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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.

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 the U.S. demand for foreign goods lead to an initial depreciation, followed by further depreciation over time. Increases in the 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 the U.S. demand for foreign goods and increases in the 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 four countries, the United States, the Euro area, Japan, and China. 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 an old (largely and unjustly forgotten) set of papers by Masson [1981], Henderson and Rogoff [1982], and, especially, Kouri [1983].[1] These papers relax the interest parity condition and assume instead imperfect substitutability of domestic and foreign assets. Masson and 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.[2]

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 [2005] and Lane and Milesi–Ferretti [2002], [2004]—, and play an important role in the

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.

2. A survey of this early literature was given by Branson [1985].

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].[3]

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 overall

3. We limit ourselves in our model to valuation effects originating from exchange rate movements. Valuation effects can and do also arise from changes in asset prices, in particular stock prices. The empirical analysis of a much richer menu of possible valuation effects has recently become possible, thanks to the data on gross financial flows and gross asset positions put together by Lane and Milesi–Ferretti.

levels of spending, or U.S. or foreign changes in the composition of spending between foreign and domestic goods at a given exchange rate—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 grow 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 an increase in z is more limited, and by implication, the current account deficit is larger and longer lasting. The second is that, under imperfect substitutability, asset preferences matter. An increase in the foreign demand for U.S. assets for example—an experiment that obviously could not be analyzed in the model with perfect substitutability we just presented—leads to an initial appreciation and a current account deficit. And such a shift has 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^* denote 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^e be the relative expected gross real rate of return on holding U.S. assets versus foreign assets:

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

Under perfect substitutability, the case studied above, R^e was always equal to one; this need not be the case under imperfect substitutability.

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

$$\alpha = \alpha(R^e, s),\ \ \alpha_{R^e} > 0,\ \alpha_s > 0 \qquad \alpha^* = \alpha^*(R^e, s),\ \ \alpha^*_{R^e} < 0\ \alpha^*_s < 0$$

A higher relative 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:

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

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

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

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

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

where R^e 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.

To see its implications most clearly, consider the limiting case where the degree of substitutability is equal to zero, so the shares α and α^* do not depend on the relative rate of return:

- In this case, the portfolio balance condition fully determines the exchange rate as a function of the world distribution of wealth, $(X-F)$, and $(X^*/E-F)$. In sharp contrast to the case of perfect substitutatibility, news about current or future current account balances, such as a permanent shift in z, have no effect on the current exchange rate.
- Over time, current account deficits lead to changes in F, thus to changes in the exchange rate. The slope of the relation between net debt and the exchange rate is given by

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

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.

Going away from this limiting case, the portfolio balance determines only a relation between the exchange rate and the expected rate of depreciation. The exchange rate is no longer determined myopically. But the two insights from the limiting case remain: On the one hand, the exchange rate will respond less to news about the current account than under perfect substitutability. On the other, it will respond to changes in either the world distribution of wealth, or in portfolio preferences.

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:

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

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

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

We shall call this the **current account balance** relation.[4]

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 [2005], and Lane and Milesi–Ferretti [2004].[5] 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.

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4. This appears to give a special role to α rather than α^*. This is not the case: A symmetrical expression can be derived with α^* appearing instead. Put another way, F, α and α^* are not independent. F_{+1} can be expressed in terms of any two of the three.

5. As a matter of logic, one can have perfect substitutability and valuation effects. (Following standard practice, we ignored them in the perfect substitutability 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 dollar assets.) Under perfect substitutability however, there is no guide as to what determines the shares, and therefore what determines the gross positions of U.S. and foreign investors.

Putting things together: 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 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 is 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 relation is the portfolio balance equation (2). Given the equality of interest rates and the constant exchange rate, $R^e = 1$ and the relation takes the form:

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

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

The second relation 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:

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

This 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.[6]

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.[7] 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 this 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.

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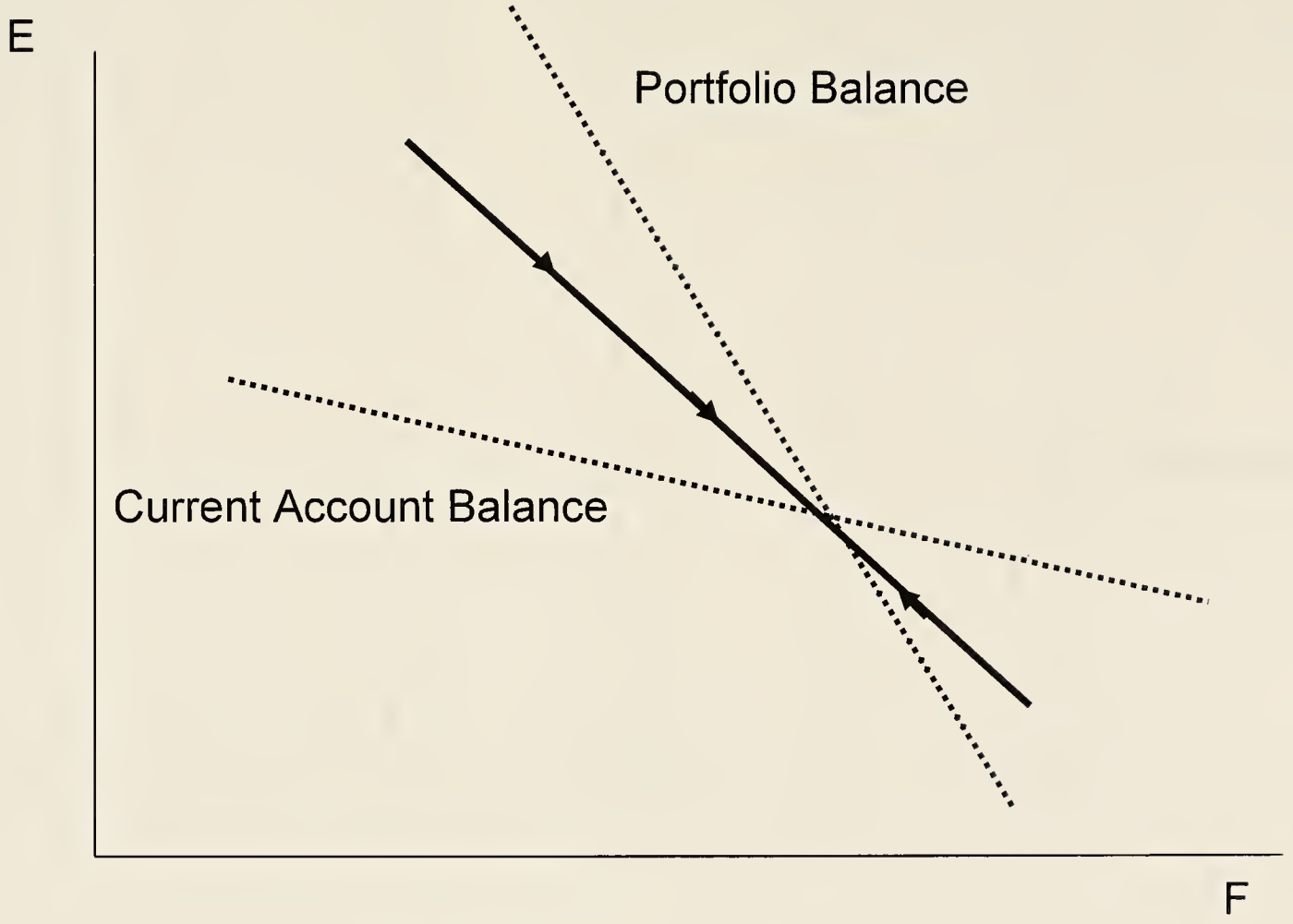
6. If we had allowed r and r^* to differ, the relation would have an additional term and take the form: $0 = rF + (1 - \alpha)(r - r^*)(X - F) + D(E, z)$. This additional term implies that if, for example, a country pays a lower rate of return on its liabilities than it receives on its assets, it may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

