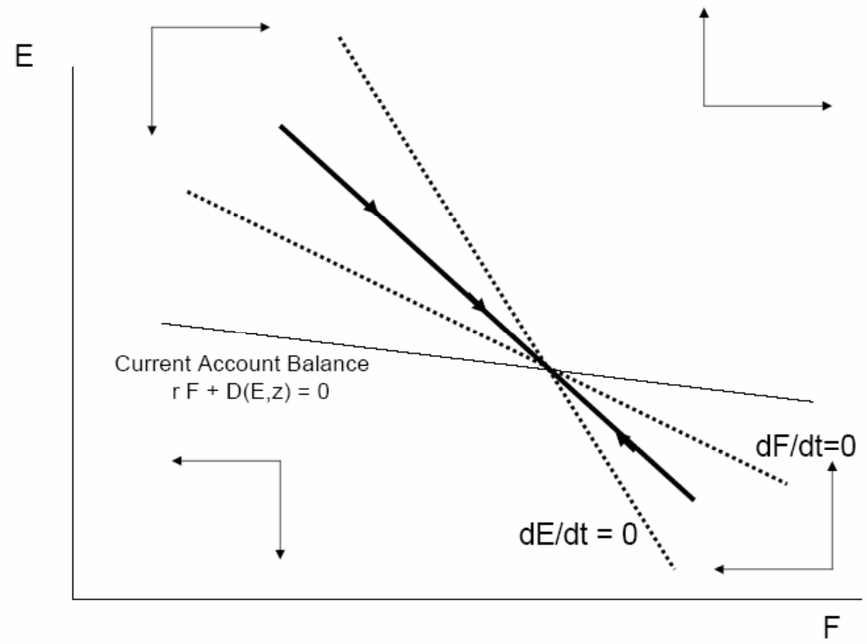
The derivatives α_R and α_R^* do not affect the slope of the $\dot{E} = 0$ locus. They do however affect the slope of the $\dot{F} = 0$. The smaller these derivatives (the lower the degree of substitutability between assets), the closer the locus ($\dot{F} = 0$) is to the ($\dot{E} = 0$). In the limit, if the degree of substitutability between U.S. and foreign assets is equal to zero, the two loci coincide. The larger these derivatives (the higher the degree of substitutability between assets), the closer the ($\dot{F} = 0$) locus is to the current account balance locus: $0 = rF + D(E)$.

The condition for the equilibrium to be saddle point stable is that the locus ($\dot{E} = 0$) be steeper than the ($\dot{F} = 0$) locus (which turns out to be the same as the condition given in the text, that the portfolio balance relation be steeper than the current account balance relation). For this to hold, the following condition must be satisfied:

$$\frac{r}{ED_E} < \frac{\alpha + \alpha^* - 1}{(1 - \alpha^*)X^*/E}$$

The interpretation was given in the text. The condition is more likely to be satisfied, the lower the interest rate, the larger the home bias, and the larger the response of the trade balance to the exchange rate. If the condition is satisfied, the dynamics are as shown in Figure A1. The saddle path is downward sloping, implying that the adjustment to the steady state from below is associated with an expected depreciation, the adjustment from above with an expected appreciation. Valuation effects imply that unex-

Figure A1. Adjustment of the exchange rate and the net debt position.



pected shifts in z or s are associated with initial changes in F, according to:

$$\Delta F = (1-\alpha)(1+r^*)(X-F)\frac{\Delta E}{E}$$

The effect of the degree of substitutability on the dynamics is as follows:

The smaller α_R and α_R^*, the closer the locus $(\dot{F}=0)$ is to the $(\dot{E}=0)$, and so the closer the saddle point path is to the $(\dot{E}=0)$. In the limit, if the degree of substitutability between U.S. and foreign assets is equal to zero, the two loci and the saddle point path coincide, and the economy remains on and adjusts along the $(\dot{E}=0)$, the portfolio balance relation.

The larger α_R and α_R^*, the closer the $(\dot{F}=0)$ locus is to the locus given by $0 = rF + D(E)$, and the closer the saddle point path is to that locus as well. Also the larger α_R and α_R^*, the slower the adjustment of F and E over time. The slow adjustment of F comes from the fact that we are close to current account balance. The slow adjustment of E comes from the fact that, the larger the elasticities, the smaller is $\dot{E}$ for a given distance from the $\dot{E}=0$ locus.

The limiting case of perfect substitutability is degenerate. The rate of adjustment to (unexpected, permanent) shifts in z goes to zero. The economy is always on the locus $0 = rF + D(E)$. For any level of net debt, the exchange rate adjusts so net debt remains constant, and, in the absence of shocks, the economy stays at that point. There is no unique steady state, and where the economy is depends on history.

Appendix 2. Construction of the Shares

The portfolio shares underlying Table 1 refer both to portfolio investment narrowly defined and to foreign direct investment positions.

Data on the country allocation of gross portfolio investments are from the IMF Coordinated Portfolio Survey for 2002. Data for the country allocation of direct investment are from the OECD and also refer to 2002. Financial wealth for the USA, the Euro area and Japan, which we need to compute the home bias of portfolios, are from the Flow of Funds.[23]

The a_{ij} are then constructed in two steps. First we compute the geographical allocation of net foreign investment positions by weighting the share of portfolio assets and fdi's allocated to country j by the relative importance of portfolio and direct investment in country i's total investments abroad. We then scale these shares by the share of total foreign investment $(1-a_{ii})$, so that

$$a_{ij} = [(pf_i/(pf_i + fdi_i))\ a_{ij,p} + (fdi_i/(pf_i + fdi_i))a_{ij,fdi}] * (1-a_{jj})$$

23. Source for Japan: http://www.boj.or.jp/en/stat/sj/sj.html); for the Euro area, ECB Economic Bulletin (released February, 2005), or http://www.ecb.int/pub/html/index.en.html).

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Global Current Account Imbalances and Exchange Rate Adjustments

THIS IS THE third in a series of papers we have written over the past five years about the growing U.S. current account deficit and the potentially sharp exchange rate movements any future adjustment toward current account balance might imply.[1] The problem has hardly gone away in those five years. Indeed, the U.S. current account deficit today is running at around 6 percent of GDP, an all-time record. Incredibly, the U.S. deficit now soaks up about 75 percent of the combined current account surpluses of Germany, Japan, China, and all the world's other surplus countries.[2] To balance its current account simply through higher exports, the United States would have to increase export revenue by a staggering 58 percent over 2004 levels. And, as we argue in this paper, the speed at which the U.S. current account ultimately returns toward balance, the triggers that drive that adjustment, and the way in which the burden of adjustment is allocated across Europe

Eyal Dvir, José Antonio Rodriguez-Lopez, and Jón Steinsson provided dedicated and excellent research assistance, for which we are extremely grateful. We also thank Philip Lane and Gian Maria Milesi-Ferretti for discussions and data. Jane Trahan's technical support was outstanding.

1. See Obstfeld and Rogoff (2000a, 2004). From an accounting perspective, a country's current account balance essentially adds net interest and dividend payments to its trade balance. As we discuss below, the United States presently receives about the same amount of income on its foreign assets as it pays out to foreign creditors. Hence, for the United States (and indeed many countries), the current account balance and the trade balance are quantitatively very similar. As we later emphasize, however, the current account does not include capital gains and losses on existing wealth. Thus the overall change in a country's net foreign asset position can, in principle, be less than or greater than its current account deficit or surplus.

2. Calculated from the World Economic Outlook database of the International Monetary Fund, using current account data from 2004.

and Asia all have enormous implications for global exchange rates. Each scenario for returning to balance poses, in turn, its own risks to financial markets and to general economic stability.

Our assessment is that the risks of collateral damage—beyond the risks to exchange rate stability—have grown substantially over the five years since our first research paper on the topic, partly because the U.S. current account deficit itself has grown, but mainly because of a mix of other factors. These include, not least, the stunningly low U.S. personal saving rate (which, driven by unsustainable rates of housing appreciation and record low interest rates, fell to 1 percent of disposable personal income in 2004). But additional major risks are posed by the sharp deterioration in the U.S. federal government's fiscal trajectory since 2000, rising energy prices, and the fact that the United States has become increasingly dependent on Asian central banks and politically unstable oil producers to finance its deficits. To these vulnerabilities must be added Europe's conspicuously inflexible economy, Japan's continuing dependence on export-driven growth, the susceptibility of emerging markets to any kind of global financial volatility, and the fact that, increasingly, the counterparties in international asset transactions are insurance companies, hedge funds, and other relatively unregulated nonbank financial entities. Perhaps above all, geopolitical risks and the threat of international terror have risen markedly since September 2001, confronting the United States with open-ended long-term costs for financing wars and homeland security.

True, if some shock (such as a rise in foreign demand for U.S. exports) were to close up these global imbalances quickly without exposing any concomitant weaknesses, the damage might well be contained to exchange rates and to the collapse of a few large banks and financial firms—along with, perhaps, mild recession in Europe and Japan. But, given the broader risks, it seems prudent to try to find policies that will gradually reduce global imbalances now rather than later. Such policies would include finding ways to reverse the decline in U.S. saving, particularly by developing a more credible strategy to eliminate the structural federal budget deficit and to tackle the country's actuarially insolvent old-age pension and medical benefit programs. More rapid productivity growth in the rest of the world would be particularly helpful in achieving a benign adjustment, but only, as the model we develop in this paper illustrates, if that growth is concentrated in nontraded (domestically produced and consumed) goods rather than the export sector, where such productivity growth could actually widen the U.S. trade deficit.

It is also essential that Asia, which now accounts for more than one-third of global output on a purchasing power parity basis, take responsibility for bearing its share of the burden of adjustment. Otherwise, if demand shifts caused the U.S. current account deficit to close even by half (from 6 percent to 3 percent of GDP), while Asian currencies remain fixed against the dollar, we find that European currencies would have to depreciate by roughly 29 percent. Not only would Europe potentially suffer a severe decline in export demand in that scenario; it would also incur huge losses on its net foreign asset position: Europe would lose about $1 trillion if the U.S. current account deficit were halved, and twice that sum if it went to zero.

We do not regard our perspective as particularly alarmist. Nouriel Roubini and Brad Setser make the case that the situation is far grimmer than we suggest, with global interest rates set to skyrocket as the dollar loses its status as the premier reserve currency.[3] Olivier Blanchard, Francesco Giavazzi, and Filipa Sa present an elegant and thoughtful analysis suggesting that prospective dollar exchange rate changes are even larger than those implied by our model.[4] William Cline argues that an unsustainable U.S. fiscal policy has substantially elevated the risk of an adverse scenario.[5] In our view, any sober policymaker or financial market analyst ought to regard the U.S. current account deficit as a sword of Damocles hanging over the global economy.

Others, however, hold more Panglossian views. One leading benevolent interpretation, variously called the "Bretton Woods II" model or the "Deutsche Bank" view, focuses on China; that view is forcefully exposited in this volume by Michael Dooley and Peter Garber. This theory explains the large U.S. current account deficit as a consequence of the central problem now facing the Chinese authorities: how to maintain rapid economic growth so as to soak up surplus labor from the countryside. For China, a dollar peg (or near peg) helps preserve the international competitiveness

3. Roubini and Setser (2004).
4. Blanchard, Giavazzi, and Sa (this volume).
5. Cline (forthcoming). Mann (2005), although not alarmist, also points to risks in the adjustment process. Of course, similar discussions accompanied earlier U.S. adjustment episodes, but the present situation is quite different in both scale and setting. Krugman (1985, 1991) takes as dim a view as anyone on the sustainability of long-term twin (fiscal and current account) deficits. His views on the 1980s experience would seem to apply with even greater force to the current scene.

of exports while attracting foreign direct investment and avoiding stress on the country's fragile banking system. Is this argument plausible? Set aside the fact that China maintained its peg even through the Asian financial crisis of 1997–98 and as the dollar soared at the end of the 1990s (presumably making Chinese exports much less competitive), or that China risks a classic exchange rate crisis if its fortunes ever turn, say, because of political upheaval in the transition to a more democratic system. The real weakness in the Bretton Woods II theory is that the Chinese economy is still less than half the size of Japan's, and less than three-quarters the size of Germany's, at market exchange rates. So, while running surpluses of similar size to China's relative to their GDP, Germany and Japan actually account for a much larger share of global surpluses in absolute terms. (After all, Germany, not China, is the world's leading exporter.) And surplus labor is hardly the problem in these aging countries.

U.S. Federal Reserve Chairman Alan Greenspan, in a 2003 speech at the Cato Institute and in many subsequent speeches, offers an intriguing argument.[6] He agrees that the United States is unlikely to be able to continue borrowing such massive amounts relative to its income indefinitely, and he recognizes that the U.S. current account deficit will therefore narrow substantially someday. Greenspan argues, however, that increasing global financial integration is both what allows the United States to run such large deficits and the saving factor that will greatly cushion the process of unwinding those deficits.

We completely agree that increasing global financial integration can explain larger current account deficits, particularly to the extent that greater trade integration helps underpin financial integration, as in our original analysis.[7] Indeed, this was a major point of our first approaches to this problem. A narrowing of the U.S. current account deficit must ultimately be the result, however, of more balanced trade, because the trade account is overwhelmingly the main component of the current account. And, as seemingly open as the U.S. economy is to financial flows, international product markets remain quite imperfectly integrated.

Thus any correction to the trade balance is likely to entail a very large change in the real effective dollar exchange rate: our baseline figure, which assumes a moderate speed of adjustment and that the world's major

6. Greenspan (2004).
7. Obstfeld and Rogoff (2000a, 2000b).

regions all return to current account balance, is 33 percent. A much smaller dollar devaluation is possible only if the adjustment is stretched over a very long period (say, a decade), in which case labor and capital mobility across sectors and economies can significantly reduce the need for relative price changes. On the other hand, should adjustment take place very abruptly (say, because of a sudden collapse in U.S. housing prices leading to an increase in saving, or a dramatic reallocation of global central bank reserves toward the euro), the potential fall in the dollar is much larger than our baseline estimate of 33 percent, primarily because sticky nominal prices and incomplete exchange rate pass-through hamper adjustment.

True, in a recent Federal Reserve study, Hilary Croke, Steven Kamin, and Sylvain Leduc argue that sustained current account imbalances in industrial countries have typically terminated in a relatively benign fashion.[8] But their threshold for a current account "reversal"—the country must have run a deficit of at least 2 percent of GDP for three years, and must have improved its current account balance by at least 2 percent of GDP and a third of the total deficit—is a very low bar compared with where the United States stands today. (Croke, Kamin, and Leduc are forced to choose a low threshold, of course, because current account deficits of the size, relative to GDP, of the recent U.S. deficits, although far from unprecedented, are not the norm.) Most important, the United States accounts for over 75 percent of global deficits today, as we have noted, and so any comparison based on the experience of small countries, even small industrial countries, is of limited value.

In addition to Chairman Greenspan, a number of academic researchers have emphasized how some important changes in the global financial system, particularly over the past ten years, have changed the nature of international financial adjustment. Philip Lane and Gian Maria Milesi-Ferretti, in a series of papers, have documented the explosion of gross asset flows.[9]

8. Croke, Kamin, and Leduc (2005). Freund and Warnock (2005) survey current account adjustment in industrial countries and find that deficits tend to be associated with real depreciations, which are larger for consumption-driven deficits.

9. See especially Lane and Milesi-Ferretti (2005a, 2005b). In line with this development, Cooper (2001) identifies ongoing international portfolio diversification as a driving force behind the U.S. deficit. Diversification does not, however, require any *net* capital flows: even with a balanced current account, foreigners and U.S. residents can still swap assets. According to preliminary estimates by the Bureau of Economic Analysis, for example, private foreign investors added $1.1 trillion in U.S. assets to their portfolios in 2004, far more than that year's U.S. current account deficit of $666 billion.

They and Cédric Tille, as well as Pierre-Olivier Gourinchas and Hélène Rey, have shown that asset revaluation effects from dollar depreciation can have a significant impact on U.S. net financial obligations to foreigners.[10] Gourinchas and Rey point out, in fact, that the historical extent of such revaluations suggests that the United States might need to adjust its trade balance by only two-thirds of the amount that would be needed to fully repay its net external debt; even this, however, would still imply very large dollar movements. We agree that the size and composition of gross asset positions are increasingly important, and our model simulations in this paper explicitly take account of the revaluation channel. We find, however, that valuation effects mute the requisite exchange rate changes only modestly.

The growing financial globalization that these authors and Chairman Greenspan emphasize is, moreover, a two-edged sword. Enhanced global financial integration may well facilitate gradual current account and exchange rate adjustment, but it might also promote the development of large, unbalanced financial positions that leave the world economy vulnerable to financial meltdown in the face of sharp exchange rate swings. The net foreign asset revaluation channel might help modestly, but a rise in U.S. interest rates could well wipe out the benefits. Because the United States borrows heavily in the form of low-risk bonds, while lending heavily in the form of equities and high-risk bonds, it is especially sensitive to even a modest rise in the interest rates it pays on its foreign debt. Indeed, we show that, in terms of exchange rate adjustments, the adverse effect of a 1.25-percentage-point rise in the interest rate that the United States pays on its short-term foreign debt is similar in magnitude to the benefits gained via the valuation channel, even with a 20 percent dollar depreciation. More generally, although increased global financial integration and leverage can indeed help countries diversify risk, they also expose the system to other vulnerabilities—such as counterparty risk—on a much larger scale than ever before. All in all, although we believe that growing financial globalization is largely a positive development, it does not justify excessive confidence in a benign adjustment process.

This paper begins by trying to put the recent U.S. experience with current account imbalances in historical perspective. We hope this first section will provide a useful reference, although some readers will already be famil-

10. Tille (2004); Gourinchas and Rey (2005a, 2005b).

iar with the essential elements. One historical observation that is important for our later analysis is that the United States (so far) has had the remarkable ability to consistently pay a lower rate of interest on its liabilities than it earns on its assets. Some component of this differential in returns has been due to luck, another to huge central bank holdings of U.S. Treasury bills, another perhaps to the unique and central role of the dollar in international finance. Still another, which we have already emphasized, is the fact that Americans hold a much larger share of their foreign assets in equities and high-risk (equity-like) bonds than foreigners hold of U.S. assets (and thus benefit more from the equity premium). An open question is whether this advantage can continue in the face of large and persistent U.S. deficits.

We then provide a nontechnical summary of our core three-region (Asia, Europe, and the United States) model. Readers interested in the technical details of our model can read the theoretical section that follows, and the most adventurous can venture into appendix A, where we fully lay out the structure. Our model simulations calibrate the requisite dollar decline against European and Asian currencies under various scenarios. Most of our analysis focuses on real exchange rates, but, by assuming that the regions' central banks target GDP or consumption deflators (or sometimes, in the case of Asia, exchange rates against the dollar), we are able to extract nominal exchange rate predictions (relative to the initial position) as well.

As noted earlier, our baseline simulation, in which Asia's, Europe's, and the United States' current accounts all go to zero, implies that the dollar needs to depreciate in real effective terms by 33 percent (and in nominal terms by a similar amount). Because the trade balance responds to an exchange rate change only with a lag, this exercise slightly overstates the necessary depreciation relative to today's exchange rates. However, our calibration assumes flexible prices and does not allow for possible exchange rate overshooting, which could significantly amplify the effect. A halving of the U.S. deficit, with counterpart surplus reductions shared by Asia and Europe in the same proportions as in the first simulation (arguably a more likely scenario over the short term) of complete current account adjustment, would lead to a depreciation of the real effective dollar of 17 percent. In our base case the real value of Asian currencies would need to rise by 35 percent and that of European currencies by 29 percent against the dollar.

If, however, Asia sticks to its dollar exchange rate peg as the U.S. current account deficit narrows, the real effective value of the European currencies would have to rise by almost 60 percent. Indeed, to maintain its

dollar peg in the face of global demand shifts that fully restore U.S. current account balance, Asia would actually have to better than double its already massive current account surplus. Even halving these numbers (corresponding, for example, to the case in which the U.S. current account deficit falls only by half), one can still appreciate the enormous protectionist pressures that are likely to emerge if Asia tries to stick to its dollar peg in the face of a significant pullback in the United States' voracious borrowing.

It is perhaps surprising that, despite Asia's current account surplus being several times that of Europe (which we define broadly here to include the euro zone and the other largest non-Asian, non-U.S. economies), the required rise in the Asian currencies relative to the European currencies is not even larger in the global rebalancing scenario. As we shall see, a couple of factors drive this result: one is that Asia's economies are relatively more open than Europe's to the rest of the world, so that a given exchange rate change has a bigger impact on trade; the other is that a large, unanticipated dollar depreciation inflicts brutal damage on Asia's net foreign asset position, a factor we explicitly incorporate in our calibrations.

The analysis highlights two important but widely misunderstood points about the mechanism of U.S. current account deficit reduction. First, real dollar depreciation is not a substitute for policies that raise U.S. saving, such as reductions in the federal fiscal deficit. Instead, depreciation and saving increases are complements: exchange rate changes are needed to balance goods markets after a change in global consumption patterns, whereas dollar depreciation that is not accompanied by U.S. expenditure reduction will lead to inflationary pressures that, over time, will offset the initial gains in U.S. competitiveness. The second, and related, point is that it makes little sense to ask how much dollar depreciation is needed to reduce the current account deficit by 1 percent of GDP. Exchange rates and current account balances are jointly determined endogenous variables. As the simulations in this paper illustrate, there are numerous different scenarios in which the U.S. external deficit might be erased, all with different implications for the dollar's foreign exchange value.

Although our model is considerably richer than those previously advanced in the literature (including our own earlier studies), it remains subject to a wide range of qualifications and interpretations; we try to emphasize the most important ones. Nevertheless, we view the simulations as quite useful. The paper's final section highlights the main conclusions that we draw from the technical analysis.

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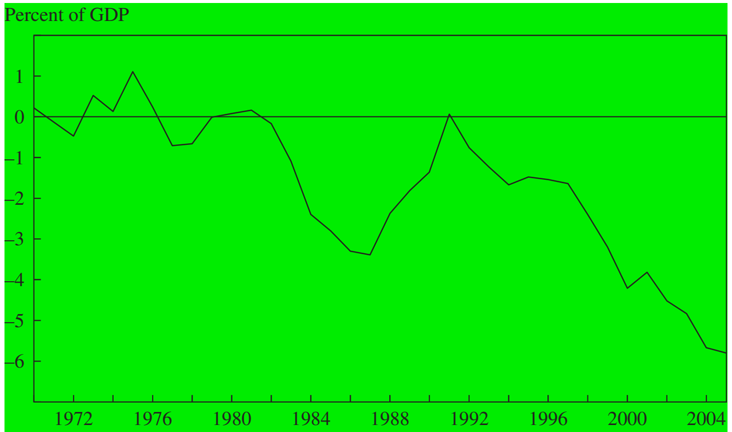
The U.S. Current Account and Foreign Wealth Position, 1970–2005 and Beyond

The main analytical contribution of the paper is its modeling and numerical calibration of exchange rate and net foreign asset valuation adjustments under alternative scenarios for reducing the U.S. current account deficit. Our framework is intended as a tool for assessing risks and evaluating policy options. At some level, however, the exercise must entail an assessment of how unstable the current trajectory of external payments imbalances really is, along with the likelihood of adjustment taking place in the next few years. In order to think about this overarching issue, it is helpful to understand the history of the problem.

Perspectives on the U.S. Deficit

Figure 1 traces the U.S. current account balance as a percent of GDP from 1970 to the present. After fluctuating between +1 and −1 percent of GDP during the 1970s, the current account began to go into deep deficit during the mid-1980s, reaching 3.4 percent of GDP in 1987. After recovering temporarily at the end of the 1980s and actually attaining a slight surplus

Figure 1. Current Account, 1970–2005[a]



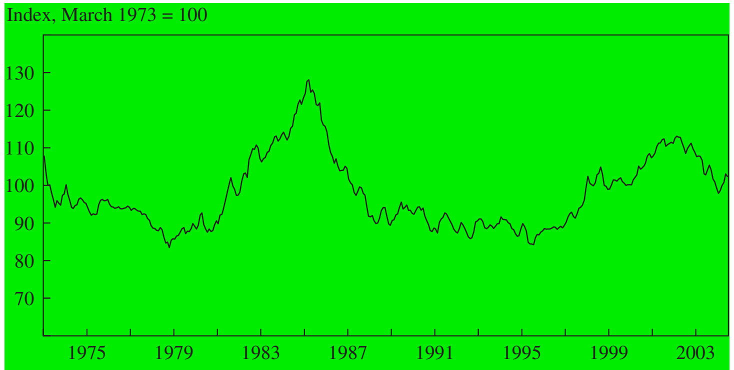
Source: Bureau of Economic Analysis, National Income and Product Accounts, International Transactions Accounts.
a. Data for 2005 are projections.

in 1991 (propped up by a large, one-time transfer from foreign governments to help pay for the Gulf War), the U.S. current account balance began a slow, steady deterioration throughout the 1990s, which continues today. As already noted, U.S. international borrowing in 2004 accounted for about 75 percent of the excess of national saving over investment of all the world's current account surplus countries.

What are the proximate causes of this profound deterioration in the U.S. external balance? That, of course, is the $666 billion (and rising) question. Since, in principle, the current account balances of all countries should add up to zero, the U.S. current account deficit—equal to the excess of U.S. investment over national saving—has to be viewed as the net result of the collective investment and saving decisions of the entire world. German demographics, OPEC oil revenue investment decisions, depressed investment in Asia—all these factors and many others impinge on global interest rates and exchange rates and, in turn, on U.S. investment and saving. We do not believe there is any simple answer.

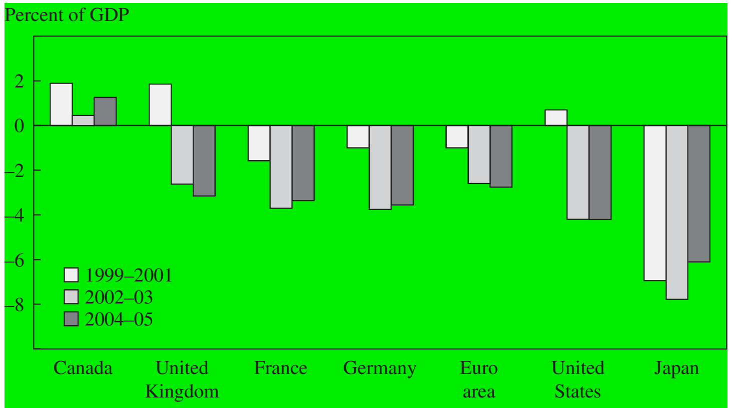
Nevertheless, U.S. fiscal policy clearly has played a dominant role in some episodes. The current account balance equals, by definition, the sum of government saving less investment plus private saving less investment. Because the Ricardian equivalence of public debt and taxes does not seem to hold in practice, the big Reagan tax cuts of the 1980s almost certainly played a role in the U.S. current account deficits of that era. Similarly, the Bush II tax cuts of the 2000s have likely played a role over the past few years, preventing the current account deficit from shrinking despite the post-2000 collapse in U.S. investment. Currency over- and undervaluations also loomed large in both episodes, usually operating with a lag of one to two years. For example, the peak of the U.S. current account deficit in 1987 lagged by two years the peak of the real trade-weighted dollar exchange rate (figure 2). The weak dollar of the mid-1990s was matched by a pause in the U.S. current account's decline, and the dollar peak in early 2002 was followed again, with some lag, by a sharp worsening in the external balance. Admittedly, both correlations with the current account deficit—of fiscal deficits and dollar appreciation—are fairly loose. As figure 3 illustrates, U.S. fiscal deficits have expanded massively in recent years compared with those of the rest of the world. But, as the figure also illustrates, Japan has run even larger fiscal deficits relative to its GDP than the United States, yet at the same time it has consistently run the world's largest current account surplus in absolute terms.

Figure 2. Real Effective Exchange Rate of the Dollar, 1973–2004[a]



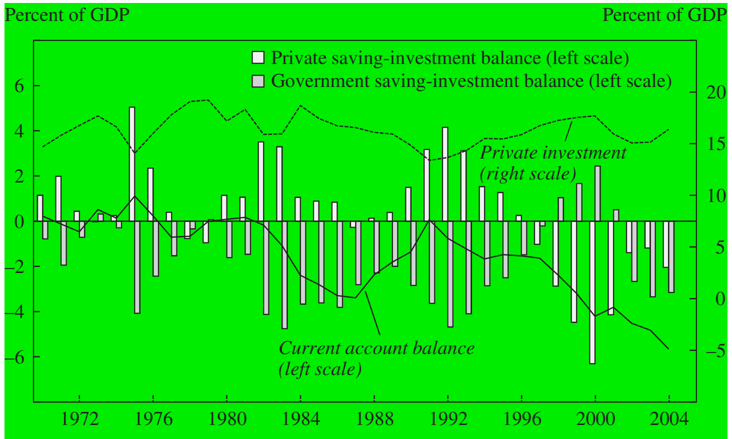
Source: Federal Reserve data.
a. Broad currency index.

Figure 3. Fiscal Balances in Selected Major Economies[a]



Source: *2005 OECD Factbook, OECD Economic Outlook* No. 77.
a. The data are on a national accounts basis, averaged across years indicated.

Figure 4. U.S. Current Account, Saving, and Investment, 1970–2004



Source: Bureau of Economic Analysis data.

Indeed, during the 1990s the major proximate drivers of the U.S. current account balance were a declining rate of private saving and rising rate of investment. The U.S. personal saving rate, which had been stable at around 10 percent of disposable personal income until 1985, has steadily declined since, reaching a mere 1 percent in 2004. The declining private saving rate has apparently been driven first by the stock price boom of the 1990s and then by the still-ongoing housing price boom.[11] Were the U.S. personal saving rate simply to rise to 5 percent of disposable personal income, or halfway toward its level of two decades ago, more than half of today's current account deficit could be eliminated.

