International Financial Adjustment*

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Abstract

The paper explores the implications of a country's external budget constraint to study the dynamics of net foreign assets and exchange rate movements. We show that deteriorations in a country's net exports or net foreign asset position relative to their trend have to be matched either by future net export growth (the trade channel) or by future increases in the returns of the net foreign asset portfolio, a hitherto unexplored valuation channel. Using a newly constructed data set on US gross foreign positions, we find that stabilizing valuation effects contribute as much as 27% of the cyclical external adjustment. Our approach also has asset pricing implications. Our measure of external imbalance predicts net foreign asset portfolio returns one quarter to two years ahead and net exports at longer horizons. The exchange rate affects the trade balance *and* the valuation of net foreign assets. It is forecastable in and out of sample at one quarter and beyond. A one standard deviation increase in external imbalances predicts an annualized 4% depreciation of the exchange rate over the next quarter.

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1 Introduction

Understanding the dynamic process of adjustment of a country's external balance is one of the most important questions for international economists. 'To what extent should surplus countries expand; to what extent should deficit countries contract?' asked Mundell (1968). These questions remain as important today as then. The modern theory focusing on those issues is the 'intertemporal approach to the current account' (see Sachs (1982) and Obstfeld and Rogoff (1995)). It views the current account balance as the result of forward-looking intertemporal saving decisions by households and investment decisions by firms. As Obstfeld (2001)[p11] remarks, 'it provides a conceptual framework appropriate for thinking about the important and interrelated policy issues of external balance, external sustainability, and equilibrium real exchange rates'.

This approach has yielded major insights into the current account patterns that followed the two oil price shocks of the seventies and the large U.S. fiscal deficits of the early eighties. Yet in many instances, its key empirical predictions are rejected by the data. Our paper suggests that this approach falls short of explaining the dynamics of the current account because it fails to incorporate capital gains and losses on the net foreign asset position.[1] The recent wave of financial globalization has come with a sharp increase in gross cross-holdings of foreign assets and liabilities. Such leveraged country portfolios open the door to potentially large wealth transfers across countries as asset and currency prices fluctuate. These valuation effects are absent not only from the theory but also from official statistics. The National Income and Product Accounts (NIPA) and the Balance of Payments report the current account at historical cost. Hence they give a very approximate and potentially misleading reflection of the change of a country's net foreign asset position.

These considerations are essential to discuss the sustainability of the unprecedently high US current account deficits. According to our calculations, the US experienced a strong deterioration of its net foreign asset position, from a sizeable creditor position in 1952 (15% of GDP) to a large debtor position by the end of 2003 (-24% of GDP) (see Figure 1). Moreover, the US foreign liability to GDP ratio has more than quadrupled since the beginning of the 1980s to reach 99% of GDP in 2003, while its foreign asset to GDP increased to 75% of GDP. The intertemporal approach to

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[1] Some papers have introduced time-varying interest rates (e.g. Bergin and Sheffrin (2000)). But most of these models either assume away predictable returns and wealth effects or reproduce complete markets –which reduces the current account to an accounting device. Kehoe and Perri (2002) is an interesting exception that introduces specific forms of endogenous market incompleteness. See also Kraay and Ventura (2000) and Mercereau (2003) for models that allow investment in risky assets with interesting empirical predictions.

the current account suggests that the US will need to run trade surpluses to reduce this imbalance. We argue instead that part of the adjustment can take place through a change in the returns on US assets held by foreigners relative to the return on foreign assets held by the US residents. Importantly, this wealth transfer may occur via a depreciation of the dollar. Since almost all of US foreign liabilities are in dollars and approximately 70% of US foreign assets are in foreign currencies, a back of the envelope calculation indicates that a 10% depreciation of the dollar represents, *ceteris paribus*, a transfer of 5.3% of US GDP from the rest of the world to the US. For comparison, the US trade deficit on goods and services was 'only' 4.5% of GDP in 2003.

[**Figure 1 about here**]

Our approach emphasizes this international financial adjustment mechanism. We start from a country's intertemporal budget constraint and derive two implications. The first is the link between a current shortfall in net savings and future trade surpluses. If total returns on net foreign assets are expected to be constant, today's current account deficits must be compensated by future trade surpluses. This is the traditional *'trade channel'*. The second (new) implication is at the center of our analysis. In the presence of stochastic asset returns which differ across asset classes, expected capital gains and losses on gross external positions constitute a hitherto unexplored *'valuation channel'*. An expected increase in the return on US equities relative to the rest of the world, for example, tightens the external constraint of the United States by raising the total value of the claims the foreigners have on the US. We estimate the respective contributions of the trade and valuation channels to the external adjustment process using a newly constructed data set on US gross foreign positions. We first control for slow moving trends in exports, imports, external assets and liabilities that we attribute to the gradual process of trade and financial integration. We construct a measure of external imbalances in *deviation from these trends*. It incorporates information both from the trade balance (the flow) and the foreign asset position (the stock). In the data, we find that, historically, about 27% of the cyclical international adjustment of the US is realized through valuation effects.

Our set up has also asset-pricing implications. The budget constraint implies that today's current external imbalances *must predict* either future export growth or future movements in returns of the net foreign asset portfolio, or both. We show in section 3 that our measure of external imbalances contains significant information about future returns on the US net foreign portfolio from a quarter up to two years out. A one standard deviation increase in external imbalances predicts an annualized excess return on foreign assets relative to US assets of 17% over the next quarter. At long horizons, it also helps predict net export growth. Hence, at short to medium horizons, the brunt of the (predictable) adjustment goes through asset returns, while at longer horizons it occurs via the trade balance. The valuation channel operates in particular through expected exchange rate changes. The dynamics of the exchange rate plays a major role since it has the dual role of changing the differential in rates of return between assets and liabilities denominated in different currencies and also of affecting future net exports. We find in section 3 that our measure of today's imbalances forecasts exchange rate movements at *short, medium and long horizons both in and out-of-sample.* In particular, we overturn the classic Meese and Rogoff (1983) result for the dollar multilateral exchange rate. A one standard deviation increase in our measure of external imbalances predicts an annualized 4% depreciation of the exchange rate over the next quarter.

Our methodology builds on the seminal works of Campbell and Shiller (1988) and, more recently, of Lettau and Ludvigson (2001) on the implication of the consumption wealth ratio for predicting future equity returns. In contrast with these papers, however, we also allow for slow-moving structural changes in the data capturing increasing trade and financial integration. Few papers have thought of the importance of valuation effects in the process of international adjustment. Lane and Milesi-Ferretti (2002) point out that the correlation between the change in the net foreign asset position at market value and the current account is low or even negative. They also note that rates of return on the net foreign asset position and the trade balance tend to comove negatively, suggesting that wealth transfers affect net exports. More recently, Tille (2003) discusses the effect of the currency composition of US assets on the dynamics of its external debt, Corsetti and Konstantinou (2004) provide an empirical analysis of the responses of US net foreign debt to permanent and transitory shocks, while Lane and Milesi-Ferretti (2004) document exchange rate effects on rates of return of foreign assets and liabilities for a cross-section of countries. None of these papers, however, provides a quantitative assessment of the importance of the financial and trade channels in the process of international adjustment nor explores the asset pricing implications of the theory.