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



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 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

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

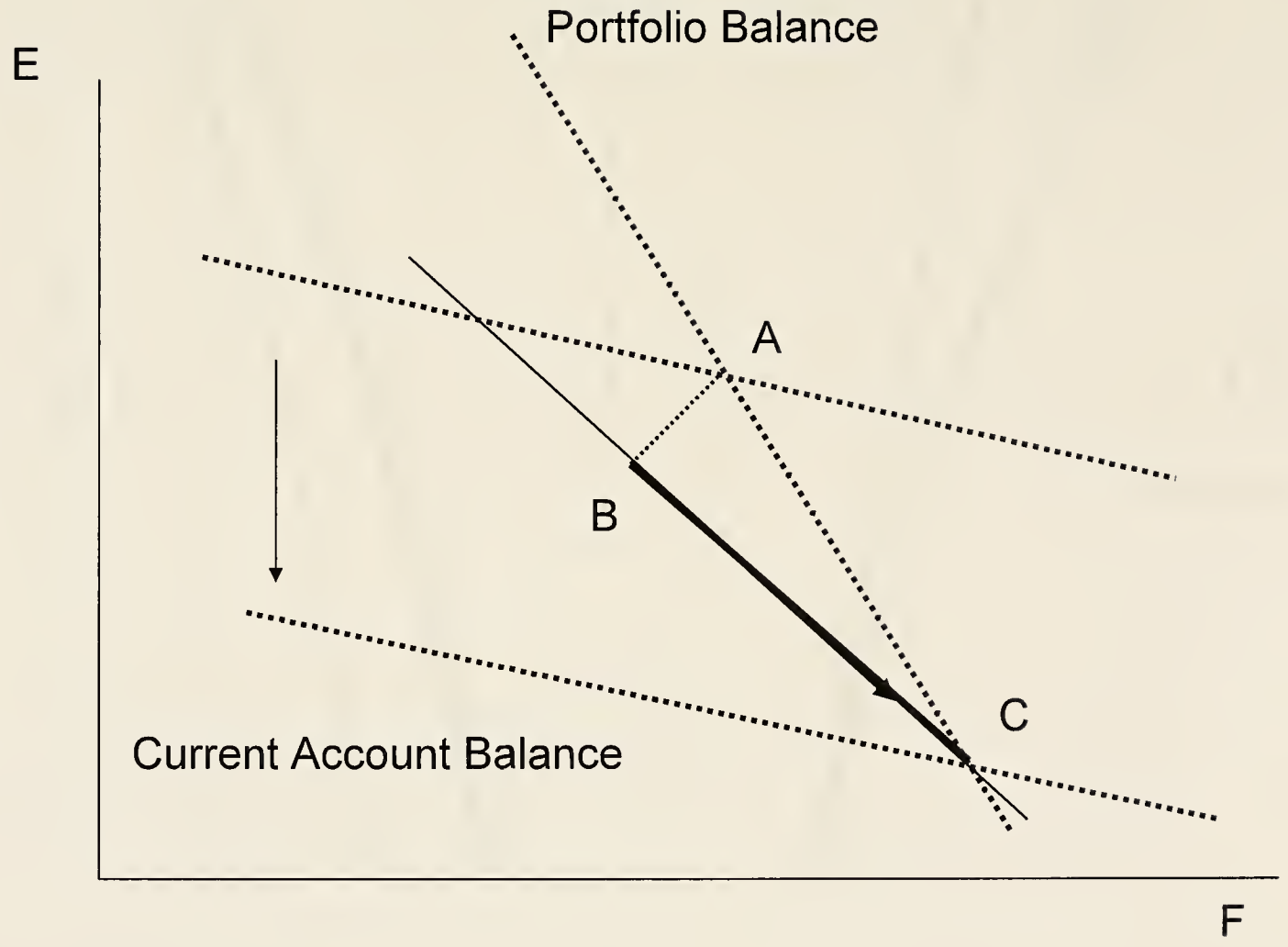
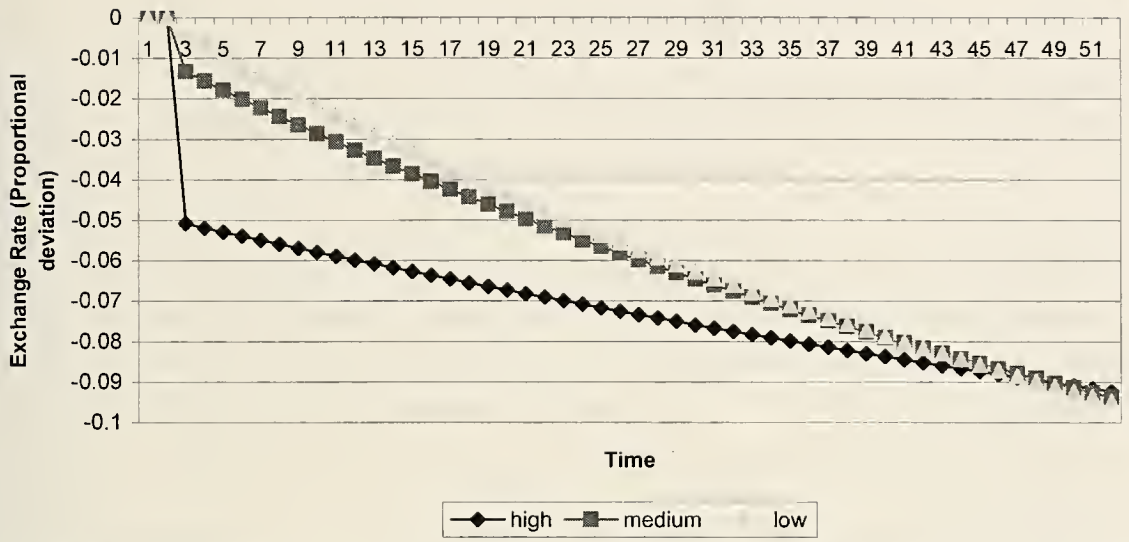
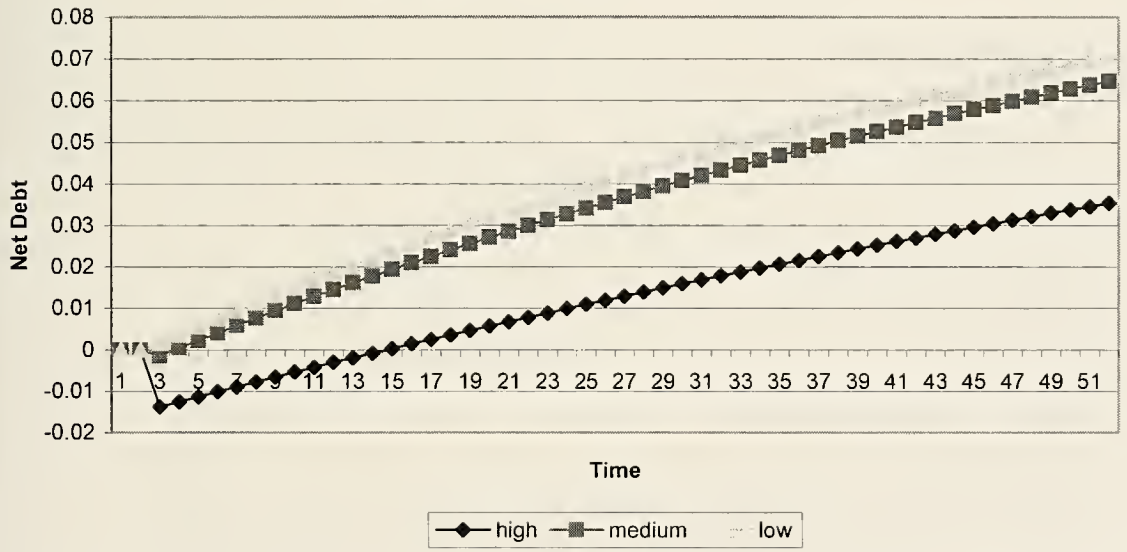


Figure 2b
Response of the Exchange Rate to a Shift in z



Response of Net Debt to a Shift in z



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.

