Could capital gains smooth a current account rebalancing?*

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Abstract

A narrowing of the U.S. current account deficit through exchange rate movements is likely to entail a substantial depreciation of the dollar, as stressed in the widely-cited contribution by Obstfeld and Rogoff (2005). We assess how the adjustment is affected by the high degree of international financial integration in the world economy. A growing body of research stresses the increasing leverage in international financial positions, with industrialized economies holding substantial and growing financial claims on each other. Exchange rate movements then leads to valuations effects as the currency compositions of a country's assets and liabilities are not matched. In particular, a dollar depreciation generates valuation gains for the U.S. by boosting the dollar value of the large amount of its foreign-currency denominated assets. We consider an adjustment scenario in which the U.S. net external debt is held constant. The key finding is that while the current account moves into balance, the pace of adjustment is smooth. Intuitively, the valuation gains stemming from the depreciation of the dollar allow the U.S. to finance ongoing, albeit shrinking, current account deficits. We find that the smooth pattern of adjustment is robust to alternative scenarios, although the ultimate movements in exchange rates are affected.

Keywords: Current account, Exchange rates, Valuation Effects.
JEL classification codes: F31; F32; F41

1 Introduction

A central feature of the global economy is the extent of international imbalances, mainly the large and growing current account deficit of the United States. The U.S. external deficit increased gradually in the early 1990s to reach a moderate level of 1.7 percent of GDP in 1997 (Figure 1, dotted line), and subsequently widened at a fast pace, hitting 6.5 percent of GDP in 2005. This substantial borrowing from the rest of the world has pushed the U.S. into a substantial net debt vis-à-vis foreign investors, with the net liabilities amounting to 21.7 percent of GDP at the end of 2004 (Figure 1, solid line).

The sustainability of this situation, as well as the pattern of an eventual adjustment, are the objects of substantial analysis and debate, with the volume by Clarida (2006) providing an overview of the various positions. Overall there is a consensus that the international imbalances will eventually unwind. Whether this adjustment is likely to occur smoothly, or to be sudden and disruptive, remains debated. Several economists argue that the current situation is driven by policy choices that are likely to persist over several years (Dooley et al., 2005, 2006), and that the U.S. is not condemned to face a disruptive adjustment in order to stabilize its borrowing (Backus et al., 2005). The U.S. may also have better growth prospects than the rest of the world, leading it to account for a permanently higher share of world GDP. In this situation foreign investors increase the share of U.S. assets in their portfolio, leading to sustained U.S. deficits, with a gradual adjustment once the portfolio re-allocation has run its course (Engel and Rogers, 2006). Another scenario is that the U.S. financial sector has an advantage in intermediating world savings. Under this scenario, the transit of world savings through the U.S. to be converted into investment leads to sustained current account imbalances (Caballero, Farhi and Gourinchas, 2005).

On the other side of the debate, many argue that the current situation is not sustainable and will lead to a substantial depreciation of the dollar vis-à-vis other currencies. This adjustment can be gradual and relatively benign (Blanchard, Giavazzi, and Sa, 2005, Helbling et al., 2005, Faruqee et al., 2006). Several contributions however point to the risk of a rapid adjustment, with disruptive consequences for the world economy (Obstfeld and Rogoff, 2005, 2006, Roubini and Setser, 2005). A representative, and widely-cited contribution of the later view is the work by Obstfeld and Rogoff (2005, 2006). They show that the return of the U.S. current account deficit to balance entails a depreciation of the U.S. dollar of 30-35 percent against the main world currencies. In addition, they argue that such an adjustment could take place in a disruptive manner if stemming from a loss of confidence by foreign investors in the U.S. economy.

Exchange rate movements play a central role in most scenario of international adjustment, with a depreciation of the dollar in real terms (i.e., even when adjusted for inflation differentials). First, a depreciation improves the competitiveness of U.S. goods in world markets by making them cheaper, relative to foreign goods. As a result, consumer worldwide re-allocate their consumption towards U.S. goods, thereby boosting U.S. exports and reducing its imports. Second, and more importantly, a real depreciation implies that the price of non-traded goods in the U.S. (such as services) falls relative to the price of traded goods (such as manufactured goods), inducing U.S. consumers to re-allocate their purchases towards non-traded goods. Obstfeld and Rogoff (2005, 2006) point that this second channel plays a key role in the adjustment.

This paper assesses how the adjustment of the U.S. current account deficit interacts with the high degree of financial integration in the world economy. A growing body of research points that the degree of financial integration has dramatically increased since the early 1990s (Gourinchas and Rey, 2005, 2006, Lane and Milesi-Ferretti, 2003, 2005, 2006, Obstfeld, 2004, Tille, 2003, 2005). The world has moved from a situation where net positions were dominant, with some countries being creditors and other debtors, to a situation where cross-holdings of financial assets across countries have surged, with the values of gross assets and liabilities positions dwarfing the value of net positions. This development has opened a new channel through which exchange rate movements affect the world economies, namely the so-called valuation effect. If countries are leveraged in terms of currencies, with the currency composition of their assets differing from that of their liabilities, exchange rate fluctuations have a different effect on the two sides of the balance sheet, leading to sizable capital gains and losses in net terms. This mechanism is illustrated by the case of the United States: while U.S. liabilities are nearly exclusively denominated in dollars, about two-thirds of U.S. assets are denominated in foreign currencies (Tille, 2005). A depreciation of the dollar then leads to a capital gain for the U.S., as it boosts the dollar value of a given amount of foreign-currency assets. This valuation channel is playing an increasingly large role in driving the U.S. net investment position. Indeed, Figure 1 shows an apparently puzzling pattern with the U.S. net international debt remaining steady at 20-25 percent of GDP over the last three years despite a current account deficit in the order of 5-6 percent of GDP. This odd pattern is a consequence of the valuation effect of exchange rate movements. Figure 2 shows the change in the net international investment position of the U.S. over the last 20 years. The solid line represents the total change, which is driven by several factors. First, net financial flows (the first bars from the left) consistently pushed the U.S. into debt, reflecting the increasingly large current account deficits. Second, the valuation effects of exchange rate movements (the second bars from the left) substantially affected the U.S. position. In particular, the depreciation of the dollar since 2002 generated capital gains that amount to about two-thirds of the current account deficit. Other factors driving the U.S. net positions, such as movements in asset prices (the second bars from the right) and changes in data coverage (the first bars from the right) played a relatively smaller role.

While some analyses of a narrowing of the U.S. current account deficit take financial integration into account, they do so in a way that limits its impact on the adjustment.[1] In particular, Obstfeld and Rogoff (2005, 2006) argue that taking into account the valuation effect of exchange rate movements reduces the required depreciation of the dollar only modestly. This modest effect reflects the exact nature of their experiment. Abstracting from valuation effects, the stabilization of U.S. net external debt at its current level requires the current account to move into balance. When taking valuation effects into account, Obstfeld and Rogoff still require the current account to move immediately into balance. This generates a valuation effect that substantially improves the U.S. position, reducing U.S. net external debt by a factor of three, but has a limited impact on the magnitude of the exchange rate movement.

The magnitude of exchange rate movements is however only one dimension of adjustment. Another aspect is the pace of these movements, with a given adjustment being less likely to be disruptive if spread over several years. For instance, a 30 percent depreciation of the dollar would entail more adverse effects if concentrated over a year than if smoothed over a decade. Our paper focuses on this dimension by considering an alternative experiment. Rather than immediately bringing the current account to zero, we consider a scenario where U.S. net external debt is kept constant. We regard such a scenario as realistic, as the current level of U.S. net external debt

[1] The valuation effects are incorporated in the analyses of Blanchard et al. (2005) and Obstfeld and Rogoff (2005, 2006).

has so far proved manageable. We find that the presence of valuation effects then allows for a "smooth landing" with the U.S. current account imbalance gradually disappearing.

Intuitively, the smooth pattern of the adjustment reflects the fact that the capital gains stemming from the depreciation of the dollar are now used to finance ongoing, albeit shrinking, current account deficits during the adjustment. In the first year of the adjustment, the dollar depreciates, generating a capital gain through the valuation effect. This gain is used to finance net imports, so the current account does not have to fall to zero immediately. This reduces the pressure on the exchange rate in the first year, with the dollar depreciating by only 9 percent. In the second year of the adjustment, this pattern is repeated, with a further narrowing of the current account deficit, and a dollar depreciation reaching 15 percent from the initial situation. Our adjustment scenario does ultimately bring the current account to balance, as this is the only way to stabilize the U.S. net debt once the world economy has reached a new steady path. However, the adjustment is quite gradual, with the current account deficit halving in three years.

An important feature of our scenario is that while net international asset positions are kept constant, the values of gross assets and liabilities increased substantially. There is therefore a large, and increasing, amount of leverage in international balance sheets. This dimension is beneficial to the U.S. as we assume that it earns a higher rate of return on its assets than it pays on its liabilities, an "exorbitant privilege" discussed by Gourinchas and Rey (2006), and Lane and Milesi-Ferretti (2006). We assess the sensitivity of our results through several angles. We first set gross financial flows to zero so leverage is kept constant, and find that our results are little changed. We also consider a scenario where the interest rate on U.S. liabilities permanently increases to match the world interest rate. This convergence scenario boosts the magnitude of exchange rate movements, but the presence of valuation effects still smooths the pace of adjustment. A third extension allows for the interest rate on U.S. liabilities to temporarily increase when the dollar depreciates. We find that the results are robust to this extension.

The remainder of the paper is organized as follows. Section 2 reviews the building blocks of the model. The dynamics of international assets and liabilities are described in Section 3. Section 4 presents our adjustment scenario, as well as a sensitivity analysis to alternative scenarios. Section 5 concludes.

2 A three-country model of interdependence

As our analysis is based on the work of Obstfeld and Rogoff (2005), this section focuses on the main elements of setup and the dimensions along which we extend their model. More details are given in the Appendix.

2.1 Consumption allocation and relative prices

The model economy consists of three regions: the U.S., Europe, and Asia, which are indexed by U, E, and A, respectively. The regions are linked by trade flows and by cross-holdings of financial instruments. Each region produces a traded good and a non-traded good, with the three traded goods being imperfect substitutes. The aggregate consumption index in region i, denoted by C^i, is given by:

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

where C_T^i represents a consumption index of domestic and foreign traded goods, and C_N^i denotes consumption of the domestic non-traded good. The parameter θ represents the elasticity of substitution between traded and non-traded goods, with γ and $1-\gamma$ being their respective shares in consumption. The consumption index of traded goods, C_T^i, includes the consumption of goods made in the U.S., Europe, and Asia, denoted by C_U^i, C_E^i, and C_A^i respectively. The exact specification of the baskets of traded goods consumption in the three regions, C_T^U, C_T^E, and C_T^A, is given by:

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

$$C_T^E = \left[(\beta-\alpha)^{\frac{1}{\eta}} \left(C_U^E\right)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} \left(C_E^E\right)^{\frac{\eta-1}{\eta}} + (1-\beta)^{\frac{1}{\eta}} \left(C_A^E\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{3}$$

$$C_T^A = \left[\left(\frac{1-\delta}{2}\right)^{\frac{1}{\eta}} \left(C_U^A\right)^{\frac{\eta-1}{\eta}} + \left(\frac{1-\delta}{2}\right)^{\frac{1}{\eta}} \left(C_E^A\right)^{\frac{\eta-1}{\eta}} + \delta^{\frac{1}{\eta}} \left(C_A^A\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{4}$$

The parameter η represents the elasticity of substitution between various traded goods. In the U.S. and Europe, domestically produced goods represent a share α of the aggregate consumption of tradable goods, with the goods produced in the other non-Asia region representing a share equal to $\beta - \alpha$.

Asian-produced goods represent a share $1-\beta$ of the traded basket, both in the U.S. and Europe. U.S.- and European-made goods each represent a share $(1-\delta)/2$ of the Asian basket of traded goods consumption, with Asian-made goods accounting for the remaining share, δ. We adopt the parametrization of Obstfeld and Rogoff (2005) where $1 > \beta > \alpha > 0.5$, and $\delta > 0.5$. This implies a home bias in traded goods consumption, i.e. each country has a relative preference for domestically produced good.

Based on the consumption baskets (1)-(4), we compute the price indexes that correspond to the smaller amount of income required to purchase a unit quantity of the corresponding basket. For simplicity we use the U.S. currency as a numeraire. The consumer price index in region i, expressed in dollars P_C^i, is given by:

$$P_C^i = \left[\gamma \left(P_T^i\right)^{1-\theta} + (1-\gamma)\left(P_N^i\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}, \quad i = U, E, A, \tag{5}$$

where P_T^i is the price index of traded goods and P_N^i is the price of non-traded goods in region i. The price indices of traded consumption in the three regions expressed in dollars, P_T^U, P_T^E, and P_T^A, are:

$$P_T^U = \left[\alpha (P_U)^{1-\eta} + (\beta-\alpha)(P_E)^{1-\eta} + (1-\beta)(P_A)^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{6}$$

$$P_T^E = \left[(\beta-\alpha)(P_U)^{1-\eta} + \alpha (P_E)^{1-\eta} + (1-\beta)(P_A)^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{7}$$

$$P_T^A = \left[\frac{1-\delta}{2}(P_U)^{1-\eta} + \frac{1-\delta}{2}(P_E)^{1-\eta} + \delta (P_A)^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{8}$$

where P_i is the dollar price of the traded good produced in region i. Throughout the paper we assume that all prices are fully flexible. There are also no impediments to trade, so that the law of one price holds for each single traded good (i.e., the price of a given traded good is the same across the world, adjusted for the exchange rate).

The demands for the various goods in a given region are driven by the aggregate consumption in the region, as well as the various relative prices. The bilateral terms-of-trade $\tau_{i,j}$, are the price of the traded good produced in region j, relative to the price of the traded good produced in region i:

$$\tau_{U,A} = \frac{P_A}{P_U}, \quad \tau_{U,E} = \frac{P_E}{P_U}, \quad \tau_{E,A} = \frac{P_A}{P_E} = \frac{\tau_{U,A}}{\tau_{U,E}}. \tag{9}$$

An increase in $\tau_{U,E}$ is a deterioration of the U.S. terms-of-trade vis-à-vis Europe, as European-made goods are now more expensive in terms of U.S.-produced goods. It can also interpreted as a competitiveness gain for the U.S. vis-à-vis Europe.

A key relative price in region i is the price of the domestic non-traded goods, relative to the price of the traded basket in the region:

$$x^i = P_N^i / P_T^i, \quad i = U, E, A. \tag{10}$$

An increase in x^i indicates that, in region i, non-traded goods are more expensive in terms of the composite traded consumption basket.

The bilateral nominal exchange rates represent the value of a currency in terms of another, with $E_{i,j}$ being the amount of region i's currency that is required to purchase one unit of region j's currency. Throughout the paper we refer to the currencies of the U.S., Europe and Asia as the dollar, the euro, and the yen, respectively. The three bilateral nominal exchange rates in our setup are $E_{U,E}$, $E_{U,A}$, and $E_{E,A}$, with an increase in $E_{U,E}$ reflecting a nominal depreciation of the dollar against the euro. While nominal exchange rates indicate the relative values of currencies, they do not capture the level of consumer prices in the various regions. If a depreciation of the dollar against the euro is exactly offset by an increase in the consumer price index (5) in the U.S., then the ratio of U.S. and European consumer prices in a given currency is unchanged.

The real exchange rates (RER) represents the relative prices in terms of aggregate price indexes (5). The three bilateral real exchange rates in our setup are:

$$q_{U,A} = \frac{P_C^A}{P_C^U}, \quad q_{U,E} = \frac{P_C^E}{P_C^U}, \quad q_{E,A} = \frac{P_C^A}{P_C^E} = \frac{q_{U,A}}{q_{U,E}}. \tag{11}$$

An increase in $q_{U,E}$ is an increase in the European consumer price index, relative to the U.S. Such an increase represents a *real depreciation* of the dollar against the euro, that is a depreciation of the U.S. currency that is not offset by movements in the local currency price index. Bilateral real exchange rates are driven by both the terms-of-trades and the relative prices of non-traded goods.

An effective measure of the external value of a currency by taking weighted averages of the various bilateral exchange rates:

$$\begin{aligned} q^U &= (q_{U,E})^{\frac{\beta-\alpha}{1-\alpha}} (q_{U,A})^{\frac{1-\beta}{1-\alpha}}, && (12) \\ q^E &= (q_{U,E})^{-1} (q_{U,A})^{\frac{1-\beta}{1-\alpha}}, && (13) \\ q^A &= (q_{U,A})^{-1} (q_{U,E})^{\frac{1}{2}}. && (14) \end{aligned}$$

An increase in q^U indicates that dollar depreciates in real effective terms, reflecting a depreciation against the euro (an increase in $q_{U,E}$) or the yen (an increase in $q_{U,A}$).

While real exchange rates are driven entirely by *relative* prices, namely the terms-of-trade and the relative prices of non-traded goods, the nominal exchange rates are also affected by the *level* of prices in particular regions. Solving for nominal exchange rates then requires a specification of monetary policy to determine the price levels. We follow Obstfeld and Rogoff (2005) and assume that central banks keep the price of a basket of domestically-produced goods constant in local currency. We focus our discussion on real exchange rates, as the movements in nominal exchange rates are very similar.