The remainder of the paper is structured as follows. Section 2 presents the theoretical framework that guides our analysis. Empirical results are presented in section 3. We first quantify the importance of the valuation and trade channels in the process of external adjustment. We then explore the asset pricing implications of our theory. Section 4 concludes.

2 International financial adjustment.

This section explores the implications of a country's external budget constraint and long run stability conditions for the dynamics of external adjustment. We define a measure of external imbalances and show that current imbalances must be offset by future improvements in trade surpluses, or excess returns on the net foreign portfolio, or both.

We start with the accumulation identity for net foreign assets between period t and $t+1$:

$$NA_{t+1} \equiv R_{t+1}\left(NA_t + NX_t\right) \tag{1}$$

NX_t represents net exports, defined as the difference between exports X_t and imports M_t of goods and services. NA_t represents net foreign assets, defined as the difference between gross external assets A_t and gross external liabilities L_t measured in the domestic currency, while R_{t+1} denotes the (gross) return on the net foreign asset portfolio, a combination of the (gross) return on assets R^a_{t+1} and the (gross) return on liabilities R^l_{t+1}.[2] Equation (1) states that the net foreign position improves with positive net exports and with the return on the net foreign asset portfolio.[3]

To explore further the implications of equation (1), a natural strategy consists in observing that, along a balanced-growth path, the ratios of exports, imports, external assets and liabilities to wealth are all statistically stationary.[4] In that case, one could follow the methodology of Campbell and Shiller (1988) and Lettau and Ludvigson (2001) and log-linearize equation (1) around the steady state mean ratios to obtain an approximate external constraint.[5] For the U.S., however, we face the immediate problem that the ratios of exports, imports, external assets and liabilities to wealth are not stationary over the postwar period. As figure 2 indicates, the variables Z_t/W_t, where

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[2] In equation (1), net foreign assets are measured at the beginning of the period. This timing assumption is innocuous. One could instead define NA'_t as the stock of net foreign assets at the end of period t, i.e. $NA_{t+1} = R_{t+1}NA'_t$. The accumulation equation becomes: $NA'_{t+1} = R_{t+1}\ NA'_t + NX_{t+1}$.

[3] In practice, net foreign assets could also change because of unilateral transfers, capital account transactions or errors and omissions. Transfers and capital account transactions are typically small for the US, while errors and omissions are excluded from the financial account in the BEA's estimates of the US International Investment Position. We abstract from these additional terms. See Gourinchas and Rey (forthcoming 2006) for details.

[4] For instance, in a Merton-type portfolio allocation model, the portfolio shares A_t/W_t and L_t/W_t are stationary as long as gross assets and liabilities are not perfect substitutes.

[5] See Appendix A for a detailed derivation along these lines.

$Z_t \in \{X_t, M_t, A_t, L_t\}$ and W_t denotes domestic wealth, exhibit a strong upward trend.[6] Where are these trends coming from? A natural explanation is that they represent structural changes in the world economy, such as financial and trade globalization. International financial interdependence has grown tremendously among industrial countries. In the past twenty years, for example, gross assets and liabilities have tripled as a share of GDP.[7] This increased financial integration has been brought about in particular by the phasing out of the Bretton-Woods-inherited restrictions on international capital mobility and by fast progress in telecommunication and trading technologies. In parallel, trade flows have also sizably increased, spurred by declines in unit transport costs, and the development of multinational companies.[8] Indeed, looking at international financial integration from a historical perspective (see for example Obstfeld and Taylor (2004)), capital mobility increased between 1880 and 1914; decreased between the First World War and the end of the Second World War; and has been increasing since then.

[**Figure 2 about here**]

The approach we develop in this paper has nothing to say about these structural changes. Henceforth, we study the process of international adjustment *around* these slow-moving trends. Formally, we make the assumption that the intertemporal budget constraint holds *along* these trends. This is a natural assumption since there are no reason to think that long-run structural shifts in goods and financial market integration lead the U.S. to violate its budget constraint in the absence of shocks. Under that assumption, we show that we can 'purge' the data from the trend component in Z_t/W_t and concentrate on the fluctuations of the net asset and net export variables in *deviation* from these trends.[9]

2.1 Log-linearization of the external constraint

Formally, using lower-case variables to denote the logarithm of upper-case variables ($z \equiv \ln Z$), and Δ to denote first differences ($\Delta z_{t+1} \equiv z_{t+1} - z_t$), we make the following assumptions:

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[6] Formal tests confirm the visual impression. Simple ADF-tests of the non-stationarity of $\ln Z_t/W_t$ fail to reject the null of unit root for all four variables while the Kwiatkowski, Phillips, Schmidt and Shin (1992)'s test of stationarity rejects mean stationarity at the 1% level.

[7] For the US, gross external assets (resp. liabilities) increased from 30% (resp. 22%) of GDP in 1982, to 75% (resp. 99%) in 2003.

[8] For the US, the ratio of exports (resp. imports) over GDP increased from 5.3% (resp. 4.3%) in 1952, to 9.8% (resp. 14.1%) in 2004.

[9] An analogy might help: our enterprise is parallel to the business cycle literature which separates trend growth from medium frequency fluctuations and focuses exclusively on the latter. It differs in that the trends we consider have considerably lower frequency. Section 3 discusses our approach to detrending in more detail.

Assumption 1 *Let* $z_t \in \{x_t, m_t, a_t, l_t\}$ *and* w_t *be stochastic processes.*

(a) The variables $z_t - w_t$ *admit the following decomposition:*

$$z_t - w_t = \ln \mu_t^{zw} + \epsilon_t^z \tag{2}$$

where $\ln \mu_t^{zw}$ *represents the trend and* ϵ_t^z *the stationary components of* $z_t - w_t$*.*

(b) The trend components μ_t^{zw} *converge asymptotically to a constant value:*

$$\lim_{t \to \infty} \mu_t^{zw} = \mu^{zw}$$

Assumption 2 *The growth rate of domestic wealth* Δw_{t+1} *is stationary with steady state mean value* $\ln \Gamma$.