Figure 3a. Adjustment of the Exchange Rate and the Net Debt Position to a Portfolio Shift Towards U.S. Assets

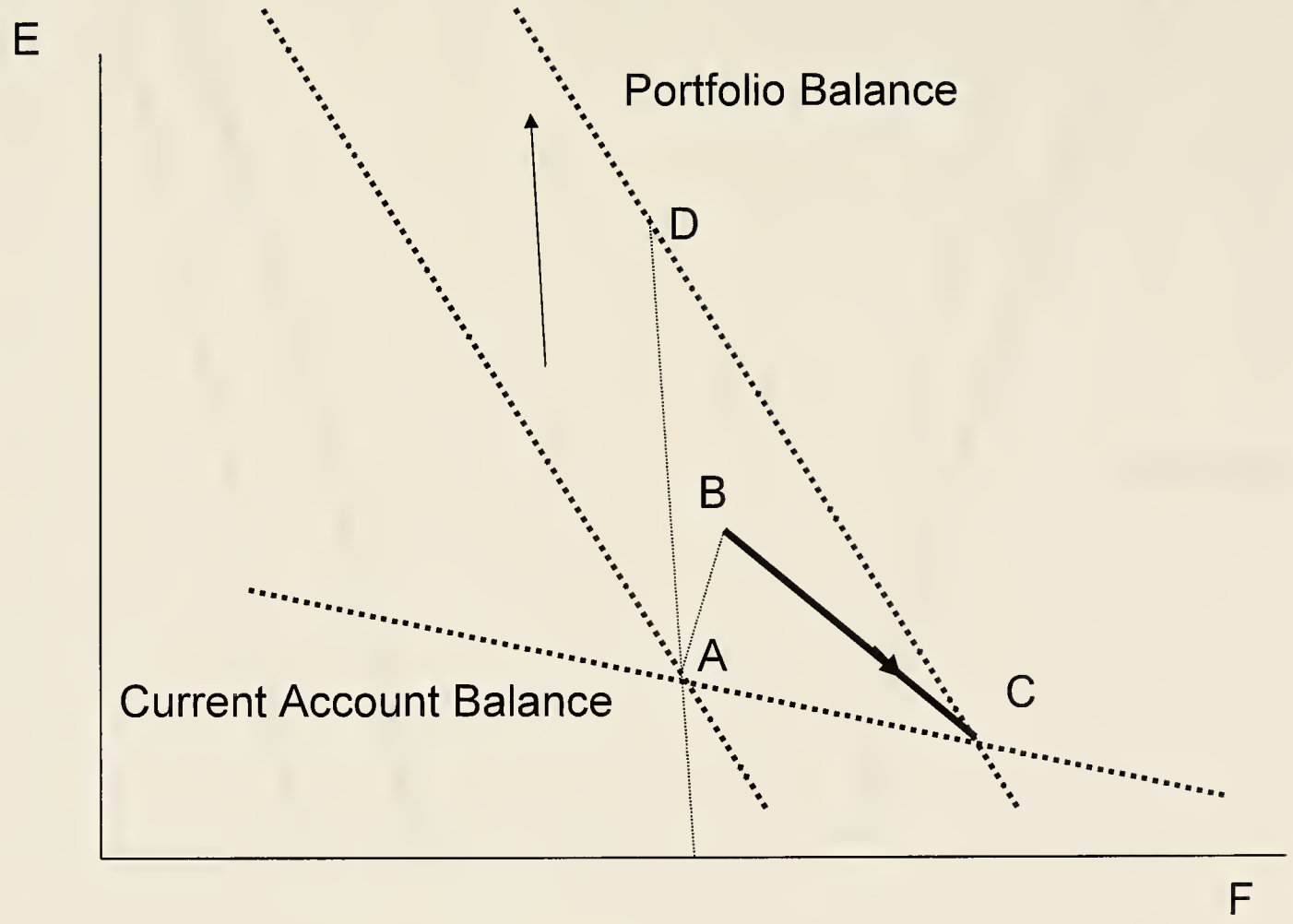
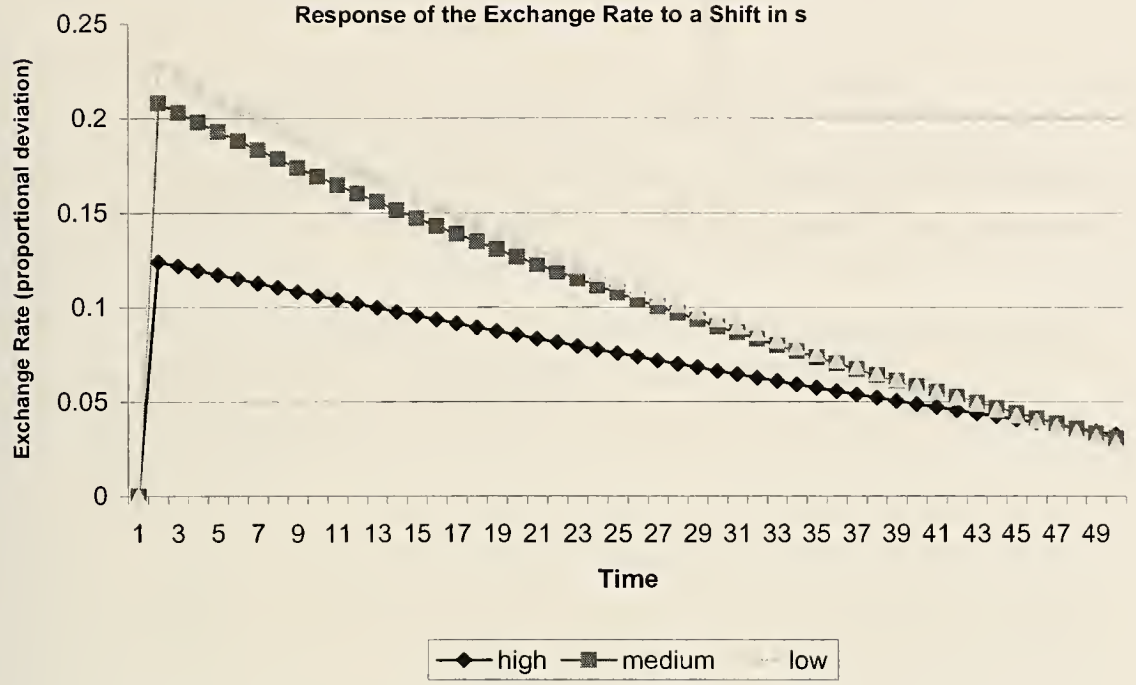
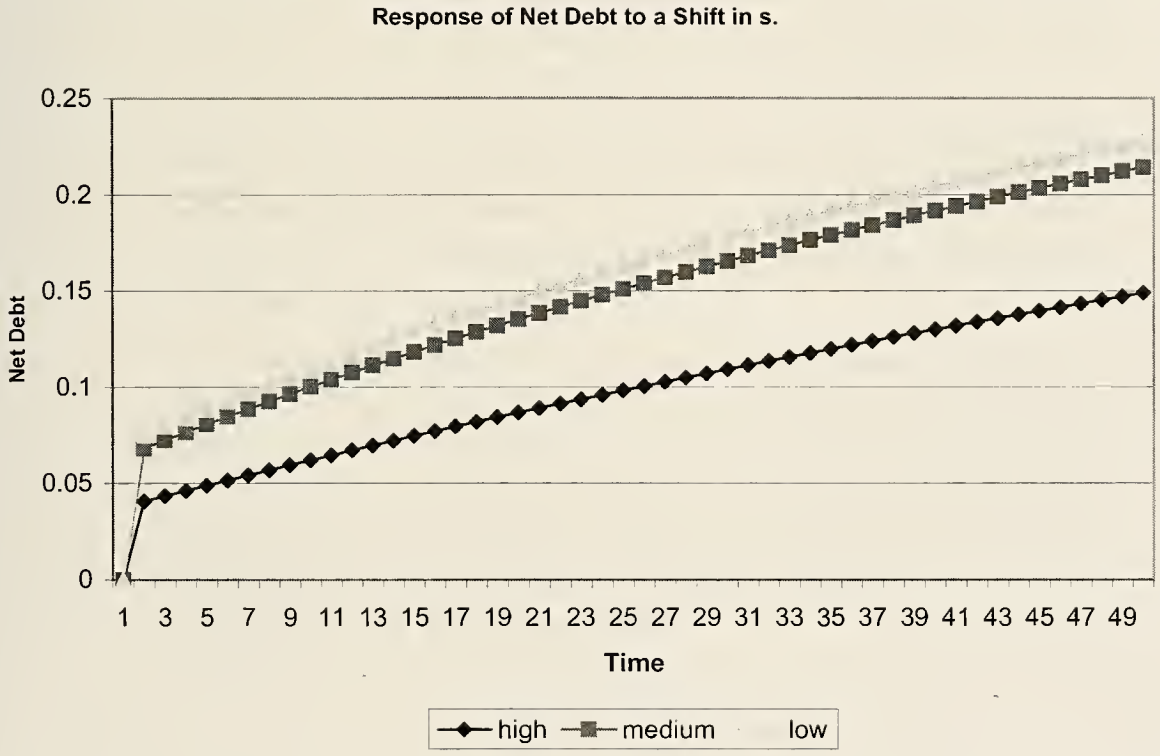