During the late 1990s U.S. investment was robust, as shown in figure 4, so that the United States' high external borrowing really was, in principle, financing future growth. Today, however, the picture has changed. As figure 4 also shows, the main proximate driver of recent U.S. current account deficits has been low private and government saving rather than high

11. Obviously, if one measures saving taking into account capital gains and losses on wealth, the trend decline in saving is much less, although housing wealth is largely not internationally tradable and both housing and securities wealth can evaporate quickly.

investment. So much for the prominent view of former Treasury secretary Paul O'Neill, who argued that the U.S. external deficit was driven mainly by foreigners' desire to invest in productive U.S. assets. The more sophisticated analysis of Jaume Ventura is also inconsistent with declining U.S. investment.[12]

Another important factor contributing to the U.S. current account deficit since the late 1990s has been the persistently low level of investment in Asia since the region's 1997–98 financial crisis. Indeed, today, sluggish investment demand outside the United States, particularly in Europe and Japan but also in many emerging markets, is a major factor holding global interest rates down. Low global interest rates, in turn, are a major driver in home price appreciation, which, particularly in the United States with its deep, liquid home-equity loan markets, contributes to high consumption.

International Assets, Liabilities, and Returns

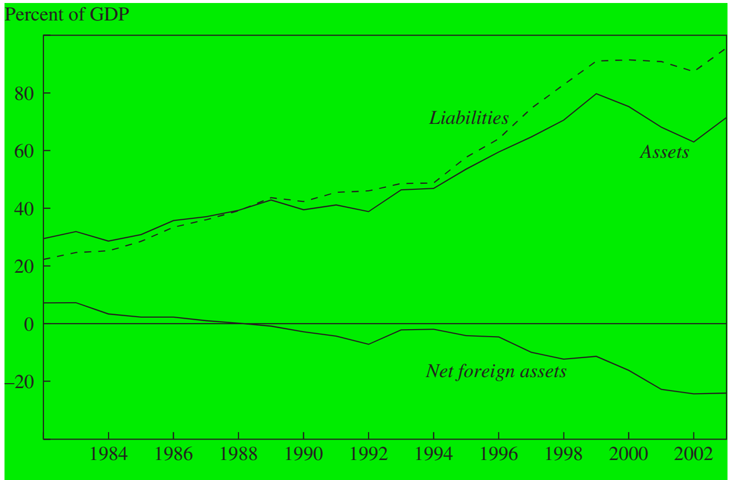
Naturally, this sustained string of current account deficits has led to a deterioration in the United States' net foreign asset position, as illustrated in figure 5. In 1982 the United States held net foreign assets equal to just over 7 percent of GDP, whereas now the country has a net foreign debt amounting to about 25 percent of GDP. Accompanying this growth in net debt has been a stunning increase in *gross* international asset and liability positions, as figure 5 also shows. From 29.5 percent and 22.3 percent of GDP in 1982, U.S. gross foreign assets and liabilities, respectively, had risen to 71.5 percent and 95.6 percent of GDP by the end of 2003. This process of increasing international leverage—borrowing abroad in order to invest abroad—characterizes other industrial country portfolios and is in fact much further advanced for some smaller countries such as the Netherlands and primary financial hubs such as the United Kingdom; see table 1 for some illustrative comparative data.[13]

The implications of the reduction in U.S. net foreign wealth would be darker but for the fact that the United States has long enjoyed much better

12. Ventura (2001).

13. See also Lane and Milesi-Ferretti (2005a, 2005b) and Obstfeld (2004). The BEA applies market valuation to foreign direct investment holdings starting only in 1982. Gourinchas and Rey (2005b) construct U.S. international position data going back to 1952. In 1976, with foreign direct investment valued at current cost rather than at market value, U.S. gross foreign assets amounted to 25 percent of GDP, and gross foreign liabilities were 12.6 percent of GDP.

Figure 5. U.S. Foreign Assets and Liabilities, 1982–2003



Source: Bureau of Economic Analysis data.

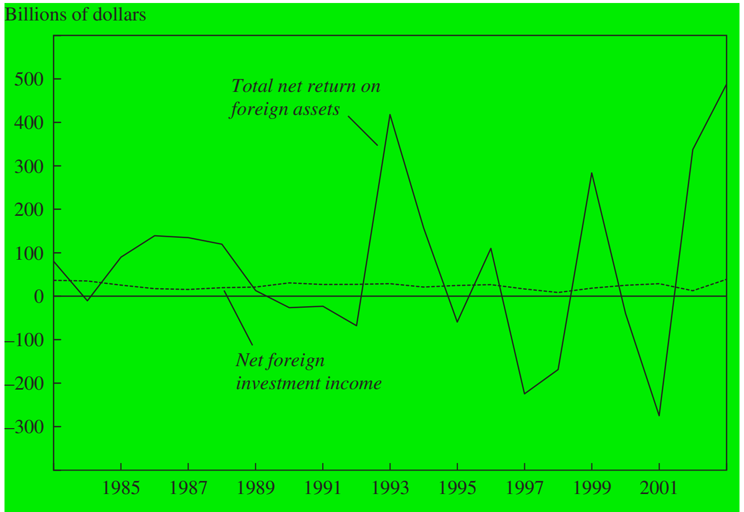
investment performance on its foreign assets than have foreign residents on their U.S. assets. This rate-of-return advantage, coupled with the expansion in foreign leverage documented in figure 5, has so far allowed the United States to maintain a generally positive balance of net international investment income even as its net international investment position has become increasingly negative. Figure 6 shows two measures of U.S.

Table 1. International Investment Positions of Selected Industrial Countries, 2003
Percent of GDP[a]

Country	*Gross assets*	*Gross liabilities*	*Net position*
Canada	75	93	−18
Euro area	107	118	−10
France	179	172	7
Germany	148	141	6
Italy	95	100	−5
Japan	87	48	39
Switzerland	503	367	135
United Kingdom	326	329	−2

Source: International Monetary Fund, International Financial Statistics.
a. Gross assets may differ from the sum of gross liabilities and the net position because of rounding.

Figure 6. U.S. Net Foreign Investment Income and Total Net Return on Foreign Assets, 1983–2003



Source: Bureau of Economic Analysis, National Income and Product Accounts, International Transactions Accounts.

net international investment income.[14] The first, net foreign investment income (income receipts on U.S. assets owned abroad less income payments on foreign-owned assets in the United States), is taken from the U.S. balance of payments accounts and comprises transactions data only, that is, actual income earned on assets. Interestingly, this balance has not yet entered negative territory, although it could do so soon. Over 1983–2003 the income return on U.S.-owned assets exceeded that on U.S. liabilities by 1.2 percentage points a year on average.

A more comprehensive investment income measure adds the capital gains on foreign assets and liabilities, reflecting price changes that could be due to either asset price movements (such as stock price changes) or exchange rate changes. The Bureau of Economic Analysis (BEA) incorporates estimates

14. Gourinchas and Rey (2005b) present a similar graph covering a much longer period. The estimates in the text are consistent with those found by Obstfeld and Taylor (forthcoming) using a different methodology. For a complementary discussion of returns on foreign assets and liabilities, see Lane and Milesi-Ferretti (2005b).

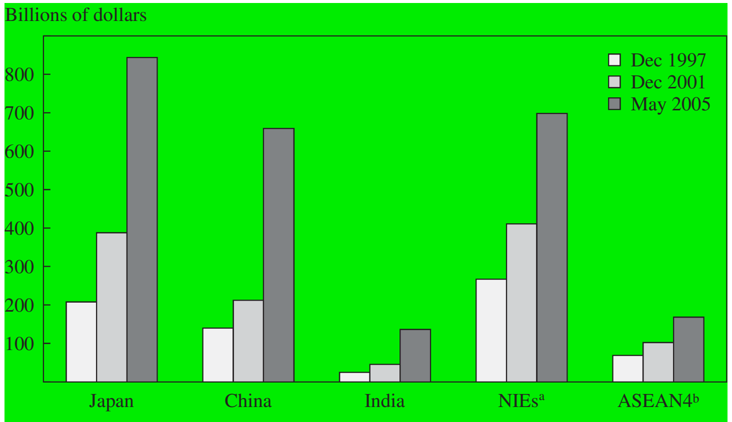
of these gains into its updates of the U.S. international investment position, although they do not appear in the international transactions or national income accounts. As one would expect, figure 6 shows this net income measure to be much more volatile than that based on investment income alone. Although it is negative in some years, cumulatively this balance is even more favorable for the United States than the smoother transactions measure. On average over 1983–2003, the total return on the United States' foreign investment, inclusive of capital gains, exceeded that on U.S. liabilities to foreigners by a remarkable 3.1 percentage points a year.[15]

To understand better the implications of the U.S. rate-of-return advantage, let r^W be the rate of return on foreign assets, r^U the rate of return on liabilities, F the stock of net foreign assets, and L gross liabilities. Then the net total return on the international portfolio is $r^W F + (r^W - r^U)L$. This expression shows that, even when $F < 0$ as it is for the United States, total investment inflows can still easily be positive when $r^W > r^U$ and the stock of gross liabilities is sufficiently large. The expression also reveals, however, that the leveraging mechanism generating the U.S. surplus on investment returns also heightens the risk associated with a possible reversal. An unresolved but critical question is whether the United States' favorable position in international markets will be sustained in the face of a large and growing external debt. Should the United States at some point be forced to pay a higher rate on its liabilities, the negative income effect will be proportional to the extent of leverage, L.

Part of the historical U.S. international investment advantage is a matter of chance and circumstance. Japanese investors famously bought trophy properties like Pebble Beach golf club, Rockefeller Center, and Columbia Pictures at premium prices, only to see those investments sour. Europeans poured money into the U.S. stock market only at the end of the 1990s, just as the technology bubble was about to burst. However, a deeper reason why the United States' net debt position has accumulated only relatively slowly is that Americans hold a considerably larger fraction of their foreign assets

15. The broad rate-of-return measures for gross assets and liabilities are constructed by adding to the investment income flow the total capital gain on the previous end-of-period assets (or liabilities) and then dividing this total return by the previous value of assets (or liabilities). Thus, in 2003, a year in which the dollar depreciated, the rate of return on U.S. foreign assets was 19 percent, and that on liabilities 8.4 percent. Total capital gains are calculated by subtracting the change in U.S.-owned assets abroad (change in foreign-owned assets in the United States), as reported in the financial account, from the change in U.S. foreign assets (liabilities) at market value, as reported in the BEA international position data.

Figure 7. Foreign Exchange Reserves, Selected Countries, Various Years



Sources: *The Economist,* Ministry of Finance of Japan.
a. Newly industrializing economies (Brazil, Hong Kong, Korea, Singapore, Taiwan).
b. Four members of the Association of Southeast Asian Nations (Indonesia, Malaysia, Philippines, Thailand).

in equities (both portfolio equity and foreign direct investment) than do foreigners of their U.S. assets. At the end of 2003, Americans held almost $7.9 trillion in foreign assets, of which 60 percent was in equities, either foreign stocks or foreign direct investment (here measured at market value). Foreigners, by contrast, held only 38 percent of their $10.5 trillion in U.S. assets in the form of equity. Given that equity has, over long periods, consistently paid a significant premium over bonds, it is not surprising that U.S. residents have remained net recipients of investment returns even though the United States apparently crossed the line to being a net debtor in the late 1980s.

A major reason why foreigners hold relatively more U.S. bonds than Americans hold foreign bonds is that the dollar remains the world's main reserve and vehicle currency. Indeed, of the $3.8 trillion in international reserves held by central banks worldwide, a very large share is in dollars, and much of it is in short-term instruments.[16] Figure 7 illustrates the burgeoning reserves of Asia, now in excess of $2 trillion. According to the

16. See the survey in *Central Banking,* "The Rise of Reserve Management," March 2005, p. 14.

BEA, over 45 percent of the $700 billion stock of dollar currency is held abroad, and this is probably an underestimate.[17] (Note that, when one speaks of the United States enjoying rents or seigniorage from issuing a reserve currency, the main effects may come from foreigners' relative willingness to hold cash or liquid short-term Treasury debt, rather than from any substantial inherent U.S. interest rate advantage.) In any event, our empirical analysis will take account of the systematically lower return on U.S. liabilities than on assets elsewhere, and will ask what might happen should that advantage suddenly disappear in the process of current account reversal.[18]

At present, as we have noted, the net U.S. foreign debt equals about 25 percent of GDP. This ratio already roughly equals the previous peak of 26 percent, reached in 1894. A simple calculation shows that if U.S. nominal GDP grows at 6 percent a year and the current account deficit remains at 6 percent of nominal GDP, the ratio of U.S. net foreign debt to GDP will asymptotically approach 100 percent. Few countries have ever reached anywhere near that level of indebtedness without having a crisis of some sort.[19]

If large, sudden exchange rate movements are possible, the greater depth of today's international financial markets becomes a potential source of systemic stress. As we have documented, the volume of international asset trading is now vast. Although many participants believe themselves to be hedged against exchange rate and interest rate risks, the wide range of lightly regulated or unregulated nonbank counterparties now operating in the markets raises a real risk of cascading financial collapse. In a world where a country's current account may adjust abruptly, bringing with it large changes in international relative prices, a persistently large U.S. deficit constitutes an overhanging systemic threat.

A sober assessment of present global imbalances suggests the need for a quantitative analysis of how a U.S. current account adjustment would affect exchange rates. We take this up next.

17. See Porter and Judson (1996).
18. Of course, multinationals' practice of income shifting in response to differing national tax rates on profits distorts reported investment income flows, making an accurate picture of the true flows difficult to obtain. See, for example, Grubert, Goodspeed, and Swenson (1993) and Harris and others (1993). The expansion of gross international positions over the past decade may have worsened this problem.
19. Obstfeld and Rogoff (2000a).

Summary of the Analytical Framework

Here we summarize the main features and mechanisms in our analysis. After reading this section, readers who are primarily interested in our exchange rate predictions can skip the following section, which presents the details of the model, and proceed directly to the discussion of our numerical findings.

We work within a three-region model of a world economy consisting of the United States, Europe, and Asia. These regions are linked by trade and by a matrix of international asset and liability positions. Each region produces a distinctive export good, which its residents consume along with imports from the other two regions. In addition, each region produces nontraded goods, which its residents alone consume.

A key but realistic assumption is that each country's residents have a substantial relative preference for the traded good that is produced at home and exported; that is, consumption of traded goods is intensive in the home export, creating a home bias in traded goods consumption. This feature builds in a "transfer effect" on the terms of trade, which provides one of the key mechanisms through which changes in the international pattern of current account balances change real and nominal exchange rates. A reduction in the U.S. current account deficit, if driven by a fall in U.S. spending and a matching rise in U.S. saving, represents a shift in world demand toward foreign traded goods, which depresses the price of U.S. exports relative to that of imports from both Asia and Europe. (The international terms of trade of the United States deteriorate.) Because the U.S.-produced export good has a larger weight in the U.S. consumer price index (CPI) than that of foreign imports, whereas foreign export goods similarly have larger weights in their home countries' CPIs, the result is both a real and a nominal depreciation of the dollar.

This terms-of-trade effect of current account adjustment has been prominent in the literature, but it is potentially less important quantitatively than is a *second* real exchange rate effect captured in our model. That effect is the impact of current account adjustment on the prices of *nontraded* goods. The CPI can be viewed as made up of individual sub-CPIs for traded and nontraded goods, with the latter empirically having about three times the weight of the former in the overall CPI, given the importance of nontraded service inputs into the delivery even of traded products to consumers. The real exchange rate between two currencies is the ratio of the

issuing countries' overall CPIs, both expressed in a common currency. Thus a fall in a country's prices for nontraded goods, relative to the same-currency price of nontraded goods abroad, will depress its relative price level just as a terms-of-trade setback does, causing both a real and a nominal depreciation of its currency. Because nontraded goods are so important a component of the CPI, ignoring effects involving their prices would omit much of the effect of current account adjustment on exchange rates. Hence this additional mechanism, absent from much of the policy discussion, is critical to include.

When the U.S. external deficit falls as a result of a cut in domestic consumption, part of the reduction in demand falls on traded goods (exports as well as imports), but much of it falls on U.S. nontraded goods. The consequent fall in the nontraded goods' prices reinforces the effect of weaker terms of trade in causing the dollar to depreciate against the currencies of Europe and Asia. As noted, in our calibration this second effect receives more than twice the weight that terms-of-trade effects receive in explaining exchange rate movements.

We consider several scenarios for U.S. current account adjustment, involving different degrees of burden sharing by Europe and Asia and the resulting effect on those regions' bilateral and effective exchange rates. For example, if Europe's deficit rises to offset a fall in America's deficit, while Asia's surplus remains constant, the dollar will depreciate more against Europe's currencies, and less against Asia's, than if Asia and Europe shared in the burden of accommodating the U.S. return to external balance. In terms of its trade-weighted effective exchange rate, the dollar depreciates more under the second of these two scenarios. Because Asia trades more with the United States than Europe does, bilateral depreciation against Asia's currencies plays the more important role in determining the effective depreciation.

We also consider the effect of dollar exchange rate changes in revaluing gross foreign asset positions, thus redistributing the burden of international indebtedness, as well as the possibility that the adjustment process, especially if disorderly, could entail higher interest payments abroad on U.S. short-term foreign obligations. Finally, key parameters in our model govern the substitutability in consumption among various traded goods and between traded and nontraded goods. In general, the lower these substitution elasticities, the greater the relative price changes caused by current account adjustment and the greater, therefore, the resulting terms-of-trade and exchange rate responses. Because the values of these elasticities are quite uncertain and can differ between the short and the long run, we quantitatively examine their role in generating our numerical estimates.

The Model

The three-country endowment model we develop here extends our earlier small-country and two-country frameworks.[20] We label the three countries (or regions), whose sizes can be flexibly calibrated, *U* (for the United States), *E* (for Europe), and *A* (for Asia). The model distinguishes both between home- and foreign-produced traded goods and between traded and nontraded goods (with the latter margin, largely ignored in many discussions of the U.S. current account deficit, turning out to be the more important of the two quantitatively in our simulations). Our focus here will be on articulating the new insights that can be gained by going from two countries to three, particularly in understanding different scenarios of real exchange rate adjustment across regions as the current account deficit of the United States falls to a sustainable level.

Four features of our model are of particular interest. First, by assuming that endowments are given exogenously for the various types of outputs, we implicitly assume that capital and labor are not mobile between sectors in the short run. To the extent that global imbalances close only slowly over long periods (which experience suggests is not the most likely case), factor mobility across sectors will mute any real exchange rate effects.[21] Second, we do not allow for changes in the mix of traded goods produced or for the endogenous determination of the range of nontraded goods, two factors that would operate over the longer run and could also mute the effects on real exchange rates of current account movements. Third, our main analysis assumes that nominal prices are completely flexible. That assumption—in contrast to our assumption on factor mobility—almost surely leads us to understate the likely real exchange rate effects of a current account reversal. As we discuss later, with nominal rigidities and imperfect pass-through from exchange rates to prices, the exchange rate will need to move more, and perhaps much more, than in our base

20. See Obstfeld and Rogoff (2000a and 2004, respectively).
21. Obstfeld and Rogoff (1996).

case in order to maintain employment stability. Fourth, we do not explicitly model the intertemporal allocation of consumption, but rather focus on the intratemporal price consequences of alternative patterns of production-consumption imbalances.

The Core Model

Although notationally intricate, our core three-region model is conceptually quite simple. We assume that consumers in each of the three regions allocate their spending between traded and nontraded goods. Within the category of traded goods, they choose among goods produced in each of the three regions. The equilibrium terms of trade and the relative price of traded and nontraded goods (and thus both bilateral and effective real exchange rates) are determined endogenously. Given assumptions about central bank policy (depending, for example, on whether the central bank aims to stabilize the CPI deflator, the GDP deflator, or a bilateral exchange rate), the model can also generate nominal exchange rates.

We begin by defining $C_j^i \equiv$ country i consumption of good (or good category) j. The comprehensive country i consumption index depends on U.S., European, and Asian traded goods consumption (T), as well as consumption of domestic nontraded goods (N). It is written in the following nested form:

$$(1) \qquad C^i = \left[\gamma^{\frac{1}{\theta}}\left(C_T^i\right)^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}}\left(C_N^i\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}, \quad i = U, E, A,$$

with

$$(2) \qquad C_T^U = \left[\alpha^{\frac{1}{\eta}}\left(C_U^U\right)^{\frac{\eta-1}{\eta}} + (\beta-\alpha)^{\frac{1}{\eta}}\left(C_E^U\right)^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}\left(C_A^U\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

$$C_T^E = \left[\alpha^{\frac{1}{\eta}}\left(C_E^E\right)^{\frac{\eta-1}{\eta}} + (\beta-\alpha)^{\frac{1}{\eta}}\left(C_U^E\right)^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}}\left(C_A^E\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

$$C_T^A = \left[\delta^{\frac{1}{\eta}}\left(C_A^A\right)^{\frac{\eta-1}{\eta}} + \left(\frac{1-\delta}{2}\right)^{\frac{1}{\eta}}\left(C_E^A\right)^{\frac{\eta-1}{\eta}} + \left(\frac{1-\delta}{2}\right)^{\frac{1}{\eta}}\left(C_U^A\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}.$$

We do not assume identical preferences in the three countries. On the contrary, we wish to allow, both in defining real exchange rates and in assessing the effects of shocks, for a realistic home bias in traded goods consumption, such that each country has a substantial relative preference for the traded good that it produces and exports abroad.[22] Home consumption bias gives rise to a "transfer effect," whereby an increase in relative national expenditure improves a country's terms of trade, that is, raises the price of its exports relative to that of its imports.

In the equations above, the United States and Europe are "mirror symmetric" in their preferences for each other's goods, but each attaches the same weight to Asian goods. Asia weights U.S. and European imports equally but may differ in openness from the United States and Europe. Specifically, we assume that $1 > \beta > \alpha > \frac{1}{2}$. We also assume that $\delta > \frac{1}{2}$. For example, if $\beta = 0.8$ and $\alpha = 0.7$, then the U.S. traded goods consumption basket has a weight of 0.7 on U.S. exports, 0.1 on European exports, and 0.2 on Asian exports. (A very similar—and for many exercises isomorphic—model arises if one assumes that all countries have identical preferences, but that international trading costs are higher than domestic trading costs.)[23]

The values of the two parameters θ and η are critical in our analysis. Parameter θ is the (constant) elasticity of substitution between traded and nontraded goods. Parameter η is the (constant) elasticity of substitution between domestically produced traded goods and imports from either foreign region. The two parameters are important because they underlie the magnitudes of price responses to quantity adjustments. Lower substitution elasticities imply that sharper price changes are needed to accommodate a given change in quantities consumed.

Price Indexes and Real Exchange Rates

Using standard methods, we derive exact consumption-based price indexes.[24] Define $P_j^i \equiv$ the country i exact price index for consumption category j. The corresponding overall CPIs, in dollars, are

$$P_C^i = \left[\gamma\left(P_T^i\right)^{1-\theta} + (1-\gamma)\left(P_N^i\right)^{1-\theta}\right]^{\frac{1}{1-\theta}},\ i = U, E, A, \tag{3}$$

22. Warnock (2003) also takes this approach.
23. Obstfeld and Rogoff (2000b).
24. See, for example, Obstfeld and Rogoff (1996).

where subscript C denotes the comprehensive consumption basket. (Our main analysis is in terms of real prices and exchange rates, so all prices can be expressed in terms of the common numeraire.) In equation 3,

$$\begin{aligned} P_T^U &= \left[\alpha P_U^{1-\eta} + (\beta-\alpha)P_E^{1-\eta} + (1-\beta)P_A^{1-\eta}\right]^{\frac{1}{1-\eta}} \\ P_T^E &= \left[\alpha P_E^{1-\eta} + (\beta-\alpha)P_U^{1-\eta} + (1-\beta)P_A^{1-\eta}\right]^{\frac{1}{1-\eta}} \\ P_T^A &= \left[\delta P_A^{1-\eta} + \left(\frac{1-\delta}{2}\right)P_U^{1-\eta} + \left(\frac{1-\delta}{2}\right)P_E^{1-\eta}\right]^{\frac{1}{1-\eta}}. \end{aligned} \tag{4}$$

Here P_i, $i = U, E, A$, is just the price of the differentiated traded good produced by country i.

We assume the law of one price for traded goods, so that the price of any given country's traded good is the same in all regions. (In practice, of course, the law of one price holds mainly in the breach, partly because of the difficulties in separating out the truly tradable component of "traded" goods.) Because of the home export consumption bias we have assumed, the price indexes for traded goods P_T^i can differ across countries even when the law of one price holds, reflecting the asymmetric consumption weightings. As a result, changes in the terms of trade, through their differential effects on countries' price levels for traded goods, affect real exchange rates.

There are three bilateral terms of trade, three bilateral real exchange rates, and three real effective exchange rates. The terms of trade are

$$\tau_{U,E} = \frac{P_E}{P_U},\ \tau_{U,A} = \frac{P_A}{P_U},\ \tau_{E,A} = \frac{P_A}{P_E} = \frac{\tau_{U,A}}{\tau_{U,E}}. \tag{5}$$

Here, for example, a rise in $\tau_{U,E}$ is a rise in the price of European traded goods in terms of U.S. traded goods, that is, a deterioration in the U.S. terms of trade. Bilateral real exchange rates are

$$q_{U,E} = \frac{P_C^E}{P_C^U},\ q_{U,A} = \frac{P_C^A}{P_C^U},\ q_{E,A} = \frac{P_C^A}{P_C^E} = \frac{q_{U,A}}{q_{U,E}}. \tag{6}$$

A rise in $q_{U,E}$, for example, is a rise in the price of the European consumption basket in terms of the U.S. consumption basket, that is, a real depreciation of the dollar.

As we have noted, asymmetric preferences over traded goods allow the terms of trade to affect traded goods price indexes. The United States' price index places a comparatively high weight on U.S. exports, whereas

Europe's does the same for its own exports. Thus the U.S. traded goods price index falls relative to Europe's when Europe's bilateral terms of trade against the United States improve. Denoting a percent change with a caret, we can logarithmically approximate the evolution of the relative European-to-American traded goods price ratio as

$$\hat{P}_T^E - \hat{P}_T^U = (2\alpha - \beta)\hat{\tau}_{U,E}. \tag{7}$$

(Exact formulas for relative price indexes, which we use to generate the numerical results reported below, are given in appendix A.) This expression equates the difference between European and U.S. price inflation in traded goods to the European consumption weight on its own exports, α, less the U.S. consumption weight on imports from Europe, $\beta - \alpha$, all multiplied by the percentage increase in Europe's terms of trade against the United States. Observe that the terms of trade against Asia do not enter this expression. Given the bilateral Europe-U.S. terms of trade, changes in the terms of trade against Asia enter the European and U.S. traded goods price indexes symmetrically (that is, with identical consumption weights of $1 - \beta$) and therefore drop out in computing their log-difference change.

Similarly, the evolution of the Asian price level for traded goods relative to that of the United States also reflects terms-of-trade movements. But because, under our assumptions, Asia trades more extensively with Europe than the United States does, the prices of European exports have a relatively bigger impact on Asia's average import prices. This is shown by the following logarithmic approximation:

$$\hat{P}_T^A - \hat{P}_T^U = [\delta - (1 - \beta)]\hat{\tau}_{U,A} + \left[\left(\frac{1-\delta}{2}\right) - (\beta - \alpha)\right]\hat{\tau}_{U,E}. \tag{8}$$

The weights on the terms-of-trade changes here simply reflect relative consumption weights, as before. Now, however, given the bilateral Asia-U.S. terms of trade, an improvement in Europe's terms of trade vis-à-vis the United States raises Asia's price index for traded goods relative to that in the United States when, as we assume in our simulations, the Asian consumption weight on European imports, $(1 - \delta)/2$, exceeds the weight attached by U.S. consumers, $\beta - \alpha$. Such third-country asymmetries cannot be captured, of course, in a two-country framework.

Bilateral real exchange rate movements follow immediately from the expressions above. For Europe and the United States, for example, the log

change in the bilateral real exchange rate is simply the consumption weight on traded goods times the log change in relative traded goods price indexes, plus the consumption weight on nontraded goods times the log change in relative nontraded goods price indexes:

$$\hat{q}_{U,E} = \gamma(2\alpha - \beta)\hat{\tau}_{U,E} + (1 - \gamma)\left(\hat{P}_N^E - \hat{P}_N^U\right). \tag{9}$$

Analogously, between the United States and Asia we have

$$\hat{q}_{U,A} = \gamma[\delta - (1 - \beta)]\hat{\tau}_{U,A} + \gamma\left[\left(\frac{1-\delta}{2}\right) - (\beta - \alpha)\right]\hat{\tau}_{U,E} + (1 - \gamma)\left(\hat{P}_N^A - \hat{P}_N^U\right). \tag{10}$$

We emphasize one key aspect of these expressions. The weight on nontraded goods is likely to be quite large because of the large component of nontradable services included in the consumer prices of goods generally classified as entirely tradable. In our simulations we therefore take the weight on nontraded goods above, $1 - \gamma$, to be 0.75. An implication is that, although the terms of trade certainly are an empirically important factor in real exchange rate determination given home consumption bias, relative prices for nontraded goods potentially play an even larger quantitative role.

Solution Methodology

The methodology we use to calculate the effects of current account shifts on relative prices is essentially the same as that in our earlier papers, extended to a three-region setting.[25] Given fixed output endowments, an assumed initial pattern of current account imbalances, an assumed initial pattern of international indebtedness, and a global interest rate, relative prices are determined by the equality of supply and demand in all goods markets. Changes in the international pattern of external imbalances, whether due to consumption shifts or other changes (including changes in productivity), shift the supply and demand curves in the various markets, resulting in a new set of equilibrium prices. These are the price changes we report below, under a variety of current account adjustment scenarios. (The global sums of external imbalances and of net international asset positions are both constrained to be zero.)

25. The methodology is specified in appendix A and further online at www.economics.harvard.edu/faculty/rogoff/papers/BPEA2005.pdf.