Assumption 3 *The return on gross assets* R_{t+1}^a*, gross liabilities* R_{t+1}^l *and the net foreign asset portfolio* R_{t+1} *are stationary with a common steady state mean value* R *that satisfies* $R > \Gamma$*.*

Assumption 4 *The external constraint (1) holds 'along the trend', i.e.:*

$$\left(\mu_{t+1}^{aw} - \mu_{t+1}^{lw}\right) = R/\Gamma \left(\mu_t^{aw} - \mu_t^{lw} + \mu_t^{xw} - \mu_t^{mw}\right) \tag{3}$$

Assumption 1-(a) decomposes the variables of interest into a trend and a stationary component. Assumption 1-(b) allows different variables to have different trends in the sample, as observed on Figure 2 (the figure reports our estimates of the trends μ_t^{zw} as well as the deviations ϵ_t^z). Together with assumption 2, it imposes that all variables eventually grow at the same rate Γ along a balanced-growth path. We view these restrictions as very mild: they simply rule out the implausible situation where, e.g., the rate of growth of external assets would *permanently* exceed the rate of growth of the economy. On the other hand, they allow for a permanent increase in the ratio of gross assets to wealth, as observed in the data. The assumption that the long-term growth rate of the economy is lower than steady-state rates of return (assumption 3) is a common equilibrium condition in many growth models. In our context, it has an intuitive interpretation: manipulating equation (1), one can show that if assumption 3 holds, the steady state mean ratio of net exports to net foreign assets NX/NA satisfies

$$NX/NA = \rho - 1 < 0 \tag{4}$$

where $\rho \equiv \Gamma/R < 1$. In words, countries with long run creditor positions ($NA > 0$) should run trade deficits ($NX < 0$) while countries with steady state debtor positions ($NA < 0$) should run trade surpluses ($NX > 0$).

Assumption 4 is quite natural: it implies that, absent any shocks, the U.S. would still face its external constraint, but now evaluated at the mean growth-adjusted return R/Γ.[10] We discuss its empirical validity in details in section 3.

The following lemma establishes that –under the above assumptions– we can derive a simple and intuitive log-linear approximation of the external budget constraint.

Lemma 1 *Define* $nx_t \equiv \mu_t^x \epsilon_t^x - \mu_t^m \epsilon_t^m$, $na_t \equiv \mu_t^a \epsilon_t^a - \mu_t^l \epsilon_t^l$ *and* $\hat{r}_{t+1} \equiv \mu_{t+1}^a r_{t+1}^a - \mu_{t+1}^l r_{t+1}^l$. *Under assumptions 1-4, a first-order approximation of the external constraint (1) satisfies:*

$$na_{t+1} \approx \frac{1}{\rho_t} na_t + (\hat{r}_{t+1} - \Delta w_{t+1}) - \left(\frac{1}{\rho_t} - 1\right) nx_t \tag{5}$$

where

$$\begin{aligned} \mu_t^x &= \frac{\mu_t^{xw}}{\mu_t^{xw} - \mu_t^{mw}}; \quad \mu_t^m = \mu_t^x - 1; \\ \mu_t^a &= \frac{\mu_t^{aw}}{\mu_t^{aw} - \mu_t^{lw}}; \quad \mu_t^l = \mu_t^a - 1; \\ \rho_t &\equiv 1 + \frac{\mu_t^{xw} - \mu_t^{mw}}{\mu_t^{aw} - \mu_t^{lw}}. \end{aligned}$$

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Proof. See appendix B. ■

The weights μ_t^z are not constant but converge asymptotically to a constant μ^z. Similarly, the growth-adjusted discount factor ρ_t is also time varying and converges asymptotically to ρ. μ_t^x represents the (trend) share of exports in the trade balance. Similarly, μ_t^a denotes the (trend) share of assets in the net foreign assets.[11] The variable nx_t is a linear combination of the stationary components of (log) exports and imports to wealth ratios that we shall call, with some abuse of language, 'net exports'. In the same fashion, na_t is a linear combination of the stationary components (log) assets and liabilities to wealth ratios, that we call, also with some abuse of language, 'net foreign assets'. Finally, $\hat{r}_{t+1}$, is an approximation of the net portfolio return, i.e. a linear combination of the (log) return on assets $r_{t+1}^a \equiv \ln R_{t+1}^a$ and the (log) return on liabilities $r_{t+1}^l \equiv \ln R_{t+1}^l$. Equation (5) carries the same interpretation as equation (1) with a few differences. First, it involves only the stationary component ϵ_t^z of the ratios $\ln Z_t/W_t$; second, these stationary components are multiplied by time-varying weights μ_t^z that reflect the trends in the data; finally,

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[10] The assumption of a constant return along the trends simplifies the derivation and can be relaxed if we assume a different mean return on assets and liabilities (Gourinchas and Rey (forthcoming 2006) show that the return on US external assets consistently exceeds the return on gross liabilities). Appendix A of our working paper (Gourinchas and Rey (2005)) shows that this does not alter our analysis substantially.

[11] These trend-weights are well-defined since $\mu_t^{aw} \neq \mu_t^{lw}$ and $\mu_t^{xw} \neq \mu_t^{mw}$ almost everywhere in our sample.

everything is normalized by wealth, hence the rate of return $\hat{r}_{t+1}$ is adjusted for the growth rate of wealth (Δw_{t+1}).

2.2 A measure of external imbalances

Equation (5) simplifies drastically in the special case where the trend components μ_t^{zw} have a common -possibly time-varying- growth rate. In that case, the weights μ_t^z are constant, equal to their asymptotic value μ^z and ρ_t is constant and equal to ρ. This is an important case for two reasons. First, from assumption 1, this is the relevant case asymptotically. Second, and more importantly, we show in section 3 that assuming constant weights provides a robust and accurate approximation of the general case.[12] Hence we make the following assumption:

Assumption 5 *The trend components admit a common, possibly time varying, growth rate: for* $z_t \in \{x_t, m_t, a_t, l_t\}$, $\mu_t^{zw} = \mu^{zw} \cdot \mu_t$.

We obtain the following result:

Lemma 2 *Under assumptions 1-5, a first-order approximation of the external constraint (1) satisfies:*

$$nxa_{t+1} \approx \frac{1}{\rho} nxa_t + r_{t+1} + \Delta nx_{t+1} \tag{6}$$

where:

$$\begin{aligned} nxa_t &\equiv |\mu^a| \cdot \epsilon_t^a - |\mu^l| \cdot \epsilon_t^l + |\mu^x| \cdot \epsilon_t^x - |\mu^m| \cdot \epsilon_t^m && (7) \\ \Delta nx_{t+1} &\equiv |\mu^x| \cdot \Delta\epsilon_{t+1}^x - |\mu^m| \cdot \Delta\epsilon_{t+1}^m - \Delta w_{t+1} && (8) \\ r_{t+1} &\equiv |\mu^a| r_{t+1}^a - |\mu^l| r_{t+1}^l && (9) \end{aligned}$$

Proof. See appendix B. ■

nxa_t combines linearly the stationary components of exports, imports, assets and liabilities. It is a well-defined measure of cyclical external imbalances. Unlike the current account, it incorporates information both from the trade balance (the flow) and the foreign asset position (the stock). Since it is defined using the absolute values of the weights μ^z, nxa always increases with assets and exports and decreases with imports and liabilities.

Δnx_{t+1} represents net export growth between t and $t+1$, while the return r_{t+1} is defined so as to increase with return on foreign assets and decrease with the return on foreign liabilities.[13] Just

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[12] It is important to realize that the assumption that the weights are constant does not imply that $z_t - w_t$ is stationary. It only imposes a common -and time-varying- trend growth rate for X, M, A and L.