Figure 3b


Response of the Exchange Rate to a Shift in s
Exchange Rate (proportional deviation)
0.25
0.2
0.15
0.1
0.05
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Time
high
medium
low


Response of Net Debt to a Shift in s.
Net Debt
0.25
0.2
0.15
0.1
0.05
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
Time
high
medium
low

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).[8] Non–U.S. world financial wealth is harder to assess. For the Euro Area, financial wealth was about 16 trillion euros in 2003, with a GDP of 7.5 trillion.[9] For Japan, financial wealth was about 900 trillion yen in 2004, with a GDP of 500 trillion.[10] Extrapolating from 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.

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.[11] 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).

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8. 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
9. Source: Europe: ECB Bulletin, February 2005, Table 3.1.
10. Source: Flow of Funds, Bank of Japan, http://www.boj.or.jp/en/stat/sj/sj.html
11. 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

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 implies a decrease in the demand for U.S. assets of $(\alpha + \alpha^* - 1)$ dollars, or 47 cents.[12]

Table 1 summarizes the relevant numbers.

Table 1. Basic portfolio numbers. United States and Rest of the World.

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

We would like to know not only the values of the 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 [2005] 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

12. 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.

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. 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.

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.[13]

It is then tempting at this point to ask what size unexpected depreciation would lead to a sustainable current account deficit **today**?[14] 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

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

14. This is also the question taken up by the Obstfeld and Rogoff paper in this volume [2005]. Their focus, relative to ours, is on the required adjustments in both the terms of trade and the real exchange rate, starting from a micro founded model with non traded goods, exportables and importables.

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.

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:

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

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 (which we presented earlier) shows the effects of an increase in z of 1% of U.S. GDP. Figure 3b (also presented earlier) 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.

Looking at 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.

Looking at Figure 3b leads to similar conclusions. The initial effect of the increase in s is to lead to an appreciation of the dollar, 23% if $b = 0.1$, 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):

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

We have decomposed z into two components, Z, 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 $\tilde{z^*}$, shifts in the relative demand for U.S. versus foreign goods.

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^*.[15] 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

15. 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].

United States and its export–weighted partners since the early 1990s.[16]

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.

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:[17] 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.[18]

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16. 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.

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

18. The model has a set of disaggregated export and import equations. Most of the elas-

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 is 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 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 the volume of 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. One 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

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ticities 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).

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 from 1985 to 1987 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.[19]

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 are 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).[20]

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"

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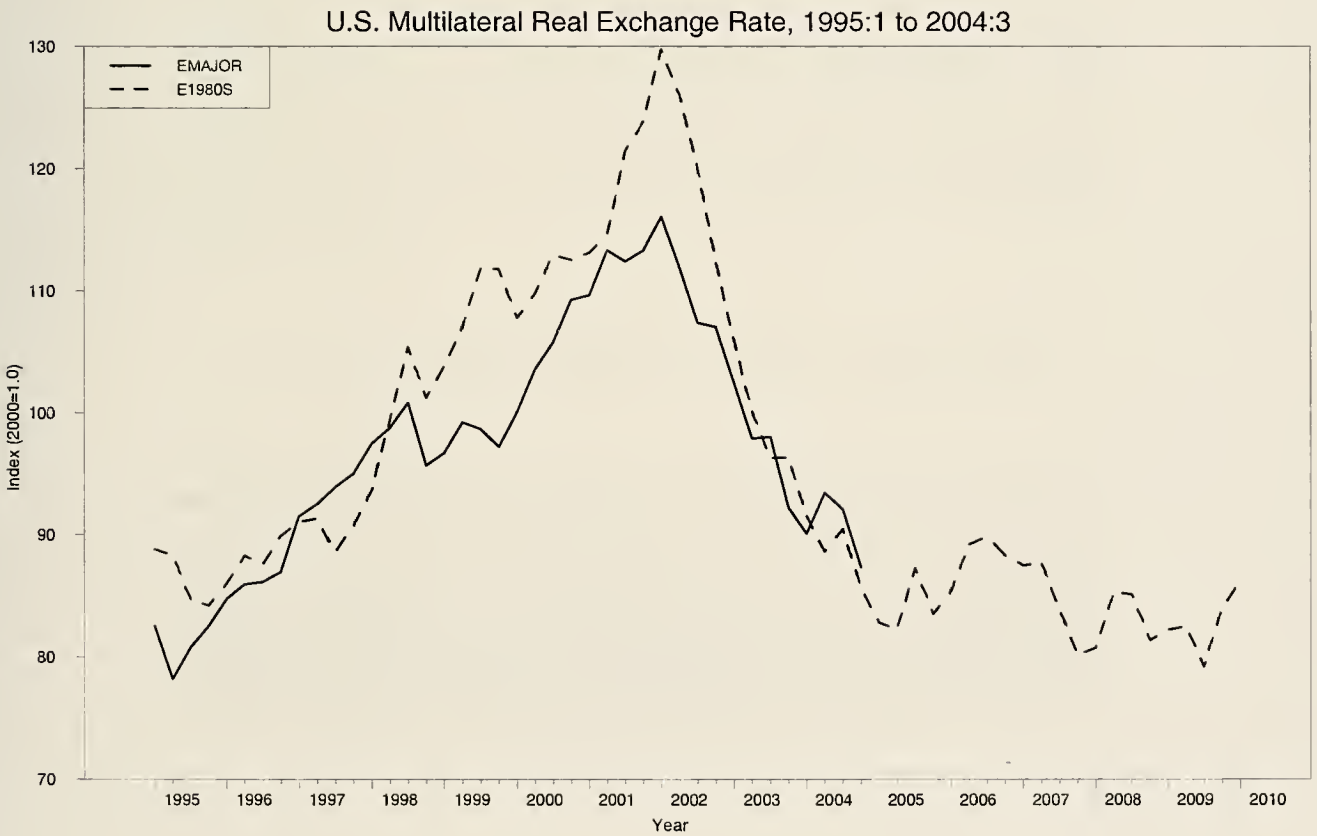
19. These issues were discussed at length in the Brookings Papers then. (For example Cooper [1986], Baldwin and Krugman [1987], Dornbusch [1987], Sachs and Lawrence [1988], with post-mortems by Lawrence [1990] and Krugman [1991].) Another much discussed issue was the respective roles of fiscal deficit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