2.2 Market-clearing conditions

In each region, the current account, in dollars, is the sum of net interest income and the trade balance. The net interest income of region i is the interest earned on its international assets, minus the interest paid on its liabilities. We denote it by NI^i, and present a more detailed description of its composition in our discussion of international balance sheets below. The trade balance of region i is the difference between the value of its output of tradable goods, $P_i Y_T^i$, and its consumption of tradable goods, $P_T^i C_T^i$. For simplicity, the supply-side of the world economy is modeled as an endowment economy, denoting the endowments of tradable and non-traded goods in region i by Y_T^i and Y_N^i, respectively. The current accounts are written as:

$$\begin{aligned} CA^U &= NI^U + P_U Y_T^U - P_T^U C_T^U, && (15) \\ CA^E &= NI^E + P_E Y_T^E - P_T^E C_T^E, && (16) \\ CA^A &= NI^A + P_A Y_T^A - P_T^A C_T^A = -\left(CA^U + CA^E\right). && (17) \end{aligned}$$

Notice that that the current accounts are not affected by the impact of exchange rate movements on the value of international assets and liabilities.

This is because these valuation effects do not entail any financial flows across countries.

The clearing of goods markets requires that the endowments of the various goods are equal to domestic and foreign consumptions, which depend on aggregate consumptions in the various regions and on relative prices. We define the following ratios between the various endowments of tradable and non-traded goods:

$$
\begin{aligned}
\sigma_{U/E} &= \frac{Y_T^U}{Y_T^E}, \quad \sigma_{U/A} = \frac{Y_T^U}{Y_T^A}, \\
\sigma_{N/U} &= \frac{Y_N^U}{Y_T^U}, \quad \sigma_{N/E} = \frac{Y_N^E}{Y_T^E}, \quad \sigma_{N/A} = \frac{Y_N^A}{Y_T^A}.
\end{aligned} \tag{18}
$$

We denote the value, in dollar, of region i's exports to region j by GH_j^i. For instance, GH_A^E is the value of European exports to Asia. We use lower-case variables to denote the ratio between a dollar value and the value of the endowment of U.S. tradable good: $gh_j^i = GH_j^i/(P_U Y_T^U)$. The net interest incomes and current accounts are similarly scaled:

$$
ni^U = \frac{NI^U}{P_U Y_T^U} \quad ni^E = \frac{NI^E}{P_U Y_T^U} \quad ca^U = \frac{CA^U}{P_U Y_T^U} \quad ca^E = \frac{CA^E}{P_U Y_T^U}
$$

Using consumption demands, we can write the various trade flows in terms of relative prices (the terms-of-trade and price between traded and non-traded goods), and the trade balances (current account net of interest income). The resulting expression for U.S. exports as:

$$
gh_E^U = \frac{\beta - \alpha}{(\beta - \alpha) + \alpha\left(\tau_{U,E}\right)^{1-\eta} + (1-\beta)\left(\tau_{U,A}\right)^{1-\eta}} \begin{bmatrix} \frac{\tau_{U,E}}{\sigma_{U/E}} \\ + ni^E - ca^E \end{bmatrix} \tag{19}
$$

$$
gh_A^U = \frac{1 - \delta}{(1-\delta) + (1-\delta)\left(\tau_{U,E}\right)^{1-\eta} + 2\delta\left(\tau_{U,A}\right)^{1-\eta}} \begin{bmatrix} \frac{\tau_{U,A}}{\sigma_{U/A}} \\ - \left(ni^U + ni^E\right) \\ + \left(ca^U + ca^E\right) \end{bmatrix} \tag{20}
$$

The market-clearing condition for U.S. produced tradable goods combined the domestic demand for these goods along with the foreign demands (19)-(20) is:

$$
1 = \frac{\alpha}{\alpha + (\beta - \alpha)\left(\tau_{U,E}\right)^{1-\eta} + (1-\beta)\left(\tau_{U,A}\right)^{1-\eta}} \left[1 + ni^U - ca^U\right] + gh_E^U + gh_A^U \tag{21}
$$

Similar relations give the market-clearing condition for European and Asian tradable goods.

The market-clearing conditions for the U.S. non-traded goods are:

$$\sigma_{N/U} = \frac{1-\gamma}{\gamma}\left[x^U\right]^{-\theta}\left[\alpha + (\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta} + (1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\right]^{-\frac{1}{1-\eta}}\left[1+ni^U - ca^U\right] \tag{22}$$

With similar conditions for European and Asian non-traded goods.

Given the current accounts and net interest incomes (ca^U, ca^E, ni^U, ni^E) we use (19)-(22) to compute the various terms-of-trade and traded-non-traded prices. Aggregate consumption in region i can be inferred from its exogenous endowment of non-traded good, and the various relative prices, using the demand for non-traded good:

$$C^i = \frac{1}{1-\gamma}\left[\frac{P_N^i}{P_C^i}\right]^{\theta} Y_N^i = \frac{1}{1-\gamma}\left[\gamma\left(x^i\right)^{\theta-1} + (1-\gamma)\right]^{-\frac{\theta}{1-\theta}} Y_N^i. \tag{23}$$

2.3 Solution method

Our method computes the various prices in a period based on the international balances sheets at the beginning of the period, and structural parameters. Given an initial structure of assets and liabilities and initial nominal exchange rates, the net interest incomes are computed by applying the exogenous interest rates on the various components of the international balance sheets, with more details given below. We then pick values for the U.S. and European current accounts in dollars, CA^U and CA^E, and the endowment of U.S. tradable goods, Y_T^U. The current account values are not freely picked. For instance, when we aim for constant net asset positions, we iterate our procedure so the current accounts lead to constant positions. Similarly, the endowment of U.S. tradable goods is computed based on the current allocation (as in Obstfeld and Rogoff, 2005) and then held constant.

Armed with the values for the U.S. and European current accounts, the net interest incomes, and the endowment of U.S. tradable goods, Y_T^U, we compute the terms-of-trade $\tau_{U,A}$ and $\tau_{U,E}$, the relative prices of non-traded goods, x^U, x^E, and x^A, and the price of the U.S. tradable good, P_U. This is done by numerically solving a system including the market-clearing conditions, and the expression for price of the U.S. tradable good. Having solved the various relative prices, the real and nominal exchange rates easily follow.

Combining the nominal exchange rates with the ones taken from the previous period, we compute the valuations effects on assets and liabilities.

3 The dynamics of international balance sheets

3.1 The central role of cross-country holdings

Our discussion so far has focused entirely on a static dimension, where the various endogenous variables for a period are computed conditional on a structure of international assets and liabilities at the beginning of the period, and restrictions on the balances sheets at the end of the period (such as an unchanged net asset position). The dynamic linkages across periods come entirely through the dynamics of the international balance sheets, as the positions at the end of period t are the initial conditions for solving the allocation at period $t+1$. There is no other dynamic linkage in our analysis. For instance, consumption is not computed from an intertemporal optimization using an Euler equation, but is given by the exogenous endowments and the current accounts, the later being set by our assumption of the dynamics of international balance sheets.

In view of this stylized dynamic structure, we stress that our analysis should be interpreted as a scenario in the following sense: we assume a path for international balance sheets (such as constant net positions in all countries), which in turn implies paths for the current accounts and exchange rates, from which we get paths for consumptions.

In addition of specifying a path for the net international positions across countries, we need to specify the dynamics of gross positions. This dimension is crucial given our emphasis on valuation effects. Consider the case of a country with all its assets in foreign currencies, and all its liabilities in its own currency. Assuming that the net asset position of this country is unchanged through time is not enough, as it can be consistent with an infinite number of combinations of gross positions. A first possibility is to keep the gross assets and liabilities unchanged. Another possibility would be to increase them substantially, but by the same amount. In both cases the net position is the same, but in the second case the leverage between the foreign currency assets and the domestic currency liabilities has increased. The two cases have different implications. In particular, an exchange rate movement in the future will have a larger valuation impact when gross positions increase.

The need to impose some structure on the gross assets and liabilities is the consequence of our focus on an adjustment scenario that operates through several periods. This issue is absent in models where all the adjustment occurs in one period, such as Obstfeld and Rogoff (2005), and we discuss the steps involved in deriving this structure.

3.2 International interest rates

Following Obstfeld and Rogoff (2005), the interest rates paid on international assets and liabilities are specified exogenously. We consider that all assets pay an exogenous interest rate r^W. The notable exception to this rule is the interest rate on U.S. liabilities, which is denoted by r^U. Our baseline scenario considers that the U.S. earns a higher return on its assets that it pays on its liabilities, so $r^U < r^W$. This captures the "exorbitant privilege" from which the U.S. has benefited for decades (Gourinchas and Rey, 2006, Higgins, Klitgaard and Tille, 2005, Lane and Milesi-Ferretti, 2006).

We do not limit ourselves to this baseline case, and consider alternative scenarios. One alternative is to consider the adjustment if the U.S. looses its ability to pay a relatively low return on its liabilities, in which case r^U increase permanently to match r^W. Another alternative allows for temporary movements in the rate of return on U.S. liabilities due to exchange rate movements. Specifically, we consider that the rate of return at time t is:

$$r_t^U = \bar{r}^U + \kappa \text{Depr}_{t,t-1}\left(E^U\right) \tag{24}$$

where $\text{Depr}_{t,t-1}\left(E^U\right)$ is the percentage depreciation of the effective nominal exchange rate of the dollar, E^U, between period $t-1$ and t. $\bar{r}^U$ is an exogenous steady state level of the interest rate, and κ is a parameter capturing the sensitivity of the interest rate to exchange rate movements. The specification (24) allows for a feedback of exchange rate movements on interest rates. When the dollar depreciates, foreign investors ask for a higher return on U.S. securities to limit their capital loss.

3.3 Initial asset and liability positions

We adopt the following notation: we denote region i's foreign assets by H^i, and its liabilities by L^i, expressing all values in dollars without loss of generality. The difference represents the net international position of the region, which we denote by $F^i = H^i - L^i$.

Assets and liabilities in each region's balance sheet consists of assets denominated in different currencies. Exchange rate movements, then, affect their values and lead to capital gains and losses across the three regions. H_j^i denotes region i's assets that are denominated in region j's currency. For instance, H_U^E is the value of dollar-denominated assets held by European investors. Similarly, L_j^i denotes region i's liabilities that are denominated in region j's currency. Positions are in a high-return bond paying an exogenous interest rate r^W, except for the liabilities of the U.S. which are in a low-return dollar denominated bond paying an interest rate r^U, as discussed above. Positions in the low-return bond are denoted by a tilde.

Table 1 illustrates the initial composition of *international* balance sheets in the three regions. The values are derived from those used by Obstfeld and Rogoff (2005). The top section of Table 1 shows the assets and liabilities of the U.S. The assets include positions in all currencies, and liabilities in the low return dollar denominated bond:

$$H^U = H_U^U + H_E^U + H_A^U \qquad\qquad L^U = \tilde{L}_U^U.$$

The U.S. in a net debtor. A sizable share of U.S. assets (60 percent) is denominated in foreign currencies, while all U.S. liabilities are in dollar, in the low-return bond. This pattern is consistent with the U.S. numbers detailed in Tille (2005). The U.S. net position is then highly leveraged, with substantial asset positions in foreign currencies and large liabilities in dollar. The middle section of Table 1 shows the European balance sheet, with assets and liabilities in all currencies:

$$H^E = \tilde{H}_U^E + H_U^E + H_E^E + H_A^E \qquad\qquad L^E = L_U^E + L_E^E + L_A^E.$$

The position of Europe is balanced with equal amounts of assets and liabilities. European assets are mostly denominated in euro and dollar (57 and 37 percent of the total, respectively), with the latter consisting mostly of low-return bonds invested in the U.S. Similarly, European liabilities are predominantly denominated in euro (80 percent), with the remainder in dollar. The bottom section of Table 1 shows the Asian balance sheet:

$$H^E = \tilde{H}_U^A + H_U^A + H_E^A + H_A^A \qquad\qquad L^A = L_U^A + L_E^A + L_A^A.$$

Asia is a net creditor to the rest of the world, with the bulk (80 percent) of its assets consisting of dollar-denominated assets, essentially in low-return bonds invested in the U.S. The liability side is relatively evenly split across the three currencies. In net terms, Asia is substantially leveraged, with large assets in dollar and substantial liabilities in yen, and to a lesser extent in euro.

3.4 Dynamics of balance sheets

3.4.1 The scaling of gross financial flows

The value of each region's assets and liabilities fluctuates for three reasons. First, the existing positions generate a stream of interest payments. Second, exchange rate fluctuations affect the value of positions in different currencies. Third, gross trade flows lead to the accumulation of additional assets and liabilities, i.e. gross financial flows.

Before reviewing each of these three drivers in more details, we discuss the issue of scaling gross financial flows. For brevity, our discussion considers a model with two-country (U and E). GH_E^U denotes the exports from U to E, expressed in the currency of country U (dollar), while GH_U^E denotes the reverse gross trade flows. GI^U is the gross interest revenue earned by country U on its assets in country E, with GI^E being the gross interest liability of country U. The net interest is then: $NI^U = GI^U - GI^E = -NI^E$. The current account of country U is then:

$$CA^U = GH_E^U + GI^U - GH_U^E - GI^E$$

The above relation is expressed in terms of trade flows and interest earnings. It can also be expressed in terms of financial flows. Consider that a fraction π_1 of the gross exports and interest earnings of country U are invested in assets in country E, leading to a gross financial flow from country U to country E. Similarly, a fraction π_2 of the gross exports and interest earnings of country E is invested in assets in country U. In addition, country U earns a capital gain on its assets denominated in currency E because of exchange rate movements. We denote this gain by V_E^U, and consider that a fraction π_3 of this gain is added to the asset held by country U in country E, with the remaining fraction $1 - \pi_3$ being repatriated to country U (a capital inflow in country U).

With this notation, the net capital outflows from country U to country E are:

$$FF^U = \pi_1 \left(GH_E^U + GI^U\right) - \pi_2 \left(GH_U^E + GI^E\right) - (1 - \pi_3) V_E^U$$

In addition, the change in the net asset position of country U is the sum of the net capital outflows and the valuation effect of exchange rate movements:

$$\Delta F^U = FF^U + V_E^U = \pi_1 \left(GH_E^U + GI^U \right) - \pi_2 \left(GH_U^E + GI^E \right) + \pi_3 V_E^U$$

The balance of payments identity requires that the current account balance be equal to the net financial flows: $CA^U = FF^U$. This implies the following restriction on the parameters π_1, π_2 and π_3:

$$0 = (1 - \pi_1) \left(GH_E^U + GI^U \right) - (1 - \pi_2) \left(GH_U^E + GI^E \right) + (1 - \pi_3) V_E^U \quad (25)$$

(25) is clearly satisfied if $\pi_1 = \pi_2 = \pi_3 = 1$. This however implies large gross financial flows, and an unrealistic increase in gross financial positions.

In general, we could assume several different values of π_1, π_2 and π_3, provided (25) holds. In the three-countries and three-currencies model that we consider, this would however make the analysis substantially more complicated. An attractive alternative is to set $\pi_1 = \pi_2 = \pi_3 = \pi$. While this comes at the cost of limiting the model flexibility, it has the advantage of facilitating the interpretation of the results. We follow this strategy, and leave the sensitivity analysis of a richer specification of the π's for future work. While appealing for its simplicity, setting all the π's to be equal violates (25) in general. Specifically, with $\pi_1 = \pi_2 = \pi_3 = \pi$, (25) becomes:

$$0 = (1 - \pi) \left(CA^U + V_E^U \right)$$

which is not satisfied in general. The exception is the case where the current account and the valuation gain exactly offset each other, leaving the net asset position unchanged:

$$CA^U + V_E^U \Rightarrow \Delta F^U = 0$$

In this case, any value of π is consistent with (25).

As our analysis focuses on scenarios where net asset positions are held constant, we assume that a share π of gross trade flows and interest income translates into gross financial flows, and a share $1 - \pi$ of valuation gains is repatriated. We should nonetheless bear in mind that this simple parametrization would not be valid in a scenario where net asset positions are allowed to change.

3.4.2 Interest payments and valuation gains

The first driver of changes in asset and liabilities is the flow of interest income. The *net* interest income for each region is the difference between the interest earned on its assets and that paid on its liabilities. Based on the structure of the balance sheets presented above, we write net interest incomes for the three regions as:

$$NI^U = r^W H^U - r^U L^U \tag{26}$$

$$NI^E = r^U \tilde{H}_U^E + r^W \left(H_U^E + H_E^E + H_A^E\right) - r^W L^E \tag{27}$$

$$NI^A = r^U \tilde{H}_U^A + r^W \left(H_U^A + H_E^A + H_A^A\right) - r^W L^A = -NI^U - NI^E \tag{28}$$

The second driver of balance sheet dynamics are the valuation effects stemming from exchange rates movements. As we express all positions in dollar, there is no such effect for the positions in dollar-denominated assets. However, the dollar value of positions in euro- or yen-denominated assets is affected. We denote by VH_j^i the change in the value of region i's gross assets denominated in region j's currency due to exchange rate movements. VL_j^i is defined similarly for liabilities. The valuation effects are driven by nominal exchange rates. Consider a period where the dollar-euro exchange rate changes from $E_{U,E0}$ to $E_{U,E}$, while the dollar-yen exchange rate goes from $E_{U,A0}$ to $E_{U,A}$. The valuation changes for U.S. assets denominated in euro and yen are:

$$VH_E^U = \left(\frac{E_{U,E}}{E_{U,E0}} - 1\right) H_E^U \qquad VH_A^U = \left(\frac{E_{U,A}}{E_{U,A0}} - 1\right) H_A^U \tag{29}$$

The valuation effects for Europe and Asia are computed along similar lines.