[13] The term in Δw_{t+1} enters the definition of Δnx_{t+1} because ϵ_t^x (resp. ϵ_t^m) measure the stationary component of the ratio of exports (resp. imports) to wealth.

like (1) and (5), equation (6) shows that a country can improve its net foreign asset position either through a trade surplus ($\Delta nx_{t+1} > 0$) or through a high return on its net foreign asset portfolio ($r_{t+1} > 0$).

We can solve equation (6) forward under the no-ponzi condition that nxa cannot grow faster than the steady state growth adjusted interest rate:

Assumption 6 *nxa_t satisfies the no-ponzi condition*

$$\lim_{j \longrightarrow \infty} \rho^j nxa_{t+j} = 0 \textit{ with probability one}$$

We obtain:

Proposition 1 *Lemma 2 and assumption 6, imply that the intertemporal external constraint satisfies approximately:*

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j \left[r_{t+j} + \Delta nx_{t+j} \right] \tag{10}$$

Proof. See appendix B. ■

Finally, since equation (10) must hold along every sample path, it must also hold in expectations:

Corollary 1 *Under the conditions for proposition 1 the intertemporal external constraint satisfies approximately:*

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j E_t \left[r_{t+j} + \Delta nx_{t+j} \right] \tag{11}$$

Equation (11) is central to our analysis. It shows that movements in the trade balance and the net foreign asset position must forecast either future portfolio returns, or future net export growth, or both. Consider the case of a country with a negative value for nxa, either because of a deficit in the cyclical component of the trade balance, or a cyclical net debt position, or both. Suppose first that returns on net foreign assets are expected to be constant: $E_t r_{t+j} = r$. In that case, equation (11) posits that any adjustment *must* come through future increases in net exports: $E_t \Delta nx_{t+j} > 0$. This is the standard implication of the intertemporal approach to the current account.[14] We call this channel the *trade channel*.

We emphasize instead that the adjustment may also come from high expected net foreign portfolio returns: $E_t r_{t+j} > 0$.[15] We call this channel the *valuation channel*. Importantly such

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[14] See Obstfeld and Rogoff (forthcoming 2006) for an analysis along these lines.

[15] It is of course possible that some of today's adjustment comes from an *unexpected* change in asset prices or exports. These unexpected changes would be reflected simultaneously in the left and right hand side of equation (11). We do not focus on such surprises.

predictable returns can occur via a depreciation of the domestic currency. While such depreciation certainly also helps to improve future net exports, the important point is that it operates through an entirely different channel: a predictable wealth transfer from foreigners to domestic residents. While the empirical asset pricing literature has produced a number of financial and macro variables with forecasting power for stock returns and excess stock returns in the U.S, to our knowledge, our approach is the first to produce a predictor of the return on domestic assets relative to foreign assets.

The role of the exchange rate can be illustrated by considering the case -relevant for the US- where foreign liabilities are denominated in domestic currency while foreign assets are denominated in foreign currency. We can then rewrite r_{t+1} as:

$$r_{t+1} = |\mu^a| \cdot \left(r^{*a}_{t+1} + \Delta e_{t+1}\right) - |\mu^l| \cdot r^l_{t+1} - \pi_{t+1} \tag{12}$$

where r^{*a}_{t+1} represent the (log) *nominal* returns *in foreign currency*, Δe_{t+1} is the rate of depreciation of the nominal exchange rate (measured as the domestic price of the foreign currency) and π_{t+1} is the realized domestic inflation rate between periods t and $t+1$. Holding local currency returns constant, a currency depreciation increases the domestic return on foreign assets, an effect that can be magnified by the degree of leverage of the net foreign asset portfolio when $|\mu^a| > 1$.

It is important to emphasize that since equation (10) holds in expectations but also along every sample path, one cannot hope to 'test' it.[16] Yet it presents several advantages that guide our empirical strategy. First, this identity contains useful information: a combination of exports, imports, gross assets and liabilities -properly measured- can move *only if it forecasts either future returns on net foreign assets or future net export growth*. The remainder of the paper evaluates empirically the relative importance of these two factors in the dynamics of adjustment and investigates at what horizons they operate. Second, our modeling relies only on the intertemporal budget constraint and some long run stability conditions. Hence, it is consistent with most models. We see this as a strength of our approach, since it nests any model that incorporates an intertemporal budget constraint. More specific theoretical mechanisms can be introduced and tested as restrictions within our set up. They will have to be consistent with our empirical findings regarding the quantitative importance of the two mechanisms of adjustment and the horizons at which they operate. Thus our findings provide useful information to guide more specific theories.

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[16] Technically, only equation (1) is an identity. Equation (11) holds up to the log-linearization approximations if (a) assumptions 1-6 hold and (b) expectations are formed rationally.

3 Empirical results.

3.1 Measuring External Imbalances

In section 2 we used the intertemporal budget constraint to construct a measure of external imbalances, nxa_t, defined as a linear combination of detrended (log) exports (ϵ_t^x), imports (ϵ_t^m), gross foreign assets (ϵ_t^a) and liabilities (ϵ_t^l) relative to wealth. In this section, we estimate nxa_t and quantify the share of the adjustment coming from net exports and from valuation effects using a vector autoregression (VAR). We then investigate the forecasting properties of our measure of external imbalance. To implement empirically our methodology we use newly constructed quarterly estimates of the US net and gross foreign asset positions at market value between 1952:1 and 2004:1, as well as estimates of the capital gains and total returns on these global country portfolios. Figure 1 reports net foreign assets and net exports, relative to GDP. A brief description of the data is relegated to appendix C.[17]

We decompose the variables $z_t - w_t$ into a low-frequency trend $\ln \mu_t^{zw}$ and a stationary component ϵ_t^z according to equation (2). μ_t^{zw} reflects low frequency structural changes in the world economy due to trade and financial integration. If the twentieth century has been characterized by one wave of decreasing globalization (from 1913 to 1945), followed by one -unfinished- period of increased globalization, it seems appropriate to define the trend component as a low-pass filter with a relatively low frequency cut-off. In practice, we choose to implement this with a Hodrick-Prescott filter set to filter out cycles of more than fifty years.[18] We note three important features of our filtering procedure. First, by construction, the HP filter removes unit roots from the data (see King and Rebelo (1993)). Second, since we eliminate only very low frequencies, the variables ϵ_t^z still contain most frequency components. In other words, our approach enables us to render the data stationary while keeping most of the information from the time series. Third, filtering out only very low frequencies mitigates end point problems common with two-sided filters.[19] We per-

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[17] See Gourinchas and Rey (forthcoming 2006) for a detailed description of the data.

[18] To select the smoothing parameter of the HP filter we impose that the frequency gain of the filter be equal to 70% at the frequency corresponding to a fifty-year cycle. In standard business cycle applications with quarterly data, the gain is 70% at 32 quarters (8 years).