20. On the other hand, gross positions, and thus the scope for valuation effects from dollar depreciation, are much larger now than they were then. In 1985, gross U.S. holdings of foreign assets were $1.5 trillion, compared to $ 8 trillion today.

Figure 4. A comparison of 1979-1994 and 1995-?



adjusted ratio of the current account deficit to GDP of 4-5% instead of 6%.[21] 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%)).[22]

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 these 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:

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

21. The forecast from the macroeconometric model developed by Macroeconomic Advisors gives an improvement of the trade balance of $75 billion over the next two years—so less than 1% of GDP (the forecast is based on a depreciation of the dollar of 4% over the next two years.) The equations of the model however show an unusually low pass–through of the dollar decline to import prices over the recent past, and the forecast above is based on an assumption of continuing low pass–through. If the pass–through was to return to its historical average, the improvement in the trade balance could be larger.

22. This number is surprisingly close to the 33% number obtained in answer to the same question by Obstfeld and Rogoff [2005] in their article in this volume.

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 0.05 divided by 3).[23]

If, however, shares of 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 investors—those who do not anticipate to sell—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

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23. While a comparison is difficult, this rate appears lower than the rate of depreciation implied by the estimates of Gourinchas and Rey [2005]. 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.

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 $(1 - \alpha^*(R^e))$, and/or that domestic investors will be willing to further increase $\alpha(R^e)$ 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 0.8 percentage points a year (0.47 times 5% divided by 3), so say 4% over the next five years, a large increase by historical standards.[24]

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

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24. 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 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.

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.

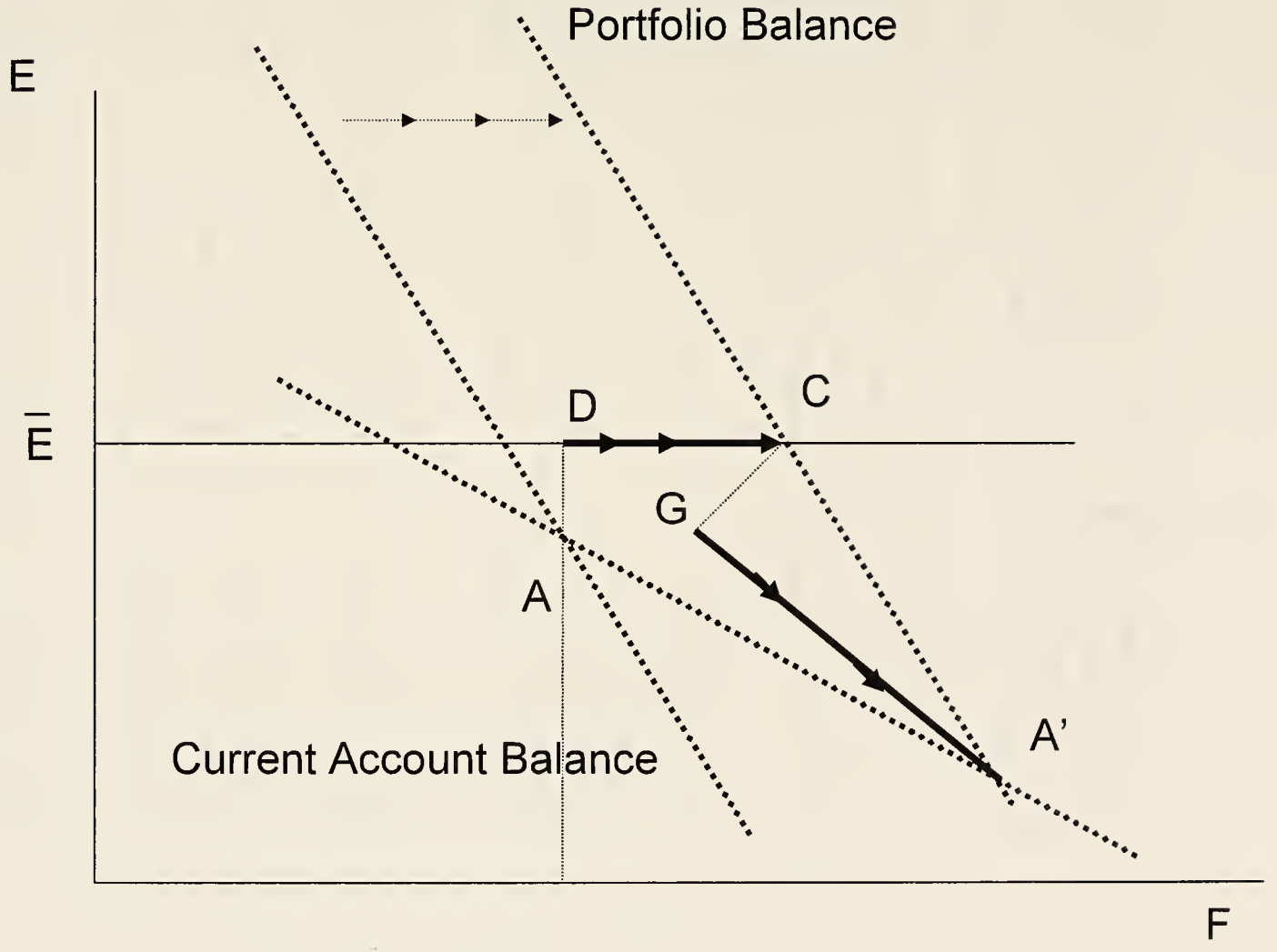
Consider pegging first. Pegging means that the foreign central bank buys dollar assets so as keep $E = \bar{E}$.[25] Let B denote the reserves (i.e the U.S. assets) held by the foreign central bank, so

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

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 unchanged 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

25. 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.