There are six market-clearing conditions, covering the three regional nontraded goods markets and the three global markets for traded goods (although one of these is redundant by Walras' Law). The five independent equilibrium conditions allow solutions for

—the U.S. terms of trade against Europe, $\tau_{U,E}$

—the U.S. terms of trade against Asia, $\tau_{U,A}$

—the price of nontraded goods in terms of traded goods in the United States, P_N^U/P_T^U

—the price of nontraded goods in terms of traded goods in Europe, P_N^E/P_T^E

—the price of nontraded goods in terms of traded goods in Asia, P_N^A/P_T^A.

One can then calculate the three bilateral real exchange rates, for which these five relative prices are the critical inputs. Because of the asymmetric preferences over traded goods, there is, as we have noted, a transfer effect in the model (wealth transfers feed into the terms of trade and through that channel into real exchange rates), although it is more complex than would be the case with only two countries in the world. Finally, we will also want to define and analyze real *effective* (loosely speaking, trade-weighted) exchange rates:

$$q^U = \frac{\left(P_C^E\right)^{\frac{\beta-\alpha}{1-\alpha}}\left(P_C^A\right)^{\frac{1-\beta}{1-\alpha}}}{P_C^U} \tag{11}$$

$$q^E = \frac{\left(P_C^U\right)^{\frac{\beta-\alpha}{1-\alpha}}\left(P_C^A\right)^{\frac{1-\beta}{1-\alpha}}}{P_C^E}$$

$$q^A = \frac{\left(P_C^U\right)^{\frac{1}{2}}\left(P_C^E\right)^{\frac{1}{2}}}{P_C^A}.$$

Three extensions to the analysis add to its relevance and realism.[26] First, we ask how real exchange rate changes translate into nominal exchange rate changes; this depends on central bank policy. In general, this turns out not to be a critical issue empirically; the other two extensions are potentially far more important. One of these is to take into account how exchange rate changes affect the net foreign asset positions of the different regions, because of currency mismatches between gross

26. Details can be found in appendix A and online at www.economics.harvard.edu/faculty/rogoff/papers/BPEA2005.pdf.

assets and liabilities.[27] This valuation effect is significant, but its impact on aggregate demand is of secondary importance compared with the primary demand shifts emphasized in our preceding analysis. Finally, our third extension takes into account the effect of a rise in relative U.S. interest rates (due, say, to concern about government deficits or erosion of the dollar's reserve currency status). This effect, which works to worsen rather than ease the adjustment problem, is also significant, although again it is less important (at least over the range of interest rates we consider) than the primary effects of a rebalancing of global demand.

Model Predictions

With these critical behavioral parameters in hand, we are now ready to explore the model's quantitative predictions for global exchange rates and the terms of trade under various scenarios for rebalancing the U.S. current account. We first need to think about parametrizing the model.

Choosing Parameters

As we have already observed, the critical parameters in the model are θ, the elasticity of substitution in consumption between traded and nontraded goods, and η, the elasticity of substitution in consumption among the traded goods produced by the three regions. The lower are these elasticities, the greater the exchange rate and price adjustments needed to accommodate any interregional shifts in aggregate demand. Most of our simulations will be based on a value of $\theta = 1$, which is high relative to some estimates suggested in the literature.[28] We will also report results, however, for an even higher elasticity of $\theta = 2$.

Our baseline choice of $\eta = 2$ as a representative aggregate trade elasticity is a compromise between two sets of evidence. Estimates based on trade flows within disaggregated product categories cover a wide range

27. As noted above, this effect has recently been emphasized by Tille (2004), Lane and Milesi-Ferretti (2005a, 2005b), and Gourinchas and Rey (2005a, 2005b).

28. Mendoza's (1991) point estimate is 0.74, Ostry and Reinhart (1992) report estimates in the range 0.66 to 1.28 for a sample of developing countries, and Stockman and Tesar (1995) use an estimate of 0.44. Using a different approach, Lane and Milesi-Ferretti (2004) derive estimates as low as 0.5. Indeed, for larger and relatively closed economies (such as the United States, Europe, and Japan), they suggest that the value should be even lower.

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but typically include many values much higher than $\eta = 2$.[29] On the other hand, conventionally estimated aggregate trade equations, as well as calibrations of dynamic general equilibrium models, tend to indicate much smaller values for η, typically 1 or even lower.

A number of mechanisms have been suggested to explain this discrepancy, some echoing Guy Orcutt's classic skepticism about the low elasticities seemingly implied by macro-level estimators.[30] Aggregation bias lowers estimated macroelasticities because the price movements of low-elasticity goods tend to dominate overall movements in import and export price indexes.[31] Another issue is that macroeconomic estimates of business-cycle frequency correlations tend to confound permanent and temporary price movements, in contrast to micro-level cross-sectional or panel studies centered on trade liberalization episodes.[32] In taking $\eta = 2$, we try, in a crude way, to address these biases while also recognizing the empirically inspired rules of thumb that inform policymakers' forecasts. We also include an illustrative simulation of the case $\eta = 100$ (in which all traded goods are essentially perfect substitutes). That simulation shuts down the terms-of-trade effects and thereby shows how large a role is being played by substitution between traded and nontraded goods, the channel we have emphasized elsewhere.[33]

We set both α and δ equal to 0.7; these are the consumption weights that Americans and Europeans, on the one hand, and Asians, on the other, attach to their own domestic products within their traded goods consumption baskets. That choice is plausible based on our discussion in an earlier

29. Examples are the estimates of Feenstra (1994) and the more recent figures of Broda and Weinstein (2004).

30. Orcutt (1950).

31. For an excellent example of this bias in action, see Hooper, Johnson, and Marquez (2000), who report that, because oil and tourism demand are relatively price-inelastic, trade equations based on aggregates that include oil and services imply apparently much lower price elasticities than equations for nonoil manufactures only. For the Group of Seven countries, Hooper, Johnson, and Marquez report short-run price elasticities for imports and exports (including oil and services) that in most cases do not satisfy the Marshall-Lerner condition. We view the elasticities implied even by aggregated estimates that exclude oil and services as unreasonably low; but, if they are accurate, they imply larger terms-of-trade and real exchange rate effects of international spending shifts.

32. See Ruhl (2003). Our model omits not only dynamics of the type suggested by Ruhl, but also those resulting from the introduction of new product varieties, which would act over the longer run to dampen the extent to which a rise in a country's relative productivity lowers its terms of trade. See, for example, Krugman (1989) and Gagnon (2003).

33. Obstfeld and Rogoff (2000a).

paper.[34] We set $\beta = 0.8$, implying that Europe and the United States alike place weights of $\beta - \alpha = 0.1$ on each other's traded goods, and twice that weight (0.2) on Asian goods. Asia, by assumption, distributes its demand evenly across the other two regions (placing a weight of 0.15 on the exports of each). So, in our model, Europe and the United States both trade more with Asia than with each other. We assume that all three regions produce the same number of units of tradable goods output.

Appendix A discusses in detail our assumptions regarding gross liabilities and assets for each region, as well as the currencies of denomination of these stocks. The point we stress here is that, to a first approximation, the United States is a net debtor (to the tune of 25 percent of its GDP, or 100 percent of its exportable GDP), and greater Europe has approximately a zero net international position. Our model's third region, Asia, therefore is left as a net international creditor in an amount equal to 100 percent of U.S. tradable GDP. U.S. gross foreign liabilities are almost all in dollars, but U.S. gross foreign assets are only about 40 percent in dollars. We assume that greater Asia's gross liabilities are equally divided among U.S., European, and Asian currencies (because Japan borrows in yen), whereas Asian gross foreign assets are 80 percent in dollars and 20 percent in European currencies. For Europe we assume that gross foreign assets are 32 percent in dollars, 11 percent in Asian currencies, and 57 percent in European currencies. In our model, 80 percent of European gross liabilities are denominated in European currencies, and the balance in dollars. These numbers are very rough approximations, based in some cases on fragmentary or impressionistic data, but portfolio shares can shift sharply over time, and so there is little point in trying too hard to refine the estimates. As we shall see, these shares do imply large potential international redistributions of wealth due to exchange rate changes, but those redistributions themselves have only a secondary impact on the exchange rate implications of current account adjustment.

For nominal interest rates we take a baseline value of 3.75 percent a year for U.S. liabilities but 5 percent a year for all other countries' liabilities. This assumption captures the "exorbitant privilege" the United States has long enjoyed of borrowing from the world more cheaply than it lends.[35]

34. Obstfeld and Rogoff (2000b).

35. The phrase "exorbitant privilege" is commonly but wrongly attributed to French president Charles de Gaulle. For its true origin, see the interesting historical note provided by Gourinchas and Rey (2005b).

Turning to current accounts, we place the U.S. external deficit at 20 percent of U.S. tradable GDP.[36] This is consistent with a U.S. current account deficit of 5 percent of total GDP, a reasonable baseline if part of the 2004 deficit is due to temporarily high oil prices. Because we find our simulation results to be approximately linear within the parameter space we are considering, it is easy to adjust the prediction to the case in which the 2004 deficit of 6 percent of GDP persists. In any event, what matters most for our calibration is how much the current account balance adjusts (for example, from 6 to 3 percent of GDP). We assume an initial position with Europe's current account surplus at 5 percent of U.S. tradable GDP and Asia's at 15 percent.[37]

A final benchmark to establish is our initial reference value for measuring subsequent exchange rate adjustments. This issue was less critical in our earlier two papers, because trade-weighted effective exchange rates move more slowly than the bilateral exchange rates that we consider below. In our basic model prices are flexible and economic responses to them are immediate. In practice, however, there are considerable lags: Michael Mussa, for example, posits the rule of thumb that the U.S. trade balance responds with a two-year lag to dollar exchange rate changes.[38] In that case, if today's current account balances reflect averages of exchange rates over the past two years, it would be more accurate to think of our simulations as giving exchange rate changes relative to two-year average reference rates rather than current rates. Table 2 presents some resulting reference exchange rates. (The Chinese and Malaysian currencies have been pegged over the past two years, and so their current and average rates are the same.)

Simulations

With the model and our parameter assumptions in hand, we are ready to consider alternative simulations. Underlying much of our analysis is the assumption that demand shocks (such as a rise in U.S. saving) are driving the redistribution of global imbalances. This seems by far the most realistic assumption, given the magnitude of the external financing gaps.

36. As noted earlier, we estimate tradable GDP to be at most 25 percent of total GDP.
37. It would be interesting and useful to extend the model to include emerging markets and OPEC as a composite fourth region, as suggested by our discussant T. N. Srinivasan.
38. Mussa (2005).

Table 2. Recent and Two-Year-Average Exchange Rates of Selected Currencies
Currency units per dollar except where noted otherwise

	Exchange rate	
Currency	*As of June 1, 2005*	*Two-year average*
U.K. pound sterling[a]	1.81	1.79
Canadian dollar	1.25	1.23
Euro[a]	1.22	1.23
Korean won	1,010	1,129
New Taiwan dollar	31.30	33.21
Singapore dollar	1.67	1.69
Japanese yen	108.4	109.3

Source: Federal Reserve data.
a. In dollars per indicated currency unit.

Tables 3 through 6 lay out the results of three scenarios under which the U.S. current account balance might improve by 20 percent of tradable GDP or, equivalently, 5 percent of total GDP. (All simulations include the effect of exchange rate changes in revaluing the regions' foreign assets and liabilities.) In the "global rebalancing" scenario (the first column in each table), all regions' current account balances go to zero (with trade balances adjusting as needed to service interest flows on the endogenously determined stocks of net foreign assets). Looking first at bilateral real exchange rates, in table 3, we see that Asia's exchange rate with the United States rises by 35.2 percent, and Europe's rises by 28.6 percent (we define the real exchange rate such that these changes indicate real depreciations of the dollar). Europe sees an improvement in its terms of trade against the United States (a rise in the price of Europe's exports relative to its U.S. imports) of 14.0 percent, and Asia sees an improvement of 14.5 percent.

What are the implications for *nominal* exchange rates? To answer this question we must specify monetary policies. We consider two possibilities: that central banks stabilize the domestic CPI, and that they stabilize the domestic GDP deflator. Table 4 reports the results. Under CPI targeting, the monetary authorities hold overall price levels constant, so that the only source of real exchange rate change is nominal exchange rate change. As a result, nominal and real exchange rate changes are equal, as can be seen by comparing table 4 with table 3.[39] Because none of the three regions is extremely open to trade, movements in CPIs and in GDP deflators are

39. We provide a detailed account of nominal exchange rate determination under GDP deflator targeting at www.economics.harvard.edu/faculty/rogoff/papers/BPEA2005.pdf.

Table 3. Changes in Real Exchange Rates and Terms of Trade Following U.S. Current Account Adjustment under Baseline Assumptions[a]
Log change × 100

Real exchange rate or terms of trade	Adjustment scenario: Global rebalancing[b]	Bretton Woods II[c]	Europe and United States trade places[d]
Real exchange rate			
United States/Europe	28.6	58.5	44.6
United States/Asia	35.2	−0.5	19.4
Europe/Asia	6.7	−59.0	−25.2
Terms of trade			
United States/Europe	14.0	29.4	22.0
United States/Asia	14.5	7.2	11.1
Europe/Asia	0.5	−22.2	−10.8

Source: Authors' calculations using model described in the text.
a. Exchange rates are defined such that an increase represents a real depreciation of the first region's currency against the second's; terms of trade are defined such that an increase represents a deterioration for the first region (that is, a fall in the price of the first region's export good against the second). Assumed parameter values are as follows: substitution elasticity between traded and nontraded goods $\theta = 1$; substitution elasticity between traded goods of different regions $\eta = 2$; share of traded goods in total consumption $\gamma = 0.25$.
b. Current account balances of all three regions go to zero.
c. Asia's current account surplus rises to keep its exchange rate with the dollar fixed. Europe's current account absorbs all changes in the U.S. and Asian current accounts.
d. Europe absorbs the entire improvement in the U.S. current account balance while Asia's current account balance remains unchanged.

Table 4. Changes in Nominal Exchange Rates Following U.S. Current Account Adjustment under Alternative Inflation Targets[a]
Log change × 100

Nominal exchange rate	Adjustment scenario: Global rebalancing	Bretton Woods II	Europe and United States trade places
Target is consumer price index[b]			
United States/Europe	28.6	58.5	44.6
United States/Asia	35.2	−0.5	19.4
Europe/Asia	6.7	−59.0	−25.2
Target is GDP deflator			
United States/Europe	30.0	61.4	46.8
United States/Asia	36.9	0.0	20.6
Europe/Asia	6.9	−61.4	−26.3

Source: Authors' calculations using model described in the text.
a. See table 3 for definitions of exchange rates, scenarios, and parameter assumptions.
b. With flexible prices and CPI targeting by central banks, nominal exchange rate changes are equal to the real exchange rate changes reported in table 3.

Table 5. Changes in Real and Nominal Effective (Trade-Weighted) Exchange Rates Following U.S. Current Account Adjustment under Baseline Assumptions[a]
Log change × 100

Effective exchange rate[b]	Adjustment scenario: Global rebalancing	Bretton Woods II	Europe and United States trade places
U.S. real	−33.0	−19.1	−27.8
U.S. nominal	−34.6	−20.5	−29.3
Europe real	5.1	58.9	31.7
Europe nominal	5.4	61.4	33.1
Asia real	20.9	−29.8	−2.9
Asia nominal	21.9	−30.7	−2.9

Source: Authors' calculations using model described in the text.
a. See table 3 for definitions of scenarios and parameter assumptions. An increase is an appreciation of the indicated currency against foreign currencies.
b. Nominal exchange rate changes are calculated under the assumption of GDP deflator targeting; see appendix A for details.

fairly close, and, as a result, nominal exchange rate changes when the GDP deflator is stabilized differ very little from those under CPI stabilization.

The appreciation of Europe's currencies against the dollar is smaller than that of Asia's under the first scenario, because Asia starts out in our simulation with a much larger external surplus than Europe does, and so it has more adjusting to do. But the Asian currencies' appreciation against the dollar is mitigated somewhat by the fact that Asia trades more with the United States than Europe does.[40] We see in table 5 that Europe's real *effective* currency appreciation—represented, as is traditional for such multilateral indexes, by a positive number—is much smaller than Asia's: only 5.1 percent versus 20.9 percent. Again, this reflects the greater weight of the dollar in Asia's trade-weighted real exchange rate than in Europe's. Notice that, as in table 4, nominal (under GDP deflator targeting) and real effective exchange rate changes are again quite close numerically.

Another factor underlying the equilibrium exchange rate responses is that dollar depreciation implies a much bigger reduction in Asia's net foreign asset position than in Europe's. (Table 6 shows the impacts under GDP

40. Indeed, if one recalibrates the model so that $\beta = 0.85$ (in which case all countries' preferences are completely symmetric, so that Europeans and Americans no longer prefer Asian goods to each other's), then, in the global rebalancing scenario, Asia's currency appreciates in real terms against the dollar by 37.8 percent and against European currencies by 12.2 percent. These numbers exceed the 35.2 percent and 6.7 percent reported in table 3.

Table 6. Net Foreign Assets by Region Following U.S. Current Account Adjustment[a]
Ratio to value of U.S. traded goods output

Region	Baseline net foreign asset position	Adjustment scenario[b] Global rebalancing	Bretton Woods II	Europe and United States trade places
United States	−1.0	−0.3	−0.1	−0.2
Europe	0.0	−0.1	−0.7	−0.4
Asia	1.0	0.4	0.8	0.6

Source: Authors' calculations using model described in the text.
a. See table 3 for definitions of exchange rates, scenarios, and parameter assumptions.
b. Net asset positions taking into account valuation effects of changes in nominal exchange rates under GDP deflator targeting.

deflator targeting.) Asia has 80 percent of its assets, but only 34 percent of its liabilities, in dollars. Thus, under the global rebalancing scenario, dollar depreciation raises Asia's gross liabilities relative to its gross assets, pushing its net foreign assets down (as a fraction of U.S. tradable GDP) by 60 percent. Europe, by contrast, has only 32 percent of its assets and 20 percent of its liabilities in dollars. The fact that Asia loses so much on the asset side implies that its trade surplus shrinks by less than its current account surplus does. Because trade surpluses are what drive the constellation of real exchange rates, the real appreciation of the Asian currencies is mitigated. In sum, thanks to Asia's greater openness and to the fact that Asia suffers particularly large capital losses on foreign assets when the dollar falls, Asian exchange rates do not need to change quite as much as a model-free, back-of-the-envelope calculation might suggest.

The tables cover two other possible scenarios. The second column in tables 3 through 6 analyzes a "Bretton Woods II" scenario, in which Asia clings to its dollar peg.[41] We calibrate this case by setting the U.S. current account balance to zero and endogenously varying Asia's and Europe's current account balances in a way that both maintains Asia's bilateral nominal exchange rate with the United States (assuming GDP deflator targeting) and absorbs the fall in U.S. borrowing. (Of course, nonmonetary policy instruments such as fiscal policy would have to be used to attain just the right constellation of current account balances.) In this case the bilateral real exchange rates of the European currencies against the dollar

41. Dooley, Folkerts-Landau, and Garber (2004a, 2000b).

must rise spectacularly, by 58.5 percent, and they would rise against the Asian currencies by 59 percent. This result also is approximately linear in the change in the U.S. current account balance. Thus, under the Bretton Woods II scenario, eliminating only half the U.S. current account deficit would raise the real value of the European currencies against the dollar by as much as would occur in a global rebalancing scenario that eliminates the U.S. current account deficit entirely.

For Asia to maintain its nominal exchange rate peg in the face of a balanced U.S. current account, it must drive its own current account balance significantly further into surplus, from 15 percent to 31 percent of U.S. tradable GDP. And Europe would have to move from a surplus equal to 5 percent of U.S. tradable GDP to a 31 percent deficit! (See the footnotes to table 3.) When Asia pegs its currencies to a falling dollar, its own traded goods become more competitive and its imports more expensive relative to domestic nontraded goods. Both factors shift world demand away from Europe, which, by assumption, is passively absorbing the blow, and toward Asia. These calibrations make patently clear why sustaining Asia's dollar peg is likely to be politically unpalatable for many of its trading partners if the U.S. current account deficit ever shrinks. Asia would be extremely vulnerable to a protectionist backlash.

As table 6 shows, the sharp appreciation of Europe's currencies in the Bretton Woods II scenario also decimates its external asset position, which declines from balance to −70 percent of the value of U.S. tradable production. Asia suffers somewhat, and the U.S. net asset position is the major beneficiary, because U.S.-owned foreign assets are concentrated in European currencies. Europe is thus hammered both by a sharp decline in its competitiveness and by a loss on its net foreign assets of about $2 trillion.

The third scenario reported in tables 3 through 6 is a muted version of the Bretton Woods II scenario. Here, instead of maintaining its dollar currency peg, Asia maintains its current account surplus unchanged in the face of U.S. adjustment to a balanced position. That is, rather than increasing its current account surplus, it allows enough exchange rate adjustment to keep the surplus constant. In this case, as table 5 shows, Europe's real effective exchange rate rises by much less than in the Bretton Woods II scenario (31.7 percent versus 58.9 percent), and the Asian currencies experience a real effective depreciation of only 2.9 percent, versus 29.8 percent in Bretton Woods II. Still, because the U.S. current account balance improves dramatically while Asia's holds steady, the Asian currencies rise in real terms by 19.4 percent against the dollar (table 3). This exercise reveals a fallacy in the argument that Asia cannot allow its dollar peg to move without losing the ability to absorb its surplus labor. To the extent that European demand increases, Asia can retain its external surplus while releasing its dollar peg.

In table 7 we revisit the global rebalancing scenario but vary the critical substitution elasticities in the model. (Only real exchange rate changes, which equal nominal changes under CPI inflation targeting, are listed.) In the first column we assume an elasticity of substitution between traded and nontraded goods, θ, of 2 instead of 1. As we have already argued, the limited evidence in the empirical macroeconomics literature suggests that this estimate is well on the high side, but it allows us to incorporate a more conservative range of potential exchange rate adjustments alongside our baseline estimates. Under this assumption the real dollar exchange rate with the European currencies rises by only 19.3 percent, instead of 28.6 percent as in the first column of table 3, and the Asian currencies rise against the dollar by 22.5 percent instead of 35.2 percent. The dollar falls in real effective terms (results not shown) by 21.5 percent rather than 33 percent. These calculations show that, even with a relatively high value for θ, the required adjustment of exchange rates is quite significant even if, as here, prices are flexible.

Table 7. Changes in Real Exchange Rates and Terms of Trade in the Global Rebalancing Scenario under Alternative Calibrations[a]

Log change × 100

Real exchange rate or terms of trade	*Higher elasticity of substitution between traded and nontraded goods ($\theta = 2$, $\eta = 2$)*	*Very high elasticity of substitution between regions' traded goods ($\theta = 1$, $\eta = 100$)*
Real exchange rate		
United States/Europe	19.3	16.5
United States/Asia	22.5	23.5
Europe/Asia	3.3	7.0
Terms of trade		
United States/Europe	14.6	0.0
United States/Asia	15.1	0.0
Europe/Asia	0.5	0.0

Source: Authors' calculations using model described in the text.
a. In the global rebalancing scenario all regions' current account balances go to zero. See table 3 for definitions of exchange rates and other parameter assumptions.

The second column in table 7 examines the case in which $\theta = 1$ but $\eta = 100$, so that the various countries' tradable outputs are almost perfect substitutes. This exercise, which essentially eliminates terms-of-trade adjustments as a factor in moving real exchange rates, allows us to see how much of the change in exchange rates is due to within-country substitution between traded and nontraded goods. This variation mutes the exchange rate changes by an amount roughly similar to those found in the previous exercise. The real effective dollar exchange rate (again not shown) falls by 21 percent. According to this calibration, roughly two-thirds of the needed dollar adjustment is driven by substitution between traded and nontraded goods, and only one-third is driven by the terms-of-trade channel typically emphasized in the literature. This should not be surprising, given that (according to our previously cited calibration) roughly 75 percent of GDP is nontraded. With more conservative assumptions about international trade, however (either greater home bias in consumption or lower substitutability of countries' traded outputs, such that $\eta = 1$), the terms-of-trade channel would become more important.

At present the United States is absorbing traded goods (domestic and foreign) equivalent to roughly 30 percent of its GDP. This demand needs to adjust downward while avoiding a reduction in nontraded goods absorption if full employment is to be maintained; such a shift will therefore require a significant change in the relative price of nontraded goods. Still, terms-of-trade changes do account for about one-third of the overall adjustment, a proportion slightly larger than that found in our two-country model, where we did not allow for trade or terms-of-trade adjustments between non-U.S. economies.

Given the United States' leveraged international portfolio, with gross debts mostly in dollars and assets significantly in foreign currencies, an unexpected dollar depreciation reduces the U.S. net foreign debt. The first two columns of table 8 report the results of simulations, within the global rebalancing scenario, that illustrate the quantitative importance of such asset valuation effects. Gourinchas and Rey have recently estimated that nearly one-third of the settlement of the U.S. net foreign debt has historically been effected by valuation changes, with the remaining two-thirds covered by higher net exports.[42] The first column in table 8 shows results

42. Gourinchas and Rey (2005a).

Table 8. Changes in Real Exchange Rates and Terms of Trade in the Global Rebalancing Scenario with and without Valuation and Interest Rate Effects[a]

Log change × 100

Real exchange rate or terms of trade	*With valuation effects and without interest rate effects*[b]	*Without valuation effects or interest rate effects*	*With valuation effects and interest rate effects*[c]
Real exchange rate			
United States/Europe	28.6	33.7	30.1
United States/Asia	35.2	40.7	37.2
Europe/Asia	6.7	7.0	6.3
Terms of trade			
United States/Europe	14.0	16.5	15.1
United States/Asia	14.5	16.5	15.3
Europe/Asia	0.5	0.0	0.2

Source: Authors' calculations using the model described in the text.

a. In the global rebalancing scenario all regions' current account balances go to zero. See table 3 for definitions of exchange rates and other parameter assumptions.

b. Same as the baseline scenario reported in first column of table 3.

c. Interest rates on U.S. short-term liabilities held by foreigners are assumed to rise 1.25 percentage points, to the same level as the return earned by U.S. residents abroad.

for the global rebalancing scenario with valuation effects taken into account (identical to the first column in table 3). The second column shows the changes in bilateral exchange rates that would be required if there were no valuation effects (or, equivalently, if exchange rate changes were accurately anticipated and nominal returns adjusted fully to compensate). All relative price changes against the United States are larger in this case, because the United States does not get the benefit of a sharp reduction in its net dollar liabilities. Correspondingly, the U.S. trade balance needs to adjust more for any given adjustment in the current account deficit. The real exchange rate between the dollar and the European currencies needs to move by 33.7 percent, rather than 28.6 percent when valuation effects are taken into account, and the real value of the Asian currencies needs to rise by 40.7 percent against the dollar instead of 35.2 percent. The real effective dollar exchange rate falls by 37.8 percent instead of 33.0 percent (results not shown). According to these numbers, asset revaluation effects will mute the required movement in exchange rates as the U.S. current account closes up, but the trade balance has to do the heavy lifting, since 87 percent (33.0 ÷ 37.8) of the necessary real exchange rate adjustment remains. That valuation effects have only a secondary effect on equilibrium relative price changes is not surprising: big valuation effects can only come from big exchange rate movements.

Our calculations so far do not take into account the likelihood of an accompanying rise in global interest rates, which would hurt the United States (a net debtor) and help Asia (a net creditor). A broad range of scenarios are possible here; we examine only a single very simple one. (Appendix A gives details of the calculation.) In the third column of table 8, we assume that annual interest rates on short-term U.S. debt rise from 3.75 percent to 5 percent, the same level assumed for all other liabilities. In other words, perhaps because of heightened risk perceptions, the United States simply loses its historical low borrowing rate and is put on a par with other debtors. This change wipes out a good deal of the effect of the valuation changes (and would wipe out even more if it applied to all U.S. external liabilities, not just the roughly 30 percent consisting of short-maturity debt). As our introductory discussion suggested, the United States, as an important issuer of bonds relative to equity, is extremely vulnerable to increases in interest rates, even when all global bond rates rise together.

Until now we have been concentrating on demand shocks. Productivity shocks may make the adjustment process more or less difficult, depending on their source. Higher productivity in foreign traded goods production can actually result in an even greater real depreciation of the dollar as equilibrium is reestablished in world markets. If, on the other hand, it is nontraded goods productivity in Asia and Europe that rises, the exchange rate effects of global rebalancing will be muted. As table 9 illustrates, a

Table 9. Changes in Real Exchange Rates and Terms of Trade in Global Rebalancing Scenario with Higher Productivity in Non-U.S. Nontraded Goods[a]

Log change × 100

Real exchange rate or terms of trade	*Without increase in productivity*[b]	*With 20 percent increase in productivity in European and Asian nontraded goods*
Real exchange rate		
United States/Europe	28.6	17.0
United States/Asia	35.2	23.6
Europe/Asia	6.7	6.6
Terms of trade		
United States/Europe	14.0	15.0
United States/Asia	14.5	15.3
Europe/Asia	0.5	0.2

Source: Authors' calculations using model described in the text.

a. In the global rebalancing scenario all regions' current account balances go to zero. See table 3 for definitions of exchange rates and other parameter assumptions.

b. Same as the baseline scenario reported in the first column of table 3.

20 percent rise in nontraded goods productivity outside the United States implies notably smaller real exchange rate changes, although the terms-of-trade shifts are similar. A large rise in U.S. traded goods productivity would also facilitate a softer landing. In this case, however, although the extent of real dollar depreciation is somewhat reduced, the U.S. terms of trade fall much more sharply (results not reported).

Some Further Considerations

We believe our model offers many useful insights, but of course there are many caveats to its interpretation. Some of these suggest that our results understate the dollar's potential decline, and some that they overstate it.