3.4.3 Trade flows

The final factor reflects gross trade flows. The exact mapping of trade flows into the dynamics of the balance sheet requires additional assumptions on the currency compositions of associated gross financial flows. If the U.S. accumulate assets in foreign currencies, future exchange rate movements will lead to a larger valuation effect than if the additional U.S. assets are in dollar. In terms of region i's exports to region j, GH_j^i, we assume that a share $\mu_{j,U}^i$ of these flows leads to the accumulation of assets denominated in dollar. Similarly, a share $\mu_{j,E}^i$ leads to the accumulation of assets denominated in euro, and a share $\mu^i_{j,A} = 1 - \mu^i_{j,U} - \mu^i_{j,E}$ leads to the accumulation of assets denominated in yen.

While we lack evidence on the currency composition of gross financial flows, to our knowledge, we take an educated guess relying on the available evidence on the invoicing of international trade flows, as reported by Goldberg and Tille (2005),[2] who show a prominent role of the dollar in trade flows involving the U.S.. Our assumption is presented in Table 2. The top section of Table 2 shows the composition for U.S. exports, which lead mostly to the accumulation of dollar assets. We assume that half of the financial flows from exports to Europe leads the U.S. to accumulate assets in dollar, with the other half leading to the accumulation of assets in euro. Exports to Asia translate mostly into the accumulation of dollar-denominated assets (85 percent), with the residual being in yen-denominated assets. All accumulation of U.S. assets is in high-return bonds.

The middle section of Table 2 shows the situation for European exports. All exports to the U.S. lead to the accumulation of dollar-denominated assets, which we take to be in the low-return bond. Exports to Asia lead mostly to the accumulation of euro-denominated assets (50 percent), with also a substantial accumulation of dollar-denominated assets (35 percent) and a small accumulation of yen-denominated assets. We consider that all assets accumulated from exports to Asia consist of high-return bonds.

The bottom section of Table 2 corresponds to Asian exports. All exports to the U.S. lead to the accumulation of dollar-denominated assets, which we take to be in the low-return bond. Exports to Europe lead mostly to the accumulation of euro-denominated assets (80 percent), with the residual equally divided between dollar-denominated and yen-denominated assets. We assume that all assets accumulated from exports to Europe consist of high-return bonds.

3.4.4 Overall dynamics

The dynamics of the various positions are given by combining the three channels detailed above. For instance, the U.S. assets and liabilities at the end of a period are given as follows, with a prime indicating values at the

[2] While a flow can be invoiced in a currency and transacted in another, we posit that the invoicing currency is a good indicator of the transaction currency.

end of the period:

$$
\begin{aligned}
H_U^{U\prime} &= H_U^U + \pi\left[r^W H_U^U + \mu_{E,U}^U G H_E^U + \mu_{A,U}^U G H_A^U\right] \\
H_E^{U\prime} &= H_E^U + \pi\left[r^W H_E^U + \mu_{E,E}^U G H_E^U + \mu_{A,E}^U G H_A^U + V H_E^U\right] \\
H_A^{U\prime} &= H_A^U + \pi\left[\begin{array}{c} r^W H_A^U + \left(1-\mu_{E,U}^U-\mu_{E,E}^U\right) G H_E^U \\ +\left(1-\mu_{A,U}^U-\mu_{A,E}^U\right) G H_A^U + V H_A^U \end{array}\right] \\
\tilde{L}^{U\prime} &= \tilde{L}^U + \pi\left[r^U \tilde{L}^U + \left(G H_U^E + G H_U^A\right)\right]
\end{aligned}
$$

The dynamics of the European and Asian balance sheets are computed along similar lines. These dynamics provide the intertemporal linkage of our model, with the balance sheets at the end of the period being the initial positions underpinning the allocation of the next period.

Aggregating the various components of balance sheet dynamics, the changes in the net foreign asset positions of the various countries (which are held at zero in our scenarios) are the sums of the current accounts and the valuation effects on assets and liabilities:

$$
\begin{aligned}
0 &= CA^U + \left(V H_E^U + V H_A^U\right), && (30)\\
0 &= CA^E + \left(V H_E^E + V H_A^E\right) - \left(V L_E^E + V L_A^E\right) && (31)\\
0 &= CA^A + \left(V H_E^A + V H_A^A\right) - \left(V L_E^A + V L_A^A\right) && (32)
\end{aligned}
$$

4 Global adjustment under various scenarios

4.1 Parametrization

The various parameter values that are presented in Table 3. Whenever possible, we take the same values as in Obstfeld and Rogoff (2005), and refer the reader to their contribution for a detailed discussion. The 'baseline' column of Table 3 shows our baseline choice, with the 'extensions' column showing alternative values considered in extensions.

Our sensitivity analysis focuses on the magnitude of gross financial flows, captured by π, and the international interest rates. We pick π using empirical evidence on the relative magnitude of gross trade and financial flows, as economic theory does not provide us with an a-priori guess. Data for the U.S. are presented in Figure 3, where the solid line is the ratio between gross financial outflows and gross exports, while the dotted line is the ratio between gross financial inflows and gross imports. Both lines show similar positive trends, despite sizable year-to-year fluctuations, with gross financial flows increasing from 10-15 percent of trade flows in the early 1960's to 40-50 percent currently, a pattern that reflects the increase in financial integration. Based on this evidence, we assume that a fraction $\pi = 0.5$ of trade flows map into corresponding financial flows. We consider an extension with no accumulation of assets and liabilities beyond the current positions ($\pi = 0$), thereby limiting the degree of balance sheet leverage.

In terms of international interest rates, we take a rate of 5% for r^W. Our baseline scenario considers that r^U is constant at 3.75% and is not sensitive to the exchange rate, so $\kappa = 0$ in (24). We consider a first alternative where r^U immediately goes to 5%, with the U.S. loosing its advantage in terms of rate of return, while maintaining κ at 0.

In addition, we explore the effect of a feedback from the exchange rate to the interest rate. The possibility of such an effect has received substantial attention, and remains debated. Should the dollar depreciate to a sizable extent, one would expect foreign investors to ask for higher returns on their holdings in the U.S. The evidence for industrialized countries is mixed, with some studies finding little evidence of interest rate increases before and during depreciations, as inflation remains low (Gagnon 2005, Croke, Kamin and Leduc 2005). Gagnon (2005) points that interest rates actually fall during episodes of depreciation. This is not necessarily in contradiction with the possibility of large depreciation leading to higher interest rates before the actual onset of the depreciation. Gagnon (2005) argues that on average interest rate are increased by $0.5 - 0.8$ percentage points prior to episodes of depreciations, with depreciations averaging 30% over two years. Other authors argue for a more sizable impact of foreign capital flows on U.S. interest rates. Warnock and Warnock (2005) and IMF (2006, Box 2.3) estimate that purchases of U.S. bonds by foreign investors in the 12 months to May 2005 lowered U.S. interest rates by 150 basis points. Purchases from foreign official investors alone reduced the interest rate by 90 basis points.

While these studies do not directly translate into the parameter κ in (24), we can draw a parallel. We express $\mathrm{Depr}_{t,t-1}\left(E^U\right)$ in (24) as the percentage points depreciation, so the annual 15% depreciation indicated by Gagnon (2005) corresponds to $\mathrm{Depr}_{t,t-1}\left(E^U\right) = 15$. The impact on interest rates found by Gagnon (2005) then points to a value of $0.03 - 0.05$ for κ. We consider two alternative parametrizations. The first is $\kappa = 0.05$, in line with the evidence of Gagnon (2005), in which case a 10% depreciation boosts r^U

by 0.5 percentage points. In a second alternative, we boost κ fourfold to 0.2, which gives an upper range of the feedback effect of exchange rate movements on the interest rate.

An alternative specification would be to include a feedback linking the interest rate at period t to the total depreciation remaining from period t to the long run, as opposed to the depreciation from period $t-1$ to period t, with a smaller value for κ.[3] We explored this alternative, and found results very close to our specification.

4.2 Static scenarios

We start by briefly reviewing the results of Obstfeld and Rogoff (2005). They consider static scenarios in the sense that the current accounts in all countries return to zero immediately.[4] Column (a) of Table 4 shows the main results for their analysis. The top section indicates the real depreciation of the dollar against the other currencies, while the middle section shows the effective real depreciations of the various currencies (the movements in nominal exchange rates are very similar). The bottom section shows the changes in aggregate consumption in all regions.[5]

Column (a) in Table 4 shows a scenario that entirely abstract from any valuation effect, that is, a scenario where all assets and liabilities are denominated in dollar. The global rebalancing of the world economy requires a sharp depreciation of the dollar of 38 percent in effective terms, mirrored principally by a substantial yen appreciation. The adjustment entails a 5.6 percent contraction in U.S. consumption, with expansions abroad, especially in Asia. Obstfeld and Rogoff (2005) also consider valuation effects, a case presented in column (b) of Table 4. Their exact scenario still requires all current accounts to move to zero. The adjustment entails a substantial depreciation of the dollar. This, in turn, generates a substantial capital gain for the U.S., as a large share of its assets is denominated in foreign currencies.

[3] We thank Helene Rey for suggesting this alternative specification.

[4] Obstfeld and Rogoff (2005) do not present their scenario as the adjustment taking place in one period, but rather in terms of comparing the current situation with a steady state where net positions are constant. However, as they abstract from any dynamics, their scenarios implicitly assumes an immediate adjustment.

[5] The numbers in Table 4 slightly differ form the ones presented in Obstfeld and Rogoff (2005) as we consider a structure of assets and liabilities in Table 1 that is slightly different from the one they use.

In other words, Obstfeld and Rogoff (2005) use the capital gain of the U.S. to pay down a substantial amount of the foreign debt. Table 5 shows the net asset positions of all regions, expressed in percent of the value of U.S. traded output. The first row is the initial situation, while the second row shows the scenario considered by Obstfeld and Rogoff (2005). The Table shows a very large valuation gain that allows the U.S. to cut its net debt by 70 percent, mostly at the expense of Asia. As the depreciation of the dollar substantially improves the U.S. balance sheet, the net interest payments of the U.S. to the rest of the world are also improved. With the current account being the sum of these payments and the trade balance, the improvement in net interest payments reduces the magnitude of the improvement in the trade balance that is required to bring the current account to zero. This, in turn, reduces the required movement in the exchange rate, as shown in column (b) of Table 4. Obstfeld and Rogoff (2005) argue that the benefits from the valuation effect are secondary, as the dollar still has to depreciate by 33 percent.

4.3 A baseline dynamic scenario

4.3.1 Stabilization of net investment positions

The limited impact of the valuation effect on the exchange rate in Obstfeld and Rogoff (2005) is a consequence of using the valuation gain to reduce the U.S. net debt, while still requiring an immediate adjustment in the current account. This is only one of several possible use of the valuation gains, and our analysis focuses on an alternative use. Specifically, we consider a scenario where net international investment positions are held constant in all three regions. We regard this scenario as a reasonable alternative, as the U.S. net external debt has remained essentially unchanged in the last three years (Figure 1) at a level that has so far proved manageable. In our scenario, the valuation effects stemming from exchange rate movements allow the various regions to run current account surpluses and deficits. These imbalances are financed by valuation gains and losses, keeping international investment positions constant, as shown in equations (30)-(32).

Our scenario highlights two dimensions of adjustment, namely the ultimate movements in the various variable and the pace of adjustment. Equation (29) shows that valuation effects require movements in nominal exchange rate. In the long run, once adjustment has run its course, the economy reaches a new steady state where all variables are constant, including nominal ones as we assume that the central banks stabilize prices. There is therefore no ongoing valuation in the long run, and equations (30)-(32) show that the current accounts are in balance. While our scenario still requires an ultimate balancing of current accounts, it can accommodate a gradual adjustment. This dimension is relevant in assessing whether the re-balancing of imbalances can be disruptive, as a sizable depreciation of the dollar is likely to be more benign if spread through several years than if occurring in a short span.

4.3.2 Pace of adjustment

The key feature of our alternative scenario is that the adjustment takes place at a much smoother pace than under the static scenarios. Figure 4 shows the path of the various current accounts, expressed as percentage of the value of U.S. traded output. All current accounts eventually go to zero, as the economy is then in a new steady state. The adjustment is quite gradual and spread over several periods (years). For instance, the U.S. current account deficit is only halved in the first three years.

The smooth pattern of adjustment is also observed for exchange rates. Figure 5 shows the paths of bilateral and effective real exchange rates, expressed in percentage changes from the initial levels. The dashed lines indicate the adjustment in the static scenario with valuation effect (column b of Table 4),[6] while the solid lines show the adjustments under the dynamic scenario. The depreciation of the dollar clearly takes place at a gradual pace, both against the euro (panel A), the yen (panel B) and in trade-weighted terms. For instance, the dollar depreciates by 8.6 percent in the first year (in trade-weighted), and 15 percent by the second year. A similar pattern of gradual adjustment is observed for the (moderate) appreciation of the euro and the (substantial) appreciation of the yen.

Intuitively, the gradual nature of the adjustment reflects the use of valuation gains to finance international imbalances. The depreciation of the dollar leads to a sizable capital gain for the U.S., which uses the proceed to finance a trade deficit. While this mechanism can operate only temporarily, as valuation gains eventually go to zero, it allows for a gradual decline in trade gaps. In the first year, the 8.6 percent depreciation of the dollar allows

[6] As Obstfeld and Rogoff (2005) do not compute dynamic path, we simply take the long run effect that they find.

the U.S. to finance a current account deficit of 15.7 percent of its tradable output, which represents a narrowing by only 4.3 percentage points from the initial deficit. The 6.4 percent depreciation in the second year generates a smaller capital gain, with the current account deficit narrowing an additional 3.6 percentage points to 12.1 percent of U.S. tradable output. This pattern is repeated period after period, with the exchange rate ultimately stabilizing and the current account returning into balance. Throughout the adjustment, the net positions of all regions has remained unchanged, as shown in the last row of Table 5.[7]

4.3.3 Magnitude of adjustment

In addition to the gradual nature of the adjustment, our dynamic scenario allows for a moderate reduction in its ultimate magnitude. Column (c) of Table 4 shows the magnitude of depreciation in our dynamic scenario after 10 periods. The magnitude of the various effects is close to the scenario of Obstfeld and Rogoff (2005) that take valuation effects into account (column (b) of Table 4). The magnitude is however substantially reduced from the scenario ignoring valuation effects (column (a) of Table 4), with exchange rate movements dampened by about one-fifth. This magnitude is consistent with the results in Gourinchas and Rey (2005) who find that valuation effects stemming from exchange rate movements accounts for one-third of the historical adjustment of U.S. external imbalances. Using a richer multi-country model, Helbling, Batini and Cardarelli (2005) argue that higher financial integration facilitates the process of current account adjustment.

The magnitude of adjustment in the long run (10 periods) depicted in Table 4 is however only a partial measure. In particular, the reduction of U.S. consumption, and the increases in the rest of the world, are similar under the scenario of Obstfeld and Rogoff (2005) with valuation effects (column (b), and the dynamic scenario (column (c)). This however masks the fact that consumption gradually reaches this level under the dynamic scenario, while it contracts immediately in the Obstfeld and Rogoff (2005) scenario. The gradual response allows U.S. agents to temporarily maintain consumption above its long-run level. We capture this dimension by computing the net

[7] Table 5 shows a moderate narrowing of the positions when scaled by U.S. tradable output. This is because we hold the net position unchanged in dollar. An increase in the price of the U.S. made tradable good, P^U, raises the value of the U.S. tradable output, thereby reducing the scaled positions.

present value of the change in consumption, expressing in as the equivalent permanent change in consumption.[8] The results are illustrated in Table 6, where we focus on U.S. consumption for brevity. The first row indicates the change in consumption after 10 periods, and correspond to the bottom panel of Table 4. The second row shows the equivalent permanent change in consumption computed over the first 10 periods, while the last row shows the equivalent permanent change computed over the infinite horizon.[9] There is of course no distinction between the three rows for the static scenarios (columns (a) and (b)) as consumption immediately jumps to its long run level. While U.S. consumption ultimately contracts to a similar extent in the dynamic scenario, it does so gradually. The net present value of the consumption contraction is then equivalent to a immediate and permanent fall of 3.4 percent, when computed over the first 10 periods. Looking over the entire horizon, the gradual adjustment is equivalent to an immediate 4.2 percent contraction. The gradual nature of the adjustment therefore reduces the permanent cost in terms of consumption by 0.7 percentage point, a magnitude that is non-negligible.

4.3.4 The impact on international balance sheets

The pacing of adjustment over several years in our scenario implies that the movements in international balance sheets over the period are not negligible. This is illustrated by the cumulative valuation gains in the three regions, shown in Figure 6. The thick solid line represents the cumulative gain for the U.S., with the thin dotted and solid lines showing the mirroring losses in Europe and Asia. The substantial depreciation of the dollar results in a large capital gain for the U.S., amounting to \$ 1.8 trillion. This comes essentially at the expense of Asia, which suffers a loss of \$1.4 trillion, while Europe faces a moderate capital loss. The high exposure of Asia to capital loss is consistent with the findings of Higgins and Klitgaard (2004).

[8] To avoid any distortions of our computations, we consider a discount rate of $r^W = 5\%$ for all computations of net present values.

[9] Under our assumption that the interest rate on U.S. liabilities is below the rate on U.S. assets, the model does not converge in the long run when gross financial positions increase ($\pi > 0$). As the U.S. benefits from a interest rate spread, increases in the positions make this benefit ever larger, leading to a continuing appreciation of the dollar starting around period 11. To avoid this, we keep $\pi = 0.5$ until period 10, and then set $\pi = 0$ to ensure long run convergence.