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



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 GA'. 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 610 billion, Japanese reserves to 840 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

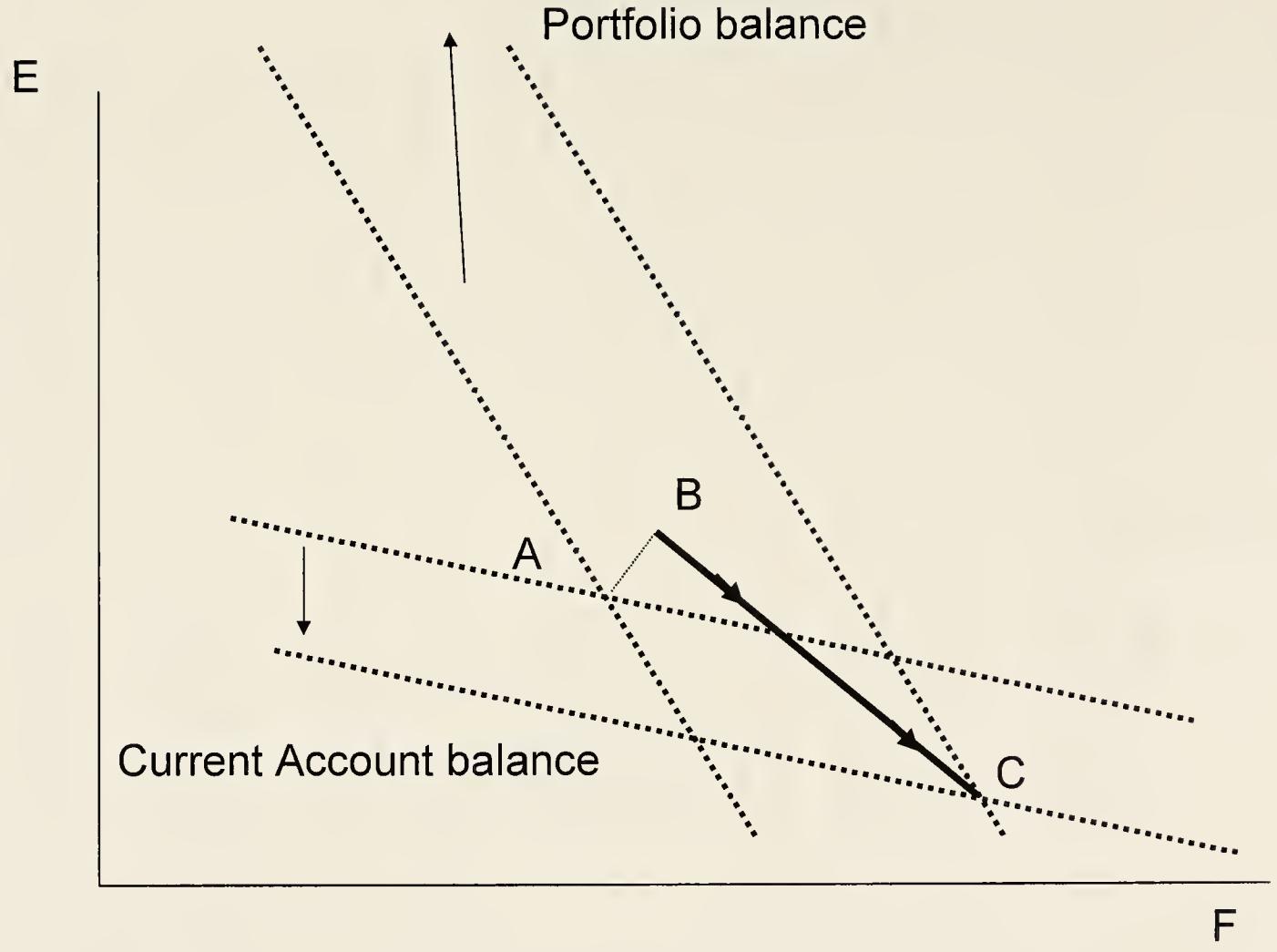
likely scenario is the opposite, a decrease in shares due in particular to diversification of reserves by central banks. If and when this happens, the dollar will depreciate. Note however that the larger the adverse shift, the larger the initial depreciation, but the smaller the accumulation of debt 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 requires a 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

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



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 as the dollar depreciates, either slowly along the saddle path, or more strongly, in response for example to adverse portfolio shifts. 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 the budget deficit.[26] 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.[27] (Frequently heard statements that deficit reduction would reduce the need for a dollar depreciation leave us puzzled). If the decrease in the budget deficit is not accompanied by a depreciation, the result is likely to be lower demand, and a recession. While the recession reduces the current account deficit, this is hardly a desirable outcome. If the depreciation is not accompanied by a reduction in the budget deficit, 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.

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26. 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.

27. 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 indeed to come, against which currencies will the dollar fall? If China abandons the peg, or if Asian central 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 billion was with China, $75 billion with Japan, $71 billion with the Euro area, and the remainder, $346 billion, 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

$$\alpha_{ij}(.) = a_{ij} + \sum_k \beta_{ijk} \, R_k^e$$

where R_k^e is expected gross real rate of return, in dollars, from holding asset of country k (so R_k^e denotes a rate of return, not a relative rate of return as in our two-country model).

We assume further that $b_{ijk} = b_{jk}$, so the effect of the return on asset k on the demand for asset j is the same for all investors, independent of the country of origin. This 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 (the condition that the shares sum to one, for any set of expected rates of return), it follows that $\sum_j a_{ij} = 1$ for all i, and $\sum_j \beta_{jk} = 0$ for all k. The home bias assumption takes the form: $\sum_i a_{ii} > 1$. The demand functions are

assumed to be homogenous of degree zero in expected gross rates of return, so $\sum_k \beta_{jk} = 0$ for all j.

Domestic interest rates, in domestic currency, are assumed to be constant, and all equal to r. Exchange rates, E_k, are defined as the price of U.S. goods in terms of foreign goods (so $E_1 = 1$, and an increase in E_2 for example indicates an appreciation of the dollar vis a vis the euro—equivalently, a depreciation of the euro vis a vis the dollar.) It follows that the expected gross real rate of return, in dollars, from holding assets of country k is given by $R_k^e = (1+r)E_k/E_{k,+1}^e$.

In steady state, $R_k^e = (1+r)$, so $\sum_k \beta_{jk} R_k^e = 0$ and we can concentrate on the a_{ij} s. The portfolio balance conditions, absent central bank intervention, are given by:

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

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.[28]
- We assume that, to peg the renminbi–dollar 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

28. 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.

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

Consider now an increase in U.S. net debt equal to dF_1. 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 that the change in

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

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} 's is symmetric in the following way: $a_{ii} = a$ and $a_{ij} = c = (1-a)/2 < a$ for $i \neq j$.[29] 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 allocate the rest of their portfolio equally among foreign assets.

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

$$\begin{aligned}
\frac{dE_2}{dF_1} &= -\frac{(a-c)(1-\gamma)[x(1-a)+c(1-x)]}{(1-a)^2-c^2} + \frac{c\gamma}{1-a-c} \\
\frac{dE_3}{dF_1} &= -\frac{(a-c)(1-\gamma)[xc+(1-a)(1-x)]}{(1-a)^2-c^2} + \frac{c\gamma}{1-a-c}
\end{aligned}$$

Consider first the effects of γ, the share of U.S. net debt held by China.

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29. The assumption of equal size countries allows us to specify the matrix in a simple and transparent 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.

- For $\gamma = 0$, dE_2/dF_1 and dE_3/dF_1 are both negative. Not surprisingly, an increase in U.S. net debt leads to a depreciation of the dollar vis a vis both the euro and the yen.
- As γ increases, the depreciation of the dollar vis a vis the euro and the yen becomes smaller. Again, this is not surprising. What may be more surprising however is that for high values of γ, the depreciation turns into an appreciation. For $\gamma = 1$ for example, the dollar appreciates vis a vis both the euro and the yen. 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 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, the share of the U.S. net debt held by Europe, excluding the net debt held by China. For simplicity, put γ equal to zero.