[19] Stock and Watson (1999) argue for a one-sided HP filter. We obtained similar results using their one-sided filter. In finite sample, however, a one-sided filter is problematic since it acts as a filter with varying frequency cut-off at different points in the sample. At the beginning of the sample, it keeps inside the trend more high frequency components since it has few observations to work with (think about computing a trend with only two observations: necessarily everything is kept inside the trend; the HP filter needs at least four observations, but the basic point remains). As more observations are added, the frequency cut-off effectively drops, so that the trend contains less and less high frequency components for later observations in the sample. We dislike the one-sided filter for another reason: from the point of view of in-sample regressions, dropping observations leads to a less accurate estimate of the trend component (even if the frequency cut-off was appropriately maintained).

formed numerous robustness checks by considering shorter cycles (30 and 40 years), longer cycles (100 years) and the extreme case of linear trends.[20] The exact filter used does not matter provided it takes out only slow moving trends[21]**.** Figure 2 reports the constructed values for the trend and cycle components.

It is worth pausing here to discuss in more details how our detrending procedure might affect our empirical results**.** By assuming that the US external constraint holds along the trend (assumption 4), we purposely abstract from the mechanisms that ensure that this trend external constraint holds. Our interpretation is that they are irrelevant for the process of adjustment which we do study in this paper, i.e. the cyclical adjustment. Clearly, in the sample some significant imbalances are building along these trends (see figure 2). This raises a number of important questions. Shouldn't the exchange rate or other asset returns play a role in the rebalancing of these 'trend imbalances'? If so isn't a trend estimated on the entire sample period already capturing part of the impact of exchange rates on net foreign asset positions? These are important points to address. Indeed, US 'trend-imbalances' will need to stabilize at some point in the future. Does this imply that we are throwing away relevant information with our detrending procedure? There are two reasons why this issue is not a concern for our empirical work.

First, suppose that there is indeed a link between 'trend imbalances' and future exchange rate or asset price movements. For instance, suppose that –given the large current US 'trend imbalances'– the US dollar does need to depreciate in the future. If anything, this should *reduce* the predictive power of our variable nxa, since it is constructed from detrended variables. This is especially so given that we predict the *actual* (not detrended in any way) depreciation rate of the currency and the *actual* returns on the net portfolio, equities, etc... (see equation (11)). Therefore if there is any information in the trends that is relevant for *any* of these variables, by taking the trends out, we are biasing the exercise towards finding *no* predictability.[22]

Second, we only take out very slow moving trends (with cycle of 50 years and more in our benchmark estimates). This could still be a problem to the extent that real exchange rates too

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[20] We also experimented with Christiano and Fitzgerald (2003)'s asymmetric filter and using GDP instead of household wealth in the denominator. All our results are very robust to these changes and are reported in an appendix available upon request.

[21] Since the different estimates of nxa are essentially identical, this indicates that sampling uncertainty is not a relevant issue when using nxa as a regressor.

[22] Another possibility is that our predictability results are spurious. For this to be the case, it would have to be that the predictive power in our regressions does not come from our variable nxa, as we think it does, but instead that nxa is correlated with these trends. Yet we find no correlation between the 'trend' and 'cyclical' imbalances: 'trend imbalances' have been increasing more or less monotonically throughout the sample. By contrast nxa is large and negative in 1983-1990, then large and positive in 1990-2000 (see figure 3).

may exhibit low frequency trends. But theories of long run trends in real exchange rates, such as Balassa Samuelson, emphasize the role of productivity differentials. These models do not have any particular implication for long-run trade balances. The key insight is that Balassa Samuelson effects come from the supply side, independently from the demand structure. In turn, the demand structure controls what happens to the trade balance. Hence it is possible to have trending real exchange rates due to productivity differentials and worsening, improving or unchanged long run trade imbalances, depending upon the specification of preferences. A real world example of this is the appreciation of the Japanese real exchange rate between the 1950s and the 1990s, which has not been matched by any secular trend in the bilateral Japan US trade.

While, as just argued, trends in real exchange rates may have no effect on trade balances, they may, in theory, still contribute to the valuation channel by changing the relative value of gross assets and gross liabilities. This would have two implications for our analysis. First, it would imply that our detrending procedure tilts the results in favor of the trade channel of adjustment and against the valuation channel: removing the trend part of A and L, we also eliminate their potential contributions to explaining the 'trend exchange rate'. Again, this would bias the exercise against finding predictability in returns. To the extent that we want to establish the importance of the valuation channel, our results should then be interpreted as lower bounds on the contribution of that channel. Second, "a trend valuation channel" would require that predictable excess returns persist over very long horizons (basically, at the horizon at which we are detrending: 50 years and above). We find this hard to believe. If, as seems more reasonable, predictable excess returns disappear at these very long horizons, then the logical implication is that valuation effects cannot be playing a role in the trend rebalancing, and the trend in real or nominal exchange rates does not play any role in the valuation channel either. Either way, we feel our results are quite robust to trends in the exchange rate.

To summarize, the null we maintain is one where we remain agnostic about the role of the exchange rate in eliminating US 'trend imbalances'. The alternative –where exchange rates would have a role in the 'trend adjustment' at the horizons we investigate would bias our exercise againt finding forecastability since by detrending, we would be throwing away relevant information.

To construct the net foreign assets na_t and net exports nx_t (see lemma 1) we need estimates of the time-varying weights μ_t^z. Doing so raises two important empirical issues. First, since the U.S. goes from being a net creditor/net exporter to being a net debtor/net importer, these weights exhibit large non-linear variations, especially in the neighborhood of $\mu_t^{aw} = \mu_t^{lw}$ and $\mu_t^{xw} = \mu_t^{mw}$.

Clearly, these fluctuations dominate the movements in na and nx but have little to do with the adjustment process. Second, our variables (especially A, L and W, less so X and M) are measured imprecisely. These measurement errors get magnified by the non-linearity in the weights. In order to get around these issues, we replace the time varying weights by their sample average. With constant weights, corollary 1 applies and we can construct an approximate measure of external imbalances as $nxa_t = |\mu^a| \centerdot \epsilon_t^a - |\mu^l| \centerdot \epsilon_t^l + |\mu^x| \centerdot \epsilon_t^x - |\mu^m| \centerdot \epsilon_t^m$ (see equation 7). The benefits of doing so are threefold. First, by fixing the weights, we reduce the impact of measurement errors. This makes our empirical exercise much more robust. Second, constant weights are consistent with our approach, which focuses on the adjustment in the deviations from trend (ϵ_t^z) as opposed to the internal dynamics imparted by the trends themselves (μ_t^{zw}). Third, our constructed nxa is robust to the changes in sign of the net foreign assets and net exports variables. The drawback is that we are losing some information. We diagnose how serious this loss is in three steps. First, we directly check the accuracy of equation (6) and find a small and stationary approximation error (see below). Second, using our VAR estimates, we show that this approximation error is conditionally uncorrelated with the variables of interest (see section 3.2). Third, we show that, even with constant weights, our measure of external imbalances performs very well and predict future returns and exchange rates in and out of sample (sections 3.3-3.6). Hence, it seems that little relevant information is omitted by setting the weights to their sample average.[23]

Using quarterly data from the first quarter of 1952 to the first quarter of 2004, we obtain the following estimates:

$$\mu^a = 8.49\ ;\ \mu^l = 7.49\ ;\ \mu^x = -9.98\ ;\ \mu^m = -10.98; \qquad \rho = 0.95$$

and construct nxa using equation (7) to obtain:[24]

$$nxa_t = 0.85 \centerdot \epsilon_t^a - 0.75 \centerdot \epsilon_t^l + \epsilon_t^x - 1.1 \centerdot \epsilon_t^m$$

We observe that nxa puts similar weights on gross assets, gross liabilities, gross exports and gross imports. The resulting nxa is reported on Figure 4(a). Several features are noteworthy. First, we observe a pattern of growing cyclical imbalances, starting in 1976-79, then 1983-89 and 2001

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[23] As a robustness check, we also computed different weights for the first part of the sample (between 1952 and 1973) and the second part of the sample (post Bretton Woods). The results are very similar and available from the authors upon request.