Intersectoral Factor Mobility

A critical implicit assumption of our model is that capital and labor cannot quickly migrate across sectors, so that prices rather than quantities must bear the burden of adjustment in response to any sudden change in relative demands for different goods. This assumption seems entirely reasonable if global current account adjustment (full or partial) takes place moderately quickly, say, over one to two years. In the short run, workers cannot change location easily, worker retraining is expensive, and a great deal of capital is sector-specific. Over much longer periods, however (say, ten to twelve years), factor mobility is considerable. If, for example, prices rise dramatically in the U.S. traded goods sector, new investment will be skewed toward that sector, as will new employment. Thus, in principle, a gradual closing of the U.S. current account deficit would facilitate much smoother adjustment with less exchange rate volatility. Unfortunately, our model is not explicitly dynamic.[43] One can, however, artificially approximate gradual current account adjustment by allowing for progressively higher elasticities of substitution. We do this in table 10, where we reconsider our central scenario (which assumed $\theta = 1$ and $\eta = 2$) by comparing it with two cases in which substitution elasticities are much higher. As the table shows, in the case with "gradual" unwinding (proxied

43. For an example of a dynamic approach see the small-country q-model analysis in Obstfeld and Rogoff (1996, chapter 4).

Table 10. Changes in Real Exchange Rates under Alternative Assumed Speeds of Global Rebalancing[a]
Log change × 100

	Speed[b]		
Real exchange rate	*Moderate (1–2 years)*[c]	*Gradual (5–7 years)*	*Very gradual (10–12 years)*
United States/Europe	28.6	13.4	6.5
United States/Asia	35.2	17.3	8.5
Europe/Asia	6.7	3.9	2.0

Source: Authors' calculations using model described in the text.
a. In the global rebalancing scenario all regions' current account balances go to zero. See table 3 for definitions of exchange rates and other parameter assumptions.
b. Proxied by varying elasticities of substitution: moderate, $\theta = 1$, $\eta = 2$; gradual, $\theta = 2$, $\eta = 4$; very gradual, $\theta = 4$, $\eta = 8$.
c. Same as the baseline scenario reported in the first column of table 3.

by $\theta = 2$ and $\eta = 4$), which we loosely take to capture a five- to seven-year adjustment horizon, the bilateral exchange rate changes involving the dollar are only about half as big as in our central global rebalancing scenario. For a "very gradual" unwinding (which we take to occur over ten to twelve years, with $\theta = 4$ and $\eta = 8$), the same real exchange rate changes are less than a quarter as large as in the central scenario.

Sticky Prices

Factor mobility kicks in to smooth current account adjustment if the adjustment is slow and relatively well anticipated. If, on the other hand, current account imbalances have to close up very quickly (say, because of a collapse in U.S. housing prices), the bias in our estimates would point in the other direction. Nominal rigidities in prices would then play a large role, and actual exchange rate movements would likely be two or more times as large as in our central scenario, for several reasons.[44]

For one thing, our model assumes that the law of one price holds for traded goods, whereas in fact at most half of an exchange rate adjustment typically passes through to traded goods prices even after one year.[45] Thus, in order to balance supply and demand for the different categories of goods

44. See the discussion in Obstfeld and Rogoff (2000a).
45. P. Goldberg and Knetter (1997); Campa and L. Goldberg (2002). For recent evidence suggesting a substantial decline in pass-through to U.S. import prices, see Marazzi and others (2005).

while maintaining full employment, central banks would have to allow much larger exchange rate movements—possibly double those suggested by the model. These larger movements would be "overshoots" in the sense that they would unwind over time as domestic prices adjust.

The nominal prices of nontraded goods are typically even stickier than those of traded goods; this further amplifies the overshooting effect. In general, both sticky prices and slow factor mobility point toward the likelihood that a slow unwinding of the U.S. current account deficit will lead to smaller changes in real exchange rates than would a relatively abrupt correction.

Rising U.S. Interest Rates and the Dollar

Another qualification to our results is that our model does not account for financial factors, and in particular for the possibility of temporarily high real interest rates in the United States muting the dollar's decline. Using the Federal Reserve's macroeconomic model, David Reifschneider, Robert Tetlow, and John Williams estimate that a 1-percentage-point rise in the federal funds rate (presumably unmatched by the rest of the world) leads to a 2.2 percent appreciation of the dollar after one year, and a 4.9 percent appreciation after two years.[46] Therefore the fact that, over the past year, U.S. short-term interest rates have been rising relative to Europe's is a countervailing consideration to those discussed above (although our calculations suggest that it is likely to be far less important quantitatively). In addition, Europe and Asia can always choose to lower their interest rates to further mute the dollar's decline. Of course, interest rate policy can only affect the dollar's real value temporarily, and so long-term global rebalancing will still require a combination of real exchange rate adjustment and factor reallocation across sectors.

The Fundamental Unpredictability of Exchange Rates

Our model suggests that the gaping U.S. current account deficit is a very large negative factor in assessing the future prospects of the dollar. It

46. Reifschneider, Tetlow, and Williams (1999). A back-of-the-envelope calculation based on the Dornbusch overshooting model (Dornbusch, 1976) yields a similar result.

is well known, however, that it is extremely difficult to explain exchange rate swings between major currencies, much less forecast them, at least at horizons up to eighteen months.[47] Although a number of small qualifications must be made to this result,[48] it remains broadly true. How, then, can one be concerned about a medium-term dollar decline if a rise is equally likely? There are two broad answers to this question. First, even the most cheery U.S. current account optimist would have to concede that an abrupt reversal is a potential risk, particularly while federal government deficits remain less than fully tamed. Reversal need not result from what Guillermo Calvo, in the context of emerging markets, has called a "sudden stop" of capital inflows;[49] as we have noted, it could follow, for example, from a rise in U.S. saving due to a purely domestic asset price collapse. Our calibrations are useful in laying out the exchange rate consequences and in illuminating how the burden of adjustment might be shared among the major economies.

Second, and more fundamentally, there is some evidence that nonlinearities are also important, so that, when exchange rates are particularly far out of line with one or more fundamentals, some predictability emerges. Obstfeld and Alan Taylor, for example, argue that convergence to purchasing power parity is much more important quantitatively when a currency is relatively heavily over- or undervalued compared with its long-term real exchange rate.[50] Gourinchas and Rey argue that, contrary to the canonical Meese-Rogoff result, there is a forecastable component to trade-weighted dollar exchange rate movements when net foreign assets or debts are large relative to the United States' net export base.[51] Their work supports much earlier work by Peter Hooper and John Morton suggesting that net foreign assets may be important in explaining dollar movements.[52] As we argued in the introduction, the U.S. current account deficit today is so large and unprecedented that it is difficult to project its future path and the consequences thereof simply by extrapolating from past data.

47. Meese and Rogoff (1983).
48. See the survey in Frankel and Rose (1995), for example.
49. Calvo (1998).
50. Obstfeld and Taylor (1997).
51. Gourinchas and Rey (2005a).
52. Hooper and Morton (1982).

Conclusions

We have developed a simple stylized model that can be used to calibrate exchange rate changes in response to various scenarios under which the U.S. current account deficit might be reduced from its unprecedented current level. Aside from its quantitative predictions, the model yields a number of important qualitative insights.

First, Asia's greater openness to trade implies that the requisite exchange rate adjustments for that region are not all that much greater than Europe's. This appears true despite the fact that Asia starts from a much larger current account surplus than Europe.

Second, we find that, if Asia tries to stick to its dollar peg in the face of, say, a rise in the U.S. saving rate that closes up the U.S. current account gap even partly, Asia will actually have to run significantly *larger* surpluses than it does now. Europe would bear the brunt of this policy, ending up with a current account deficit even larger than that of the United States today, while at the same time suffering a huge loss on its net foreign assets.

Third, although dollar depreciation does tend to improve the U.S. net foreign asset position (because virtually all of its gross foreign liabilities, but less than half of its gross foreign assets, are denominated in dollars), this effect only slightly mitigates the requisite exchange rate change. Valuation effects will not rescue the United States from a huge trade balance adjustment. Indeed, if relative interest rates on U.S. short-term debt rise even moderately during the adjustment process, this adverse effect could easily cancel out any gain due to valuation effects.

Fourth, our model suggests that the need for deficit countries to shift demand toward nontraded goods (and for surplus countries to shift demand away from them) is roughly twice as important quantitatively as the much more commonly stressed terms-of-trade channel (which involves substitution between the traded goods produced by different countries). The importance of the terms of trade would be greater with lower international trade elasticities than we have assumed, or with a greater degree of home bias in consumption.

We have only scratched the surface of the possible questions that can be asked within our framework. To that end, we have tried to make our approach as transparent as possible so that other researchers can easily investigate alternative scenarios using the model. Clearly, it would be interesting to extend the model in many dimensions, in particular to allow for sticky

prices and for dynamic adjustments, such as factor movement across sectors. It would also be interesting to extend the framework to allow for more regions of the world economy, for example, oil producers, non-Asian emerging markets, and Asian subregions. Nonetheless, in a literature that is often long on polemics and short on analysis, we hope it is useful to have a concrete model on which to base policy evaluation.

APPENDIX A

Equilibrium Prices, Revaluation Effects, and Interest Rate Effects

Equilibrium Prices

Here we show how real exchange rates depend on equilibrium relative prices, and we spell out the relevant equilibrium conditions for our three-region world economy. By definition, real exchange rates depend on relative international prices for both traded and nontraded goods. We take up relative traded goods prices first.

As the text noted, notwithstanding the law of one price, the assumed internationally asymmetric preferences over tradables permit relative regional price indexes for tradable consumption to vary over time. Instead of being fixed at unity, these ratios are given in our model by

$$\text{(A1)} \quad \frac{P_T^E}{P_T^U} = \frac{\left[\alpha\tau_{U,E}^{1-\eta} + (\beta-\alpha) + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\tau_{U,E}^{1-\eta} + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}$$

$$\frac{P_T^A}{P_T^U} = \frac{\left[\delta\tau_{U,A}^{1-\eta} + \left(\frac{1-\delta}{2}\right) + \left(\frac{1-\delta}{2}\right)\tau_{U,E}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\tau_{U,E}^{1-\eta} + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}$$

$$\frac{P_T^A}{P_T^E} = \frac{\left[\delta\tau_{U,A}^{1-\eta} + \left(\frac{1-\delta}{2}\right) + \left(\frac{1-\delta}{2}\right)\tau_{U,E}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha\tau_{U,E}^{1-\eta} + (\beta-\alpha) + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}.$$

Thus shifts in interregional real exchange rates q reflect both shifts in the relative prices of traded and nontraded goods and shifts in the relative prices of exports and imports:

$$\text{(A2)} \quad q_{U,E} = \frac{P_T^E}{P_T^U} \times \frac{\left[\gamma + (1-\gamma)\left(P_N^E/P_T^E\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(P_N^U/P_T^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}$$

$$= \frac{\left[\alpha\tau_{U,E}^{1-\eta} + (\beta-\alpha) + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\tau_{U,E}^{1-\eta} + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}} \times \frac{\left[\gamma + (1-\gamma)\left(P_N^E/P_T^E\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(P_N^U/P_T^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}$$

$$q_{U,A} = \frac{P_T^A}{P_T^U} \times \frac{\left[\gamma + (1-\gamma)\left(P_N^A/P_T^A\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(P_N^U/P_T^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}$$

$$= \frac{\left[\delta\tau_{U,A}^{1-\eta} + \left(\frac{1-\delta}{2}\right) + \left(\frac{1-\delta}{2}\right)\tau_{U,E}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\tau_{U,E}^{1-\eta} + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}} \times \frac{\left[\gamma + (1-\gamma)\left(P_N^A/P_T^A\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(P_N^U/P_T^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}.$$

Having defined relative price indexes, one can easily derive global market-clearing conditions for each region's tradable output, again using very standard techniques for constant elasticity of substitution models such as the one we have here.[53] For real U.S. tradable goods output, the market-clearing condition is given by

$$\text{(A3)} \quad Y_T^U = \gamma\alpha\left(\frac{P_U}{P_T^U}\right)^{-\eta}\left(\frac{P_T^U}{P_C^U}\right)^{-\theta} C^U + \gamma(\beta-\alpha)\left(\frac{P_U}{P_T^E}\right)^{-\eta}\left(\frac{P_T^E}{P_C^E}\right)^{-\theta} C^E + \gamma\left(\frac{1-\delta}{2}\right)\left(\frac{P_U}{P_T^A}\right)^{-\eta}\left(\frac{P_T^A}{P_C^A}\right)^{-\theta} C^A,$$

53. As illustrated, for example, in Obstfeld and Rogoff (1996).

and that for real European traded goods output is given by

$$\text{(A4)} \quad Y_T^E = \gamma\alpha\left(\frac{P_E}{P_T^E}\right)^{-\eta}\left(\frac{P_T^E}{P_C^E}\right)^{-\theta} C^E + \gamma(\beta-\alpha)\left(\frac{P_E}{P_T^U}\right)^{-\eta}\left(\frac{P_T^U}{P_C^U}\right)^{-\theta} C^U + \gamma\left(\frac{1-\delta}{2}\right)\left(\frac{P_E}{P_T^A}\right)^{-\eta}\left(\frac{P_T^A}{P_C^A}\right)^{-\theta} C^A.$$

Walras' Law implies that the condition for Asian traded goods equilibrium is superfluous, given the two others. One can similarly derive the market-clearing condition for U.S. nontraded goods as

$$\text{(A5)} \quad Y_N^U = (1-\gamma)\left(\frac{P_N^U}{P_C^U}\right)^{-\theta} C^U$$

(which depends, of course, only on U.S. demand), as well as the two corresponding conditions for European and Asian nontraded goods.

We take output endowments as given, and we then use the market-equilibrium conditions just stated to solve for relative prices as functions of current account balances and initial net foreign asset positions. (In our simulations we allow for currency revaluation effects on foreign assets and liabilities, and for the feedback to trade balances needed to sustain any given constellation of current accounts.)

To proceed, we first rewrite the equilibrium condition for the U.S. export good's market as

$$\text{(A6)} \quad Y_T^U = \alpha\left(\frac{P_U}{P_T^U}\right)^{-\eta} C_T^U + (\beta-\alpha)\left(\frac{P_U}{P_T^E}\right)^{-\eta} C_T^E + \left(\frac{1-\delta}{2}\right)\left(\frac{P_U}{P_T^A}\right)^{-\eta} C_T^A,$$

or, in nominal terms, as

$$\text{(A7)} \quad P_U Y_T^U = \alpha\left(\frac{P_U}{P_T^U}\right)^{1-\eta} P_T^U C_T^U + (\beta-\alpha)\left(\frac{P_U}{P_T^E}\right)^{1-\eta} P_T^E C_T^E + \left(\frac{1-\delta}{2}\right)\left(\frac{P_U}{P_T^A}\right)^{1-\eta} P_T^A C_T^A.$$

If trade were balanced and international debts zero, then, of course, the value of U.S. traded goods consumption would have to equal that of U.S.

traded goods production. Here we want to allow for international debt as well as for trade and current account imbalances (which are the same in the model except for net factor payments). The U.S. current account surplus in dollars is given by

$$CA^U = P_U Y_T^U + rF^U - P_T^U C_T^U, \tag{A8}$$

where F^U is the stock of U.S. net foreign assets (in dollars) and r is the nominal (dollar) rate of interest. Similarly, for Europe (and again measuring in dollars),

$$CA^E = P_E Y_T^E + rF^E - P_T^E C_T^E. \tag{A9}$$

In the aggregate, of course (in theory if not in the actual data),

$$CA^U + CA^E + CA^A = 0. \tag{A10}$$

Similarly,

$$F^U + F^E + F^A = 0. \tag{A11}$$

Thus,

$$CA^A = -(CA^U + CA^E) = P_A Y_T^A - r(F^U + F^E) - P_T^A C_T^A. \tag{A12}$$

In this framework one can consider the effects of a variety of shocks that change the current nexus of global current account imbalances into one where, say, $CA^U = 0$. (Other external balance benchmarks can be analyzed just as easily.)

To do so, we use the above current account equations (and the implied trade balances) to substitute for dollar values of consumption of traded goods in the goods-market equilibrium conditions. The results are

$$\begin{aligned} P_U Y_T^U = {} & \alpha\left(\frac{P_U}{P_T^U}\right)^{1-\eta}\left(P_U Y_T^U + rF^U - CA^U\right) \\ & + (\beta-\alpha)\left(\frac{P_U}{P_T^E}\right)^{1-\eta}\left(P_E Y_T^E + rF^E - CA^E\right) \\ & + \left(\frac{1-\delta}{2}\right)\left(\frac{P_U}{P_T^A}\right)^{1-\eta}\left[P_A Y_T^A - r\left(F^U + F^E\right) + CA^U + CA^E\right] \end{aligned} \tag{A13}$$

$$\begin{aligned} P_E Y_T^E = {} & \alpha\left(\frac{P_E}{P_T^E}\right)^{1-\eta}\left(P_E Y_T^E + rF^E - CA^E\right) \\ & + (\beta-\alpha)\left(\frac{P_E}{P_T^U}\right)^{1-\eta}\left(P_U Y_T^U + rF^U - CA^U\right) \\ & + \left(\frac{1-\delta}{2}\right)\left(\frac{P_E}{P_T^A}\right)^{1-\eta}\left[P_A Y_T^A - r\left(F^U + F^E\right) + CA^U + CA^E\right]. \end{aligned}$$

Critically, current account imbalances also spill over into relative prices for nontraded goods, to a degree that depends on the elasticity of substitution between traded and nontraded goods. For the three nontraded goods markets, one can show that

$$\begin{aligned} P_N^U Y_N^U &= \frac{1-\gamma}{\gamma}\left(\frac{P_N^U}{P_T^U}\right)^{1-\theta} P_T^U C_T^U \\ &= \frac{1-\gamma}{\gamma}\left(\frac{P_N^U}{P_T^U}\right)^{1-\theta}\left(P_U Y_T^U + rF^U - CA^U\right) \\ P_N^E Y_N^E &= \frac{1-\gamma}{\gamma}\left(\frac{P_N^E}{P_T^E}\right)^{1-\theta}\left(P_E Y_T^E + rF^E - CA^E\right) \\ P_N^A Y_N^A &= \frac{1-\gamma}{\gamma}\left(\frac{P_N^A}{P_T^A}\right)^{1-\theta}\left[P_A Y_T^A - r\left(F^U + F^E\right) + CA^U + CA^E\right]. \end{aligned} \tag{A14}$$

Revaluation of Gross Asset Stocks through Exchange Rate Changes

A key variable in the simulation analysis is f^i, which is the ratio of net foreign assets (in dollars), F^i, divided by the dollar traded goods income of the United States, $P_U Y_T^U$. In reality, a country's gross assets and liabilities are often denominated in different currencies, so that focusing only on the net position misses important revaluation effects that can occur as the exchange rate changes. Here we show how we have modified our simulation analysis to take into account both the normalization of dollar net foreign assets and the revaluation effects of exchange rate changes.[54]

54. Details can be found online at www.economics.harvard.edu/faculty/rogoff/papers/BPEA2005.pdf.

Let H^i equal the gross assets of country i and L^i its gross liabilities, measured in dollars. Then

$$F^i = H^i - L^i \tag{A15}$$

and

$$f^i = \frac{H^i - L^i}{P_U Y_T^U}. \tag{A16}$$

One can show that, under a monetary policy that targets the GDP deflator,

$$P_U = \left(\frac{P_N^U}{P_T^U}\right)^{\gamma-1}\left[\alpha + (\beta-\alpha)\tau_{U,E}^{1-\eta} + (1-\beta)\tau_{U,A}^{1-\eta}\right]^{\frac{\gamma-1}{1-\eta}}. \tag{A17}$$

The first step is to substitute this formula for P_U into the denominators of f^U, f^E, and f^A. The second step is to consider how exchange rate changes affect the numerators.

Let ω_j^i be the share of region i gross foreign assets denominated in the currency of region j, $j = U, E, A$, where the European and (especially) the Asian regional currencies are composites. Similarly, define the portfolio currency shares λ_j^i on the liability side. We will assume that central banks target GDP deflators and that $E_{U,j}$ denotes the (nominal) dollar price of currency j ($j = E, A$) under the monetary rule. Then, after a change in exchange rates, the new dollar values of net foreign assets (with values after the change denoted by primes) are

$$\begin{aligned}
F^{U\prime} &= F^U + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\omega_E^U H^U - \lambda_E^U L^U) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\omega_A^U H^U - \lambda_A^U L^U) \\
F^{E\prime} &= F^E + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\omega_E^E H^E - \lambda_E^E L^E) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\omega_A^E H^E - \lambda_A^E L^E) \\
F^{A\prime} &= F^A + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\omega_E^A H^A - \lambda_E^A L^A) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\omega_A^A H^A - \lambda_A^A L^A).
\end{aligned} \tag{A18}$$

Note that the following two constraints must hold in a closed system:

$$\begin{aligned}
\omega_E^U H^U + \omega_E^E H^E + \omega_E^A H^A &= \lambda_E^U L^U + \lambda_E^E L^E + \lambda_E^A L^A \\
\omega_A^U H^U + \omega_A^E H^E + \omega_A^A H^A &= \lambda_A^U L^U + \lambda_A^E L^E + \lambda_A^A L^A.
\end{aligned} \tag{A19}$$

So we can eliminate the European asset shares by writing the preceding as post-change net asset values:

$$\begin{aligned}
F^{U\prime} &= F^U + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\omega_E^U H^U - \lambda_E^U L^U) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\omega_A^U H^U - \lambda_A^U L^U) \\
F^{E\prime} &= F^E + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\lambda_E^U L^U + \lambda_E^A L^A - \omega_E^U H^U - \omega_E^A H^A) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\lambda_A^U L^U + \lambda_A^A L^A - \omega_A^U H^U - \omega_A^A H^A) \\
F^{A\prime} &= F^A + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)(\omega_E^A H^A - \lambda_E^A L^A) \\
&\quad + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)(\omega_A^A H^A - \lambda_A^A L^A).
\end{aligned} \tag{A20}$$

We also know that

$$H^U + H^E + H^A = L^U + L^E + L^A. \tag{A21}$$

For our numerical findings we must posit estimated values for nominal assets and liabilities. Given the well-known measurement problems, any numbers are bound to be loose approximations at best. For the United States, the numbers we use are for end-2003 (from the 2005 *Economic Report of the President*) and show foreign-owned assets in the United States to be \$10.5 trillion and U.S.-owned assets abroad to be \$7.9 trillion. We take the current values to be \$11 trillion and \$8.25 trillion, respectively, for purposes of our simulations. To a first approximation, essentially all U.S. foreign liabilities are denominated in dollars, but only about 40 percent of U.S. foreign assets are. (In principle, foreign assets such as stocks and land are real, but in practice the dollar returns on these assets are highly correlated with dollar exchange rate movements.) Of the remaining 60 percent, we take 41 percent to be in European currencies and 19 percent in Asian currencies. Following Tille (2004), and including Canada, the United Kingdom, and Switzerland in region *E,* the United States does have a very small share of its liabilities in foreign currencies. The exact portfolio weights that we assume for the United States are

$$\omega^U_E = 0.405,\ \omega^U_A = 0.193, \qquad \text{(A22)}$$
$$\lambda^U_E = 0.03,\ \lambda^U_A = 0.006.$$

Drawing on the work of Lane and Milesi-Ferretti (but taking into account the adding-up constraints that need to hold in our theoretical model), we take Asia's assets to be \$11 trillion and its liabilities to be \$8.25 trillion.[55] As for portfolio shares, on the asset side, data from the International Monetary Fund's 2001 Coordinated Portfolio Investment Survey suggest that most Asian countries hold predominantly U.S. dollars (and some yen), but that Japan's foreign assets are more evenly balanced between dollar and euro holdings. If we assume that Japan owns about 40 percent of the region's gross foreign assets, we have the following approximation:

$$\omega^A_E = 0.2,\ \omega^A_A = 0. \qquad \text{(A23)}$$

On the liabilities side, Japan borrows in yen, but the other Asian economies have equity liabilities (including foreign direct investment) in local currencies, and extraregional debt liabilities predominantly in dollars and euros (or sterling). We assume that

$$\lambda^A_E = 0.33,\ \lambda^A_A = 0.33. \qquad \text{(A24)}$$

We again base our portfolio estimates for the *E* zone in our model on the latest data from Lane and Milesi-Ferretti, which indicate that assets and liabilities at the end of 2003 were both approximately \$11 trillion. Thus we take $H^E = L^E =$ \$11 trillion. Most of greater Europe's liabilities are in domestic currencies; here we assume the share is 80 percent. We take the remaining 20 percent to be entirely in U.S. dollars. On the asset side, however, we derive from equation A19 that 32 percent of Europe's holdings are in dollar assets, and 11 percent in assets denominated in

55. Lane and Milesi-Ferretti (forthcoming).

Asian currencies, with the remaining 57 percent in assets denominated in European currencies.[56]

In our simulations we take $P_U Y^U_T =$ \$(11/4) trillion, based on Obstfeld and Rogoff (2000b), who argue that roughly one-quarter of U.S. GDP may be regarded as traded.

Given our assumptions on each region's gross assets and liabilities and their currencies of denomination, our analysis will also tell us how net foreign assets change across various scenarios for the current account and the exchange rate, as well as allow for the feedback effect on interest payments. We will see that, given the large size of gross stocks, large changes in exchange rates can translate into large changes in net foreign asset positions. Indeed, for many short-run and medium-run issues, knowing the gross asset and liability positions is at least as important as understanding the net positions. This conclusion is very much in line with the empirical findings of Gourinchas and Rey (2005a) for the United States.

Effects of Changing Interest Rates

It seems plausible that, in the process of U.S. current account adjustment, global interest rates will shift. Such changes could come about simply as a result of the reequilibration of the global capital market, or they could also reflect a shift in the portfolio preferences of foreign investors such that, given the exchange rate of the dollar, higher dollar interest rates are necessary to persuade them to maintain their existing dollar-denominated portfolio shares. We adopt the latter perspective, allowing the interest rate on U.S. short-term debt liabilities to rise as the dollar adjusts, without a corresponding increase in the earnings on U.S. foreign assets. Capital market shifts of this nature are likely to be quantitatively more important for the dollar than more generalized, synchronized increases in world interest rates (although the United States, as a debtor, would naturally lose while its creditors would gain).

To illustrate this channel, we first, for simplicity, abstract from the effects of nominal exchange rate changes on asset stocks (for the purpose of our

56. The European position assumptions are not needed to implement equation A20, but they are necessary for assessing the effects of interest rate changes below.

simulations, this case is only a computation check). We focus on the scenario under which, as the United States adjusts, it faces a sharp increase in its borrowing rates. Thus there are two interest rates in the world economy: the rate r^U that the United States pays on its liabilities, and the rate $r^W > r^U$ that all other countries pay on their liabilities and that all countries, including the United States, earn on assets outside the United States. We focus on the implications of r^U rising when the United States adjusts; the increase in r^U may itself have an effect on U.S. adjustment, although that possibility does not affect our calculation.

There is also a long-run versus short-run distinction: in the short run only U.S. short-term liabilities will pay higher interest (as these are rolled over). According to U.S. Treasury data for September 2004 (from www.treas.gov/tic/debta904.html), U.S. short-term liabilities were about 30 percent of total liabilities (and thus about 30 percent of U.S. GDP). If the United States were required to pay, for example, 200 basis points more on this liability base, the result would be an additional drain of about $0.02 \times 0.3 = 0.6$ percent of total GDP.

Let $\tilde{\omega}^i_j$ represent the share of country i gross foreign assets invested in country j.

To make the previous modeling consistent, we replace rF^i everywhere (for the United States, Europe, and Asia, respectively) by

$$\text{(A25)}\qquad \begin{gathered} r^W H^U - r^U L^U \\ \left[\tilde{\omega}^E_U r^U + \left(1-\tilde{\omega}^E_U\right) r^W\right] H^E - r^W L^E \\ \left[\tilde{\omega}^A_U r^U + \left(1-\tilde{\omega}^A_U\right) r^W\right] H^A - r^W L^A. \end{gathered}$$

From estimates described in the last subsection, we have the dollar values of H^i and L^i. Asian currency shares probably exceed the Asian country shares, because of Asian claims on offshore Eurodollars; we might assume that $\tilde{\omega}^A_U = 0.6$. Since total U.S. liabilities equal the claims on the United States of Europe and Asia,

$$\text{(A26)}\qquad \tilde{\omega}^E_U H^E + \tilde{\omega}^A_U H^A = L^U,$$

and so, with H^E, H^A, and L^U each equal to \$11 trillion, we must have $\tilde{\omega}^E_U = 0.4$.

We now turn to the calibration of interest rates (or, rather, nominal rates of return on asset and liability portfolios). We know that, for the United States currently, $r^W H^U - r^U L^U \approx 0$. Since, also, $H^U/L^U \approx 0.75$, $r^U/r^W \approx 0.75$.

So we take $r^U = 3.75$ percent initially,[57] but we maintain the earlier baseline assumption that $r^W = 5$ percent. We ultimately wish to consider alternative increases in r^U, for example, of 125 basis points or more. These possibilities range from a scenario in which the United States simply loses its privilege of borrowing at a favorable rate, to some in which there is an element of loss of confidence in U.S. solvency absent ongoing dollar depreciation. We will also assume that only the interest rate on short-term liabilities rises in the short run. Suppose the share σ of short-term liabilities in total U.S. foreign liabilities is 30 percent, or $\sigma = 0.3$. Then the investment income account of the United States and the other two regions would change as follows:

$$\text{(A27)}\qquad \begin{aligned} & r^W H^U - r^U L^U \to r^W H^U - \left(r^U + \sigma\Delta r^U\right) L^U \\ & \left[\tilde{\omega}^E_U r^U + \left(1-\tilde{\omega}^E_U\right) r^W\right] H^E - r^W L^E \to \\ & \qquad \left[\tilde{\omega}^E_U \left(r^U + \sigma\Delta r^U\right) + \left(1-\tilde{\omega}^E_U\right) r^W\right] H^E - r^W L^E \\ & \left[\tilde{\omega}^A_U r^U + \left(1-\tilde{\omega}^A_U\right) r^W\right] H^A - r^W L^A \to \\ & \qquad \left[\tilde{\omega}^A_U \left(r^U + \sigma\Delta r^U\right) + \left(1-\tilde{\omega}^A_U\right) r^W\right] H^A - r^W L^A. \end{aligned}$$

The last two changes assume that, empirically, $\tilde{\omega}^E_U + \tilde{\omega}^A_U \approx 1$ and that Europe and Asia hold equal proportions of short-term U.S. liabilities.