- Consider first the case where $x = 0$, so the accumulation of net debt is entirely vis a vis Japan. In this case, it follows that $dE_3/dF_1 = 2\ dE_2/dF_1$. 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 to the ratio of trade deficits and thus to the relative accumulation of U.S. net debt 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. Because the end of the peg, together with the assumption of maintained capital controls, implies a zero Chinese deficit, the renminbi would have to appreciate vis a vis the dollar. 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.[30] Building on our results, this would lead to a decrease in the role of an investor with extreme dollar 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 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. For the time being, 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 to 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.

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

Two Simulations and a Look at Portfolios

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

In the first simulation, we keep the symmetric portfolio assumptions we introduced above. We take the three countries to be of the same size, and choose values for the portfolio parameters introduced above of 0.70 for a, and 0.15 for c. 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.

We do the simulation under two alternative assumptions about Chinese policy. 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, as indicated above, a zero Chinese trade deficit.

The results are shown in Figure 7. Because of symmetry, the responses 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, and the results are given in Table 2. The details of construction are

Figure 7. The effects of a U.S. trade shock on the Euro/$ and the Yen/$ exchange rates, with or without Chinese peg.

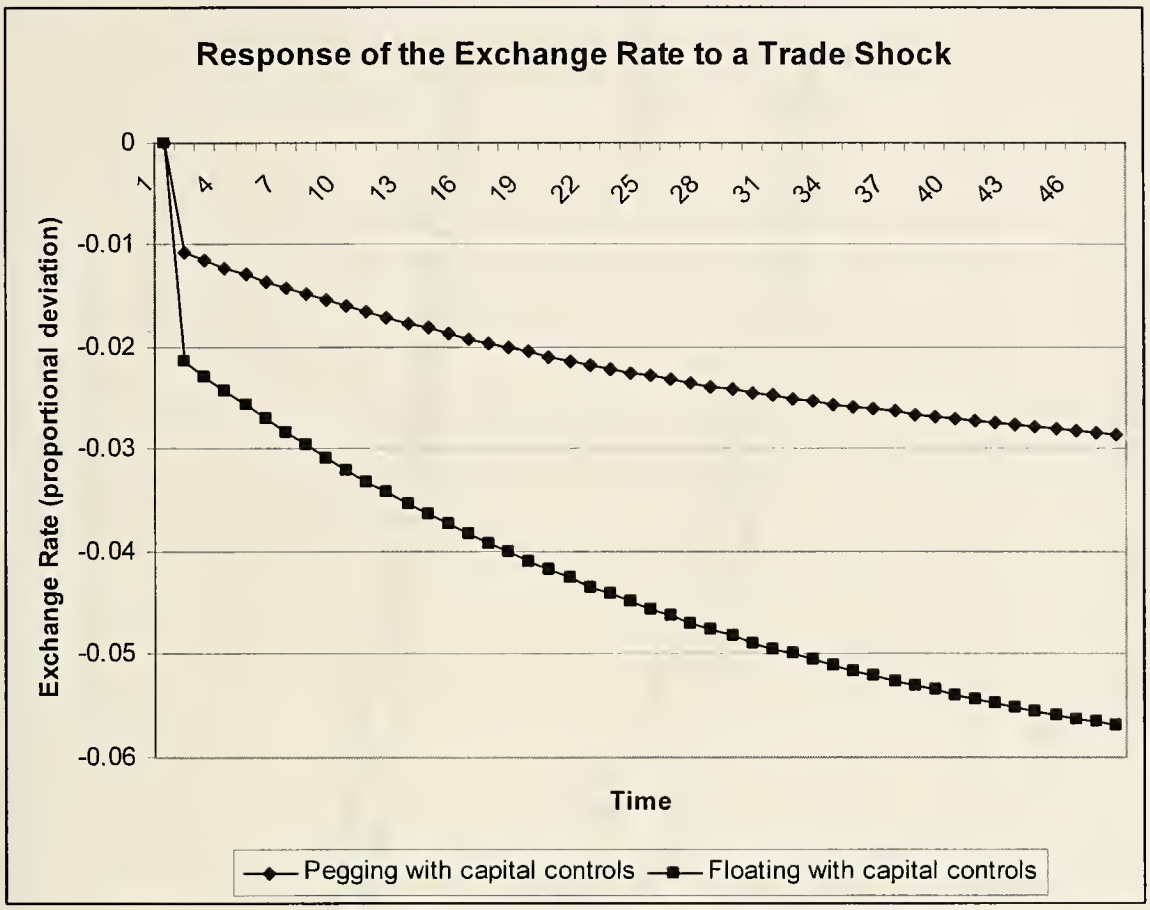
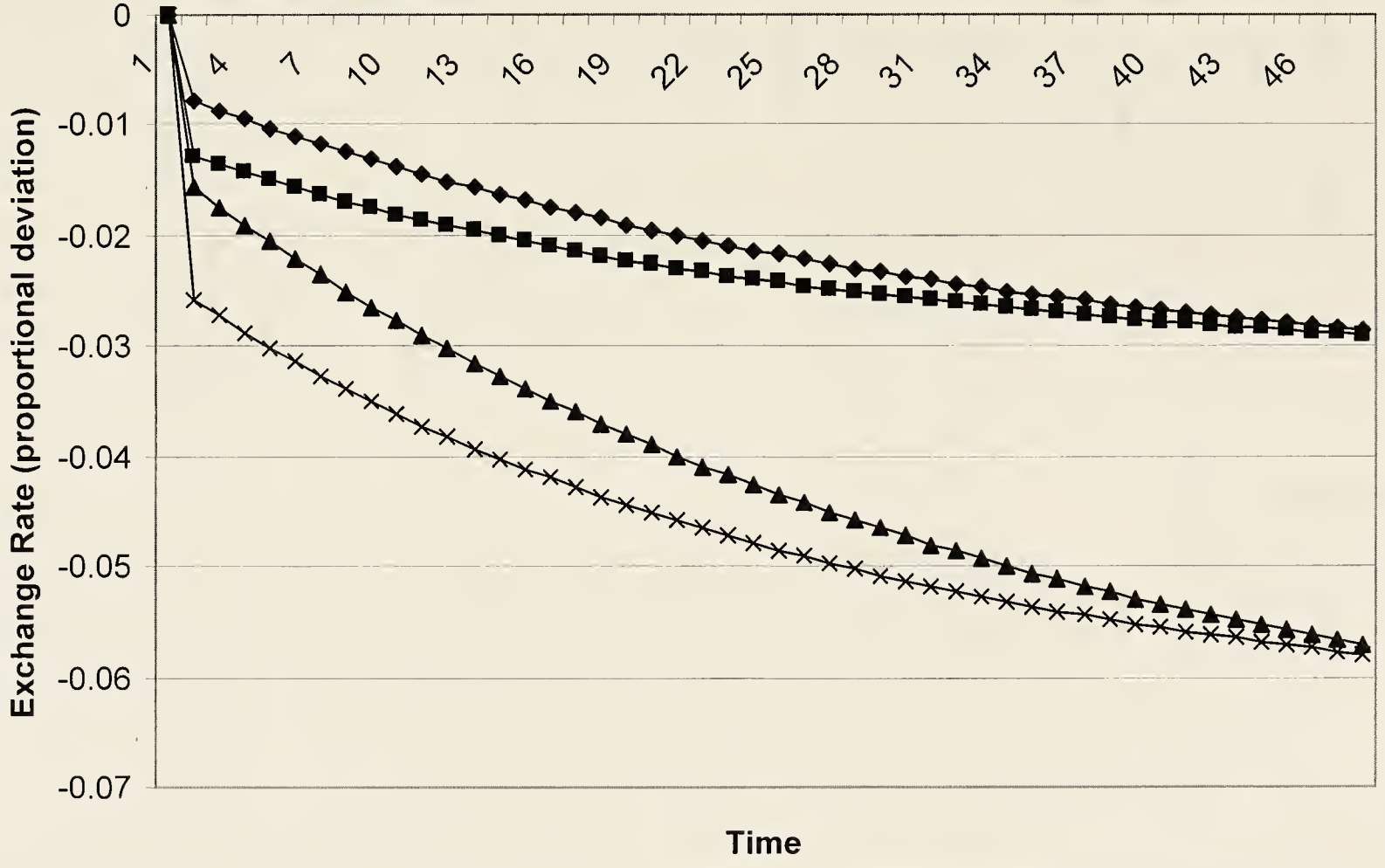