Table 7 breaks these cumulative current accounts (which are equal to the opposite of the cumulative valuation gain) into the trade balances and net interest income. As the U.S. benefits from a low interest rate on its liabilities, the increase in gross positions through time translates into a positive net interest income of \$ 0.4 trillion. This interest income comes essentially at the expense of Europe, while the net assets of Asia are large enough to offset its earning a lower rate on its assets than it pays on its liabilities. The U.S. can then run a cumulative trade deficit of \$ 2.2 trillion, in excess of the \$ 1.8 trillion current account deficit (offsetting the valuation gain).

The combination of trade flows, interest income and valuation effects leads to substantial movements in international balance sheets. Table 8 shows the positions for all regions in the initial situation and in the long run (defined as 10 years after the adjustment started). The Table indicates both the total positions and the sum of euro and yen positions, as only the latter are relevant for valuation effects. Under our assumption that one half of trade flows, interest income and valuation effects are mapped into asset and liability positions, we find that the gross positions nearly double over 10 years. As the net positions are by construction held unchanged, this represents a sizable increase in leverage, but is consistent with empirical evidence. Between 1994 and 2004 U.S. gross assets nearly doubled from 47 percent to 85 percent of GDP, while liabilities increased even more from 49 percent to 107 percent (Figure 7). The balance sheet dynamics stemming from our parametrization are therefore realistic.

The increase in gross positions, especially in euro and yen, explain the dampening of the ultimate adjustment described above. A given exchange rate movement taking place in the future generates a valuation effect that is larger than one generated by the same movement taking place in the early on, as it applies to larger positions.

4.4 Sensitivity analysis

4.4.1 Limited international leverage

In the baseline scenario describer above, the U.S. benefits from a differential in international rates of return thanks to the relatively low interest rate paid on its liabilities. This differential leads to an increasingly beneficial leverage effect for the U.S., as its gross assets and liabilities move in tandem. The net interest income is initially zero, and subsequently becomes positive, transferring \$ 0.4 trillion to the U.S. over 10 periods (Table 7).

We assess the role of this increasingly beneficial leverage by computing an alternative scenario where gross positions remain unchanged, i.e. there are no gross financial flows ($\pi = 0$). The results are depicted in Table 9, where column (a) recalls the results under the baseline scenario and column (b) presents the results under the alternative with no gross financial flows. The top three panels indicate the exchange rate movements in bilateral and effective terms, as well as the change in aggregate consumptions, all being measured after 10 periods. Holding the extent of international leverage constant increases the magnitude of the adjustment. For instance, the dollar depreciates by 36.2 percent in effective terms, compared to 31.4 percent in the baseline scenario. U.S. consumption also falls by more in the alternative scenario (5.5 percent instead of 4.7 percent).

The bottom three panels of Table 9 decompose the valuation gain between the trade balances and net interest incomes, showing the cumulative amounts over the first 10 periods, with column (a) corresponding to Table 7. The cumulative current account deficit of the U.S. is essentially unchanged in the alternative scenario, amounting to \$ 1.8 trillion. Its composition is however different: as the U.S. cannot increase its leverage between high paying assets and low paying liabilities, its net interest income remains at zero, down from \$ 0.4 trillion in the baseline scenario. The trade balance therefore must adjust by more in the alternative scenario, with a cumulative trade deficit of \$ 1.8 trillion, compared to \$ 2.2 trillion in the baseline. The larger adjustment in the trade balance puts more pressure on the exchange rate, leading to a larger depreciation of the dollar.

While the magnitude of long-run adjustment is higher under our alternative scenario, the pace remains as gradual as in the baseline. Figure 8 shows the U.S. current account, net interest income and trade balance under the baseline scenario (thick line) and the alternative with no gross financial flows (dotted line). The current account paths are indistinguishable, while the trade balance adjusts at a slightly faster pace under the alternative.

4.4.2 Convergence of interest rates

Another approach in limiting the interest rate differential is to assume that the interest rate on U.S. liabilities converges to the interest rate on U.S. assets. While the differential has been persistent for decades, one can argue that a reduction is possible, owing for instance to higher rates on the sizable debt liabilities of the U.S. (Higgins, Klitgaard and Tille 2005 provide some scenarios). We compute an alternative scenario where the interest rate on U.S. liabilities r^U starts at 3.75 percent and immediately converges to the rate on assets r^W in the first period of adjustment (this scenario holds π at 0.5). While such a quick jump is somewhat unrealistic, as a more gradual convergence is more likely, it provides us with a simple benchmark.

The magnitude of adjustment in the alternative scenario of interest rate convergence is presented in Table 10. For clarity, we recall the results under our baseline scenario, contrasting the static Obstfeld and Rogoff (2005) case with valuation (column (a)) and our dynamic adjustment (column (b)). The last two columns indicate the results under the convergence of interest rates. Column (c) shows the adjustment under a static scenario with r^U going to 5 percent, and column (d) corresponds to the dynamic scenario with convergence of interest rates.

The top three panels of Table 10 show the impact on exchange rates and consumptions after 10 periods. An increase in the cost of U.S. liabilities substantially raises the magnitude of adjustment even in a static scenario. For instance, the dollar depreciates by 39.5 percent when interest rates converge (column (c)), compared to a depreciation of 32.7 percent when the interest rate remains low (column (a)).[10] A similar feature is observed for U.S. consumption which contracts by 6.0 percent, instead of 4.9 percent.

Comparing the static and dynamic scenarios under interest rate convergence (columns (c) and (d)) shows that the magnitude of adjustment after 10 periods is essentially the same. Interestingly, the dynamic scenario is associated with a slightly larger effect under interest rate convergence, with an effective dollar depreciation of 41.4 percent compared to 39.5 percent in the static case. This is the opposite of the pattern when the interest rate on U.S. liabilities remains low, where the dynamic scenario leads to a slightly smaller adjustment.

The bottom three panels of Table 10 decompose the valuation gain between the trade balances and net interest incomes, showing the cumulative amounts over the first 10 periods. The U.S. runs a substantially larger cumulative current account deficit in the convergence scenario than in the baseline

[10] The magnitude of adjustment under interest rate convergence is larger than obtained by Obstfeld and Rogoff (2005) in a similar exercise. This is because we assume that the higher interest rate applies to all U.S. liabilities, while Obstfeld and Rogoff (2005) apply it only to U.S. debt in short-duration bonds, which represents only 30 percent of U.S. liabilities.

one (\$ 2.5 trillion compared to \$ 1.8 trillion). This could at first appear beneficial to the U.S. It is important however to take a closer look at the composition of this deficit. The higher interest rate substantially rises the debt burden of the U.S., which now pays a total of \$ 1.4 trillion in net interest costs, compared to a \$ 0.4 trillion net revenue in the baseline. This \$ 1.8 trillion difference in net interest income between the two scenario exceeds the difference in current account deficits, implying that the trade balance adjusts more under interest rate convergence: the U.S. runs a cumulative trade deficit of \$ 1.1 trillion, which is only half of the deficit in the baseline scenario. The higher interest burden therefore requires a faster convergence of the trade balance, putting pressure on the dollar. The ensuing larger depreciation in turns leads to a larger valuation gain, which dampens but does not eliminate the extra interest burden.

While the magnitude of adjustment is larger under interest convergence, the gradual nature remains. This is illustrated by Table 11 which computes the adjustment in U.S. aggregate consumption, corresponding to Table 6 for the baseline scenario. The top row shows the contraction of consumption at period 10, for the static scenarios with and without valuation (columns (a) and (b)), and the dynamic scenario. Interestingly, consumption contracts by more in the dynamic scenario (6.3 percent) than in the static case (6.0 percent). This reflects a trade-off in the presence of costly liabilities. The static scenario uses the valuation gains to pay down foreign liabilities. While this forces an immediate adjustment, the reduction on liabilities reduces the long run debt burden. In the dynamic scenario by contrast uses the valuation gain to smooth the adjustment. It however implies that the U.S. is left with a higher amount of expensive liabilities in the long run.

The bottom panel of Table 11 weights this two dimensions by computing the equivalent permanent change in consumption in the dynamic scenario. Focusing on the first 10 periods, the dynamic adjustment is equivalent to an immediate and permanent decrease in consumption of 4.4 percent. Extending the exercise to an infinite horizon brings the equivalent contraction to 5.6 percent, that is nearly half a percentage point lower than the reduction in the static scenario. These numbers therefore indicate that while the dynamic scenario implies a larger debt burden, hence lower consumption, in the long run, this is more than offset by spreading the adjustment through time, leading to a smaller contraction in terms of net present value.

The gradual nature of the adjustment is also illustrated in Figure 8 where the thin line represents the paths of the U.S. current account, net interest income and trade balance under interest rate convergence. In the first period, the U.S. current account remains unchanged, while it starts converging in the baseline scenario. This reflects the discrete increase in the cost of liabilities as r^U goes from 3.75 percent to 5 percent. In subsequent periods the current account converges to balance at a pace that is as gradual as in the baseline case. With a sizable interest burden, the trade balance has to adjust at a faster, yet still gradual, pace. The pace of exchange rate adjustment (not shown for brevity) also remains gradual.

4.4.3 Feedback effect on interest rates

Our analysis so far holds the interest rates on assets and liabilities at exogenous level. Faced with a large depreciation of the dollar, foreign investors could however ask for higher interest rates on their holdings in the U.S. We assess this dimension by considering positive values for the feedback parameter linking the depreciation of the dollar (in nominal effective terms) and the interest rate on U.S. liabilities, i.e. the parameter κ in (24). Specifically, we contrast our baseline ($\kappa = 0$) with $\kappa = 0.05$, which is inferred from the results of Gagnon (2005) and $\kappa = 0.2$, which represents a worst case scenario.

The presence of a feedback effect on interest rates leads to sizable temporary increases in the cost of U.S. liabilities. Figure 9 shows the path of r^U under the three cases (the long run interest rate is held at 3.75 percent, and π is kept at 0.5). When $\kappa = 0.05$, the interest rate increases a substantial 52 basis points to 4.27 percent in the first period, when the depreciation is the highest. It then gradually converges, still standing 14 basis points above its long run level after 5 periods. The magnitude is much larger when $\kappa = 0.2$: the interest rate surges 297 basis points to 6.72 percent in the first period, and still remains 42 basis points above the long run level after 5 periods. Movements of such a magnitude are well at the upper bound of the numbers advanced in the debate on the sensitivity of interest rates to developments in international financial markets, and this alternative scenario can be seen as a worst case outcome.

The magnitude of adjustment in the presence of a feedback effect is illustrated in Table 12, where we focus on U.S. variables for brevity. The first two columns recall the results under the static Obstfeld and Rogoff (2005) scenario with valuation (column (a)) and our baseline dynamic scenario with no feedback effect (column (b)). Columns (c) and (d) correspond to the cases with moderate ($\kappa = 0.05$) and high ($\kappa = 0.2$) feedback effects. The first line shows the effective depreciation of the dollar at period 10. While the presence of a feedback effect increases the magnitude of the exchange rate movement, this impact is very small. A similar pattern emerges from the effect on consumption at period 10, shown in the second line. The contraction is essentially the same in the cases with no and low feedback, with the high feedback case adding 0.4 percentage points to the contraction in consumption.

The relatively small impact of the feedback effect on long run variables is not surprising, as interest rates converge to the same long run level in all scenario. The impact on the pace of adjustment is more interesting: if the interest rate surges early in the adjustment, this lowers the net interest income. The trade balance then has to narrow by more to reach a given movement in the current account, and the pace of adjustment should be faster. This is illustrated in Figure 10 where the top panel shows the depreciation in the dollar in effective real terms, while the bottom panel shows the movement in U.S. consumption. While the paths are quite close for the scenarios with no and low feedback, the adjustment is faster under the scenario of high feedback.

This dimension is illustrated in the second panel of Table 12 which computes the equivalent permanent changes in consumption for the dynamic scenarios, both for the first 10 periods and the infinite horizon. Under the no and low feedback scenarios, the gradual pace of adjustment reduces the equivalent contraction in consumption by $0.6 - 0.7$ percentage points compared to the static scenario. While the adjustment is faster under the case of high feedback, the equivalent reduction in consumption is still reduced by 0.2 percentage points. The smooth nature of adjustment with valuation effects therefore remains even in the extreme scenario of a large surge in interest rates.

Table 10 also shows the cumulative current account, net interest income and trade balances for the first 10 periods. In all scenarios the U.S. runs a cumulative current account deficit of \$ 1.8 - \$ 1.9 trillions. The composition of the deficit however varies, with the net interest income being lowered when the interest rate on U.S. liabilities temporarily increases due to feedback effects. While the difference is relatively small for the low feedback case, the higher interest burden reduced the cumulative trade deficit by \$ 0.7 trillion to \$ 1.5 trillion in the high feedback case. The point is further illustrated in Figure 11 which shows the paths of the U.S. current account, net interest income and trade balance. The temporary increase in the interest cost under the low feedback case reduces the narrowing of the current account for a couple of periods. The surge of the interest burden in the high feedback case feeds both into a higher current account deficit initially, as well as a faster convergence of the trade balance. In subsequent periods, the interest burden decreases and the narrowing of the trade balance leads to a faster convergence of the current account compared to the baseline case.

Our final extension combines the feedback effects with a convergence of interest rates, with the $\bar{r}^U$ in (24) converging to $r^W = 5$ percent in the first period of adjustment. The combination of the feedback effect and a long run convergence of interest rates increases the short run response of interest rates, as shown in Figure 12. Under the low feedback scenario, the interest rate increases in the first period by 64 basis points above its long run level, the corresponding movement in the high feedback case amounting to 370 basis points.

The bottom half of Table 12 corresponds to the top half, with $\bar{r}^U$ now being set at 5 percent. As already discussed, the adjustment after 10 periods is larger in the dynamic than in the static case, as the U.S. keeps a large amount of expensive liabilities. The presence of a small feedback effect marginally raises the magnitude of adjustment, with the dollar depreciating by 42.5 percent instead of 41.4 percent. While consumption contract by more in the long run than under the static case, this remains offsets by the gradual path of adjustment. The equivalent contraction in consumption amounts to 5.8 percent over the infinite horizon in the presence of a small feedback effect, which remains slightly below the contraction in the static case. A large feedback effect substantially affects the results, by making U.S. liabilities prohibitive in the short run. This leads to a larger contraction in consumption in the long run, with only a moderate offset from the gradual pace of adjustment, as the equivalent contraction of consumption now reaches 6.4 percent. While the U.S. runs a cumulative current account deficit that is broadly similar under all scenarios, it takes mostly the form of a high interest burden in the high feedback case, with only a small cumulative trade deficit. Figure 14 illustrates the paths of the current account, net interest income and trade balance. While the trade balance is initially in deficit under the high feedback scenario, it quickly moves into a sizable surplus, leading the a small cumulative deficit after 10 periods.

5 Concluding remarks

The rapidly widening U.S. current account deficit has received a lot of attention, with several economists pointing that bringing the current account down to a more sustainable level could require a substantial, and possibly disruptive, depreciation of the dollar. This paper assesses how such an adjustment is affected by the high degree of financial integration across countries. The main consequence of financial integration is the growing relevance of valuation effects, where exchange rate movements leads to sizable changes in the value of a country's assets and liabilities. We consider an adjustment scenario where current account imbalances are resorbed, and the net asset positions of the various countries are kept constant.

Our main finding is that high financial integration can potentially generate a "smooth landing" pattern with a very gradual movement of the current accounts into balance. Focusing on the U.S. in our model, the depreciation of the dollar generates capital gains, which can be used to finance a narrowing current account deficit while keeping the net debt vis-à-vis the rest of the world unchanged. The ability to smooth the adjustment entails a sizable benefits. The narrowing of the U.S. current account deficit entails a contraction of domestic consumption. While we find that the ultimate magnitude of this adjustment is in line with the earlier work of Obstfeld and Rogoff (2005), the gradual path reduces the equivalent permanent contraction in consumption by up to 0.7 percentage points. In addition, a gradual unwinding of imbalances is more likely to be smoothly absorbed by international financial markets. One of the main concerns expressed in the global imbalance debate is that the adjustment may prove sudden and disorderly, with foreign investors loosing confidence in the U.S. for instance. Obstfeld and Rogoff (2005) stress the risk of a "hard landing," where the depreciation of the dollar that they calculate would take place in a fast and disruptive manner. While a 30 percent depreciation of the dollar in a single year could be disruptive for world markets, these would be in a better position to handle a similar movement when it is spread over several years. Our scenario finds that the largest one-year depreciation of the dollar is less than 10 percent, a magnitude that can be absorbed by markets: in 2003 and 2004 the dollar depreciated by 12.2 and 8.2 percent (as measured by the major currency index published by the Board of Governors),[11] a movement that proved

[11] The values of the index are 105.98 (2002), 93.04 (2003), and 85.42 (2004).

manageable.

We complement our baseline scenario by an extensive sensitivity analysis, focusing on the role of gross financial flows, a narrowing of the interest differential of U.S. assets and liabilities, and a feedback transmission from exchange rate movements to interest rates. Our results are robust to these alternative specification. We find that the magnitude of adjustment is sensitive to a narrowing of the interest differential, as discussed in Higgins, Klitgaard and Tille (2005). Nonetheless, the presence of a valuation channel still smooths the adjustment in that alternative scenario. We find that the benefit of a smooth adjustment is offset by a larger burden of liabilities in the long run only in a case where the narrowing of the differential is accompanied by a substantial temporary surge of interest rates in response to exchange rate movements.

Our setup can be extended along several dimensions. First, our dynamic linkages remain quite simple, as we do not consider any intertemporal optimization by agents. Richer models of the world economy, such as Blanchard et al. (2005), Helbling et al. (2005), and Faruqee et al. (2006) nevertheless also find a gradual adjustment. Second, we focus on the case of constant net asset positions across countries, assuming that a common share π of all valuation effects and trade and income flows is translated into financial flows. Varying this share across countries, as well as between valuation effects and trade and income flows, is a promising area of future work.