One might also consider a formulation where $\Delta r^U = f(\Delta CA^U)$, $f' > 0$. In this case adjustment could be quite painful if the f function is too rapidly increasing, L^U is too big, or σ is too big (or any combination of these three). We leave this possibility for future research.

Synthesis of Interest Rate Changes and Asset Revaluations

We are now ready to illustrate the techniques used to calculate the results in the third column in table 8, in which asset revaluations and interest rate changes occur simultaneously and interactively. We proceed as in the last section but add the following equations:

57. This number is in line with the estimate given above of the excess return of U.S. foreign assets over U.S. liabilities to foreigners.

$$\text{(A28)}\qquad H^{U\prime} = H^{U} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\omega_E^U H^U + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\omega_A^U H^U$$

$$H^{E\prime} = H^{E} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\omega_E^E H^E + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\omega_A^E H^E$$

$$H^{A\prime} = H^{A} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\omega_E^A H^A + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\omega_A^A H^A$$

and

$$\text{(A29)}\qquad L^{U\prime} = L^{U} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\lambda_E^U L^U + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\lambda_A^U L^U$$

$$L^{E\prime} = L^{E} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\lambda_E^E L^E + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\lambda_A^E L^E$$

$$L^{A\prime} = L^{A} + \left(\frac{E'_{U,E} - E_{U,E}}{E_{U,E}}\right)\lambda_E^A L^A + \left(\frac{E'_{U,A} - E_{U,A}}{E_{U,A}}\right)\lambda_A^A L^A.$$

These equations, rather than the equations for net positions used in the simpler revaluation exercise in which interest rates do not change, become necessary because assets and liabilities can now pay different rates of interest and therefore must be tracked separately.

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IS THE U.S. CURRENT ACCOUNT DEFICIT SUSTAINABLE? AND IF NOT, HOW COSTLY IS ADJUSTMENT LIKELY TO BE?

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ABSTRACT

In this paper I analyze the relationship between the U.S. dollar and the U.S. current account. I deal with issues of sustainability, and I discuss the mechanics of current account adjustment. The analysis presented in this paper differs from other work in several respects: First, I emphasis the dynamics of the current account adjustment, going beyond computations of the "required" real depreciation of the dollar to achieve sustainability. I show that even if foreigners' (net) demand for U.S. assets continues to increase significantly, the current account deficit is likely to experience a large decline in the (not too distant) future. Second, I rely on international evidence to explore the likelihood of an abrupt decline in capital flows into the U.S. And third, I analyze the international evidence on current account reversals, to investigate the potential consequences of a (possible) sudden stop of capital flows into the U.S. This analysis suggests that the required future adjustment of the U.S. external accounts is likely to result in a significant reduction in growth.

Keywords: *Exchange rates; U.S. dollar; real exchange rate; current account; net international investment position.*

JEL Nos: *F02, F43, O11.*

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I. Introduction

During the last few years a large number of analysts in academia, the private sector and applied research institutions have expressed increasing concerns regarding the growing U.S. current account deficit. There is a generalized sense that the current situation of global imbalances is unsustainable and that adjustment will have to take place sooner rather than later. The unprecedented magnitude of the U.S. current account deficit and the growing net indebtedness of the U.S. have fueled analysts' worries, with many arguing that unless something is done, the world will move toward a major financial crisis.[1] Some authors have gone as far as suggesting an imminent collapse of the U.S. dollar, and a global financial meltdown.[2] The main idea behind this view is that if the U.S. current account deficit is maintained at its current level, U.S. net international liabilities will reach 100% of GDP, a figure considered to be excessively large.[3] In a recent paper, Mussa has said:

> "[T]here is probably a practical upper limit for the US net external liabilities at something less than 100 percent of US GDP and, accordingly...current account deficits of 5 percent or more of US GDP are not indefinitely sustainable." (Mussa 2004, p 114).

The source of financing of the U.S. current account deficit has also become a source of concern. A number of authors have argued that by relying on foreign -- and particularly Asian -- central banks' purchases of Treasury securities, the U.S. has become particularly vulnerable to sudden changes in expectations and economic sentiments.[4]

Robert Skidelsky has recently argued in *The New York Times* that the value of the dollar is one of the most important sources of political tension between the United States and Europe. According to him, "[U]nilateralism is not more acceptable in currency matters than in foreign policy." More specifically, Skidelsky has pointed out that,

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[1] Although most of the alarmist discussions have come in the form of Op-Ed pieces, there have also been a few policy papers on the subject. See, for example, Roubini and Setser (2004).

[2] See, for example, Roubini and Setser (2004). For an excellent set of papers on the subject see Bergsten and Williamson (2004).

[3] See Mussa (2004) for a very clear discussion of this issue.

[4] See, for example, Martin Wolf's October 1st, 2003 article in the Financial Times, "Funding America's recovery is a very dangerous game," (page 15).

> "The United States is the only major country proclaiming itself indifferent to its currency value. In countries running persistent current account deficits, governments normally -- indeed must – reduce domestic consumption. But so far, the United States has relied on other countries to adjust their economies to profligate American spending… (*The New York Times*, February 20th, 2005, p.9)

There is, however, an alternative view. Some authors have argued that in an era of increasing financial globalization and rapid U.S. productivity gains, it is possible – even logical and desirable -- for the U.S. to run (very) large current account deficits for a very long period of time (say, a quarter of a century). According to this view, growing international portfolio diversification implies that the "rest of the world" will be willing to accumulate large U.S. liabilities during the next few years; maybe even in excess of 100% of U.S. GDP. According to this perspective, since the U.S. current account deficit does not pose a threat, there are no fundamental reasons to justify a significant fall in the value of the U.S. dollar (Dooley, Folkerts-Landau and Garber 2004a, 2004b). [5]

The purpose of this paper is to analyze the relationship between the U.S. dollar and the U.S. current account. In particular, I deal with issues of sustainability, and I discuss the mechanics of current account adjustment. I develop a portfolio model of the current account and I show that even under a very positive scenario, where foreigners' (net) demand for U.S. assets doubles relative to its current level, the U.S. current account will have to go through a significant adjustment in (the not too distant) future. Indeed, it is not possible to rule out a scenario where the U.S. current account deficit would shrink abruptly by 3 to 6 percent of GDP. In order to have an idea of the possible consequences of this type of adjustment, I analyze the international evidence on current account reversals. The results from this empirical investigation indicate that significant current account reversals have tended to result in large declines in GDP growth.

The rest of the paper is organized as follows: In section II I provide some background information and data. I discuss the evolution of the U.S. real exchange rate (RER) and current account during the last three decades, and I analyze some of the

[5] See, also, Cooper (2004), and Caballero, Farhi and Hammour (2004).

statistical properties of the RER. I also discuss the sources of deficit financing and I analyze the evolution of the U.S. net international assets position. In this section I also provide international comparisons, and I put the current U.S. situation in a global comparative context. In Section III I deal with the analytics of current account and real exchange rate adjustment. The analysis presented in this section focuses on transitional dynamics, and goes beyond computations of the "required" real depreciation of the dollar to achieve current account sustainability. I develop a portfolio model of current account behavior, and I discuss the response of the current account to changes in international portfolio choices. The model is quite general and allows for valuation effects stemming from exchange rate changes, and for changes in the international terms of trade. I show that under plausible parameters, an increase in the demand for U.S. assets by foreign investors results in an "overshooting" of the current account deficit. According to the model the current account deficit will increase until, at some point, it will experience a reversal. The reversal may, indeed, be quite abrupt and significant. In Section IV I use a large cross-country data set to investigate the international evidence on current account reversals. In particular, I investigate whether countries that have experienced significant and rapid reversals have faced real costs in the form of a decline in the rate of GDP growth. I argue that in spite of the uniqueness of the U.S., as a large country whose currency is at the center of the global financial system, this comparative analysis provides useful information on the likely costs an eventual U.S. current account adjustment. The paper closes with Section V, where I discuss some global policy challenges and I offer some concluding remarks.

II. The U.S. Dollar and the Current Account: A Look at the Data

In this section I provide a brief analysis of the evolution of the U.S. real exchange rate and current account since the adoption of floating exchange rates in the early 1970s. The section is divided in three parts: [6] First, I discuss the evolution of the U.S. real

[6] Due to space considerations I have not discussed in detail some important issues, such as the stationarity of the RER and its (changing) volatility through time. Most recent analyses based on panel data have found that the RER is stationary and that its half-life cycle is lower than the 3 to 5 years traditionally considered as the "consensus view." See Choi, Mark and Sul (2005). An analysis of U.S. RER volatility indicates that: For the period as a whole (1975-2004) the U.S. real exchange rate index exhibited one of the highest volatilities in the sample. Only the British pound, the Japanese yen, and the euro have higher volatilities. Second, RER volatility for the U.S. dollar was highest in 1985-1989. This period corresponds, mostly, to the rapidly depreciating Phase III in Figure 2.

exchange rate (RER) and current account during the last three decades, and I deal with the changing nature of the U.S. trade-weighted RER index. I argue that it is possible to divide the last thirty years of RER behavior into six distinct phases. Second, I discuss the most recent data on the U.S. current account, including its sources of financing. And third, I provide some international evidence on current account imbalances during the last three decades. This comparative analysis allows to place the U.S. recent experience in a historical context.

II.1 A Thirty-Year Perspective

In Figure 1 I present quarterly data for the U.S. current account balance as percentage of GDP, as well as on the evolution of the Federal Reserve trade-weighted index of the U.S. dollar real exchange rate for the period 1973-2004; in this Figure – as in the rest of this paper --, an increase in the RER index represents a real exchange rate appreciation. Several interesting features emerge from Figure 1: First, it shows that deficits have become increasingly large since 1992. Second, Figure 1 shows that for the first decade of floating exchange rates (1973-1982), the US ran, on average, a small current account surplus of 0.04% of GDP. In contrast, for the period 1983-2004 the mean current account balance has been a deficit of 2.4% of GDP. Figure 1 also shows that during the period under consideration the RER index experienced significant movements: its mean was 105.3, its minimum 91.2, and its maximum was 136.3. Finally, Figure 1 shows a pattern of negative correlation between the trade-weighted real value of the dollar and the current account balance. Periods of strong dollar have tended to coincide with periods of (larger) current account deficits. Although the relation is not one-to-one, the degree of synchronicity between the two variables is quite high: the contemporaneous coefficient of correlation between the (log of the) RER index and the current account balance is –0.53; the highest correlation of coefficient is obtained when the log of the RER is lagged three quarters (-0.60).

Current policy debates on the value of the U.S. dollar illustrate the massive changes that have occurred in U.S. trade relations during the last three decades. While in the early 1970's dollar-related discussions dealt almost exclusively with bilateral exchange rates – both nominal and real -- with respect to the industrial countries, current debates have increasingly focused on the behavior of emerging countries' currencies,

including the Chinese renminbi, the Korean won, and the Malaysian ringgit. During the last few years the Mexican peso has also become an important currency in determining the trade-weighted value of the U.S. dollar; this was not the case in 1973, at the time the Smithsonian Agreement was abandoned. Between 1995 and 2005 China's weight in the Federal Reserve trade-weighted real exchange rate index has gone from 5.67% to 11.35%; Mexico's weight has increased from 6.95% to 10.04%. On the other hand, during the same period, Japan's weight has declined from 16.54% to 10.58%. Overall, today's trade-weighted U.S. RER is dominated by the Asian nations – as a group, the Asian countries (excluding India) have a weight in the index of 38.8%. Commodity currencies, as a group, are also very important, with a weight of 24.6%. Finally, the launching of the Euro in 1999 has marginalized the British pound. Although a weight of 5.2% is still quite "respectable," the pound is not any longer among the top 5 currencies in the index. The situation was quite different in 1998, when the weight of the British pound was higher than that of all, but one, of the currencies that eventually would conform the euro (in 1998 the German mark had a weight of 6.4% and the British pound had a weight of 5.9%).[7]

As may be seen from Figure 1, it is possible to distinguish six distinct phases in U.S. dollar real exchange rate behavior for the thirty-year period 1975-2004. A brief analysis of these six phases provides a summary of the history of the international financial system since the inception of floating:[8]

- Phase I: 1973Q1-1978Q4. This period includes the early years of floating, and was characterized by a *depreciating* trend of the U.S. RER. The accumulated depreciation amounted to 18.1% during 24 quarters. During this period the standard deviation of the log differences of the RER index was 0.0205. During the early part of this phase (1973-76) the current account was in surplus. This, however, turned into a small deficit in the years 1977 and 1978.

[7] In 2005 the euro has a weight of 18.80%; in 1995 the currencies that conformed the euro had a combined weight of 17.30%.

[8] Figure 1 presents the Fed broad RER index. The same six phases are observed if alternative indexes are used.

- Phase II: *1979Q1-1985Q1*. During these 26 quarters the U.S. dollar RER experienced a 49.3% *appreciation*. During this phase the current account went into deficit, reaching 2.9% of GDP in the third quarter of 1984. The standard deviation of the monthly log differences of the RER index was 0.022, slightly higher than that of Phase I. In view of the substantial strengthening of the dollar and the related increase in the U.S. current account deficit, on September 25th 1985 the members of the G-5 (The United Sates, Japan, the United Kingdom, France, and Germany) decided to implement concerted and coordinated interventions in the foreign exchange market. As part of this agreement – known as the *Plaza Accord* – the G-5 countries committed themselves to put in place coordinated macroeconomic policies that would reduce the costs of the global adjustment process.[9]
- Phase III: *1985Q2-1988Q4*. During this period the dollar real exchange rate experienced a rapidly *depreciating* trend. The peak-to-trough change in the index was -28.7%. Real exchange rate volatility increased substantially during this 16 quarter period; the standard deviation of the monthly log differences of the RER index was 0.0268, significantly higher than in the previous two phases. The current account deficit continued to grow, until in mid 1987 it stabilized at around 3.6% of GDP. From that point onward the current account began to improve, and by the fourth quarter of 1988 the deficit had declined to 2.4% of GDP. On February 22, 1987 the Ministers of Finance and Central Bank Governors of the G-6 (G-5 plus Canada) released a communiqué – known as the *Louvre Accord* -- informing the public that significant progress had been made in achieving global adjustment, and that "further substantial exchange rate shifts among their currencies could damage growth and adjustment prospects in their countries…" The *Louvre Accord* communiqué went on to say that the G-6 countries "agreed to cooperate closely to foster stability of exchange rates around current levels."[10]

[9] For the text of the *Plaza Accord* communiqué, see http://www.g8.utoronto.ca/finance/fm850922.htm.

[10] See the text of the *Louvre Accord* at http://www.g8.utoronto.ca/finance/fm870222.htm.

- Phase IV: *1989Q1-1995Q2*. During this Phase the real value of the dollar continued to *depreciate*, but at a much lower rate than in the preceding Phase; during these 27 quarters the dollar depreciated in real terms by 10%. During this period the standard deviation of the monthly log differences of the RER index was 0.0232. During this phase the current account balance continued to improve, until in the first quarter of 1991 the U.S. posted its first current account surplus in many years. During Phase IV the average current account balance was -1.15% of GDP.
- Phase V: 1995Q3-2002Q1. This is phase is characterized by a trough-to-peak real exchange rate *appreciation* of 33.4% (notice from Figure 1 that between the fourth quarter of 1998 and the fourth quarter of 1999 there was a short lived period of real depreciation). Interestingly, during this phase real exchange rate volatility declined significantly; the standard deviation of the monthly log differences of the RER index was 0.0196. This phase was characterized by an increasingly larger current account deficit. While in late 1995 early 1996 the deficit was in the order of 1.5% of GDP, by early 2002 it was hovering just below 4% of GDP. In 1999, and for the first time in many years, the U.S. federal government posted a surplus.
- Phase VI: 2002Q2-2004Q4. During this phase the real value of the dollar experienced a 14% accumulated *depreciation*. The current account deficit continued to widen, exceeding 5% of GDP towards the end of the sample. Real exchange rate volatility increased slightly during this period; the standard deviation of the log differences of the RER index was 0.0212. Other important macroeconomic developments during this phase include the worsening of the U.S. fiscal position, and the stiff increases in the price of oil and of other commodities.

In Figure 2 I go beyond the current account, and I present data from 1973 through 2004 for (a) the balance of trade of goods and services as a percentage of GDP; (c) the balance of trade in (non financial) services as a percentage of GDP; (c) the income account, also as a percentage of GDP and (d) the transfers account as a percentage of

GDP. A number of important facts emerge from these figures. First, as Panel A shows, large and persistent trade deficits preceded in time the era of large current account deficits. Already in the late 1970s the trade account was negative, and since mid 1976 it has had only one surplus quarter (1992Q2).[11] Second, since 1996 the trade surplus in non financial services has declined steadily; in 2004 it was only 0.3 percent of GDP. Third, Panel C shows that the income account continues to be positive. Since for quite some years now the U.S. international investment position has been negative – that is, the U.S. has been a net debtor --, the fact that the income account is still positive may seem surprising. The reason for this is that the return on U.S. assets held by foreigners has systematically been lower than the return on foreign assets in hands of U.S. nationals. Finally, Panel D shows that the transfers account has been negative since 1946. During the last few years transfers account deficit gas been approximately 0.7% of GDP.

II.2 Recent Current Account Imbalances

In Table 1 I present data on the current account as a percentage of GDP, and its financing for the period 1990-2004. As may be seen, during the last few years the nature of external financing has changed significantly. In particular, since 2002 net FDI flows have been negative. This contrasts with the 1997-2001 period when FDI flow contributed in an increasingly important way to deficit financing. Also, after four years on net positive equity flows (1998-2002), these became negative in 2003-04. As the figures in Table 1 show, during 2003 and 2004 the U.S. current account deficit was fully financed through net fixed income flows, and in particular through official foreign purchases of government securities. A number of analysts have argued that by relying on foreign central banks' purchases of Treasury securities, the U.S. has become particularly vulnerable to sudden changes in expectations and economic sentiments.[12]

Current account imbalances are reflected in changes in a country's net international investment position (NIIP): deficits result in a deterioration of the NIIP, and surpluses result in an improvement in the U.S. NIIP. In Figure 3 I present the evolution of the U.S. NIIP as percentage of GDP. As may be seen, this has become increasingly

[11] Mann (2004) shows that most of the U.S. trade deficit is explained by a deficit in automobiles and consumer goods.

[12] See, for example, Martin Wolf's October 1st, 2003 article in the Financial Times, "Funding America's recovery is a very dangerous game," (page 15).

negative: in 2004 U.S. net international liabilities reached 29 percent of GDP. An important feature of the NIIP is that gross U.S. international assets and gross U.S. international liabilities are held in different currencies. While more than 70% of gross foreign assets held by U.S. nationals are denominated in foreign currency, approximately 95% of gross U.S. liabilities in hands of foreigners are denominated in U.S. dollars. This means that the *net* liabilities as a percentage of GDP are subject to "valuation effects" stemming from changes in the value of the dollar. A dollar depreciation reduces the value of net liabilities. As a result of this valuation effect, the deterioration of the U.S. NIIP during 2002-2004 was significantly smaller than the accumulated current account deficit during those two years; see Table 2 for details.

A key question in current account sustainability analyses – and one I discuss in detail below – refers to the "reasonable" long run equilibrium value the ratio of U.S. net international liabilities; the higher this ratio is, the higher will be the "sustainable" current account deficit. According to some authors the current ratio of almost 30% of GDP is excessive, while others believe that a NIIP to GDP ratio of up to 50% would be reasonable.[13]

One of the first things undergraduate students of open economy macroeconomics learn is that the current account is the difference between savings and investment. Through time a number of authors have argued that a worsening of a current account balance that stems from an increase in investment is very different from one that results from a decline in national savings. Some have gone as far as arguing that very large deficits in the current account "don't matter," as long as they are the result of higher (private sector) investment (Corden, 1994). As Figure 4 shows, the recent deterioration of the U.S. current account has largely been the result of a decline in national savings, and in particular of public and household savings. A simple implication of this trend – and one that is emphasized by most authors – is that an improvement in the U.S. current account situation will not only imply a RER adjustment; it will also require an increase in the national savings ratio, and in particular in household savings. Symmetrically, a correction of current global imbalances will also require a decline in Europe's and Japan's savings rates and/or an increase in their investment rates.

[13] See Obstfeld and Rogoff (2004) and Mussa (2004).

II.3 The U.S. Current Account Deficit in International Perspective

How large is the U.S. recent current account deficits, from a comparative point of view? And, how large is the U.S. net international liabilities position when compared, from a historical vantage, to that of other advanced countries?

In Table 3 I present data on the distribution of current account balances in the world economy, as well as in six groups of nations – Industrial, Latin America, Asia, Middle East, Africa and Eastern Europe – for the period 1971-2001. As may be seen, at almost 6% of GDP the U.S. deficit is *very large* from a historical and comparative perspective. It is in the top decile of deficits distribution for all industrial countries in the first thirty years of floating. As the data in Table 3 suggest the U.S. looks more like a Latin American or Asian country, than like an industrial nation.

Since 1971 the U.S. has been the only *large* industrial country that has run current account deficits in excess of 5%. This reflects the unique position that the U.S. has in the international financial system, where its assets have been in high demand, allowing it to run high and persistent deficits. On the other hand, this fact also suggests that the U.S. is moving into uncharted waters. As Obstfeld and Rogoff (2004), among others, have pointed out, if the deficit continues at its current level, in twenty five years the U.S. net international liabilities will surpass the levels observed by any country in modern times.

During the last 30 years only small industrial countries have had current account deficits in excess of 5% of GDP: Australia, Austria, Denmark, Finland, Greece, Iceland, Ireland, Malta, New Zealand, Norway and Portugal. What is even more striking is that very few countries – either industrial or emerging -- have had *high* current account deficits that last for more than five years. In Table 4 I present a list of countries with *persistently high* current account deficits for 1970-2001. In constructing this table I define a country as having a "*High Deficit*" if, in a particular year, its current account deficit was higher than its region's ninth decile.[14] I then defined a *persistently high deficit* country, as a country with a "*High Deficit*" (as defined above) for at least 5 consecutive years.[15] As may be seen in Table 4 the list of persistently high deficit

[14] Notice that the thresholds for defining *High* deficits are year and region-specific. That is, for every year there is a different threshold for each region.

[15] For an econometric analysis of current account deficits persistence see Edwards (2004). See also Taylor (2002).

countries is extremely short, and none of these countries is large. This illustrates the fact that, historically, periods of high current account imbalances have tended to be short lived, and have been followed by periods of current account adjustments.

In Table 5 I present data on net international liabilities as a percentage of GDP for a group of advanced countries that have historically had a large negative NIIP position.[16] As may be seen, the picture that emerges from this table is quite different than that in Table 4 on current account deficits. Indeed, a number of advanced nations have had – and continue to have – a significantly larger net international liabilities position than the U.S. This suggests that, at least in principle, the U.S. NIIP could continue to deteriorate for some time into the future. But even if this does happen, at some point this process would have to come to an end, and the U.S. net international liabilities position as percentage of GDP would have to stabilize. It makes a big difference, however, at what level U.S. net international liabilities do stabilize. For example, if in the steady state foreigners are willing to hold the equivalent of 35% of U.S. GDP in the form of net U.S. assets, the U.S. could sustain a current account deficit of (only) 2.1% of GDP.[17] If, on the other hand, foreigners' net demand for U.S. assets grows to 60% of GDP – which, as shown in Table 5, is approximately the level of (net) foreign holdings of Australian assets --, the U.S. sustainable current account deficit is 3.6% of GDP. And if foreigners' are willing to hold (net) U.S. assets for the equivalent of 100% of GDP – a figure that Mussa (2004) considers to be implausible – the sustainable U.S. current account deficit can be as high as 6% of GDP – approximately its current level. Since there are no historical precedents for a large advanced nation running persistently large deficits, it is extremely difficult to have a clear idea on what will be the actual evolution of foreigners' demand for U.S. assets. Give this lack of historical precedent, a reasonable strategy is to ask what would happen to the current account and real exchange rate dynamics if, as posited by Dooley et al (2004a) among others, foreigners' demand for U.S. assets continues to increase. This is precisely approached I follow in Section III of this paper.

[16] For the U.S. the data are from the Bureau of Economic Analysis. For the other countries the data are, until 1997, from the Lane and Milessi-Ferreti data set. I have updated them using current account balance data. Notice that the updated figures should be interpreted with a grain of salt, as I have not corrected them for valuation effects.

[17] This calculation assumes a 6% rate of growth of nominal GDP going forward. See subsection III for an analytical discussion and for the relevant equations.

III. The Analytics of Current Account and Real Exchange Rate Adjustment

The current account and the (real) exchange rate are endogenous variables jointly determined in a general equilibrium context. This means that from a policy point of view the key question is how will these two variables move as a result of a given exogenous shock – a decline in capital inflows, say --, under the assumption that other variables, including growth and the rate of unemployment, do not deviate significantly from their long term equilibrium paths. A number of authors have recently addressed this issue using a variety of simulation and econometric models. Most of these studies have asked what is the real exchange rate adjustment required to achieve a certain current account balance. Some authors, such as Obstfeld and Rogoff (2000, 2004) and Blanchard, Giavazzi and Sa (2005), have considered the case where the deficit is competently eliminated. Others, including Mussa (2004) and Roubini and Setser (2004), have considered the reduction of the deficit to a positive, but smaller than current, level. In Table 6 I provide a summary of selected studies on the subject. As may be seen, these works use different methodologies, and reach different conclusions.[18] What they do have in common, however, is that they find "required" adjustments in the trade-weighted value of the U.S. dollar is quite high – according to Blanchard, Giavazzi and Sa (2005) as high as 90%. Interestingly, the estimated figures for "required" dollar depreciation summarized in Table 6 are much higher than the figures discussed in most trade newsletters and in the media.[19]

III.1 A Portfolio Model of the Current Account and the Real Exchange Rate

From an analytical perspective the process of current account adjustment may be deconstructed into two components: (a) The dynamics of net international foreign assets; and (b) the "transfer" associated with changes in a country's net foreign assets position. Changes in international investors' willingness to hold U.S. assets will affect total absorption and relative prices, including the real exchange rate. An increase in foreigner's rate of accumulation of domestic assets will allow the country to increase absorption, generating a current account deficit and a RER appreciation. In a similar way, a reduction in the rate at which foreigners accumulate the country's assets – or,

[18] See also the studies by Mann (2003, 2004), where she extends her pioneering 1999 model.
[19] While practitioners' do believe that the dollar will weaken, they tend to consider more moderate adjustments. See, for example, the forex publications of major investment bamks.

worse yet, a reduction in their holdings of domestic assets -- will result in a drop in absorption and a decline in the relative price of nontradables, or RER depreciation. These changes in absorption, and the concomitant adjustment in relative prices, are reminiscent of discussions on the "transfer problem" that go back, at least, to the debates between Keynes and Ohlin during the 1920s. In large countries such as the U.S., however, this story is more complex. First, changes in relative prices have *valuation effects* on net foreign assets holdings that will feed back into the dynamics of net foreign assets accumulation or de-accumulation.[20] Second, in a large country changes in aggregate expenditure are likely to affect the international terms of trade, and thus the general equilibrium outcome of the original shock.

III.1.1 The Basic Model

Consider the following bare bones portfolio model of the current account:[21] Equation (1) is the basic external sector equation (in domestic currency) and states that the current account deficit (*CAD*) is equal to the trade deficit (*TD*), plus the income account (net income payments to the rest of the world) (ia_t), plus net transfers to the rest of the world (*NT*).[22]

(1) $$CAD_t = TD_t + ia_t + NT_t,$$

The income account, in turn is equal to:

$$ia_t = iD_t^f - i^* F_t^d,$$

where i is the interest rate paid on (gross) domestic assets in hand of foreigners D_t^f, and i^* is the interest rate on (gross) foreign assets held by domestic residents F_t^d. Since equation (1) is expressed in domestic currency,

$$F_t^d = E_t F_t^{d*}.$$

[20] This effect has been emphasized by Lane and Milessi-Ferreti (2002, 2004a, 2004b), Tille (2003) and Gourinchas and Rey (2005), among others. For a discussion of valuation effects in the context of emerging markets' current account sustainability, see Edwards (2003).
[21] In order to concentrate on the problem at hand and to keep the analysis tractable, I have made a number of simplifications; I have made no attempt to construct a full general equilibrium model. Recent papers that have constructed portfolio models of the current account include, Blanchard, Giavazzi and Sa (2005), Edwards (1999, 2002), Gourinchas and Rey (2005) and Kraay and Ventura (2002).
[22] Notice that I have defined the deficit as a *positive* number. In equation (1), then, negative numbers refer to a *surplus*.

Where E is the nominal exchange rate defined as units of domestic currency (U.S. dollars) per unit of foreign currency, and F_t^{d*} denotes (gross) foreign assets held by domestic residents, expressed in foreign currency. Equation (1) can then be rewritten as follows:

(1') $$CAD_t = TD_t + i\delta_t + (i - i^*)F^d + NT_t .$$

Where δ are net domestic assets in hands of foreigners $(\delta_t = D^f - F^d)$. The terms $i\delta_t$ and $(i - i^*)F^d$ capture the effect of valuation effects on the current account, recently emphasized by a number of authors including Lane and Milesi-Ferreti (2004), and Gourinchas and Rey (2005), among others.

Equation (2) is a portfolio equation that summarizes the net international demand for the country's assets δ_t. Domestic and foreign assets are assumed to be imperfect substitutes. α is the percentage of foreigners' wealth that international investors are willing to hold in the form of the domestic country's assets; W is world's wealth and W^c is the domestic country's wealth. α_{jj} is the domestic country's asset allocation on its own assets.