[24] In this expression, we normalize nxa so that the weight on exports is unity. This is a natural normalization since it implies that nxa is expressed 'in the same units as exports': it measures approximately the percentage increase in exports necessary to restore external balance.

to the present. Second, the cyclical imbalance of 2003 was in fact slightly smaller than the one of the mid-80s despite burgeoning trade deficits since the end of the 90s, indicating that most of the additional imbalances are 'trend imbalances'. According to the figure, the cyclical external imbalance represented about 25.0% of exports in 1985:4. By contrast, the external imbalance represented 'only' 18.1% of exports in 2003:1 and has since shrunk by more than half to 7.6% as of 2004:1.

[Figure 3 about here]

Table 1 reports some summary statistics on nxa_t, as well as some asset returns and the rate of depreciation of the relevant financially weighted exchange rate, constructed using FDI country weights (see appendix C). All the returns are total quarterly returns, including capital gains and losses. Table 1 indicates that nxa and the return on the portfolio on net foreign assets are quite volatile. The standard deviation of export and import growth (4.28 and 3.81) is much smaller than the standard deviation of the net portfolio return (13.16). The return on gross assets is equivalent to the return on gross liabilities (each about 0.78% per quarter), and also to the return on the net foreign position (0.72% per quarter). Looking at the subcomponents, domestic and foreign dollar equity and foreign direct investment average returns r_t^{le}, r_t^{ae} r_t^{lf} and r_t^{af} exceed average bond returns r_t^{ad} and r_t^{ld}, in turn larger than returns on short term assets r_t^{ao} and r_t^{lo}. As is well-known, the volatilities satisfy the same ranking. The exchange rate exhibits a smaller volatility than equity returns, comparable to the volatility of bond returns. Finally, most returns, exports and imports growth and the exchange rate exhibit little autocorrelation. By contrast, nxa exhibits substantial serial correlation (0.92).

[Table 1 about here]

Let us now revisit the validity of equation (6) as an approximation to the external constraint (1). We provide direct evidence that the assumptions behind lemma 2 do not do much violence to the data by looking at the approximation error from equation (6). Since the stationary components ϵ_t^z are constructed separately for each variable z, there is no reason, a priori, to expect equation (6) to hold exactly unless it represents an accurate characterization of the external dynamics around the trends. Figure 3 reports this 'approximation term' $\varepsilon_t = nxa_t - \frac{1}{\rho} nxa_{t-1} - r_t - \Delta nx_t$ defined as the difference between the left and right hand side of (6) (panel c), together with nxa_t (panel a) and the 'flow term' $r_t + \Delta nx_t$ (panel b). As can be seen immediately from the figure, this error term is quite small relative to both nxa and the flow component, for most of the sample period.[25] We emphasize that nothing in our empirical approach ensures that this term remains small. That it is so validates our empirical procedure. A second check on the validity of our assumptions relies on the VAR estimates presented in the next subsection. There, we test directly the restriction that the error term is conditionally uncorrelated with the variables of interest: $E_{t-1}[\varepsilon_t] = 0$.

3.2 The financial and trade channels of external adjustment

nxa_t is a theoretically well-defined measure of cyclical external imbalances. By decomposing it into a return and a net export component and observing their variation over time, we can gain clear insights regarding the relative importance of the trade and financial adjustment channels. We rewrite equation (11) as:

$$\begin{aligned} nxa_t &= -\sum_{j=1}^{+\infty} \rho^j E_t r_{t+j} - \sum_{j=1}^{+\infty} \rho^j E_t \Delta nx_{t+j} \\ &\equiv nxa_t^r + nxa_t^{\Delta nx} \end{aligned} \tag{13}$$

nxa_t^r is the component of nxa_t that forecasts future returns, while $nxa_t^{\Delta nx}$ is the component that forecasts future net exports growth. We follow Campbell and Shiller (1988) and construct empirical estimates of nxa_t^r and $nxa_t^{\Delta nx}$ using a VAR formulation. Specifically consider a VAR(p) representation for the vector $y_t = (r_t, \Delta nx_t, nxa_t)'$. Appropriately stacked, this VAR has a first-order companion representation: $\bar{\mathbf{y}}_{t+1} = \mathbf{A}\,\bar{\mathbf{y}}_t + \boldsymbol{\epsilon}_{t+1}$.[26] Equation (13) implies that we can construct nxa_t^r and $nxa_t^{\Delta nx}$ as:

$$\begin{aligned} nxa_t^r &= -\rho \mathbf{e}_r' \mathbf{A} \left(\mathbf{I} - \rho \mathbf{A}\right)^{-1} \bar{\mathbf{y}}_t \\ nxa_t^{\Delta nx} &= -\rho \mathbf{e}_{\Delta nx}' \mathbf{A} \left(\mathbf{I} - \rho \mathbf{A}\right)^{-1} \bar{\mathbf{y}}_t \end{aligned}$$

where $\mathbf{e}_r'$ (resp. $\mathbf{e}_{\Delta nx}'$) is a dummy vector that 'selects' r_t (resp. Δnx_t) and $\mathbf{I}$ is the identity matrix. We represent the time paths of nxa_t^r and $nxa_t^{\Delta nx}$ in figure 4-(a).[27]

Several features are noteworthy. First, nxa_t^r and $nxa_t^{\Delta nx}$ are positively correlated: the valuation and trade effects are mutually reinforcing, underlining the stabilizing role of capital gains in the

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[25] With a zero mean and a standard deviation of 1.67%, it is 7 times less volatile than nxa and 2.5 times less volatile than $r + \Delta nx$ (s.d. 4.20%). The correlation between the error term and the flow term $r + \Delta nx$ is also very small (0.05).

[26] where $\bar{\mathbf{y}}_t = (\mathbf{y}_t', \mathbf{y}_{t-1}', ..., \mathbf{y}_{t-p+1}')'$. See Appendix B of Gourinchas and Rey (2005) for a detailed derivation.

[27] We use $p = 1$, according to standard lag selection criteria.

external adjustment of the US.[28] Given our normalization of nxa, valuation effects represent the equivalent of a 7.04% contemporaneous increase in exports in 1986:3 (out of 25.89%) and 4.85% in 2003:1 (out of 18.17%).