See http://www.federalreserve.gov/releases/g5a/current/.

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A Consumption allocation

The allocation of consumption between traded and non-traded goods in region i is:

$$C_T^i = \gamma \left[\frac{P_T^i}{P_C^i}\right]^{-\theta} C^i \qquad\qquad C_N^i = (1-\gamma)\left[\frac{P_N^i}{P_C^i}\right]^{-\theta} C^i$$

The allocation of the consumption of traded goods in the three regions is given by:

$$\begin{aligned}
C_U^U &= \alpha \left[\frac{P_U}{P_T^U}\right]^{-\eta} C_T^U \qquad C_E^U = (\beta-\alpha)\left[\frac{P_E}{P_T^U}\right]^{-\eta} C_T^U \qquad C_A^U = (1-\beta)\left[\frac{P_A}{P_T^U}\right]^{-\eta} C_T^U \\
C_U^E &= (\beta-\alpha)\left[\frac{P_U}{P_T^E}\right]^{-\eta} C_T^E \qquad C_E^E = \alpha \left[\frac{P_E}{P_T^E}\right]^{-\eta} C_T^E \qquad C_A^E = (1-\beta)\left[\frac{P_A}{P_T^E}\right]^{-\eta} C_T^E \\
C_U^A &= \frac{1-\delta}{2}\left[\frac{P_U}{P_T^A}\right]^{-\eta} C_T^A \qquad C_E^A = \frac{1-\delta}{2}\left[\frac{P_E}{P_T^A}\right]^{-\eta} C_T^A \qquad C_A^A = \delta \left[\frac{P_A}{P_T^A}\right]^{-\eta} C_T^A
\end{aligned}$$

B Real and nominal exchange rates

The bilateral real exchange rates are driven by both the terms-of-trades and the relative prices of non-traded goods, and are written as:

$$\begin{aligned}
q_{U,E} &= \frac{\left[\alpha \tau_{U,E}^{1-\eta} + (\beta-\alpha) + (1-\beta)\,\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\,\tau_{U,E}^{1-\eta} + (1-\beta)\,\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}} \frac{\left[\gamma + (1-\gamma)\left(x^E\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(x^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}, \\
q_{U,A} &= \frac{\left[\delta \tau_{U,A}^{1-\eta} + \frac{1-\delta}{2} + \frac{1-\delta}{2}\tau_{U,E}^{1-\eta}\right]^{\frac{1}{1-\eta}}}{\left[\alpha + (\beta-\alpha)\,\tau_{U,E}^{1-\eta} + (1-\beta)\,\tau_{U,A}^{1-\eta}\right]^{\frac{1}{1-\eta}}} \frac{\left[\gamma^{1-\theta} + (1-\gamma)\left(x^A\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\gamma + (1-\gamma)\left(x^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}, \\
q_{E,A} &= \frac{q_{U,A}}{q_{U,E}}.
\end{aligned}$$

Turning to nominal exchange rates, we assume that central banks keep the price of a basket of domestically-produced goods constant in local currency:

$$\left[\gamma\left(P_U\right)^{1-\theta}+(1-\gamma)\left(P_N^U\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} = 1 \Rightarrow \left[\gamma+(1-\gamma)\left(\frac{P_N^U}{P_T^U}\frac{P_T^U}{P_U}\right)^{1-\theta}\right]\left(P_U\right)^{1-\theta}=1$$

$$\left[\gamma\left(P_E^*\right)^{1-\theta}+(1-\gamma)\left(P_N^{E*}\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} = 1 \Rightarrow \left[\gamma+(1-\gamma)\left(\frac{P_N^{E*}}{P_T^{E*}}\frac{P_T^{E*}}{P_E^*}\right)^{1-\theta}\right]\left(P_E^*\right)^{1-\theta}=1$$

$$\left[\gamma\left(P_A^*\right)^{1-\theta}+(1-\gamma)\left(P_N^{A*}\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} = 1 \Rightarrow \left[\gamma+(1-\gamma)\left(\frac{P_N^{A*}}{P_T^{A*}}\frac{P_T^{A*}}{P_A^*}\right)^{1-\theta}\right]\left(P_A^*\right)^{1-\theta}=1$$

Relative prices are not affected by the currency in which we express them. Given the relative price of non-traded goods, and the terms-of-trade, we derive the price of the three tradable goods, P_U, P_E^* and P_A^*:

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

$$P_E^* = \left[\gamma+(1-\gamma)\left(x^E\right)^{1-\theta}\left[(\beta-\alpha)\left(\tau_{U,E}\right)^{-(1-\eta)}+\alpha+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\left(\tau_{U,E}\right)^{-(1-\eta)}\right]^{\frac{1-\theta}{1-\eta}}\right]^{-\frac{1}{1-\theta}}$$

$$P_A^* = \left[\gamma+(1-\gamma)\left(x^A\right)^{1-\theta}\left[\frac{1-\delta}{2}\left(\tau_{U,A}\right)^{-(1-\eta)}+\frac{1-\delta}{2}\left(\tau_{U,E}\right)^{1-\eta}\left(\tau_{U,A}\right)^{-(1-\eta)}+\delta\right]^{\frac{1-\theta}{1-\eta}}\right]^{-\frac{1}{1-\theta}}$$

We solve the exchange rate by using the fact that the law of one price holds at the level of particular traded goods:

$$\tau_{U,E}=\frac{E_{U,E}P_E^*}{P_U} \qquad \tau_{U,A}=\frac{E_{U,A}P_A^*}{P_U}$$

We then get the exchange rates:

$$
\begin{aligned}
E_{U,E} &= \tau_{U,E}\frac{P_U}{P_E^*} \\
&= \left[\frac{\gamma+(1-\gamma)\left(x^U\right)^{1-\theta}\left[\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\right]^{\frac{1-\theta}{1-\eta}}}{\gamma\left(\tau_{U,E}\right)^{1-\theta}+(1-\gamma)\left(x^E\right)^{1-\theta}\left[(\beta-\alpha)+\alpha\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\right]^{\frac{1-\theta}{1-\eta}}}\right]^{-\frac{1}{1-\theta}} \\
E_{U,A} &= \tau_{U,A}\frac{P_U}{P_A^*} \\
&= \left[\frac{\gamma+(1-\gamma)\left(x^U\right)^{1-\theta}\left[\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\right]^{\frac{1-\theta}{1-\eta}}}{\gamma\left(\tau_{U,A}\right)^{1-\theta}+(1-\gamma)\left(x^A\right)^{1-\theta}\left[\frac{1-\delta}{2}+\frac{1-\delta}{2}\left(\tau_{U,E}\right)^{1-\eta}+\delta\left(\tau_{U,A}\right)^{1-\eta}\right]^{\frac{1-\theta}{1-\eta}}}\right]^{-\frac{1}{1-\theta}} \\
E_{E,A} &= E_{U,A}/E_{U,E}
\end{aligned}
$$

C Dynamics of the balance sheet

VH_j^i denotes the change in the value of region i's gross assets denominated in region j's currency due to exchange rate movements. VL_j^i is defined similarly for liabilities. The valuation changes for U.S. assets denominated in euro and yen are:

$$
VH_E^U=\left(\frac{E_{U,E}}{E_{U,E0}}-1\right)H_E^U \qquad VH_A^U=\left(\frac{E_{U,A}}{E_{U,A0}}-1\right)H_A^U,
$$

where $E_{U,E0}$ and $E_{U,A0}$ are the initial levels of exchange rates. The valuation effects for European assets and liabilities are:

$$
\begin{aligned}
VH_E^E &= \left(\frac{E_{U,E}}{E_{U,E0}}-1\right)H_E^E \qquad VH_A^E=\left(\frac{E_{U,A}}{E_{U,A0}}-1\right)H_A^E \\
VL_E^E &= \left(\frac{E_{U,E}}{E_{U,E0}}-1\right)L_E^E \qquad VL_A^E=\left(\frac{E_{U,A}}{E_{U,A0}}-1\right)L_A^E.
\end{aligned}
$$

The effects for Asian assets and liabilities are:

$$
\begin{aligned}
VH_E^A &= \left(\frac{E_{U,E}}{E_{U,E0}}-1\right)H_E^A \qquad VH_A^A=\left(\frac{E_{U,A}}{E_{U,A0}}-1\right)H_A^A, \\
VL_E^A &= \left(\frac{E_{U,E}}{E_{U,E0}}-1\right)L_E^A \qquad VL_A^A=\left(\frac{E_{U,A}}{E_{U,A0}}-1\right)L_A^A.
\end{aligned}
$$

Combining trade flows, interest payments and valuation effects gives the dynamics of the various components of the balance sheets. Denoting end-of-period positions with primes, the dynamics of the various components of U.S. assets and liabilities are:

$$\begin{aligned}
H_U^{U\prime} &= H_U^U + \pi\left[r^W H_U^U + \mu_{E,U}^U GH_E^U + \mu_{A,U}^U GH_A^U\right] \\
H_E^{U\prime} &= H_E^U + \pi\left[r^W H_E^U + \mu_{E,E}^U GH_E^U + \mu_{A,E}^U GH_A^U + VH_E^U\right] \\
H_A^{U\prime} &= H_A^U + \pi\left[r^W H_A^U + \left(1-\mu_{E,U}^U-\mu_{E,E}^U\right) GH_E^U + \left(1-\mu_{A,U}^U-\mu_{A,E}^U\right) GH_A^U + VH_A^U\right] \\
\tilde{L}^{U\prime} &= \tilde{L}^U + \pi\left[r^U \tilde{L}^U + \left(GH_U^E + GH_U^A\right)\right]
\end{aligned}$$

The dynamics of European assets and liabilities are:

$$\begin{aligned}
H_U^{E\prime} &= H_U^E + \pi\left[r^W H_U^E + \mu_{A,U}^E GH_A^E\right] \\
H_E^{E\prime} &= H_E^E + \pi\left[r^W H_E^E + \mu_{A,E}^E GH_A^E + VH_E^E\right] \\
H_A^{E\prime} &= H_A^E + \pi\left[r^W H_A^E + \left(1-\mu_{A,U}^E-\mu_{A,E}^E\right) GH_A^E + VH_A^E\right] \\
\tilde{H}_U^{E\prime} &= \tilde{H}_U^E + \pi\left[r^U \tilde{H}_U^E + GH_U^E\right] \\
L_U^{E\prime} &= L_U^E + \pi\left[r^W L_U^E + \mu_{E,U}^U GH_E^U + \mu_{E,U}^A GH_E^A\right] \\
L_E^{E\prime} &= L_E^E + \pi\left[r^W L_E^E + \mu_{E,E}^U GH_E^U + \mu_{E,E}^A GH_E^A + VL_E^E\right] \\
L_A^{E\prime} &= L_A^E + \pi\left[r^W L_A^E + \left(1-\mu_{E,U}^U-\mu_{E,E}^U\right) GH_E^U + \left(1-\mu_{E,U}^A-\mu_{E,E}^A\right) GH_E^A + VL_A^E\right]
\end{aligned}$$

The dynamics of Asian assets and liabilities are:

$$\begin{aligned}
H_U^{A\prime} &= H_U^A + \pi\left[r^W H_U^A + \mu_{E,U}^A GH_E^A\right] \\
H_E^{A\prime} &= H_E^A + \pi\left[r^W H_E^A + \mu_{E,E}^A GH_E^A + VH_E^A\right] \\
H_A^{A\prime} &= H_A^A + \pi\left[r^W H_A^A + \left(1-\mu_{E,U}^A-\mu_{E,E}^A\right) GH_E^A + VH_A^A\right] \\
\tilde{H}_U^{A\prime} &= \tilde{H}_U^A + \pi\left[r^U \tilde{H}_U^A + GH_U^A\right] \\
L_U^{A\prime} &= L_U^A + \pi\left[r^W L_U^A + \mu_{A,U}^U GH_A^U + \mu_{A,U}^E GH_A^E\right] \\
L_E^{A\prime} &= L_E^A + \pi\left[r^W L_E^A + \mu_{A,E}^U GH_A^U + \mu_{A,E}^E GH_A^E + VL_E^A\right] \\
L_A^{A\prime} &= L_A^A + \pi\left[r^W L_A^A + \left(1-\mu_{A,U}^U-\mu_{A,E}^U\right) GH_A^U + \left(1-\mu_{A,U}^E-\mu_{A,E}^E\right) GH_A^E + VL_A^A\right]
\end{aligned}$$

D Market clearing conditions

D.1 Trade flows

In each region the value of consumption of tradable goods can be written as a function of the current account, the net interest income and the value of tradable output. Using the various consumption demands, the dollar value of gross U.S. exports can then be written as:

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

Using the ratios across various outputs, we express the gross trade flows are expressed in terms of ratios to the value of U.S. traded outputs, denoted by lower case letters. The U.S. exports are:

$$
\begin{aligned}
gh_E^U &= \frac{\beta-\alpha}{(\beta-\alpha)+\alpha\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[\frac{\tau_{U,E}}{\sigma_{U/E}} + ni^E - ca^E\right] \\
gh_A^U &= \frac{1-\delta}{(1-\delta)+(1-\delta)\left(\tau_{U,E}\right)^{1-\eta}+2\delta\left(\tau_{U,A}\right)^{1-\eta}}\left[\frac{\tau_{U,A}}{\sigma_{U/A}} - \left(ni^U + ni^E\right) + \left(ca^U + ca^E\right)\right]
\end{aligned}
$$

The value of European exports is:

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

Which become in scaled terms:

$$
\begin{aligned}
gh_U^E &= \frac{(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}}{\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[1 + ni^U - ca^U\right] \\
gh_A^E &= \frac{(1-\delta)\left(\tau_{U,E}\right)^{1-\eta}}{(1-\delta)+(1-\delta)\left(\tau_{U,E}\right)^{1-\eta}+2\delta\left(\tau_{U,A}\right)^{1-\eta}}\left[\frac{\tau_{U,A}}{\sigma_{U/A}} - \left(ni^U + ni^E\right) + \left(ca^U + ca^E\right)\right]
\end{aligned}
$$

And the value of Asian exports is:

$$
\begin{aligned}
GH_U^A &= (1-\beta)\left[\frac{P_A}{P_T^U}\right]^{1-\eta}\left[P_U Y_T^U + NI^U - CA^U\right] \\
GH_E^A &= (1-\beta)\left[\frac{P_A}{P_T^E}\right]^{1-\eta}\left[P_E Y_T^E + NI^E - CA^E\right]
\end{aligned}
$$

Which we scale by U.S. traded output as:

$$
\begin{aligned}
gh_U^A &= \frac{(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}{\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[1+ni^U-ca^U\right] \\
gh_E^A &= \frac{(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}{(\beta-\alpha)+\alpha\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[\frac{\tau_{U,E}}{\sigma_{U/E}}+ni^E-ca^E\right]
\end{aligned}
$$

D.2 Goods market clearing

The market clearing conditions require the exogenous outputs of the various goods to be equal to the domestic demand and exports. The market clearing for the various tradable goods, written in terms of dollar values, are:

$$
\begin{aligned}
P_U Y_T^U &= \alpha\left[\frac{P_U}{P_T^U}\right]^{1-\eta}\left[P_U Y_T^U+NI^U-CA^U\right]+GH_E^U+GH_A^U \\
P_E Y_T^E &= \alpha\left[\frac{P_E}{P_T^E}\right]^{1-\eta}\left[P_E Y_T^E+NI^E-CA^E\right]+GH_U^E+GH_A^E \\
P_A Y_T^A &= \delta\left[\frac{P_A}{P_T^A}\right]^{1-\eta}\left[P_A Y_T^A-\left(NI^U+NI^E\right)+\left(CA^U+CA^E\right)\right]+GH_U^A+GH_E^A
\end{aligned}
$$

The market clearing for the non-traded good in region i is:

$$
Y_N^i=(1-\gamma)\left[\frac{P_N^i}{P_C^i}\right]^{-\theta}C^i=\frac{1-\gamma}{\gamma}\left[\frac{P_N^i}{P_T^i}\right]^{-\theta}C_T^i
$$

The market clearing condition for the U.S. tradable goods is:

$$
1=\frac{\alpha}{\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[1+ni^U-ca^U\right]+gh_E^U+gh_A^U
$$

The conditions for European and Asian tradable goods are:

$$
\begin{aligned}
1 &= \frac{\sigma_{U/E}}{\tau_{U,E}}\left[gh_U^E+gh_A^E+\frac{\alpha\left(\tau_{U,E}\right)^{1-\eta}}{(\beta-\alpha)+\alpha\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}}\left[\frac{\tau_{U,E}}{\sigma_{U/E}}+ni^E-ca^E\right]\right] \\
1 &= \frac{\sigma_{U/A}}{\tau_{U,A}}\left(gh_U^A+gh_E^A+\frac{2\delta\left(\tau_{U,A}\right)^{1-\eta}}{(1-\delta)+(1-\delta)\left(\tau_{U,E}\right)^{1-\eta}+2\delta\left(\tau_{U,A}\right)^{1-\eta}}\left[\begin{array}{c}\frac{\tau_{U,A}}{\sigma_{U/A}}-\left(ni^U+ni^E\right) \\ +\left(ca^U+ca^E\right)\end{array}\right]\right)
\end{aligned}
$$