(2) $$\delta_t = \alpha(W_t - W_t^c) - (1 - \alpha_{jj})W_t^c ,$$

The asset allocation shares α and α_{jj}, depend, as in standard portfolio theory, on expected real returns (i and i*), perceived risk (μ, μ^*), and the degree of segmentation of international financial markets (Equation (3)). I assume that there is "home-bias" in portfolio decisions; this is reflected in the fact that α_j and $(1 - \alpha_{jj})$ are below international market shares of domestic and foreign wealth. There is no need, however, to assume that foreign and domestic investors have the same degree of home bias.

(3) $$\alpha = \alpha(i, \mu) ; \quad \alpha_{jj} = \alpha_{jj}(i^*, \mu^*) .$$

World wealth in foreign currency W^* and in domestic currency W are related by $W_t^* = \frac{W_t}{E_t}$. Domestic and foreign interest rates are related through the following equation: $i = i^* + \frac{dE^e}{E} + \mu + k$, where $\frac{dE^e}{E}$ is the expected rate of depreciation of the domestic currency, and k is a term that captures the effect of capital controls; in a world of full capital mobility, $k = 0$. It is important to notice that in this model the term "*investors*" refers both to private and public investors, and include foreign central banks. Indeed, and as pointed out in the preceding section, recent discussions on the U.S. current account deficit have emphasized the key role played by foreign (and especially Asian) central banks in helping finance the deficit.

The counterpart of a current account deficit CAD is the change in the country's (net) assets in hand of foreigners:

(4) $$CAD_t = \Delta\delta_t .$$

Equation (5) defines the trade deficit.

(5) $$TD_t = \sum p_i^m m_i - \sum p_i^x x_i .$$

p_i^m and p_i^x are prices of importable and exportables in domestic currency. m_i is the demand for importables, which is assumed to depend on the *real* exchange rate (e), the international price of importable goods, the country's real income (y), and other factors, including the degree of protectionism (v). Exports, on the other hand, depend on the real exchange rate, the international price of exportables, the rest of the world real income (y*) and other factors (u).

(6) $$m_i = m_i(e, y, v) ; \quad x_i = x_i(e, y^*, u) .$$

m_i and x_i, in turn, may be interpreted as excess demand (supply) for importable (exportables), in the domestic country. In the basic version of the model it is assumed that the law of one price holds for importables and exportables: $p_i^m = Ep_i^{m*}; p_i^x = Ep_i^{x*}$. In the simulation exercises alternative assumptions can be made, however, including that exporters and importers price to market. Equation (7) is the equilibrium condition for the nontradable goods market in the home country, where S_t^N is the supply of nontradables in period t, assumed to depend on the real exchange rate and other factors z, and D_t^N is the demand for nontradables:

(7) $$S_t^N(e_t, z_t) = D_t^N(e_t, y_t) .$$

The domestic price level P is assumed to be a geometric average of the nominal prices of tradable goods (importables and exportables) and nontradables: $P_t = (p_t^m)^a (p_t^x)^b (p_t^N)^{(1-a-b)}$. Equation (8) is the real exchange rate.

(8) $$e_t = \frac{P_t^*}{E_t P_t},$$

where, P_t^* is the foreign country price level. As before, an increase in e represents a real appreciation; a decrease in e is a real depreciation.

The working of this model is simple. The domestic country can only run a current account deficit to the extent that foreign investors are willing to increase their net holdings of domestic assets – that is, to the extent that $\Delta\delta_t > 0$. Once $\Delta\delta_t$ is known, and for given values of other key variables, it is possible to derive the real exchange rate (e) consistent with the prevailing current account deficit (surplus). A particularly interesting exercise, given the current U.S. situation, is to analyze how changes in portfolio preferences – that is, changes in α and/or α_{jj} --, will affect the current account and the real exchange rate.

In order to close the model, it is necessary to specify a number of clearing conditions, including the savings and investment equations in the world economy; and the world clearing conditions for each importable and exportable good. These equilibrium conditions determine endogenously interest rates, and all relevant tradable goods' prices. Doing this, however, would make the model significantly more complex than what is required for dealing with the problem at hand. For this reason, instead of solving the full model, I work with a partial equilibrium version of it; in the simulations that follow I make different assumptions regarding these variables' behavior.[23]

Before continuing, however, it is important to emphasize that current account adjustments will not only imply changes in the real exchange rate; they will also require changes in savings and investments in the home country (the U.S.) and the rest of the world. From a policy perspective these adjustments in domestic savings would be greatly facilitated by an increase in public sector savings.

[23] Most recent models on global imbalances and the U.S. current account have used a partial equilibrium framework in the simulation phase.

III.1.2 Portfolio Equilibrium, Dynamics and Current Account Sustainability

External sustainability requires that a country's net external liabilities stabilize at a level compatible with foreigners' net demand for these claims, as specified by equation (2). Assuming that the home country's wealth is a multiple λ of its (potential or full employment) GDP, and that its wealth is a fraction β of world's wealth W, it is possible to rewrite the (international) net demand for the country's assets as $\delta = (\alpha\theta - (1-\alpha_{jj}))\lambda Y$, where, Y is (potential) GDP, and, $\theta = \frac{(1-\beta)}{\beta} = \frac{EW^{f*}}{W^c}$, where W^{f*} is "rest of the world" wealth expressed in foreign currency.

Denoting $\gamma^* = (\alpha\theta - (1-\alpha_{jj}))\lambda$, then, $\delta = \gamma^* Y$. This means that in long run equilibrium the net international demand for the home country's assets can be expressed as a proportion γ^* of its (potential or sustainable) GDP. The determinants of this factor of proportionality γ^* depend on relative returns and perceived risk of country j and the rest of the world, as well as on the degree of integration of international financial markets.

Assuming that g is the country's sustainable rate of growth, and π is the country's (long term) rate of inflation, the "sustainable" current account deficit to GDP ratio is given by:

(9) $$\frac{CAD}{Y} = (g+\pi)(\alpha\theta - (1-\alpha_{jj}))\lambda = \gamma^*(g+\pi).$$

Notice that if $\alpha\theta - (1-\alpha_{jj}) < 0$, domestic residents' demand for foreign assets exceeds foreigners' demand for home country assets. Under these circumstances the country will have to run a *current account surplus* in order to maintain a stable net external assets' to GDP ratio. Most authors that have studied the sustainability of the U.S. current account have used equations of the type of (9) in their analyses. Mussa (2004), for example, argues that in long term equilibrium γ^* is likely to be around 0.50.[24] In long run equilibrium the sustainable trade balance will be given by $\frac{TD}{Y} = (g-r)\gamma^*$.

[24] See, also, Edwards (1995), Ades and Kaune (1997), and O'Neill and Hatzius (2004) for this type of current account sustainability analyses.

In this model, as in the models by Edwards (1999) and Kraay and Ventura (2002), additional savings will be allocated in a way that maintains domestic and foreign assets in the same proportion as in the original portfolio. Kraay and Ventura (2002) have shown that models that combine this assumption with the assumption of transaction costs in investment go a long way in explaining international current account behavior in a large number of countries.

If the degree of riskiness of the home country declines, there will be an increase in α and, thus, in γ^*. As a result, the sustainable current account deficit will increase, or the sustainable surplus will decline (see equation 10). Equally important, changes in portfolio allocation, generated by changes in α or α_{jj}, will generate a dynamic adjustment process, during which the current account will differ from its long run sustainable level. This transitional dynamics can be incorporated into the model through the following equation:

$$(10)\qquad \left(\frac{CAD}{Y}\right)_t = (g+\pi)\gamma_t^* + \psi(\gamma_t^* - \gamma_{t-1}) - \kappa\left[\left(\frac{CAD}{Y}\right)_{t-1} - (g+\pi)\gamma_t^*\right].$$

According to equation (1) short term deviations of the current account from its long run level can result from two forces. The first is a traditional stock adjustment term $(\gamma_t^* - \gamma_{t-1})$ that captures deviations between the demanded and the actual stock of the country's assets in hands of foreign investors. ψ is the speed of adjustment, which will depend on a number of factors, including the degree of capital mobility in the country in question. The second force affecting this dynamic process, which is captured by - $\kappa\left[\left(\frac{CAD}{Y}\right)_{t-1} - (g+\pi)\gamma_t^*\right]$ in equation (10), is a self-correcting term. This term plays the role of making sure that in this economy there is some form of "consumption smoothing". The importance of this self correcting term will depend on the value of κ.[25] Whether the dynamic representation in equation (10) is appropriate is, in the final analysis, an empirical matter. As I show in subsection III.2, below, under certain

[25] If $\psi = \kappa = 1$, the current account will jump from one sustainable level to the next. There are many reasons to assume that both ψ and κ are different from zero, including the existence of adjustment costs in consumption.

parametrization this model does a (very) good job in tracking the current account behavior in the U.S. during the last few years. The dynamic behavior for the net stock of the home country's assets in hands of foreigners, as a percentage of GDP, will be given by $\gamma_t^* = [\gamma_{t-1}^* + (\frac{CAD}{Y})_{t-1}](1+g+\pi)^{-1}$.

Consider the case where for some reason the home bias in the rest of the world is reduced – that is, α in the portfolio equation (3) increases. This will result in an increase in the sustainable current account deficit (see equation 9). It will also unleash a dynamic adjustment process captured by equation (10). During this transitional period the current account deficit will exceed its new long run (higher) sustainable equilibrium; that is, during the transition the current account deficit will overshoot its new sustainable level. During the transition the trade account will move according to the following equation: $\Delta\left(\frac{TD}{Y}\right)_t = \Delta\left(\frac{CAD}{Y}\right)_t - \Delta(i\gamma_t^*) - \Delta\left((i-i^*)\frac{F^d}{Y}\right) - \Delta\left(\frac{NT}{Y}\right)$. From equations (5) through (7) -- and after making some assumptions regarding the behavior of other key variables' such as the international term of trade --, the following equation for the current account may be derived (in order to simplify the notation, the m_i and x_i have been aggregated into broad imports and exports categories):

$$(11)\qquad \Delta\left(\frac{CAD}{Y}\right)_t = \Delta(i\gamma_t^*) + \Delta\left((i-i^*)\frac{F^d}{Y}\right) + \Delta\left(\frac{NT}{Y}\right) + \{\sigma_x(1+\varepsilon_e) - \sigma_m(1+\eta_e)\}\hat{e}$$
$$+ (\sigma_m - \sigma_x)(\pi - \pi^*) + \sigma_m\eta_y g - \sigma_x\varepsilon_{y*}g^* + \sigma_m\hat{p}_m^* - \sigma_x\hat{p}_x^* - (\sigma_m - \sigma_x)(g+\pi).$$

Where σ_m and σ_x are imports and exports to GDP ratios; η_e, ε_e are the price elasticities of imports and exports, respectively ($\eta_e < 0, \varepsilon_e > 0$). η_y, ε_{y*} are the elasticities of imports and exports with respect to domestic and foreign income, respectively. g, g^* represent real GDP growth at home and in the rest of the world; π, π^* is domestic and world inflation; $\hat{p}_m^*, \hat{p}_x^*$ are the rates of changes in international prices of imports and exports, and $\hat{e}$ is the rate of change of the real exchange rate. From this equation it follows that in order for a real devaluation to improve the trade balance (and, with other things given, the current account) it is required that $\{\sigma_x(1+\varepsilon_e)-\sigma_m(1+\eta_e)\}>0$.[26]

Although equation (11) is *not* a reduced form equation, this model is useful for undertaking a number of simulation exercises. For example, form equations (2), (4), (10) and (11) -- and under assumed values of growth, inflation, interest rates and international terms of trade changes --, it is possible to analyze the way in which changes in portfolio preferences will affect the current account and real exchange rate trajectories.

III.2 Simulation Results

The bare bones model developed above may be used to compute the current account and real exchange rate adjustments consistent with shifts in portfolio preferences by foreign and domestic investors, including a reduction in the extent of home bias in portfolio investment decision.[27] A first step in this analysis is the calibration of the model. In Table 7 I present the parameter values used in the base-case simulation; most of these values are taken form existing studies of the U.S. and world economy. In the calibration I selected the values of ψ and κ that best tracked the actual dynamics of the current account between 1996 and 2004; the best results are obtained for $\psi = 0.30$ and $\kappa = 0.20$. I also assumed that foreigners' demand for U.S. assets α has increased gradually from 0.205 to 0.0.30 between 1996 and 2004 (see the values for $\alpha_{Historical}$, and $\alpha_{jj,Historical}$ in Table 7). As may be seen from Figure 5.A, for the assumed parameter values the model tracks actual current account behavior for 1996-2004 quite closely.

One of the limitations of this type of simulation exercise is that it is difficult to forecast how foreign investors' net demand for U.S. assets will behave in the future. It is precisely for this reason that a number of authors have eschewed the issue, and have computed the RER adjustment "required" to eliminate completely the current account

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26 Under balanced initial trade, this expression becomes the traditional Marshall-Lerner condition.

27 In fact, there are indications that the process of international capital markets integration will continue in the future, as some of the largest emerging countries – including China – are increasingly allowing their nationals to invest abroad. See, for example, the Financial Times, February 28, 2005 (p.6): "China to Seek Full Currency Conversion."

deficit.[28] In this section I take a different approach: instead of assuming that the current account deficit has to be reduced to zero – or to any other arbitrary number --, I analyze the dynamic of the current account under alternative assumptions regarding foreigner's net demand for U.S. assets. I am particularly interested in understanding what is likely to happen under an *optimistic scenario*, where foreigners' demand for U.S. assets continues to grow in the future. What makes this approach particularly interesting is that even under this optimistic scenario, it is highly likely that in the not too distant future the U.S. current account will undergo a significant reversal.

As may be seen in Table 7.A, in these simulation exercises I assume a gradual portfolio in the next five years: More specifically, I assume that α increases from its current value of 0.30 to 0.40 by 2010; I also assume that α_{jj} goes from 0.73 to 0.71 during the same period. This adjustment implies a reduction in the extent of home bias both in the rest of the world and in the U.S. In the base-case scenario the assumed portfolio adjustment is equivalent to foreigners' doubling their net demand for U.S. assets to the equivalent of 60% of U.S. GDP. This is a very large number. Indeed, it implies that, under the assumptions of $g = 0.03, \pi = 0.023$, during the next five years (2005-2010) the U.S. NIIP would deteriorate by a further $5.72 trillion.

Before proceeding, the following assumptions made in the base-case scenario deserve some comments (See Table 7 for details): (a) I have assumed that the U.S. and the rest of the world grow at the same rate $(g = g^*)$. Implicit in this assumption is the idea that while the U.S. will grow faster than Europe and Japan, the rest of the world – including China and India – will continue to grow at very rapid rates. In a number of alternative simulations I considered different values for growth. (b) The values of the key elasticities have been taken from existing studies on the U.S. and global economies.[29] These values reflect two important characteristics about these elasticities: the income elasticity for U.S. imports is higher than that for rest of the world imports (the so-called Houthakker-Magee effect), and the real exchange rate elasticity of U.S. imports exceeds (in absolute terms) the real exchange rate elasticity of exports by a magnitude of 3.

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28 Obstfeld and Rogoff (2000, 2004). For similar approaches see Mussa (2004) and Blanchard, Giavazzi and Sa (2005).

29 See Hooper, Johnson and Marquez (2001).

Finally, it is worth noting that in the base case scenario I assumed that the adjustment had no effect on the international terms of trade $(\hat{p}_m^* = \hat{p}_x^* = 0)$; in alternative simulations, however, I considered that case where there are changes in the terms of trade.

The results obtained from this base-case exercise are presented in Figure 5. In these simulations period 8 should be interpreted as "the initial period"; the shaded area represents recent history. Panel A depicts the current account deficit (for the first few years the actual deficit is also presented); Panel B presents the trade deficit; Panel C presents the evolution of net U.S. assets in hands of foreigners, as a percentage of U.S. GDP; and Panel D contains the simulation for the trade-weighted U.S. RER index. The most salient features of the base-case simulation may be summarized as follows:

- Under the (deliberately) optimistic assumption of a further increase in foreigners' net demand for U.S. assets, the deficit continues to increase during the next four years, until it peaks at 7.3% of GDP. From that point onwards the deficit declines towards its new steady state of 3.18% of GDP.
- Once the deficit reaches its peak, the current account reversal is quite sharp. According to the base-case scenario, during the first three years of adjustment the current account is reduced by 3.2% of GDP. The reversal of the trade deficit is even sharper. The reason for this is that with a higher net debtor position, net payments (interest and dividends) to foreign investors increase significantly, relative to GDP.
- As may be seen from Panel D, once the process of current account reversal begins, the trade-weighted RER index experiences a rapid (real) depreciation. During the first three first yeas of the adjustment the accumulated real depreciation is 21.3%. By the time the new sustainable current account deficit is reached, the accumulated depreciation of the trade-weighted RER index amounts to 28%. This result is roughly in line with other studies on the subject (See Table 6 for details on other studies). It should be noted that these simulations incorporate the valuation effect of dollar depreciation on the U.S. net foreign asset position. If the valuation effect is ignored, the resulting real depreciation is larger. For example, in the first three years of the adjustment the accumulated depreciation is 28.3%.

Naturally, these simulation results depend on the assumptions summarized in Table 7. Alternative assumptions regarding growth, inflation, interest rates, terms of trade, elasticities and other key parameters will affect the quantitative aspect of the simulations. To the extent that the changes in the assumptions are not extreme, however, the main qualitative result holds: even under a (very) optimistic assumption regarding foreigners' net demand for U.S. assets, the current account deficit is likely to go through a large reversal in the not too distant future.

An important question is how sensitive are these results to portfolio choices. In order to explore this issue, in Figure 6 I report results from a simulation exercise (*Simulation B*) that assumes that after increasing their net holdings of U.S. assets to 60% of U.S. GDP by the year 2010, foreign investors make a new portfolio adjustment, and gradually *reduce* their desired holdings of U.S. assets to "only" 50% of GDP by 2010. As may be seen from Figure 6, in this case the current account reversal is significantly more abrupt, as is the depreciation of the trade-weighted RER index. In the first three years of the adjustment the current account deficit declines by 5.3% of GDP, and the accumulated depreciation is 28.8%. Moreover, as may be seen in Figure 6.D, by the third year of the adjustment (period 15 in the simulation) the trade balance has turned into a trade surplus. It is important to keep in mind that this simulation still assumes that the long run net demand by foreigners for U.S. assets is still significantly higher – 20% of GDP higher, to be more precise – than its current level. Due to space considerations, I have not presented the results from "pessimistic" scenarios, where foreigners' reduce their net demand for U.S. assets below the current level. Suffice is to say that under that scenario the current account reversal is even more pronounced, as is the concomitant real depreciation.

The results in Figures 5 and 6, -- and in particular the abrupt current account reversal that takes place after a peak deficit is reached -- depend on the assumptions made on parameters ψ and κ; different values of these parameters would result in different dynamics. More specifically, a very large value of ψ, coupled with a very low value of κ would result in a more gradual convergence of the current account deficit to its new sustainable level. It should be noticed, however, that in this case the build-up of the deficit is also very gradual, and does not track the actual experience of the U.S. since the mid-1990s. Indeed, the values of ψ and κ used in the simulations are those that provide a better representation of the U.S. recent history.

The simulations discussed above have assumed an exogenously given rate of growth of GDP. This, of course, needs not be the case. It is likely, in fact, that current account reversals of the type and magnitude suggested by the simulation results will have an effect on real economic activity, including growth.[30] In Section IV of this paper I use a new comparative cross country data set to investigate the real consequences of current account reversals in the world economy since 1971. This comparative analysis will be useful to get some idea on the possible effects of a potential U.S. current account reversal, similar to that in the simulations in Figures 5 and 6.

IV. How Costly are Current Account Reversals? An International Comparative Analysis

The main message from the simulation exercises presented in the preceding section is that, even under very optimistic scenarios where foreigners' demand for U.S. assets increases significantly, it is very likely that the U.S. current account will experience a significant reversal in the not too distant future. A key question is what will be the nature of this adjustment process? In this section I address this issue by analyzing the international experience with current account reversals in the period 1971-2001. Although the U.S. case is unique – both because of the size of its economy and because the dollar is the main vehicle currency in the world –, an analysis of the international experience will provide some light on the likely nature of the adjustment. A particularly important question is whether this adjustment will entail real costs in the form of lower growth and higher unemployment. Previous studies on the subject have generated conflicting results: after analyzing the evidence from a large number of countries, Milesi-Ferreti and Razin (2000) concluded that major current account reversals have not been

[30] See the pioneering study on current account reversals by Milesi-Ferreti and Razin (2000). See, also, Edwards (2004).

costly. According to them, "reversals… are not systematically associated with a growth slowdown (p. 303)." Frankel and Cavallo (2004), on the other hand, concluded that sudden stops of capital inflows (a phenomenon closely related to reversals) have resulted in growth slowdown.

In what follows I analyze several aspects of current account reversals, including:[31]

- Incidence of current account reversals.
- Relationship between reversals and sudden stops of capital inflows.
- The relation between current account reversals and exchange rate depreciation.
- The factors determining the probability of a country experiencing a current account reversal.
- The costs – in terms of growth slowdown – of current account reversals.

In analyzing these issues I rely on two complementary statistical approaches: First, I use non-parametric tests to analyze the incidence and main characteristics of current account reversals. And second, I use panel regression-based analyses to estimate the probability of experiencing a current account reversal, and the cost of such reversal, in terms of short-term declines in output growth. Although the data set covers all regions in the world, in the discussion presented in this section, and in an effort to shed light on the U.S. case, I emphasize the experience of large countries.

IV.1 Current Account Reversals during 1971-2001: The International Evidence

I use two definitions of current account reversals: (a) *Reversal I* is defined as a reduction in the current account deficit of at least 6% of GDP in a three-year period. (b) *Reversal II* is defined as a reduction in the current account deficit of at least 4% of GDP in one year. [32] In *Reversal I* the magnitude of the adjustment is more pronounced, but is

[31] In Edwards (2004) I used a smaller data set to investigate reversals in emerging countries. I that paper, however, I did not consider the experience of large or industrial countries with reversals. Also, in that paper I used very simple framework for analyzing growth. In contrast, in this section I use a two steps dynamic of growth approach.

[32] In both cases the timing of the reversal is recorded as the year when the episode ends. That is if a country reduces its current account deficit by 7% of GDP between 1980 and 1982, the episode is recorded has having taken place in 1982. Also, for a particular episode to classify as a current account deficit reversal, the initial balance has to be indeed a *deficit*. Notice that these definitions are somewhat different

distributed over a longer number of years than under the *Reversal I* definition.[33] In Table 8 I present data on the incidence for both definitions of current account reversals for the complete sample as well as for the six groups of countries considered in Section III. As may be seen, for the overall sample the incidence of reversals is 9.2% and 11.8%, for *Reversals I and II,* respectively. The incidence of reversals among the industrial countries is much smaller however, at 2.7% and 2.0% for *Reversals I and II*. Indeed, the Pearson-χ^2 and F-tests reported in Table 8 indicate that the hypothesis of equal incidence of reversals across regions is rejected strongly.

The advanced countries that have experienced current account *Reversals I* are: Finland (1978, 1994), Greece (1988), Ireland (1984), New Zealand (1977-78, 1988-89), Norway (1979-80, 1989, 2000) and Portugal (1979, 1984-85). The advanced countries that have experienced current account *Reversals II* are: Austria (1982), Canada (1982), Greece (1986), Iceland (1983, 1986), Ireland (1975), Italy (1975), Malta (1997), New Zealand (1978), Norway (1989), and Portugal (1982-83, 1985). With the exception of Italy, all of these countries are very small, underlying the point that there are no historical precedents of large countries undergoing profound current account adjustments. As pointed out above, this implies that the results reported here on current account reversals should be interpreted with a grain of salt, and should not be mechanically extended to the case of the U.S.

The analysis presented above has distinguished countries by their stage of development and geographical location. An alternative way of dividing the sample – and one that is particularly relevant for the discussion of possible lessons for the U.S. – is by country size. I define "large countries" as those having a GDP in the top 25% of the distribution (according to this criterion there are 44 "large" countries in the sample). The incidence of *Reversals I* among "large" countries is 3.6% for 1971-2001; the incidence of Reversals II among "large" countries is 5.9%.

from those used in other studies, including Freund (2000), Milesi-Ferreti and Razin (2000), Edwards (2002) and Guidotti et al (2003).

[33] Notice that it is possible for a country to have experienced both a *Reversal I* and *II* during a same historical episode.

IV.1.1 Current Account Reversals and Sudden Stops of Capital Inflows

In the last few years a number of authors have analyzed episodes of *sudden stops* of capital inflows into a country.[34] From an analytical perspective sudden stops and current account reversals should be highly related phenomena. There is no reason, however, for their relationship to be one-to-one. Indeed, because of changes in international reserves, it is perfectly possible that a country that suffers a sudden stop does not experience, at the same time, a current account reversal. However, in countries with floating exchange rates changes in international reserves tend to be relatively small and, at least in principle, the relation between sudden stops and reversals should be stronger.

n order to investigate formally the relation between these two phenomena I defined a "*sudden stop*" episode as an abrupt and major reduction in capital inflows to a country that up to that time had been receiving large volumes of foreign capital. More specifically, I imposed the following requirements for an episode to qualify as a "sudden stop": (1) the country in question must have received an inflow of capital (relative to GDP) larger than its region's third quartile during the two years prior to the "sudden stop." And (2), net capital inflows must have declined by at least 5% of GDP in one year.[35]

In Table 9 I present a table for the "sudden stops" and the current account deficit reversal (I use both definitions of reversal), for three samples: (a) large countries, defined as those countries that whose GDP is in the top quartile of the distribution; (b) industrial countries; and (c) the complete sample. Table 9 shows that for the complete sample, 21.1% of countries subject to a sudden stop also faced a *Type I* current account reversal. At the same time, 15.0% of those with *Reversals I* also experienced (in the same year) a sudden stop of capital inflows. Panel C shows that 51% of countries subject to a sudden stop faced a current account reversal II. Also, 26.7% of those with *Reversals II* experienced (in the same year) a sudden stop of capital inflows. The χ^2 tests indicate that in both cases the hypothesis of independence between reversals and sudden stops is

[34] See Calvo et al (2004), Edwards (2004b).

[35] In order to check for the robustness of the results, I also used two alternative definitions of sudden stops, which considered a reduction in inflows of 3 and 7 of GDP in one year. Due to space considerations, however, I don't report detailed results using these definitions.

rejected. The data for the industrial countries show that the joint incidence of *Reversals* I and Sudden Stops is rather low. In fact, according to the χ^2 test the null hypothesis of independence between the two phenomena cannot be rejected. The relation between sudden stops and *Reversals II* and sudden stops is somewhat higher for industrial countries: the hypothesis of independence is rejected (χ^2=23.7; p=0.00). The results for "large countries" are similar to that for industrial countries.

An analysis of the lead-lag structure of reversals and sudden stops suggest that sudden stops tend to occur either before or at the same time – that is, during the same year – as current account reversals. Indeed, according to a series of non-parametric χ^2 tests it is possible to reject the hypothesis that current account reversals precede sudden stops.

IV.2 Current Account Reversals and the Exchange Rate

An important policy question – and one that is particularly relevant within the context of current policy debate in the U.S. – is whether current account reversals have historically been associated with unusually large exchange rate depreciations. The starting point for this analysis is the construction of an index of "external pressures" along the lines suggested by Eichengreen et al (1996):

(12) $$I_t = \Delta E / E - (\sigma_E / \sigma_R) * (\Delta R / R).$$

Where ($\Delta E / E$) is the rate of change of the nominal exchange rate, and ($\Delta R / R$) is the rate of change of international reserves. σ_E is the standard deviation of changes in exchange rates, and σ_R is the standard deviation of changes in international reserves. Traditional analyses define a crisis (C_t) to have taken place when the index in equation (12) exceeds the mean of the index plus k standard deviations. The crisis indicator C_t takes a value of one (crisis) or zero (no crisis) according to the following rule:[36]

(13) $$C_t = \begin{cases} 1 & if \quad I_t >= mean(I_t) + k\sigma_I \\ 0 & \qquad otherwise \end{cases}$$

[36] The pioneer work here is Eichnegreen et al (1996), who suggested that the index (12) also included changes in domestic interest rates. The original index, however, has limited use in broad comparative analyses; the reason for this is that most emerging and transition economies don't have long time series on interest rates. For this reason, most empirical analyses are based on a restricted version of the index, such as 2.

Based on equation (13), I define two currency crisis indicators: (a) Currency Crisis A: This is the traditional crises index. C_t takes the value of one if I_t exceeds its mean by 3 times its standard deviation (that is, *k*=3 in equation 13). (b) Currency Crisis B: In this case it is the nominal exchange rate by itself that triggers the C_t crisis indicator. In this case the country experiences a large exchange rate depreciation without a major loss in international reserves. This indicator is more relevant for the case of floating exchange rate countries, where changes in international reserves are minimal.

I computed a number of two-way frequency tables and both definitions of crisis and of current account reversals. I also calculated χ^2 tests for independence of occurrence of these phenomena. In Table 10 I present data on the percentage of current account reversals that also correspond to crises. The results are for three samples: large countries, industrial countries, and all countries. As above, I have defined "large countries" as having a GDP in the top 25% of the distribution.[37] The results obtained suggest that historically there have been a number of cases where current account reversals and currency crisis have occurred jointly. Consider, for example, the case of *Currency Crises A* and *Reversals I* for the large countries sample*:* 34.6% of countries with reversals experienced a contemporaneous currency crisis; 46.4% experienced a crisis in the second year of the reversal episode; and 28.6% of the reversals experienced a type *A* currency crisis in the third (and final) year of the reversal episode. For the case of industrial countries the data in Table 10 shows that countries with reversals tended to experience currency crises during the initial year of the reversal episode. As may be seen from Table 10, the p-values for the χ^2 tests indicate that, in most cases, the null hypothesis that current account reversals and currency crises are independent from each other is rejected at conventional levels. Even though these tests don't imply causality, they do provide evidence indicating that historically countries that have gone through major current account reversals have tended to also experience currency crises.