Second, the testable restriction $\mathbf{e}'_{nxa}\mathbf{I} + (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx} - \mathbf{e}'_{nxa})\, \rho \mathbf{A} = \mathbf{0}$ should be satisfied.[29] This restriction is equivalent to a test that the error term ε_{t+1} is conditionally uncorrelated with the variables of interest: $E_t\left[\varepsilon_{t+1}\right] = 0$. As discussed above, this provides our second test of the validity of our assumptions and the quality of the approximation (6). We use a Wald test and find a χ^2 equal to 0.148. With three restrictions, the p-value is 0.986, so we cannot reject the intertemporal equation (13).[30] This, and the fact that $nxa_t\,(predict) \equiv nxa_t^r + nxa_t^{\Delta nx}$ is very close to nxa_t (see Figure 4-(a)) show the excellent overall quality of our approximation.

Finally, following the same methodology, figure 4-(b) decomposes nxa_t^r into a gross asset and gross liability return components (nxa_t^{ra} and nxa_t^{rl}). The figure illustrates that financial adjustment comes mostly from excess returns on gross assets; the contribution of expected returns on gross liabilities -while positive- is always much smaller.

[Figure 4 about here]

We are also interested in the long run properties of nxa. Following Cochrane (1992), we use equation (13) to decompose the variance of nxa into components reflecting news about future portfolio returns and news about future net export growth. Given that nxa_t^r and $nxa_t^{\Delta nx}$ are correlated, there will not be a unique decomposition of the variance of nxa into the variance of nxa^r and the variance of $nxa^{\Delta nx}$. Yet, an informative way of decomposing the variance is to split the covariance term, giving half to nxa^r and half to $nxa^{\Delta nx}$, as follows:

$$\begin{aligned} 1 &= \frac{cov\,(nxa, nxa)}{var\,(nxa)} = \frac{cov\,(nxa^r, nxa)}{var\,(nxa)} + \frac{cov\left(nxa^{\Delta nx}, nxa\right)}{var\,(nxa)} \\ &\equiv \beta_r + \beta_{\Delta nx} \end{aligned} \tag{14}$$

This decomposition is equivalent to looking at the coefficients from regressing independently nxa^r and $nxa^{\Delta nx}$ on nxa. The resulting regression coefficients, β_r and $\beta_{\Delta nx}$ represent the share of

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[28] This feature may be specific to the US. In the case of emerging markets, valuation and trade effects would likely be negatively related since gross liabilities are dollarized.

[29] This restriction is obtained by left-multiplying $nxa_t = nxa_t^r + nxa_t^{\Delta nx}$ by $(\mathbf{I} - \rho\mathbf{A})$.

[30] The predicted coefficients for $e'_{nxa} = [1, 0, 0]$ are $[0.906, -0.012, 0.004]$.

the unconditional variance of nxa explained by future returns or future net export growth.[31] Table 2 reports the decomposition for different values of ρ between 0.94 and 0.96.

For our benchmark value $\rho = 0.95$, we get a breakdown of 64% (net exports) and 27% (portfolio returns) accounting for 91% of the variance in nxa. The results are sensitive to the assumed discount factor. Lower (higher) values of ρ increase (decrease) the contribution of portfolio returns.[32] For $\rho = 0.94$, we find that portfolio returns account for 29% of the total variance while for $\rho = 0.96$ their contribution decreases to 24%. The general flavor of our results is not altered by those robustness checks.

These findings have important implications. First, financial adjustment accounts for approximately 27% of cyclical external adjustment, even at long horizons, while 64% comes from movements in future net exports. Thus, our findings indicate that valuation effects do not replace the need for an ultimate adjustment in net exports via expenditure switching or expenditure reducing mechanisms, a point developed in detail in Obstfeld and Rogoff (forthcoming 2006). What our estimates indicate, however, is that valuation effects profoundly transform the nature of the external adjustment process. By absorbing 25-30% of the cyclical external imbalances, valuation effects substantially relax the external budget constraint of the US.

Using the same methodology, lines 3 and 4 of Table 2 further decompose the variance of nxa^r into the contributions of returns on gross assets and liabilities. For the standard specification, we obtain a breakdown of roughly 21% (β_{ra}) and 6% (β_{rl}) making up the 27% total contribution of the returns to the cyclical external adjustment. These findings confirm Figure 4-(b): gross asset returns account for the bulk of the variance, while returns on gross liabilities, which are all in dollars, are much less responsive.

[Table 2 about here]

3.3 Forecasting quarterly returns: the role of valuation effects

Equation (11) indicates that nxa_t should help predict either future returns on the net foreign asset portfolio r_{t+j}, or future net export growth Δnx_{t+j}, or both. This section looks specifically at the

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[31] This is not an orthogonal decomposition, so terms less than 0 or greater than 1 are possible. Empirically, the sum of β_r and $\beta_{\Delta nx}$ can differ from 1 if the approximation $nxa_t = nxa_t^r + nxa_t^{\Delta nx}$ is not satisfied. As we argued above, the quality of the approximation is very good.

[32] Whenever we perform comparative statics on the discount rate ρ we adjuste μ^a accordingly. The corresponding values are presented in line 6 of Table 2. Note that ρ controls also the steady state ratio of net exports to net foreign asset (equation (4)).

predictive power of nxa_t for future returns on the net foreign asset portfolio r_{t+j} at the quarterly horizon. Table 3 reports a series of results using nxa_t as a predictive variable. Each column of the table reports a regression of the form:

$$y_{t+1} = \alpha + \beta \; nxa_t + \delta \; z_t + \epsilon_{t+1}$$

where y_{t+1} denotes a quarterly return between $t+1$ and t, z_t denotes additional controls shown elsewhere in the literature to contain predictive power for asset returns or exchange rates and ϵ_{t+1} is a residual.

Looking first at Panel A of Table 3, we see that nxa has significant forecasting power for the net portfolio return r_{t+1} one quarter ahead (column 1). The $\bar{R}^2$ of the regressions is 0.10 and the negative and significant coefficient indicates that a positive deviation from trend predicts a decline in net portfolio return that is qualitatively consistent with equation (11). We observe also that there is essentially no forecasting power from either lagged values of the net portfolio return (column 2), the difference between domestic and foreign dividend-price ratios (column 3), or the deviation from trend of net exports, xm_t, defined as $\epsilon_t^x - \epsilon_t^m$ (column 4). We emphasize that the predictive power of the regression is economically large: the coefficient of 0.36, coupled with a standard deviation of nxa of 11.94% indicates that a one-standard deviation increase in nxa predicts a decline in the net portfolio return of about 430 basis points over the next quarter, equivalent to about 17.19 percent at an annual rate.