The market clearing condition for the various non-traded goods are:

$$\begin{aligned}
\sigma_{N/U} &= \frac{1-\gamma}{\gamma}\left[x^U\right]^{-\theta}\left[\alpha+(\beta-\alpha)\left(\tau_{U,E}\right)^{1-\eta}+(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\right]^{-\frac{1}{1-\eta}}\left[1+ni^U-ca^U\right] \\
\sigma_{N/E} &= \frac{1-\gamma}{\gamma}\left[x^E\right]^{-\theta}\left[\begin{array}{c}(\beta-\alpha)\left(\tau_{U,E}\right)^{-(1-\eta)}+\alpha \\ +(1-\beta)\left(\tau_{U,A}\right)^{1-\eta}\left(\tau_{U,E}\right)^{-(1-\eta)}\end{array}\right]^{-\frac{1}{1-\eta}}\left[1+\frac{\sigma_{U/E}}{\tau_{U,E}}\left(ni^E-ca^E\right)\right] \\
\sigma_{N/A} &= \frac{1-\gamma}{\gamma}\left[x^A\right]^{-\theta}\left[\frac{1-\delta}{2}\left(\tau_{U,A}\right)^{-(1-\eta)}+\frac{1-\delta}{2}\left(\tau_{U,E}\right)^{1-\eta}\left(\tau_{U,A}\right)^{-(1-\eta)}+\delta\right]^{-\frac{1}{1-\eta}} \\
&\quad \left[1-\frac{\sigma_{U/A}}{\tau_{U,A}}\left(ni^U+ni^E\right)+\frac{\sigma_{U/A}}{\tau_{U,A}}\left(ca^U+ca^E\right)\right].
\end{aligned}$$

Table 1: Initial structure of assets and liabilities
(Trillions $)

	Assets (a)	Liabilities (b)	Net (c)
United States			
Total	8.250	11.000	-2.750
- dollar	3.317	11.000	-7.684
- euro and yen	4.934		4.934
High return assets			
- dollar	3.317		3.317
- euro	3.341		3.341
- yen	1.592		1.592
Low return assets (dollars)		11.000	-11.000
Europe			
Total	11.000	11.000	0.000
- dollar	3.520	2.200	1.320
- euro and yen	7.480	8.800	-1.320
High return assets			
- dollar	0.495	2.200	-1.705
- euro	6.270	8.800	-2.530
- yen	1.210	0.000	1.210
Low return assets (dollar)	3.025		3.025
Asia			
Total	11.000	8.250	2.750
- dollar	8.800	2.437	6.364
- euro and yen	2.200	5.814	-3.614
High return assets			
- dollar	0.825	2.437	-1.612
- euro	2.200	3.011	-0.811
- yen	0.000	2.802	-2.802
Low return assets (dollar)	7.975		7.975

Table 2: Currency composition of gross trade flows
(Percent)

	Dollar (a)	Euro (b)	Yen (c)
Exports from the United States to:			
- Europe	50	50	0
- Asia	85	0	15
Exports from Europe to:			
- United States	100	0	0
- Asia	35	50	15
Exports from Asia to			
- United States	100	0	0
- Europe	20	80	20

Table 3: Parameters

		Baseline	Extensions
Elasticity of substition			
- among traded goods	θ	1	
- between traded and nontraded goods	η	2	
Weigths in consumption bakets	α	0.7	
	β	0.8	
	δ	0.7	
	γ	0.25	
Ratio of traded goods endowments	σ U/E	1	
	σ U/A	1	
Ratio of non-traded to traded endowments	σ N/U	3	
	σ N/E	3	
	σ N/A	3	
Interest rate on high return bonds	r W	0.05	
Steady state interest rate on low return bonds	r U	0.0375	0.05
Sensitivity of interest rate on U.S. liabilities to exchange rate movements.	κ	0	0.05 , 0.2
Share of trade flows mapped into financial flows	π	0.5	0
Initial current accounts / US traded output	ca U	-0.2	
	ca E	0.05	

Table 4: Long run adjustment
(after 10 periods)

	OR global re-balancing		Dynamic
	without valuation	with valuation	adjustment
	(a)	(b)	(c)
	Real depreciation of the dollar		
Against the euro	33.5%	28.7%	27.0%
Against the yen	40.8%	34.8%	33.6%
	Effective real depreciations		
Dollar	38.4%	32.7%	31.4%
Euro	-6.3%	-5.5%	-4.6%
Yen	-24.1%	-20.4%	-20.1%
	Change in aggregate consumption		
United States	-5.8%	-4.9%	-4.7%
Europe	2.0%	1.8%	1.6%
Asia	4.8%	4.1%	4.1%

OR global re-balancing without valuation: all current accounts gor to zero in one period,
initial positions are all in dollar

OR global re-balancing with valuation: all current accounts gor to zero in one period,
initial positions are as in table 1

Dynamic adjustment: current accounts gradually go to zero leaving the dollar value of net positions
unchanged, initial positions are as in table 1

Table 5: Final net international investment positions
(Percent of US traded output)

	U.S. (a)	Europe (b)	Asia (c)
Initial situation	-100	0	100
OR global-rebalancing	-29	-11	40
Dynamic adjustment	-90	0	90

OR global re-balancing: all current accounts gor to zero in one period, initial positions are as in table 1

Dynamic adjustment: current accounts gradually go to zero leaving the dollar value of net positions unchanged, initial positions are as in table 1

Table 6: Impact on U.S. consumption

	OR global re-balancing without valuation (a)	OR global re-balancing with valuation (b)	Dynamic adjustment (c)
Change at period 10	-5.8%	-4.9%	-4.7%
Net present value of change			
- until period 10			-3.4%
- over the infinite horizon			-4.2%

Note: in the dynamic adjustment, p = 0.5 until period 10, and p = 0 in subsequent periods to ensure convergence in the long run.

Table 7: Cumulative flows and valuation gains
(Trillions $)

Cumulative valuation gain	
U.S.	1.816
Europe	-0.378
Asia	-1.438
Cumulative net interest income	
U.S.	0.410
Europe	-0.515
Asia	0.106
Cumulative trade balance	
U.S.	-2.226
Europe	0.894
Asia	1.332

All amounts represent the total amounts between the initial period and period 10.

Table 8: Gross positions
(Trillions $)

		Initial positions (a)	Long run positions (b)	Ratio (b) / (a)
US total	Assets	8.25	15.70	1.9
	Liabilities	11.00	18.45	1.7
	Net	-2.75	-2.75	
US non-dollar	Assets	4.93	8.50	1.7
	Liabilities	0.00	0.00	
	Net	4.93	8.50	1.7
Europe total	Assets	11.00	20.08	1.8
	Liabilities	11.00	20.08	1.8
	Net	0.00	0.00	
Europe non-dollar	Assets	7.48	12.95	1.7
	Liabilities	8.80	15.98	1.8
	Net	-1.32	-3.03	2.3
Asia total	Assets	11.00	20.04	1.8
	Liabilities	8.25	17.29	2.1
	Net	2.75	2.75	
Asia non-dollar	Assets	2.20	5.51	2.5
	Liabilities	5.81	10.98	1.9
	Net	-3.61	-5.47	

Long run positions are taken 10 periods (years) after the start of the adjustment.

Table 9: Long run adjustment: impact of gross financial flows (after 10 periods)

	Baseline dynamic (a)	No gross financial flows (b)
Real depreciation of the dollar		
Against the euro	27.0%	31.6%
Against the yen	33.6%	38.5%
Effective real depreciations		
Dollar	31.4%	36.2%
Euro	-4.6%	-6.0%
Yen	-20.1%	-22.7%
Change in aggregate consumption		
United States	-4.7%	-5.5%
Europe	1.6%	2.0%
Asia	4.1%	4.5%
Cumulative valuation gain		
U.S.	1.816	1.799
Europe	-0.378	-0.360
Asia	-1.438	-1.439
Cumulative net interest income		
U.S.	0.410	0.000
Europe	-0.515	-0.378
Asia	0.106	0.378
Cumulative trade balance		
U.S.	-2.226	-1.799
Europe	0.894	0.738
Asia	1.332	1.061

Baseline adjustment: gross financial flows amount to 50 % of corresponding gross trade flows, interest rate on U.S. liabilities remains at 3.75 %.

No gross financial flows: gross financial flows amount to zero, interest rate on U.S. liabilities remains at 3.75 %.

Cumulative amounts are in $ trillions and represent the total amounts between the initial period and period 10.

Table 10: Long run adjustment: impact of interest differential
(after 10 periods)

	Baseline		Convergence of interest rates	
	OR rebalancing with valuation (a)	Dynamic (b)	OR rebalancing with valuation (c)	Dynamic (d)
Real depreciation of the dollar				
Against the euro	28.7%	27.0%	34.9%	36.3%
Against the yen	34.8%	33.6%	41.8%	44.0%
Effective real depreciations				
Dollar	32.7%	31.4%	39.5%	41.4%
Euro	-5.5%	-4.6%	-7.1%	-7.0%
Yen	-20.4%	-20.1%	-24.3%	-25.8%
Change in aggregate consumption				
United States	-4.9%	-4.7%	-6.0%	-6.3%
Europe	1.8%	1.6%	2.2%	2.2%
Asia	4.1%	4.1%	4.8%	5.1%
Cumulative valuation gain				
U.S.		1.816		2.524
Europe		-0.378		-0.562
Asia		-1.438		-1.962
Cumulative net interest income				
U.S.		0.410		-1.375
Europe		-0.515		0.000
Asia		0.106		1.375
Cumulative trade balance				
U.S.		-2.226		-1.149
Europe		0.894		0.562
Asia		1.332		0.587

Baseline adjustment: gross financial flows amount to 50 % of corresponding gross trade flows, interest rate on U.S. liabilities remains at 3.75 %.
Convergence of interest rates: gross financial flows amount to 50 % of corresponding gross trade flows, interest rate on U.S. liabilities increases to 5 % in the first period.
Cumulative amounts are in $ trillions and represent the total amounts between the initial period and period 10.

Table 11: Impact on U.S. consumption
with interest rate convergence

	OR global re-balancing without valuatior (a)	OR global re-balancing with valuation (b)	Dynamic adjustment (c)
Change at period 10	-7.1%	-6.0%	-6.3%
Net present value of change			
- until period 10			-4.4%
- over the infinite horizon			-5.6%

Table 12: Long run adjustment: impact of interest response to exchange rates

	OR rebalancing with valuation		Dynamic adjustment	
		$\kappa = 0$	$\kappa = 0.05$	$\kappa = 0.2$
	(a)	(b)	(c)	(d)
Long run interest rate on U.S. liabilities = 3.75 %				
Effective real depreciation of the dollar				
At period 10	32.7%	31.4%	32.2%	33.8%
Change in aggregate U.S. consumption				
At period 10	-4.9%	-4.7%	-4.8%	-5.1%
Net present value of change				
- until period 10		-3.4%	-3.6%	-4.2%
- over the infinite horizon		-4.2%	-4.3%	-4.7%
Cumulative flows ($ trillions)				
Valuation gain		1.816	1.853	1.911
Net interest income		0.410	0.200	-0.448
Trade balance		-2.226	-2.054	-1.463
Long run interest rate on U.S. liabilities = 5 %				
Effective real depreciation of the dollar				
At period 10	39.5%	41.4%	42.5%	45.2%
Change in aggregate U.S. consumption				
At period 10	-6.0%	-6.3%	-6.5%	-7.0%
Net present value of change				
- until period 10		-4.4%	-4.7%	-5.5%
- over the infinite horizon		-5.6%	-5.8%	-6.4%
Cumulative flows ($ trillions)				
Valuation gain		-2.524	-2.586	-2.722
Net interest income		-1.375	-1.673	-2.624
Trade balance		-1.149	-0.914	-0.098

Cumulative amounts are in $ trillions and represent the total amounts between the initial period and period 10.