Figure 8. The effects of a U.S. trade shock on the euro-dollar and the yen-dollar exchange rates, with and without Chinese peg (using actual portfolio weights.



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	0.42	0.22
Euro area	0.15	0.53	0.15
Japan	0.08	0.05	0.63

Note a number of features of the table. Note the much higher share of dollar assets in European portfolios than in Japanese portfolios. 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 now taking into account the relative size of the three countries (the X's), and using the shares in Table 2.

The main conclusion we draw from Figure 8 is that it basically looks very similar to Figure 7. The dollar depreciates however initially a bit more against the yen than against the euro. This is due to the higher share of dollar assets in European portfolios than in Japanese portfolios: A dollar transfered from the United States to Europe leads to a smaller decrease in the demand for U.S. assets than a dollar transfered from the United States to Japan.

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 central banks to diversify their reserves away from dollars, and, as a result, the share 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 an upper bound, derived by assuming that private 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 $\dot{F}$ and $\dot{E}$ are equal to zero. Using that locus makes for a simple graphical characterization of the equilibrium, but is not appropriate to study stability or dynamics.

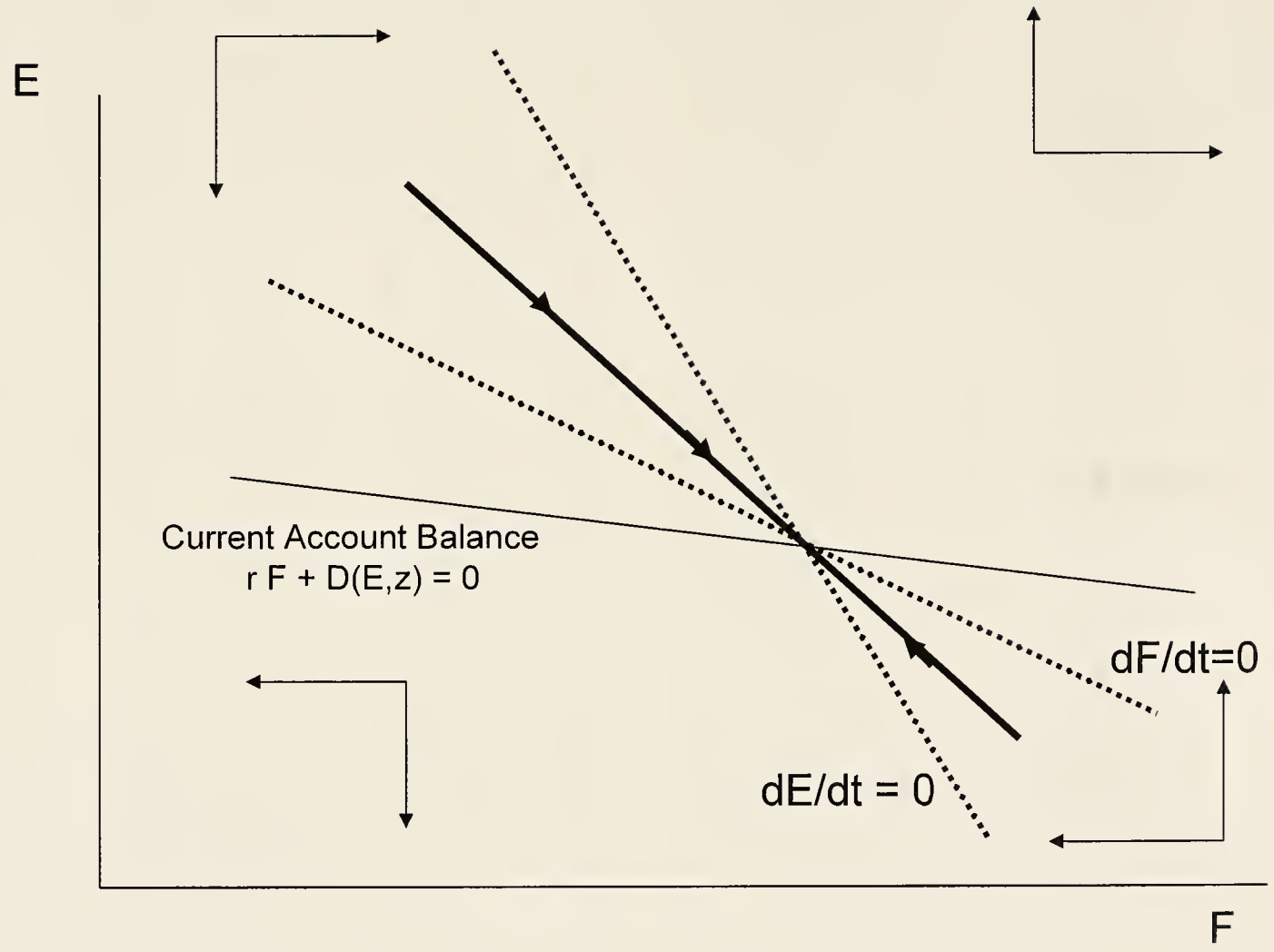
The derivatives α_R and α_R^* do not affect the slope of the locus $\dot{E} = 0$. They do however affect the slope of the locus $\dot{F} = 0$. The smaller these derivatives are (the lower the degree of substitutability between assets), the closer the locus ($\dot{F} = 0$) is to the locus ($\dot{E} = 0$). 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 are (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 locus ($\dot{F} = 0$) (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

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



below is associated with an expected depreciation, the adjustment from above with an expected appreciation. Valuation effects imply that unexpected 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 locus $(\dot{E}=0)$, and so the closer the saddle point path is to the locus $(\dot{E}=0)$. 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 $(\dot{E}=0)$ locus, 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

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.[31]

From these, we construct the a_{ij} 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

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

The results are given in Table A1:

Table A1: 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

To perform the simulation described in the text, we then allocate the shares invested in the "rest of the world" to foreign holdings so as to keep the relative shares in the remaining foreign assets the same. For the United

31. 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).

States for example, we increase the foreign shares in euro and yen assets to approximately 0.15 and 0.08 respectively. This gives us Table 2 in the text.

The simulation presented in Figure 8 uses these values, together with values for asset levels of $37.7 trillion for the United States, $23 trillion for the Euro area, and $8.0 trillion for Japan. Trade is assumed to be bilateral between the United States and each of the other regions, with elasticities of the trade balance all being equal to the elasticity used in our earlier two-country model.

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