In Table 11 I present data on the distribution of exchange rate changes for *Type I* current account reversal countries.[38] Panel A contains data on the nominal exchange rate

[37] Data on the percentage of crises that also correspond to reversals are available on request. The results of the χ^2 tests confirm those discussed above.
[38] Data on *Reversal II* countries are not presented due to space considerations. The results, however, are similar to those reported here, and are available on request.

(relative to the U.S. dollar); Panel B is for the (trade-weighted) real exchange rate. These changes are calculated as the accumulated exchange rate change in the period comprised between the year of the reversal and three years before the reversal. In Panel A a positive number indicates a nominal depreciation. For comparison purposes I have also included the distribution of three year nominal exchange rate changes for a control group of countries that have not experienced a current account reversal. The results in Table 11.A, indicate that reversal countries have tended to experience significantly larger nominal depreciations than the control group of countries. Consider, for example, the case of large countries: the average depreciation for the reversal episodes – the "treatment" column -- is 28%; it is only 9.2 for the control group of countries. In order to test formally whether *nominal* exchange rate changes behaved differently in reversal and control group countries, I estimated a series of non parametric Kruskal-Wallis χ^2 tests on the equality of the distribution of the accumulated depreciation. The null hypothesis is that the data from the reversal countries and from the control group have been drawn from the same population. As may be seen from Table 11, in the vast majority of cases the null hypothesis is rejected at conventional levels.

Table 11.B present data for the accumulated change in the RER for the reversal countries and the control group of countries. The results indicate that large countries experienced a rather small real depreciation (3.1%) in the period surrounding the current account adjustment. The magnitude of the average RER depreciation is, however, statistically larger than the average depreciation for the control group (See the p-value for the χ^2 test). The same is true for the "all countries" sample. Surprisingly, perhaps, for the industrial countries the accumulated average change in the RER is an appreciation.

The average accumulated depreciations (both nominal and real) in the reversal countries reported in Table 11 are relatively small when compared with the "required" exchange rate depreciation that has been calculated in a number of studies, including in the simulations reported in Section III of this paper. Obstfeld and Rogoff (2004), for example, estimate that eliminating the U.S. current account deficit would imply a (real) depreciation of between 16 and 36 percent. Blanchard, Giavazzi and Sa (2005) have estimated a required depreciation of the U.S. trade weighted dollar in the range of 40% to 90%. There are many possible reasons for these differences, including that the U.S is a

very large country, while the countries that have experienced reversals are much smaller. Also, the values of elasticities and other parameters may be different in the U.S. than in the average reversal country. Yet another possibility has to do with the level of economic activity and aggregate demand. Most recent models on the U.S. current account assume that the economy stays in a "full employment" path. It is possible, however, that the countries that have historically experienced reversals have also gone through economic slowdowns, and that a reduction in aggregate demand contributed to the adjustment effort.

IV.3 The Probability of Experiencing Current Account Reversals

In order to understand further the forces behind current account reversals I estimated a number of panel equations on the probability of experiencing a reversal. The empirical model is given by equations (14) and (15):

$$(14) \qquad \rho_{tj} = \begin{cases} 1, & \text{if } \rho^*_{tj} > 0, \\ 0, & \text{otherwise.} \end{cases}$$

$$(15) \qquad \rho^*_{tj} = \alpha\omega_{tj} + \varepsilon_{tj}.$$

Variable ρ_{jt} is a dummy variable that takes a value of one if country j in period t experienced a current account reversal, and zero if the country did not experience a reversal. According to equation (15), whether the country experiences a current account reversal is assumed to be the result of an unobserved latent variable ρ^*_{tj}. ρ^*_{tj}, in turn, is assumed to depend linearly on vector ω_{tj}. The error term ε_{tj} is given by given by a variance component model: $\varepsilon_{tj} = \nu_j + \mu_{tj}$. ν_j is iid with zero mean and variance σ^2_ν; μ_{tj} is normally distributed with zero mean and variance $\sigma^2_\mu = 1$. The data set used covers 87 countries, for the 1970-2000 period; not every country has data for every year, however. See the Data Appendix for exact data definition and data sources.

In determining the specification of this probit model I followed the literature on external crises, and I included the following covariates:[39] (a) The ratio of the current account deficit to GDP lagged one period. (b) A sudden stop dummy that takes the value of one if the country in question experienced a sudden stop in the previous year. (c) An index that measures the relative occurrence of sudden stops in the country's region (excluding the country itself) during that particular year. This variable captures the effect of "regional contagion." (d) The one-year lagged gross external debt over GDP ratio. Ideally one would want to have the net debt; however, there most countries there are no data on net liabilities. (e) The one-year lagged rate of growth of domestic credit. (f) The lagged ratio of the country's fiscal deficit relative to GDP. (g) The country's initial GDP per capita (in logs).

The results obtained from the estimation of this variance-component probit model for a sample of large countries are presented in Table 12; as before, I have defined "large" as having a GDP in the top 25% of its distribution. The results obtained are quite satisfactory; the vast majority of coefficients have the expected sign, and most of them are significant at conventional levels. The results may be summarized as follows: Larger (lagged) current account deficits increase the probability of a reversal, as does a (lagged) sudden stop of capital inflows. Countries with higher GDP per capita have a lower probability of a reversal. The results do not provide strong support for the contagion hypothesis: the variable that measures the incidence of sudden stops in the county's region is significant in only one of the equations (its sign is always positive, however). There is also evidence that an increase in a country's (gross) external debt increases the probability of reversals. The results also indicate that higher public sector deficits result in an increase in the probability of a *Reversal II*. Countries with looser monetary policy also have had a higher probability of experiencing a reversal. Although, the U.S. is a very special case the results reported in Table 12 provide some support to the idea that during the last few years the probability of the U.S. experiencing a reversal has increased: indeed, the U.S. has experienced steady increases in some important determinants of reversals, such as its (gross) international debt, its fiscal deficit and its current account deficit.

[39] See, for example, Frankel and Rose (1996), Milesi-Ferreti and Razin (2000) and Edwards (2002).

IV.4 Current Account Reversals and Growth

In this subsection I investigate the relation between current account reversals and real economic performance. I am particularly interested in analyzing in analyzing the following issues: (a) historically, have abrupt current account adjustments had an effect on GDP growth? (b) Have sudden stops and current account reversals had the same impact on growth? And (c), have the effects of reversals depend on the structural characteristics of the country in question, including its economic size (i.e. whether it is a large country), its degree of trade openness and the extent to which it restricts capital mobility. In addressing these issues I emphasize the case of large countries; as a comparison, however, I do provide results for the complete sample of large and small countries.

Authors that have analyzed the real effects of current account reversals have reached different conclusions. Milesi-Ferreti and Razin (2000), for example, used both *before–and-after* analyses as well as cross-country regressions to deal with this issue and concluded that "reversal events seem to entail substantial changes in macroeconomic performance between the period before and the period after the crisis but *are not systematically associated with a growth slowdown* (p. 303, emphasis added)." Edwards (2002), on the other hand, used dynamic panel regression analysis and concluded that major current account reversals had a negative effect on investment, and that they had "a negative effect on GDP per capita growth, even after controlling for investment (p. 52)."[40]

IV.4.1 Growth Effects of Current Account Reversals and Sudden Stops: An Econometric Model

The point of departure of the empirical analysis is a two-equation formulation for the *dynamics* of real GDP per capita growth of country j in period t. Equation (16) is the long run GDP growth equation; equation (17), on the other hand, captures the growth dynamics process.

(16) $$\tilde{g}_t = \alpha + x_j\beta + r_j\theta + \omega_j .$$

[40] In a recent paper, Guidotti et al (2003) consider the role of openness in an analysis of imports and exports behavior in the aftermath of a reversal. See also Frankel and Cavallo (2005).

(17) $$\Delta g_{jt} = \lambda[\tilde{g}_j - g_{jt-1}] + \varphi v_{jt} + \gamma u_{jt} + \varepsilon_{jt}.$$

I have used the following notation: $\tilde{g}_j$ is the long run rate of real per capita GDP growth in country j; x_j is a vector of structural, institutional and policy variables that determine long run growth; r_j is a vector of regional dummies; α, β and θ are parameters, and ω_j is an error term assumed to be heteroskedastic. In equation (17), g_{jt} is the rate of growth of per capita GDP in country j in period t. The terms v_{jt} and u_{jt} are shocks, assumed to have zero mean, finite variance and to be uncorrelated among them. More specifically, v_{jt} is assumed to be an external terms of trade shock, while u_{jt} captures other shocks, including *current account reversals* and *sudden stops* of capital inflows. ε_{jt} is an error term, which is assumed to have a variance component form, and λ, φ, and γ are parameters that determine the particular characteristics of the growth process. Equation (17) has the form of an equilibrium correction model and states that the actual rate of growth in period t will deviate from the long run rate of growth due to the existence of three types of shocks: v_{tj}, u_{tj} and ξ_{tj}. Over time, however, the actual rate of growth will tend to converge towards it long run value, with the rate of convergence given by λ. Parameter φ, in equation (17), is expected to be positive, indicating that an improvement in the terms of trade will result in a (temporary) acceleration in the rate of growth, and that negative terms of trade shock are expected to have a negative effect on g_{jt}.[41] From the perspective of the current analysis, a key issue is whether *current account reversals* and *sudden stops* have a negative effect on growth; that is, whether coefficient γ is significantly negative. In the actual estimation of equation (17), I used dummy variables for sudden stops and reversals. An important question – and one that is addressed in detail in the Subsection that follows – is whether the effects of different shocks on growth are different for countries with different structural characteristics, such as its degree of trade and capital account openness.

Equations (16) - (17) were estimated using a two-step procedure. In the first step I estimate the long run growth equation (16) using a cross-country data set. These data are averages for 1974-2001, and the estimation makes a correction for heteroskedasticity. These first stage estimates are then used to generate long-run predicted growth rates to replace $\tilde{g}_j$ in the equilibrium error correction model (17). In the second step, I estimated equation (17) using GLS for unbalanced panels; I used both random effects and fixed effects estimation procedures.[42] The data set used covers 157 countries, for the 1970-2000 period; not every country has data for every year, however. See the Data Appendix for exact data definition and data sources.

In estimating equation (16) for long-run per capita growth, I followed the standard literature on growth, as summarized by Barro and Sala-I-Martin (1995), Sachs and Warner (1995) and Dollar (1992) among others. I assume that the rate of growth of GDP ($\tilde{g}_j$) depends on a number of structural, policy and social variables. More specifically, I include the following covariates: the log of initial GDP per capita; the investment ratio; the coverage of secondary education, as a proxy for human capital; an index of the degree of openness of the economy; the ratio of government consumption relative to GDP; and regional dummies. The results obtained from these first-step estimates are not reported due to space considerations.

In Table 13 I present the results from the second step estimation of the growth dynamics equation (17), when random effects were used. The results are presented for the "large countries" sample (Panel A), as well as for the "all countries" sample (Panel B). The first two equations refer to current account reversals (*Reversals I* and *II*, respectively). In the next equation I have included the sudden stops indicator instead of the reversal dummy. In equations (13.4) and (13.5) I included both the sudden stops and the reversals variables as regressors.[43] The estimated coefficient of the growth gap is, as expected, positive, significant, and smaller than one. The point estimates are on the high side -- between 0.71 and 0.82 --, suggesting that, on average, deviations between long run and actual growth get eliminated rather quickly. For instance, according to equation (13.1), after 3 years approximately 85% of a unitary shock to real GDP growth per capita will be eliminated. Also, as expected, the estimated coefficients of the terms of trade

[41] See Edwards and Levy Yeyati (2004) for details.

[42] Due to space considerations, only the random effect results are reported.

[43] In the analysis that follows, and in order to focus the discussion, I will concentrate on the effects of current account reversals.

shock are always positive, and statistically significant, indicating that an improvement (deterioration) in the terms of trade results in an acceleration (de-acceleration) in the rate of growth of real per capita GDP. As may be seen from equations (13.1) and (13.2), the coefficient of the current account reversals variable is significantly negative, indicating that reversals result in a deceleration of growth. For large countries these results suggest that, on average, a *Type I* reversal has resulted in a reduction of GDP growth of 3.2%. This effect persists through time, and gets eliminated gradually as g converges towards $\tilde{g}_j$. In the case of *Reversal II* the estimated negative effect is even larger, at -4.6%. The results in equation (13.3) show that countries that have experienced a sudden stop of capital inflows have also experienced a reduction in GDP growth – for large countries the point estimate is -1.5. This is the case independently of whether the country in question has also suffered from a current account reversal. In the last two equations in Table 13 I included both the current account reversal and sudden stops indicators. The results obtained suggest that the larger costs of adjustment have been associated with current account reversals. Take, for example, equation (13.4) for the large countries sample: the coefficient of *Reversal I* is more than twice as large (in absolute terms) than that of sudden stops. According to this equation, countries that have experienced *both* a reversal and a sudden stop experienced, on average, a decline in GDP per capita growth of 5%. In equation (13.5) the coefficient of the current account reversal indicator continues to be significantly negative; the coefficient of sudden stops is negative but not significant.

To summarize, the results presented in Table 13 are revealing, and provide some light on the costs of an eventual current account reversal in the U.S. Historically, "large countries that have gone through reversals have experienced deep GDP growth reductions. These estimates indicate that, on average, and with other factors given, the declined of GDP growth per capita has been in the range of 3.6 to 5.0 percent in the first year of the adjustment. Three years after the initial adjustment GDP growth will still be below its long run trend.

IV.4.2 Extensions, Endogeneity and Robustness

In this sub-section I discuss some extensions and deal with robustness issues, including the potential endogeneity bias of the estimates. More specifically, I address the following issues: (a) the role of countries structural characteristics in determining the

costs of adjustment; (b) results from instrumental variables random effect GLS estimation; and (c) the effects of terms of trade changes;

A. Openness and the Costs of Adjustment: Recent studies on the economics of external adjustment have emphasized the role of trade openness. Edwards (2004), Calvo et al (2004) and Frankel and Cavallo (2004), among others, have found that countries that are more open to international trade tend to incur in a lower cost of adjustment. These studies, however, have not made a distinction between large and small countries, nor have they distinguished between openness in the trade account and openness in the capital account. In order to investigate whether openness has historically affected the cost of external adjustment in large countries I added two interactive regressors to equations of the type of (17). More specifically, I included the following terms: (a) a variable that interacts the reversals indicator with trade openness (measure as exports plus imports over GDP); and (b) a variable that interacts the reversal indicator with an index of the degree of international capital mobility. This index was developed by Edwards (2005), and ranges from zero to 100, with higher numbers denoting a higher degree of capital mobility. The results obtained are presented in Table 14. As may be seen, the coefficients of the reversal indicators continue to be significantly negative, as in Table 13. However, and in contrast with previous results obtained in other studies for broad samples of all countries – small and large; emerging and advanced – the variable that interacts trade openness and reversals is significantly negative, indicating that for large countries trade openness tends to amplify, rather than reduce, the negative effect of a current account reversal on growth. The coefficient for the variable that interacts reversals with capital mobility is significantly positive in equation (14.1), suggesting that large countries that have a higher degree of capital mobility experience a smaller cost of adjustment than countries that restrict capital mobility. In equation 14.2, however, the coefficient of this interactive variable is not significant.

B. Endogeneity and Instrumental Variables Estimates: The results discussed above were obtained using a random effects GLS for unbalanced panels, and under the assumption that the reversal variable is exogenous. It is possible, however, that whether a reversal takes place is affected by growth performance, and, thus, is endogenously determined. In order to deal with this issue I have re-estimated equation (17) using an instrumental variables GLS panel procedure. In the estimation the following instruments were used: (a) the ratio of the current account deficit to GDP lagged one and two periods. (b) A lagged sudden stop dummy that takes the value of one if the country in question has experienced a sudden stop in the previous year. (c) An index that measures the relative occurrence of sudden stops in the country's region (excluding the country itself) during that particular year. This variable captures the effect of "regional contagion." (d) The one-year lagged external gross debt over GDP ratio. (e) The ratio of net international reserves to GDP, lagged one year. (f) The one-year lagged rate of growth of domestic credit. (g) The country's initial GDP per capita (in logs). The results obtained are presented in Table 15. As may be seen, the coefficients of the reversal indicators are significantly negative, confirming that historically current account reversals have had a negative effect on growth. The absolute value of the estimated coefficients, however, are larger than those obtained when random effects GLS were used (See Table 13A).

C. Terms of Trade Effects: The results in Table 13 were obtained controlling for terms of trade changes. That is, the coefficient of the *Reversal I* and *II* coefficients capture the effect of a current account reversal maintaining terms of trade constant. As discussed in Sections II and III, however, in large countries external adjustment is very likely to affect the terms of trade. The exact nature of that effect will depend on a number of factors, including the size of the relevant elasticities and the extent of home bias in consumption. In order to have an idea of the effect of current account reversals allowing for international price adjustments, I re-estimated equation (17) excluding the terms of trade variable for the "large countries" sample (detailed results not reported due to space constraints). The estimated coefficients for the reversals coefficients were smaller (in absolute terms) than those in Table 12A. The estimated coefficient of the *Reversal I* is now -2.43 (it is -3.81 in Table 13A). The new estimated coefficient of *Reversal II* is now -3.63; it was -4.61 in Table 13A). This suggests that for the sample in this paper external adjustment has been associated, on average, with an improvement in the international terms of trade.

D. Robustness and Other Extensions: In order to check for the robusteness of the results I also estimated several versions of equation (17) for the large countries sample.

In one of these exercises I introduced lagged values of the reversal indicators as additional regressors. The results obtained – available on request – show that lagged values of these indexes were not significant at conventional levels. I also varied the definition of "large countries;" the main message of the results, however, is not affected by the sample.

V. Concluding Remarks

In this paper I have illustrated the uniqueness of the current U.S. external situation. Never in the history of modern economics has a large industrial country run persistent current account deficits of the magnitude posted by the U.S. since 2000. These developments can be explained in the context of a portfolio model of the current account, where for a number of reasons – the end of the Cold War, the internet revolution, and the liberalization of international capital movements in most countries -- foreign investors' increase their (net) demand for U.S. assets. Indeed, by increasing their demand for U.S. assets from 305 to 40% of their wealth, foreigners have provided American residents with the needed funds to run the large deficits of the last few years.

The future of the U.S. current account – and thus of the U.S. dollar – depend on whether foreign investors will continue to add U.S. assets to their investment portfolios. As a way of sharpening the discussion, in this paper I have deliberately made a (very) optimistic assumption: I have assumed that during the last five years foreigners' (net) demand for U.S. assets (as a proportion of U.S. GDP) doubles relative to its current level. The simulation model indicates that even under this optimistic assumption, in the not too distant future the U.S. will have to go through a significant adjustment in (the not too distant) future. Indeed, it is not possible to rule out a scenario where the U.S. current account deficit would shrink abruptly by 3 to 6 percent of GDP. According to the simulations, this type of adjustment would imply an accumulated real depreciation of the trade-weighted dollar in the range of 27%-30%.

In order to have an idea of the possible consequences of this type of adjustment, I analyze the international evidence on current account reversals. The results from this empirical investigation indicate that major current account reversals have tended to result in large declines in GDP growth. Historically, "large countries" that have gone through major reversals have experienced deep GDP growth reductions. These estimates indicate that, on average, and with other factors given, the declined of GDP growth per capita has been in the range of 3.6 to 5.0 percent in the first year of the adjustment. Three years after the initial adjustment GDP growth will still be below its long run trend.

Although the results presented in this paper are revealing, and suggest that the U.S. is likely to experience a painful and costly adjustment in the not too distant future, there many questions still unresolved. These include:

- The behavior of foreign central banks, including their future demand for U.S. assets. A particularly important question is central banks' appropriate international reserve policy in a world where most exchange rates have (at least) some flexibility. A number of analysts are concerned that the Asian central banks would reduce their demand of U.S. assets, unleashing an abrupt collapse in the value of the dollar.
- We need a better understanding of the way adjustment works in large countries. Although in Section IV I concentrated on the case of large countries, the nations in that sample that experienced current account reversals are much smaller than the U.S. In particular, there is need to analyze the potential interest rate consequences of a major U.S. current account adjustment.
- Most models on the U.S. current account imbalance – including the portfolio model in Section III -- have focused on the RER. Estimating the adjustment in the nominal exchange rates is not trivial, however. The actual adjustment will depend on the pass through coefficient, as well as on exchange rate policies followed by some important U.S. trade partners, including China, Japan and other Asian countries.

Figure 1: Real Exchange Rate and Current Account

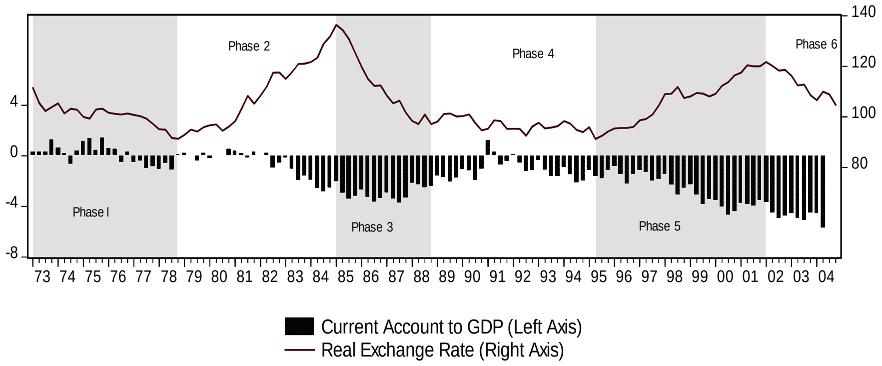
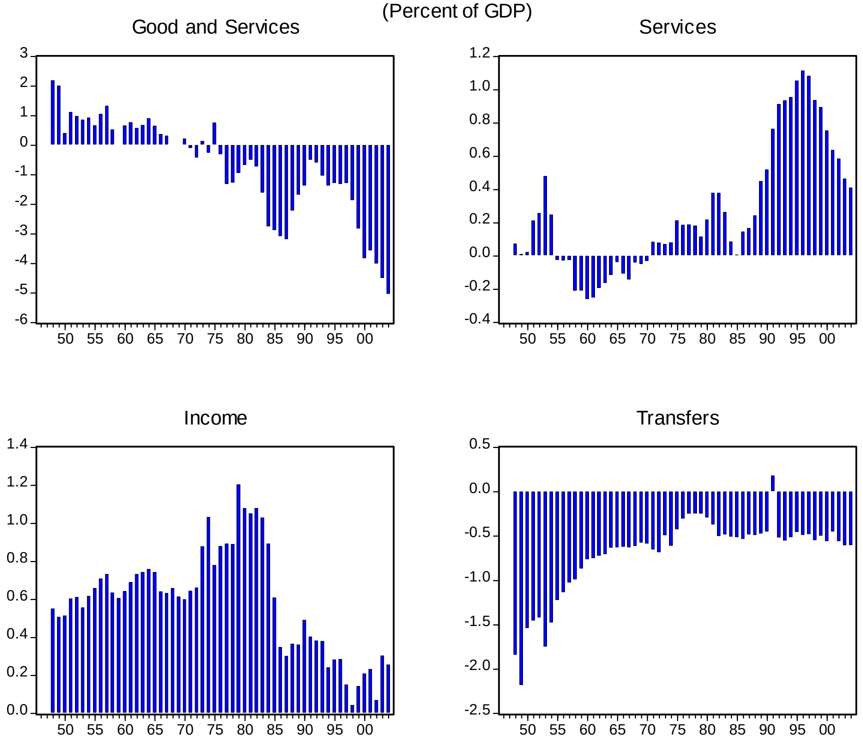


Figure 2: Components of Current Account Deficit, 1946-2004

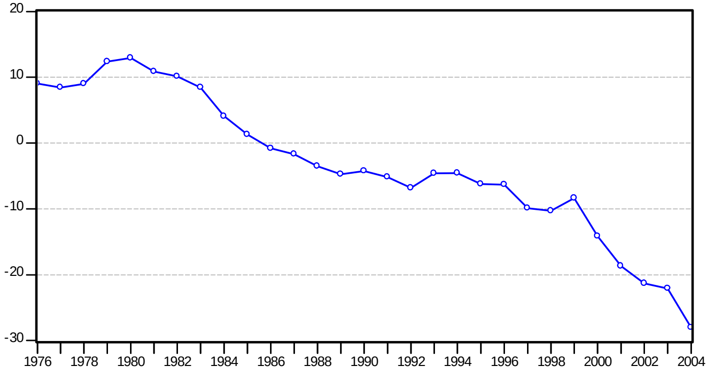
(Percent of GDP)



Source: International Transactions, Economic Report of President 2005

Figure 3: U.S. Net International Investment Position, 1976-2004

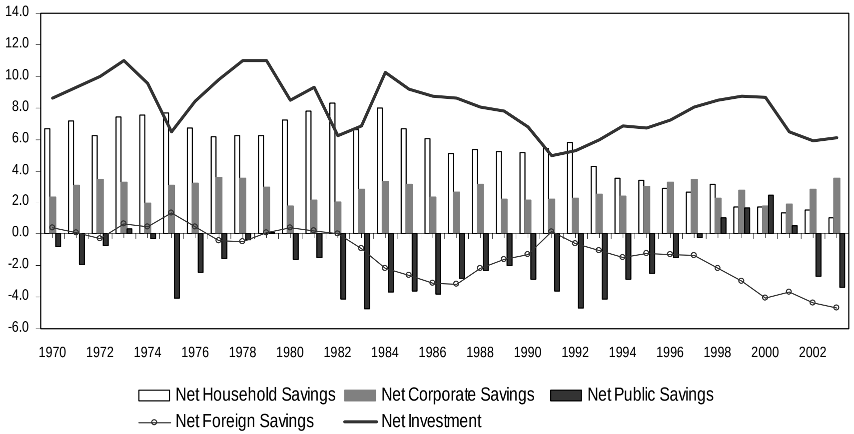
(Percent of GDP)



Source: BEA, International Investment Position

Figure 4: U.S. Investment and Savings, 1970-2003

(Percent of GDP)



Source: BEA, U.S. International Transactions

Figure 5: Base Case Simulation Results

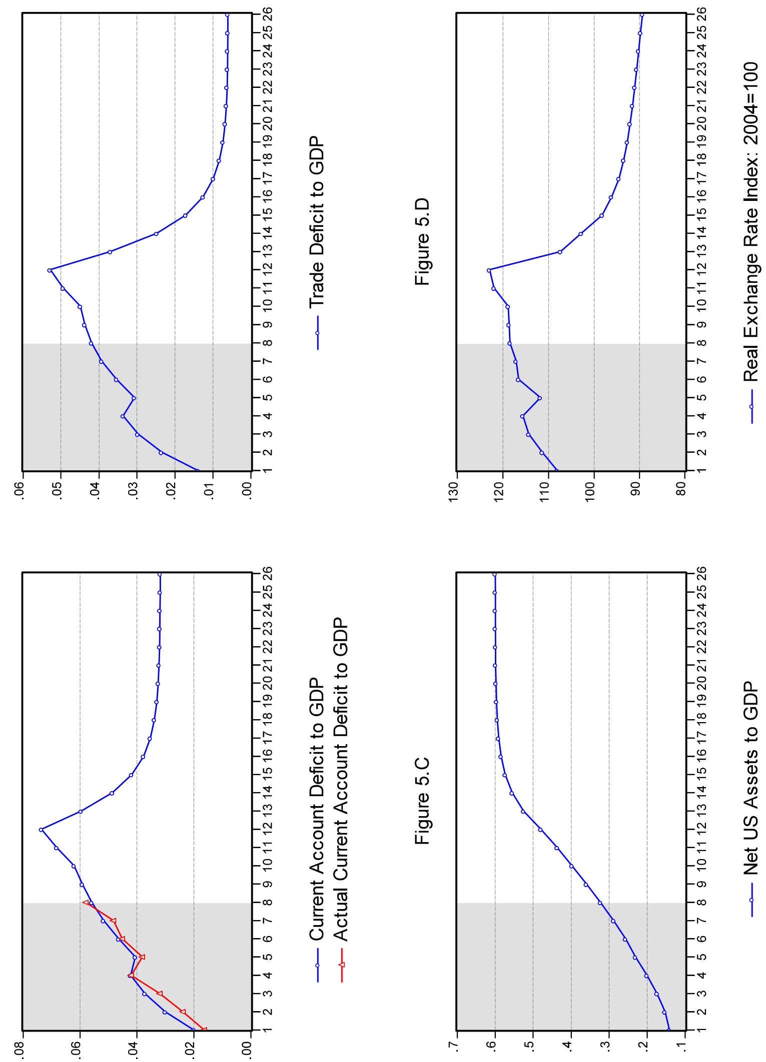


Figure 6: Simulation B Results
(Alternative Assumptions)