Figure 1: U.S. current account and net investment position
Percent of GDP

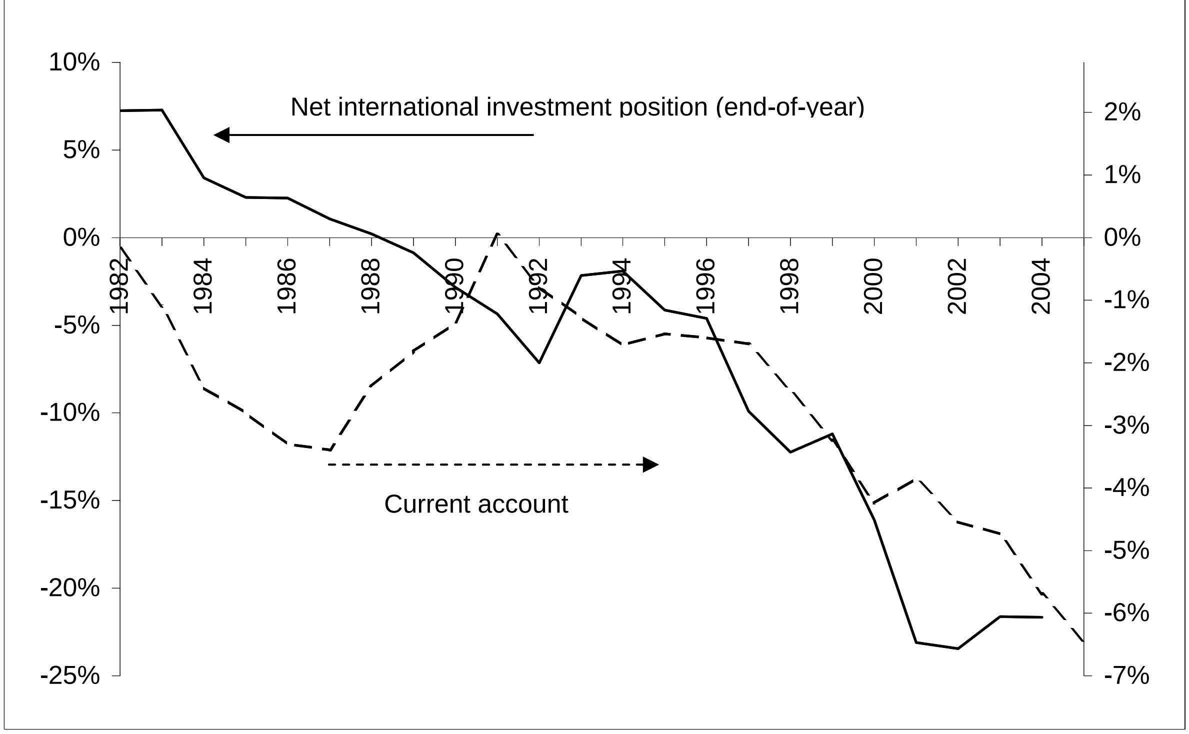


Figure 2: Change in the net investment position
Percent of GDP

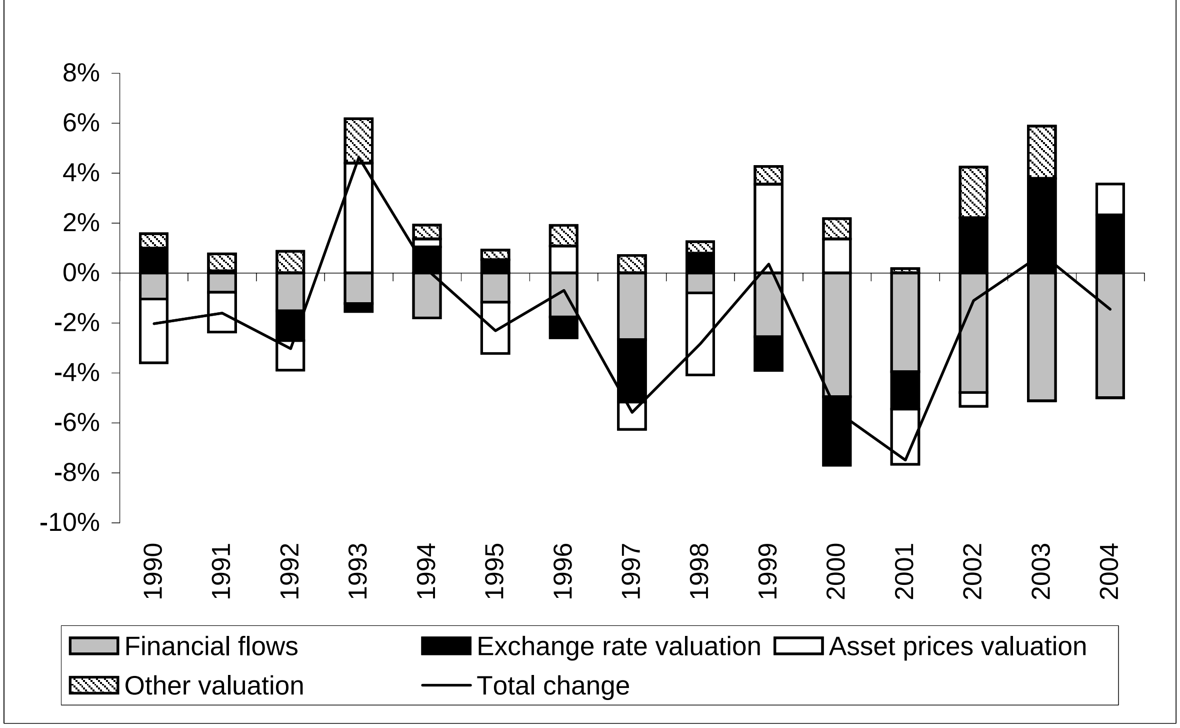


Figure 3: Ratio of gross financial flows to gross trade flows

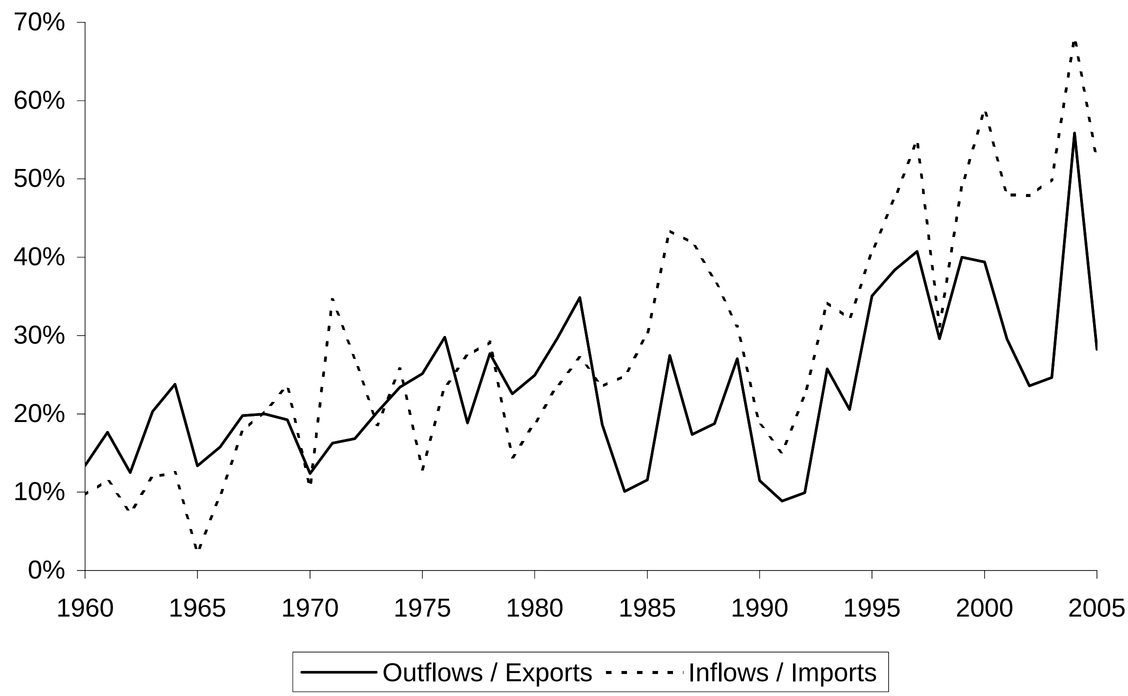


Figure 4: Current accounts, baseline scenario
Percent of US traded output

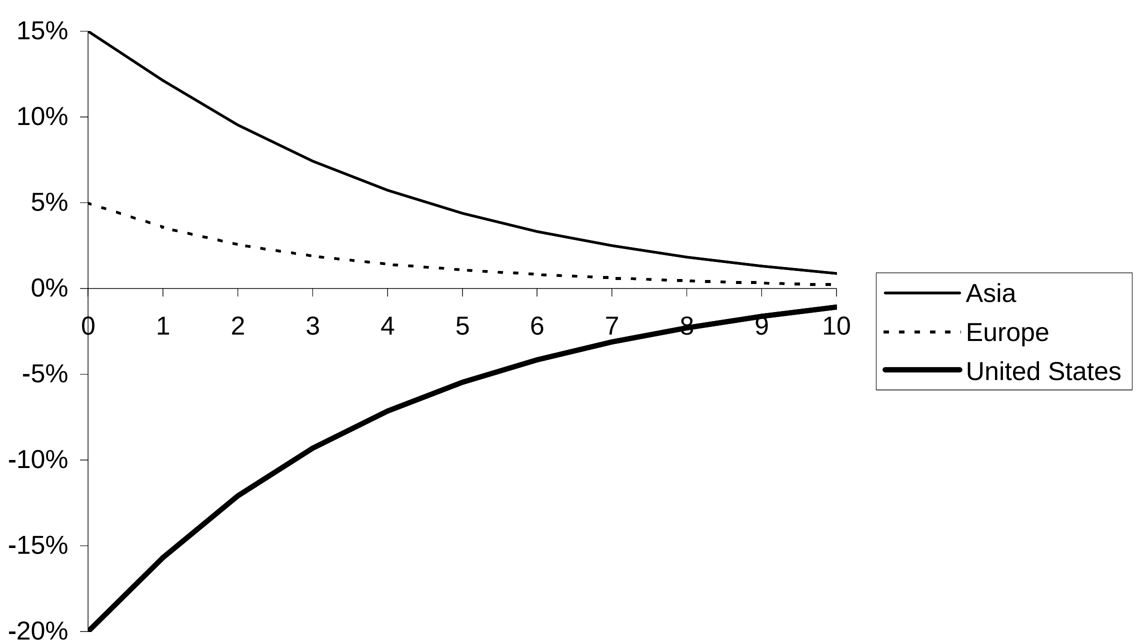


Figure 5: Real exchange rates

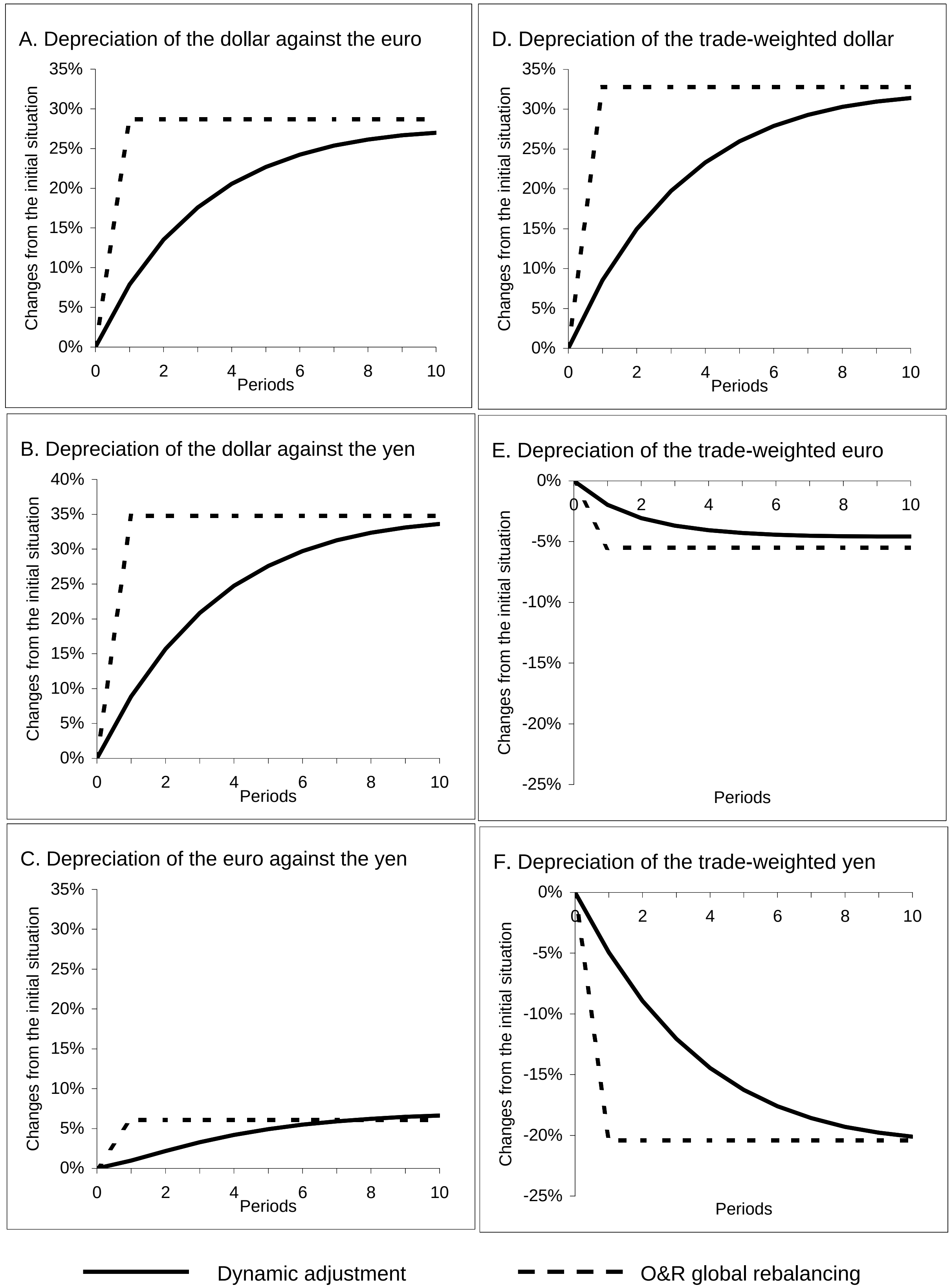


Figure 6: Cumulative valuation effects, baseline scenario
$ trillions

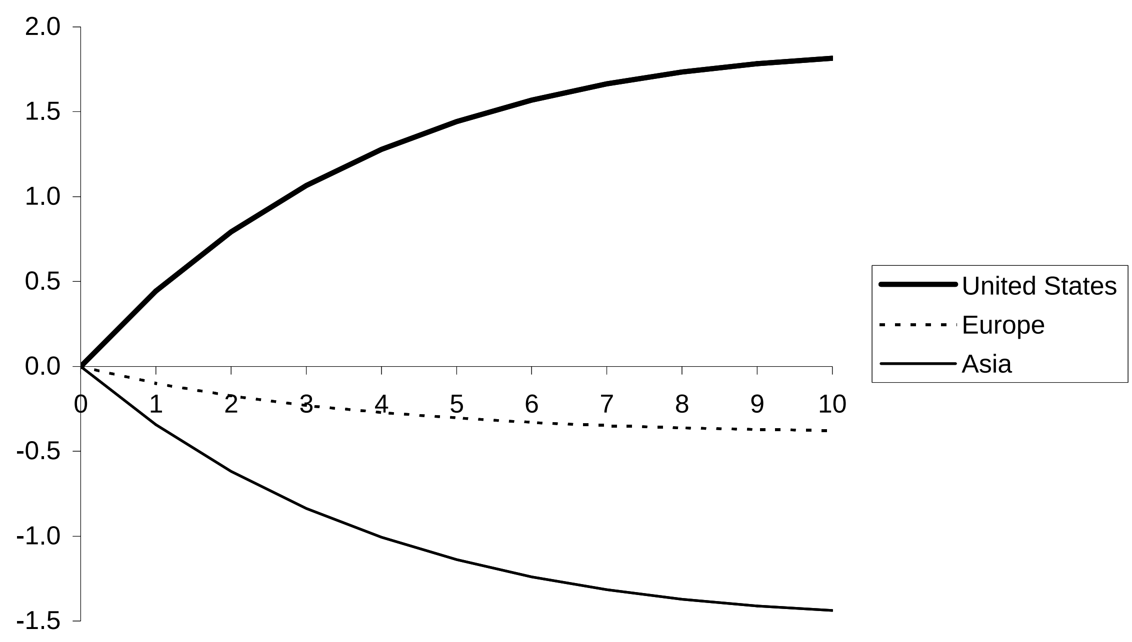


Figure 7: U.S. gross positions Percent of GDP

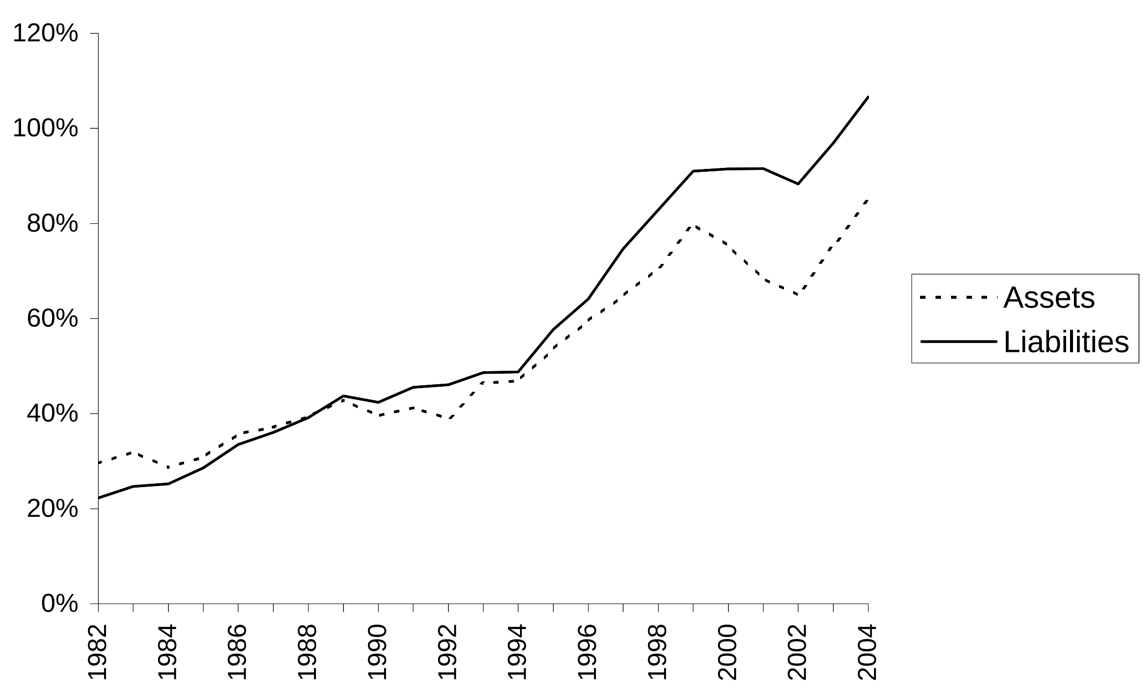


Figure 8: Components of the U.S. current account
Percent of U.S. traded output

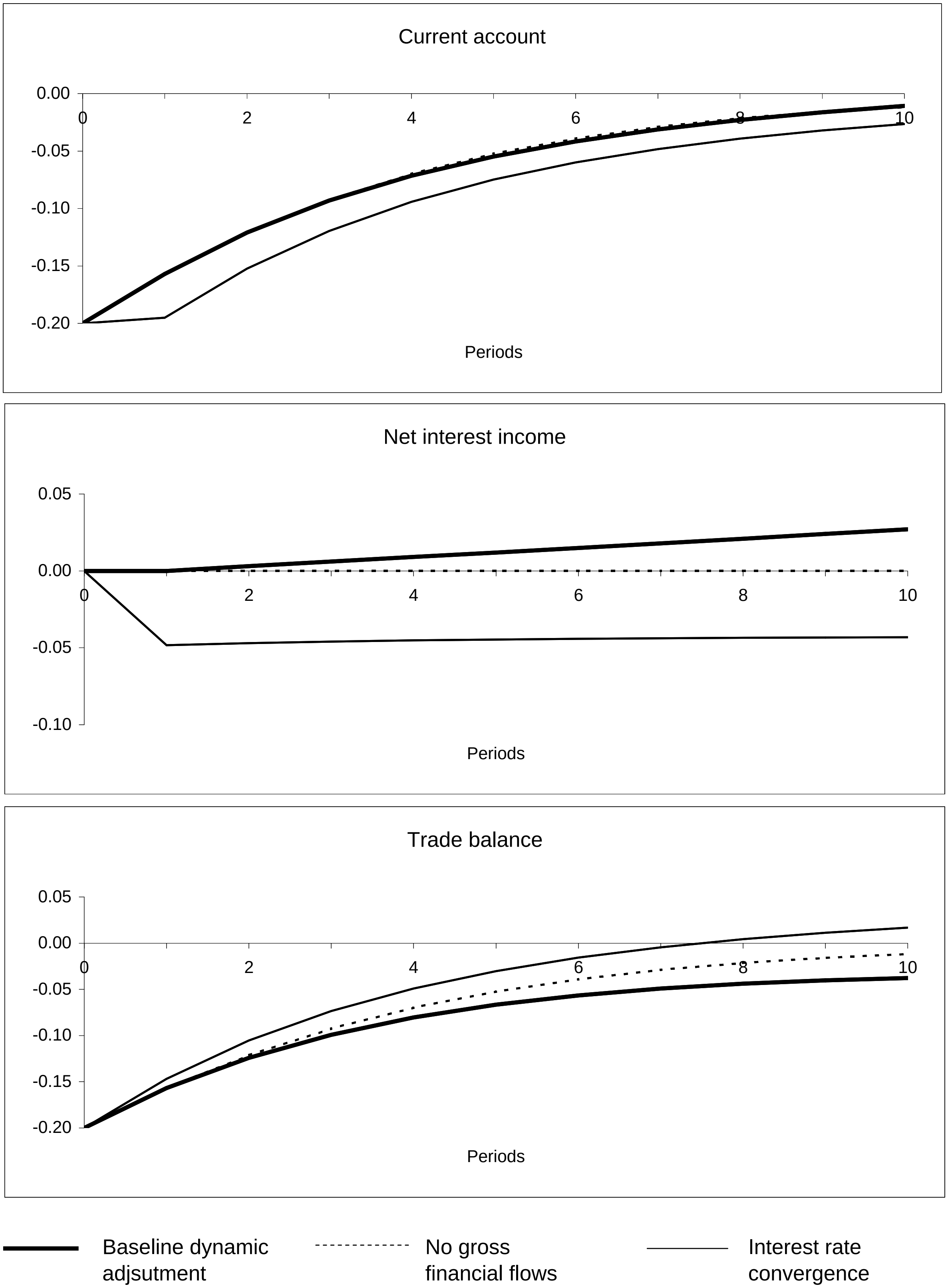


Figure 9: Interest rate on U.S. liabilities (rU)

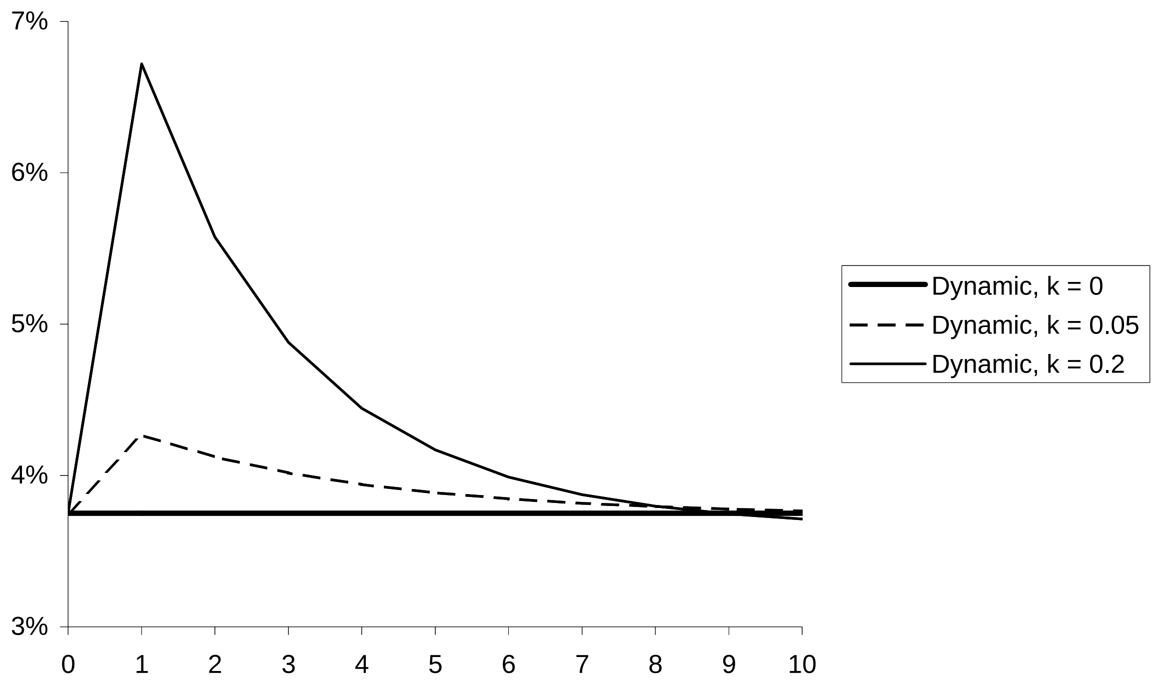


Figure 10: Impact of responsiveness of interest rates

rU long-run remains at 3.75 %

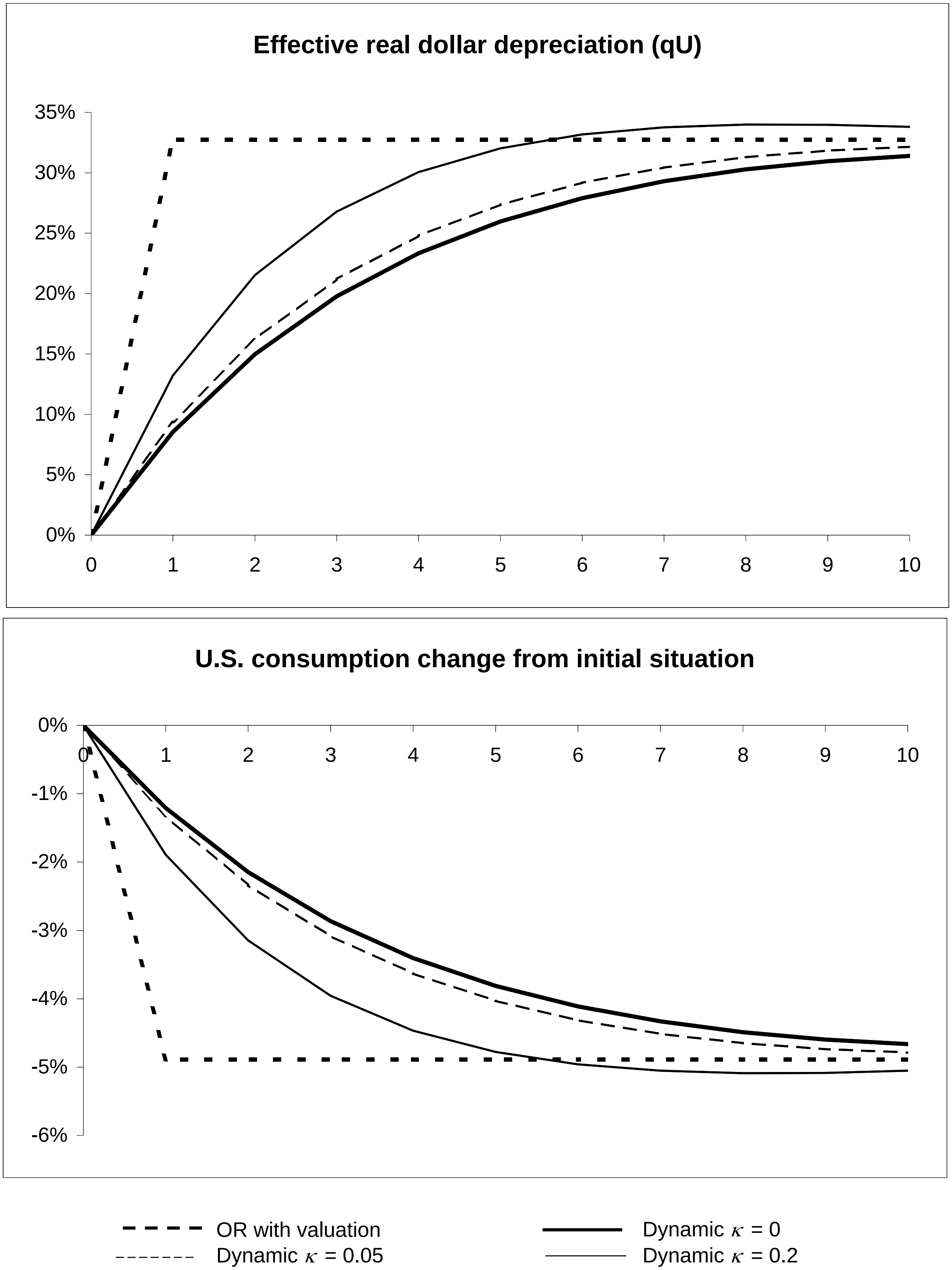
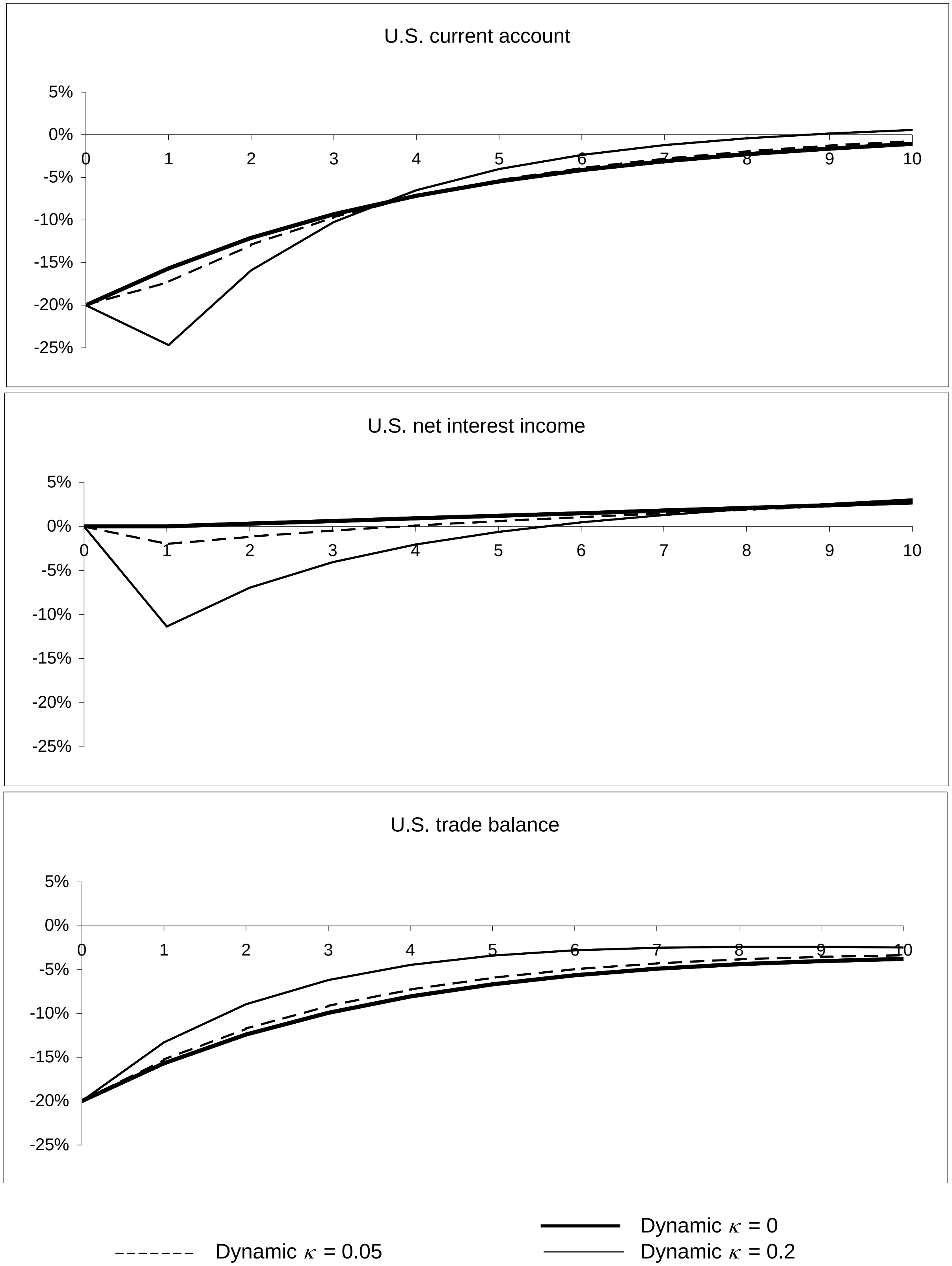


Figure 11: Impact of responsiveness of interest rates

rU long-run remains at 3.75 %



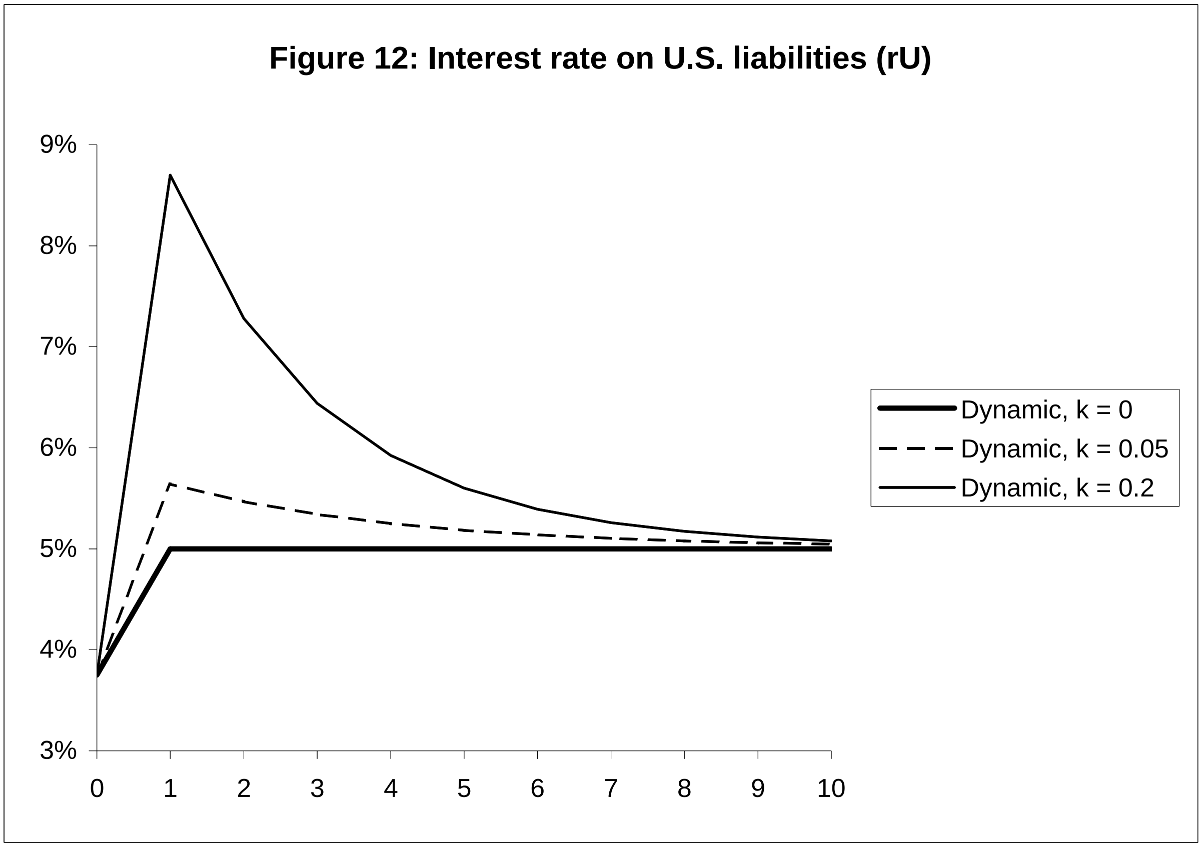


Figure 12: Interest rate on U.S. liabilities (rU)
9%
8%
7%
6%
5%
4%
3%
0
1
2
3
4
5
6
7
8
9
10
Dynamic, k = 0
Dynamic, k = 0.05
Dynamic, k = 0.2

Figure 13: Impact of responsiveness of interest rates

rU long-run goes to 5 %

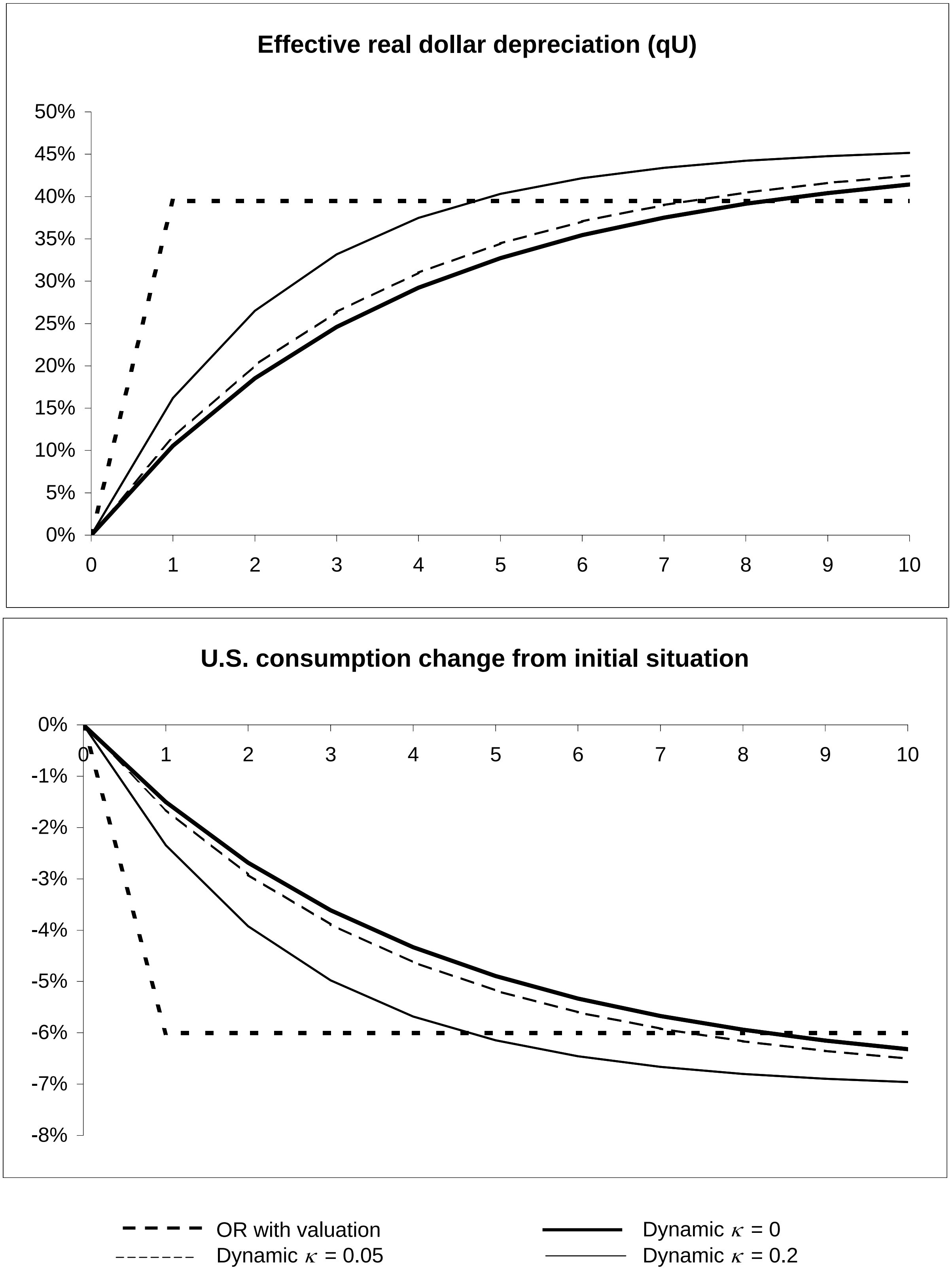


Figure 14: Impact of responsiveness of interest rates

rU long-run goes to 5 %