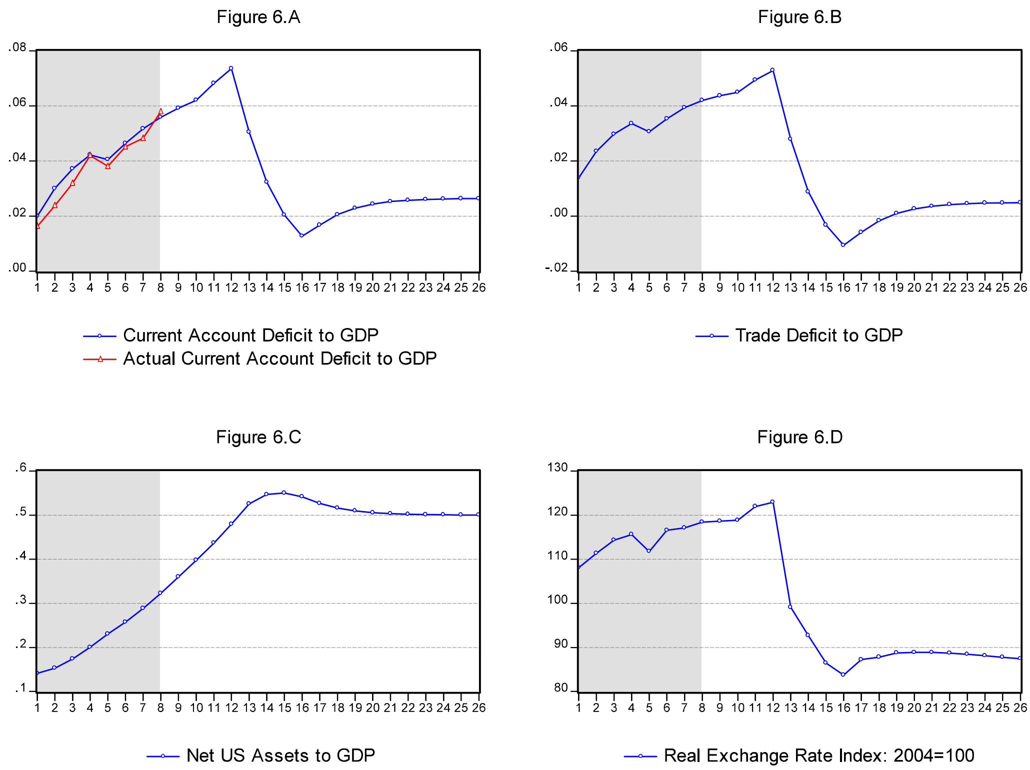


Table 1
U.S. Net Financial Flows: 1990-2004
($ Billion)

	1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Reserves (net)	31.8	23.2	44.4	70.4	44.9	100.1	133.4	18.0	-26.7	52.3	42.5	23.1	110.3	250.1	263.4
Foreign official purchases of U.S. treasuries	29.6	14.8	18.5	49.0	30.8	69.0	115.7	-6.7	-9.9	12.2	-5.2	33.7	60.5	169.7	210.4
Foreign private purchases of U.S. treasuries	-2.5	18.8	37.1	24.4	34.3	91.5	147.0	130.4	28.6	-44.5	-70.0	-14.4	100.4	113.4	109.2
Currency	18.8	15.4	13.4	18.9	23.4	12.3	17.36	24.78	16.62	22.41	5.315	23.78	21.51	16.6	9.5
Securities (net)	-27.2	-10.5	-19.1	-66.2	-6.2	-45.1	-46.0	44.6	32.1	182.6	338.0	309.2	301.4	178.6	183.0
Debt securities	-	-	-	-	-	-	13.0	84.2	145.5	104.2	267.7	300.3	269.8	241.8	270.1
Equity securities	-	-	-	-	-	-	-36.8	24.7	-30.3	84.5	93.0	12.6	37.5	-63.2	-87.1
FDI (net)	11.3	-14.7	-28.4	-32.6	-34.0	-41.0	-5.4	0.8	36.4	64.5	162.1	24.7	-62.4	-133.9	-50.5
Claims reported by non-banks (net)	17.3	8.0	13.2	11.3	-35.0	14.4	-32.6	-5.2	-15.1	-21.5	31.9	57.6	32.6	55.1	-3.0
Claims reported by banks (net)	8.6	3.4	37.4	55.7	100.1	-44.9	-75.1	7.9	4.2	-22.0	-31.7	-7.5	66.1	65.2	-55.8
Net financing	58.0	43.5	97.9	81.8	127.4	87.3	138.7	221.3	76.2	233.8	478.0	416.6	569.9	545.2	455.9
Current account deficit	79.0	-3.7	48.0	82.0	118.0	109.5	120.2	136.0	209.6	296.8	413.4	385.7	473.9	530.7	617.7

Source: BEA, U.S. International Transactions and International Investment Position

Table 2
U.S. Net International Investment Position and Current Account Deficit: 1998-2004
($ Billion)

	1998	1999	2000	2001	2002	2003	2004
NIIP	900.0	775.5	1388.7	1889.7	2233.0	2430.7	--
Change in NIIP	79.3	-124.5	613.3	500.9	343.3	197.7	--
Current Account Deficit	209.5	296.8	413.4	385.7	473.9	530.7	617.7
Valuation changes	130.2	421.3	-199.8	-115.2	130.6	333.0	--

Source: Bureau of Economic Analysis

Table 3
Distribution of Current Account Deficits
By Region: 1970-2001

Region	Mean	Median	1st Perc.	1st Quartile	3rd Quartile	9th Perc.
			A: 1970-2001			
Industrialized countries	0.6	0.7	-3.8	-1.6	3.0	4.8
Latin Am. and Caribbean	5.4	4.1	-2.5	1.1	8.0	16.9
Asia	3.0	2.7	-7.1	-0.6	6.3	11.3
Africa	6.3	5.3	-3.4	1.2	9.9	16.9
Middle East	0.0	1.4	-18.8	-5.0	6.4	13.6
Eastern Europe	3.9	3.0	-2.4	0.3	6.1	10.7
Total	3.9	3.3	-5.0	-0.1	7.1	13.1
			A: 1984-2001			
Industrialized countries	0.2	0.3	-4.7	-2.3	2.7	4.8
Latin Am. and Caribbean	5.1	3.7	-2.5	1.1	7.0	17.0
Asia	2.2	2.4	-8.0	-1.3	5.9	10.2
Africa	5.9	4.6	-3.5	0.9	9.1	16.2
Middle East	2.3	1.5	-12.4	-4.0	6.3	14.9
Eastern Europe	4.0	3.1	-2.5	0.3	6.6	10.9
Total	3.8	3.0	-4.8	-0.4	6.7	12.9

Source: Author's elaboration based on World Development Indicators

Table 4
List of Countries with Persistent High Current Account Deficits
By Region: 1970-2001

Region/ Country	Period
Industrialized Countries	
Ireland	1978-1984
New Zealand	1984-1988
Latin America and Caribbean	
Guyana	1979-1985
Nicaragua	1984-1990 & 1992-2000
Asia	
Bhutan	1982-1989
Africa	
Guinea-Bissau	1982-1993
Lesotho	1995-2000
Eastern Europe	
Azerbaijan	1995-1999

Source: Author's elaboration based on World Development Indicators

Table 5
Net Sock of Liabilities: U.S and other Industrial Countries: Selected Years
(Percent of GDP)

	1980	1985	1990	1995	2000	2003
Australia	--	--	47.4	55.1	65.2	59.1
Canada	34.7	36.3	38.0	42.4	30.6	20.6
Denmark	--	--	--	26.5	21.5	13.0
Finland	14.6	19.0	29.2	42.3	58.2	35.9
Iceland	--	--	48.2	49.8	55.5	66.0
New Zealand	--	--	88.7	76.6	120.8	131.0
Sweden	--	20.9	26.6	41.9	36.7	26.5
United States	-12.9	-1.3	4.2	6.2	14.1	22.1

Source: Bureau of Economic Analysis and Lane and Milesi-Ferretti (2001).

Table 6
U.S. Current Account Adjustment and the U.S. Dollar:
Selected Studies, 1999-2005

AUTHORS	*METHODOLOGY*	*MAIN ASSUMPTIONS*	*MAIN RESULTS*
Mann (1999)	▪ Model tracks U.S. NIIP through time. ▪ Analyzes trajectory of NIIP under three scenarios, and asks whether these trajectories are sustainable. ▪ Elasticities-based adjustment mechanism. ▪ Considers two scenarios for global growth.	▪ Income elasticity of imports (1.7) exceeds income elasticity of exports (1.0). ▪ Base case *scenario* assumes no RER adjustment for the USD. ▪ A USD adjustment *scenario* assumes a RER depreciation of 25%. ▪ A structural adjustment *scenario* assumes that exports' elasticity increases to 1.3.	▪ In base case scenario the NIIP becomes increasingly negative and the CA is unsustainable in the medium run. ▪ Under RER depreciation scenario CA is within sustainable ranges even in a 10 year *long horizon*. ▪ Under structural adjustment, CA deficit is 3% in a 10 year horizon, if the global economy has high performance.
Obstfeld and Rogoff (2000)	▪ Develops and calibrates optimizing model of small open economy, with two goods: tradable and nontradable. ▪ Output is exogenous; prices are assumed to be flexible; monetary policy stabilizes the price level. ▪ Analyzes the effect on RER of an exogenous shock that results in a reduction of the CA deficit of 4.4% of GDP.	▪ Elasticity of substitution between tradables and nontradables is assumed to be equal to one. ▪ Assumes a 6% nominal interest rate, and a NIIP of 20% of GDP. ▪ Tradables output is assumed to be 25% of GDP. ▪ Assumes that full-employment is maintained.	▪ Base case result indicates that an elimination of the CA deficit will imply a 16% RER depreciation, and a 12% nominal depreciation of the USD. ▪ Assuming a share of tradables equal to 15%, results in a RER depreciation of 20%. ▪ The effect on the nominal value of the USD could be even higher if the reduction in the CA is very rapid.

AUTHORS	*METHODOLOGY*	*MAIN ASSUMPTIONS*	*MAIN RESULTS*
O'Neill and Hatzious (2002)	▪ Analyzes the trajectory of NIIP as a percentage of GDP. ▪ Argues that at the observed levels of CA deficits, the NIIP is moving towards the levels of Canada, Australia and New Zealand. It is difficult to believe that this is possible for a large country such as the U.S. ▪ Estimates "required" RER depreciation in order to bring CA deficit to 2% and NIIP not to surpass 40%.	▪ Analyzes the rates of return obtained by foreign owners of U.S. assets. ▪ Argues that with the exception of FDI these rates of return have been modest. ▪ Shows that FDI has declined significantly as a source of financing of the U.S. CA deficit.	▪ It is unlikely that U.S. will be able to continue to attract foreign purchasing for its assets at observed low rates of return. Thus, the U.S. CA deficit is clearly unsustainable. ▪ A return to sustainability would)2% CA deficit) will imply a depreciation of the RER of as much as 43%.
Wren-Lewis (2004)	▪ Calibrates a partial equilibrium model to obtain set of bilateral RER consistent with attaining certain (exogenous) current account deficits. ▪ No attempt is made to determine what is the sustainable level of the U.S. current account. ▪ Considers the effect of a U.S. fiscal shock and of a U.S. technological shock.	▪ To determine initial conditions, author estimates "underlying" (or cycle-adjusted) CA balances. ▪ Considers 3 possible long term scenarios: 1%, 2% and 3% CA deficit. ▪ Three-good partial equilibrium model (including a nontraded) of small economy. ▪ Elasticities and other parameter values taken from regression analysis and from OECD data set.	▪ CA deficit of 2% of GDP is consistent with a yen/dollar rate of 88, and a dollar/euro of 1.18. ▪ If there is a positive technological shock, the "sustainable" CA deficit may be higher. This would be consistent a yen/dollar rate of 89-100, and a dollar/euro of 1.11-1.19. ▪ Estimates that if China has a CA surplus of 1% of GDP the Rmb/USD would be 6.71.

AUTHORS	***METHODOLOGY***	***MAIN ASSUMPTIONS***	***MAIN RESULTS***
Benassy-Quere et al (2004)	▪ Estimates econometrically RER path consistent with nontradable equilibrium. ▪ The RER is assumed to depend on the country's net foreign assets (NFA) position and on relative productivity.	▪ Model estimated simultaneously for 15 currencies. ▪ Data on NFA obtained from lane and Milessi-Ferreti (2004) and relative productivities obtained as ratio of CPI to PPI. ▪ No attempt is made to impose external equilibrium condition. ▪ Rsults provided for two cases: USD as numeraire and euro as numeraire.	▪ The extent of misalignment of the different currencies depends on how broad is the adjustment. ▪ Using the USD as numeraire, estimates that in 2003 the euro was undervalued between 1.2% and 7.6%. ▪ Using the USD as numeraire, estimates that in 2001 the yen was undervalued between 14.3% and 22.1%.
Mussa (2004)	▪ Analyzes trajectory of NIIP and argues that it is unlikely that it will continue to grow at current pace. If it did it would reach 100% of GDP. ▪ Argues that challenge is for RER adjustment to be gradual and that it does not disrupt growth. ▪ Argues that fiscal adjustment in the U.S. is necessary for smooth correction of imbalances. ▪ No attempt is made at calculating the "outer limit" of U.S. NIIP. ▪ Analyzes the RER adjustment compatible with a gradual reduction of the CA deficit to 2% of GDP and a NIIP between 40% and 50%.	▪ Based on results from large econometric models assumes that a 1% reduction of the U.S. CA deficit is associated with a 10% depreciation of the RER.	▪ Relative to its value in mid 2004, Mussa calculates that the RER will have to depreciate another 20% to achieve a long term CA deficit of 2%. ▪ Discusses policies that will assist the adjustment process: (a) Fiscal consolidation in the U.S. will help keep U.S. demand growing below the pace of output growth. (b) Monetary policy in Europe and Japan should be more expansive. ▪ Concludes that "some" international policy cooperation is likely to help the adjustment process.

AUTHORS	***METHODOLOGY***	***MAIN ASSUMPTIONS***	***MAIN RESULTS***
O'Neill and Hatzious (2004)	▪ Update of O'Neill and Hatzious (2002) model. ▪ Analyzes the trajectory of NIIP as a percentage of GDP, and finds that path is not sustainabl. ▪ Introduces the role of productivity gains to original framework. ▪ Analyzes the composition of capital flows into the U.S. ▪ Incorporates the role of valuation effects.	▪ Estimates a trade balance equation and uses the coefficients to compute the "required" RER depreciation to achieve different CA adjustment targets. ▪ Trade equation also includes foreign and U.S. demand growth.	▪ A reduction of the CA deficit to 3% would imply RER depreciation of the order of 21.6% to 23.6%. ▪ A reduction of the CA deficit to 2% would imply RER depreciation of the order of 32.1% to 34.1%. ▪ An elimination of the CA deficit to 2% would imply RER depreciation of the order of 53% to 55%. (Notice that these figures are significantly higher than those estimated by Obstfeld and Rogoff, 2004).
Obstfeld and Rogoff (2004)	▪ Extension of the Obstfeld-Rogoff (2002) model to a two-country world. ▪ Terms of trade are now endogenous. ▪ Incorporates the effects of valuation effects of exchange rate changes on NIIP. ▪ Exercise assumes an elimination of the CA deficit; that is a reduction in 5% of GDP.	▪ Ratio of CA deficit to tradables is 25%; CA deficit is 5% of GDP. ▪ Output is exogenously given in both countries. ▪ NIIP is 20% of GDP. ▪ Home country produces 22% of world tradables. ▪ Simulation is done for alternative values of elasticities, and under different assumptions regarding changes in tradables output and military spending.	▪ Assuming constant output, an elimination of the CA deficit implies RER depreciation between 14.7% and 33.6%. ▪ If tradables output increases by 20%, the RER depreciation ranges from 9.8% to 22.5%. ▪ If there is a permanent increase in military expenditure,the RER depreciation ranges from 16.0% to 36.1%.

AUTHORS	*METHODOLOGY*	*MAIN ASSUMPTIONS*	*MAIN RESULTS*
Roubini and Setser (2004)	▪ Uses macro aggregate model to project the U.S. current account. ▪ Imposes exogenous assumptions on RER, and analyzes CA path	▪First scenario considers a constant RER dollar. ▪Second scenario considers a constant trade deficit at 5% of GDP, and a RER depreciation of approximately 7%. ▪ Third scenario considers a faster rate of growth of exports, and substantial (50%) depreciation. This scenario also assumes a gradual elimination (by 2012) of the fiscal deficit.	▪In first scenario, CA deficit 13% of GDP in 2012. ▪In second scenario, CA deficit 9% of GDP in 2012. ▪In third scenario, the NIIP stabilizes at approximately 55% of GDP, and the CA deficit declines gradually, reaching 4.3% of GDP in 2012.
Blanchard, Giavazzi, Sa (2005)	▪ Uses portfolio model to analyze U.S. current account behavior. ▪ Assumes changes in portfolio preferences in world economy.	▪ Considers dynamics of adjustment. ▪ Considers valuation effects of changes in the U.S. dollar. ▪ Simulates model under certain assumptions for values of key parameters (elasticities, portfolio shares and other). ▪ The question asked is: what is the required (real) depreciation of the U.S. dollar to eliminate the current account deficit?	▪ Estimates range of required U.S. dollar real depreciation (today). After incorporating the role of valuation effects the range is estimated to be between 40% and 90% real depreciation.

Table 7
Simulation Parameters

Variables	**Parameter Values**	**Comments and Values in Alternative Simulations**
A. Portfolio Adjustment		
$W^{World}_{Initial}$	USD 80 Trillion	World wealth in U.S. dollars in 2005.
$W^{US}_{Initial}$	USD 36 Trillion	U.S. wealth in U.S. dollars in 2005.
$\alpha_{Initial}$	0.300	Foreigners' demand for U.S. assets in (early) 2005.
$\alpha_{jj,Initial}$	0.730	U.S. residents' demand for U.S. assets in (early) 2005.
α_{Final}	0.400	Foreigners' portfolio allocation for U.S. assets in 2010. In Simulation B I assume that after reaching 0.40 α declines gradually to 0.365. It reaches this new value in 2014.
$\alpha_{jj,Final}$	0.710	U.S. residents' demand for U.S. assets in (early) 2010. In Simulation B I assume that after reaching 0.71 α_{jj} changes to 0.72 as a final value in 2014.
$\alpha_{Historical}$	0.205	Foreigners' demand for U.S. assets in (early) 1996. Move to current 0.30 is assumed to have been gradual.
$\alpha_{jj,Historical}$	0.800	U.S. residents' demand for U.S. assets in (early) 1996.
λ	3	Wealth to GDP ratio.
$\gamma^*_{Initial}$	0.290	Gamma in (early) 2005.
γ^*_{Final}	0.600	Final gamma in 2010.
$\gamma^*_{Historical}$	0.150	Initial gamma in 1996.
Adjustment period for α and α_{jj}	Five years	

Table 7
Simulation Parameters
(Continuation)

Variables	Parameter Values	Comments and Values in Alternative Simulations
B. Transfer Problem		
g	0.03	Assumed to be the long-term sustainable rate of growth of U.S. GDP.
g^*	0.03	Rest of the world growth (this includes the emerging countries as well as Europe and Japan).
π	0.023	Long term U.S. inflation.
π^*	0.023	A slightly higher value (0.03) was used in some of the simulations.
i	0.043	Other simulations used a higher value in the range 0.05 to 0.065.
i^*	0.053	Alternative values in the range 0.06 to 0.075.
η_e	-1.10	This is slightly below the consensus price elasticity for U.S. imports. Range of values used in other simulations.
ε_e	0.35	Approximate consensus value for RER elasticity of U.S. exports. Sensitivity analysis used range 0.2/0.6.
η_y	1.50	Consensus value for income elasticity of U.S. imports.
ε_y	1.00	Consensus value for income elasticity of U.S. imports.
σ_m	0.14	Share of imports in U.S. GDP in 2004.
σ_x	0.09	Share of exports in U.S. GDP in 2004.
$\hat{p}^*_m$	0	In alternative simulations a range of -.05 to -.10 was used.
$\hat{p}^*_x$	0	In alternative simulations a range of .05 to .07 was used.
ψ	0.30	Partial adjustment coefficient; value chosen to obtain best possible fit for 1996-2004 period.
κ	0.20	Partial adjustment coefficient; value chosen to obtain best possible fit for 1996-2004 period.

Table 8
Incidence of Current Account Reversals: 1970-2001
(Percentages)

Region	Reversal I		Reversal II	
	No reversal	Reversal	No reversal	Reversal
Industrial countries	97.3	2.7	98.0	2.0
Latin American and Caribbean	92.0	8.0	87.7	12.3
Asia	88.3	11.7	87.7	12.3
Africa	88.3	11.7	83.4	16.6
Middle East	86.6	13.4	85.0	15.0
Eastern Europe	90.7	9.3	88.9	11.1
Total	90.8	9.2	88.2	11.8
Pearson				
Uncorrected chi2 (5)	37.31		67.42	
Design-based F(5, 12500)	7.46		13.08	
P-value	0.00		0.00	

Source: Author's elaboration based on World Development Indicators

Table 9
Incidence of Current Account Reversals and Sudden Stops: 1970-2001
(Percentages)

	Reversal I	Reversal II
A. Large Countries		
Reversal | Sudden	10.9	28.3
Sudden | Reversal	9.6	17.6
$\chi^2(1)$	3.4	34.5
P-value	0.06	0.00
B. Industrial Countries		
Reversal | Sudden	5.0	18.2
Sudden | Reversal	7.1	28.6
$\chi^2(1)$	0.4	23.6
P-value	0.51	0.00
C. All Countries		
Reversal | Sudden	21.1	51.0
Sudden | Reversal	15.0	26.7
$\chi^2(1)$	26.6	262.5
P-value	0.00	0.00

x\| y denotes the probability of occurrence of x given the occurrence of y
Source: Author's elaboration based on World Development Indicators

Table 10
Percentage of Reversals that also Correspond to Currency Crisis
(P-Value of χ^2 in parenthesis)

	Contemporaneous joint occurrence		Crisis lagged one period		Crisis lagged two periods	
	Crisis A	Crisis B	Crisis A	Crisis B	Crisis A	Crisis B
A. Reversal I						
Large Countries	34.6	23.1	46.4	17.9	28.6	7.1
	(0.03)	(0.00)	(0.00)	(0.03)	(0.13)	(0.00)
Industrial Countries	6.7	0.0	25.0	12.5	50.0	12.5
	(0.49)	(0.43)	(0.16)	(0.10)	(0.00)	(0.11)
All Countries	21.2	9.1	25.6	10.3	22.2	9.8
	(0.10)	(0.38)	(0.00)	(0.08)	(0.01)	(0.09)
B. Reversal II						
Large Countries	36.7	22.5	36.7	10.0	18.0	4.0
	(0.00)	(0.00)	(0.00)	(0.37)	(0.95)	0.39
Industrial Countries	28.6	14.3	35.7	0.0	26.7	6.7
	(0.09	(0.07)	(0.01)	(0.43)	(0.11)	(0.67)
All Countries	20.2	10.0	23.8	11.5	16.7	8.2
	(0.05	(0.03)	(0.00)	(0.00)	(0.86)	(0.47)

Source: Author's elaboration based on World Development Indicators

Table 11
Mean Changes in Nominal and Real Exchange Rates: Reversal I
Accumulated change between the year of reversal and three years before
(Percentages)

	Treatment	Control	Kruskal-Wallis test (p-value)*
		Nominal Exchange Rate	
Large Countries	28.0	9.2	0.07
Industrial Countries	18.9	3.2	0.19
All Countries	27.5	9.5	0.00
		Real Exchange Rate**	
Large Countries	-3.1	0.5	0.07
Industrial Countries	9.3	1.6	0.55
All Countries	-4.0	3.6	0.00

* Null Hypothesis: Data from treatment and control countries have been drawn from the same population.
** A positive number means real exchange rate appreciation.

Table 12
Current Account Reversals: Random Effects Probit Model – Unbalanced Panel
Large Countries

Variable	(12.1)	(12.2)	(12.3)	(12.4)
	Reversal I		Reversal II	
Current-Account deficit to GDP	0.12	0.12	0.25	0.23
	(3.02)*	(3.05)*	(5.36)*	(5.61)*
Sudden stop	1.31	1.26	1.34	1.17
	(3.66)*	(3.58)*	(3.16)*	(2.96)*
Sudden stops in region	0.67	1.36	1.11	1.79
	(0.47)	(1.07)	(0.98)	(0.86)
External debt to GDP	0.01	0.01	0.005	0.004
	(3.04)*	(2.90)*	(1.00)	(0.86)
Domestic credit growth	0.001	0.001	0.001	0.001
	(2.45)**	(2.38)**	(2.40)**	(2.15)**
Fiscal deficit to GDP	0.004	--	0.07	--
	(0.10)	--	(1.97)**	--
Initial GDP per capita	-0.22	-0.19	-0.24	-0.18
	(2.01)**	(1.87)***	(1.88)***	(1.71)***
Observations	518	565	528	579
Countries	40	43	40	43

Absolute value of z statistics are reported in parentheses; explanatory variables are one-period lagged variable; country-specific dummies are included, but not reported.
* significant at 1%; ** significant at 5%; *** significant at 10%

Table 13
Current Account Reversals, Sudden Stops and Growth

(Random Effects GLS Estimates)

	(13.1)	(13.2)	(13.3)	(13.4)	(13.5)
			A. Large Countries		
Growth gap	0.77	0.72	0.71	0.72	0.73
	(21.91)*	(23.35)*	(21.34)*	(21.32)*	(22.69)*
Change in terms of trade	0.08	0.08	0.07	0.07	0.09
	(6.99)*	(8.09)*	(6.57)*	(6.41)*	(7.79)*
Reversal I	-3.18	--	--	-3.52	--
	(5.41)*	--	--	(4.80)*	--
Reversal II	--	-4.61	--	--	-4.10
	--	(9.27)*	--	--	(7.41)**
Sudden Stop	--	--	-1.47	-1.49	-0.47
	--	--	(2.21)**	(2.23)**	(0.72)
Constant	-0.28	-0.19	-0.29	-0.19	-0.18
	(2.11)**	(1.50)	(2.15)**	(1.38)	(1.36)
Observations	721	751	715	686	714
Countries	44	44	43	43	43
R-squared	0.41	0.45	0.40	0.42	0.45
			B. All Countries		
Growth gap	0.82	0.82	0.81	0.82	0.82
	(40.26)*	(42.10)*	(40.18)*	(38.93)*	(40.76)*
Change in terms of trade	0.07	0.08	0.07	0.07	0.08
	(11.77)*	(12.65)*	(11.31)*	(11.10)*	(12.18)*
Reversal I	-1.04	--	--	-0.73	--
	(3.00)*	--	--	(2.03)**	--
Reversal II	--	-2.01	--	--	-1.80
	--	(6.64)*	--	--	(5.50)*
Sudden Stop	--	--	-1.23	-1.02	-0.53
	--	--	(2.82)*	(2.28)**	(1.19)
Constant	-0.30	-0.15	-0.27	-0.26	-0.14
	(2.26)**	(1.16)	(2.62)*	(2.33)**	(1.32)
Observations	1723	1821	1641	1546	1635
Countries	90	90	81	81	81
R-squared	0.48	0.49	0.51	0.52	0.51

Absolute value of t statistics are reported in parentheses; country-specific dummies are included, but not reported; *significant at 1%, **significant at 5%, *** significant at 10%.

Table 14
Current Account Reversals, Sudden Stops and Growth: Trade and Capital Mobility

Large Countries

(Random Effects GLS Estimates)

	(14.1)	(14.2)
Growth gap	0.68	0.68
	(21.21)*	(22.07)*
Change in terms of trade	0.08	0.09
	(7.59)*	(8.57)*
Reversal I	-5.70	--
	(2.35)**	--
Reversal I * Trade	-0.08	--
	(4.21)*	--
Reversal I * Capital Mobility	0.11	--
	(3.10)*	--
Reversal II	--	-2.54
	--	(1.64)***
Reversal II * Trade	--	-0.02
	--	(2.31)**
Reversal II * Capital Mobility	--	-0.01
	--	(0.60)
Constant	-0.37	-0.27
	(2.76)*	(2.11)**
Observations	665	689
Countries	43	43
R-squared	0.44	0.47

Absolute value of t statistics are reported in parentheses; country-specific dummies Are included, but not reported.
*significant at 1%, **significant at 5%, *** significant at 10%

Table 15
Current Account Reversals, Sudden Stops and Growth: Large Countries

(IV Estimates)

	(15.1)	(15.2)
Growth gap	0.79	0.79
	(19.57)*	(20.65)*
Change in terms of trade	0.04	0.05
	(2.98)*	(3.84)*
Reversal I	-7.70	--
	(2.68)*	--
Reversal II	--	-5.39
	--	(3.51)*
Constant	0.07	-0.19
	(0.38)	(1.38)
Observations	488	503
Countries	37	37
R-squared	0.48	0.50

Absolute value of t statistics are reported in parentheses; country-specific dummies Are included, but not reported.
*significant at 1%, **significant at 5%, *** significant at 10%

Appendix
Description of the Data

Variable	Definition	Source
Current-Account Reversal I	Reduction in the current account deficit of at least 6% of GDP in three years. Initial balance has to be a deficit	Author's elaboration based on data of current account deficit (World Development Indicators)
Current-Account Reversal II	Reduction in the current account deficit of at least 4% of GDP in one year. Initial balance has to be a deficit	Author's elaboration based on data of current account deficit (World Development Indicators)
Sudden Stop	Reduction of net capital inflows of at least 5% of GDP in one year. The country in question must have received an inflow of capital larger to its region's third quartile during the previous two years prior to the "sudden stop."	Author's elaboration based on data of financial account (World Development Indicators)
Currency Crisis A	Dummy variable for occurrence of a currency crisis: index of "external pressures" exceeds its mean by 3 standard deviation	Author's elaboration based on data of international reserves and nominal exchange rate.
Currency Crisis B	Dummy variable for occurrence of a currency crisis: index of "external pressures" exceeds its mean by 3 standard deviation exclusively by changes in the nominal exchange rate	Author's elaboration based on data of nominal exchange rate.
Nominal exchange rate	Local currency units per dollar	International Financial Statistics, IMF
Real exchange rate	Bilateral CPI based real exchange rate	Author's elaboration based on data of nominal exchange rate and CPI. (International Financial Statistics, IMF)
Terms of trade	Change in terms of trade-exports as capacity to import (constant LCU)	World Development Indicators
Reserves to GDP	Net international reserves over GDP	World Development Indicators
Domestic credit growth	Annual growth rate of domestic credit	World Development Indicators

Appendix
Description of the Data
(Continuation)

Variable	Definition	Source
External debt to GDP	Total external debt over GDP	World Development Indicators
Fiscal deficit to GDP	Overall budget to GDP	World Development Indicators
GDP per capita	GDP per capita in 1995 US$ dollars	World Development Indicators
Index of capital mobility	Index: (low mobility) to 100 (high mobility)	Edwards (2005)
Openness	Trade openness: exports plus imports over GDP	World Development Indicators

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