Panel A of Table 3 also reports the results of similar regressions for the excess equity total return, defined as the quarterly dollar total return on foreign equity r_t^{ae} (a subcomponent of US assets) minus the quarterly total return on US equity r_t^{le} (a subcomponent of US liabilities). Since r_t^a is very correlated with r_t^{ae} and r_t^l is very correlated with r_t^{le}, it is natural to investigate the predictive ability of our variables on this measure of relative stock market performance.[33] To the extent that the average weights μ^a and μ^l are imperfectly measured, the degree of leverage of the net foreign asset portfolio could also be mismeasured, which could influence our results on total net portfolio returns. We are able to confirm our results with this more partial but also arguably less noisy measure of net foreign asset portfolio returns. There is significant one-quarter ahead predictability of the excess return of foreign stocks over domestic stocks (column 5). The $\bar{R}^2$ of the regression is equal to 0.07 and the sign of the statistically significant coefficient is negative, as expected. Again, alternate regressors such as lagged returns (column 6), dividend price ratios

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[33] The correlations are 0.938 and 0.942 respectively.

(column 7), or deviations of the trade balance from trend (column 8) do not enter significatively. The predictive impact of nxa_t on $r^{ae}_{t+1}-r^{le}_{t+1}$ is smaller than on r_{t+1}, yet it is still highly economically significant. With a coefficient of -0.13, a one-standard deviation increase in nxa predicts a decline in excess returns of 155 basis points over the next quarter, or 6.21 percent annualized. It is important to emphasize that these regressions indicate significant predictability for the one-quarter ahead *relative* stock market performance![34]

[Table 3 about here]

3.4 Exchange rate predictability one quarter ahead

The results from Panel A raise an obvious and tantalizing question: could it be that the predictability of the dollar return on net assets arises from predictability in the exchange rate? After all, a depreciation of the exchange rate increases the return on gross assets relative to the return on gross liabilities. Panel B of Table 3 presents estimates using both our FDI-weighted effective exchange rate (Δe_{t+1}) and the Federal Reserve trade-weighted trade-weighted multilateral exchange rate for major currencies (Δe^T_{t+1}). The sample covers the post Bretton Woods period, from 1973:1 to 2004:1.

We observe first that nxa_t contains strong predictive power for both exchange rate series (columns 1 and 5). The coefficient is negative (around -0.09 for both series) and significant, implying that a negative nxa predicts a subsequent depreciation of the dollar against major currencies. The $\bar{R}^2$ are high (0.09 and 0.11 respectively) and the effects are also economically large: a one-standard deviation decrease in nxa predicts a 4.30% (annualized) increase in the expected rate of depreciation of the multilateral exchange rate over the subsequent quarter.

Our results are robust to the inclusion of the three-month interest rate differential $i_{t-1} - i^*_{t-1}$ where we construct i^*_t using 1997 weights from the benchmark US Treasury survey (column 4 and 8)). As before, we also find that the predictive power of xm_t on the exchange rate does not survive the inclusion in the regression of our variable nxa_t (columns 3 and 7).[35]

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[34] Our working paper, Gourinchas and Rey (2005), investigates separately the predictability pattern for the dollar and foreign currency return on gross assets and the dollar return on gross liabilities. We find no evidence of predictability for the return on gross liabilities, and limited evidence of predictability for the return on gross assets. This indicates that the correlation structure between returns on gross assets and gross liabilities plays an important role for understanding the adjustment of net foreign asset returns.

[35] Gourinchas and Rey (2005) also reports the quarter ahead predictive power of nxa_t for bilateral rates of depreciation. We find significant predictability of the US dollar against the Yen, the euro (DM before 1999) and the Swiss Franc.

Overall, these results are striking. Traditional models of exchange rate determination fare particularly badly at the quarterly-yearly frequencies. Our approach, which emphasizes a more complex set of fundamental variables, finds predictability at these horizons.[36]

3.5 Long horizon forecasts: the importance of net export growth and of the exchange rate

A natural question is whether the predictive power of our measure of external imbalances increases with the forecasting horizon. According to equation (11), nxa could forecast any combination of r_t and Δnx_t at long horizons. We investigate this question by regressing $k-$horizon returns $y_{t,k} \equiv \left(\sum_{i=1}^{k} y_{t+i}\right)/k$ between t and $t+k$ on nxa_t. Table 4 reports the results for forecasting horizons ranging between one and twenty-four quarters. When the forecasting horizon exceeds 1, the quarterly sampling frequency induces $(k-1)^{th}$ $-$order serial correlation in the error term. Accordingly, we report Newey-West robust standard errors with a Bartlett window of $k-1$ quarters.

For each horizon we report two regressions. The first one uses nxa_{t-1} as the regressor, as before. Its explanatory power is summarized by $\overline{R}^2(1)$. In the second one, we used directly ϵ_t^z as regressors (nxa_t is a linear combination of the ϵ_t^z's), to allow for the fact that the steady state weights of exports, imports, assets and liabilities may be measured with errors. We report only one summary statistic for this second regression, $\overline{R}^2(2)$.

Table 4 indicates that the in-sample predictability increases up to an impressive 0.26 (0.34 with separate regressors) for net foreign portfolio returns at a four-quarter horizon, then declines to 0.02 or 0.16 at twenty four quarters. A similar pattern is observed for total excess equity return. These results suggest that the financial adjustment channel operates at short to medium horizons, between one quarter and two years. It then declines significantly and disappears in the long run. As shown in section (3.2), its overall contribution to external adjustment amounts to roughly 27%.

[Table 4 about here]

The picture is very different when we look at net export growth. We find that nxa_{t-1} predicts a substantial fraction of future net export growth in the long run: the $\bar{R}^2$ is 0.58 at 24 quarters

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[36] There is one potential caveat to our results: tests of the predictability of returns may be invalid when the predicting variable exhibits substantial serial correlation. The pretesting procedure of Campbell and Yogo (2006, forthcoming) indicates no problem in our case for any of the forecasting regressions of this section, except for the net returns. In all cases, the correlation between the innovation in nxa and the residual from the predictability regression is smaller than 0.125 in absolute value, indicating little size distortion (i.e. a 5% nominal t-test has a true size of 7.5% at most). For net returns, the coefficient is 0.167, suggesting a potentially larger size distortion. But performing Campbell and Yogo's test leads us to reject the hypothesis of no predictability at the 5% level. Therefore all our predictability regressions are robust.

(0.79 with three regressors!). This result is consistent with a long run adjustment via the trade balance. A large positive external imbalance predicts low future net export growth, which restores equilibrium. The classic channel of trade adjustment is therefore also at work, especially at longer horizons (8 quarters and more).

Looking at exchange rates, we find a similarly strong long run predictive power on the rate of depreciation of the dollar. The $\bar{R}^2$ increases up to 0.41 (0.55 with three regressors!) at 12 quarters. There is significant predictive power at short, medium and long horizons.[37]

Taken together, these findings indicate that two dynamics are at play. At horizons smaller than two years, the dynamics of the portfolio returns seem to dominate, and exchange rate adjustments create valuation effects that have an immediate impact on cyclical external imbalances. At horizons longer than two years, there is little predictability of asset returns. But there is still substantial exchange rate predictability, which goes hand in hand with a corrective adjustment in future net exports.[38] Hence, because the exchange rate plays key roles both in the financial adjustment channel and in the trade adjustment channel it is predictable at short, medium and long horizons. The sign of the exchange rate effect is similar at all horizons since an exchange rate depreciation increases the value of foreign assets held by the US and affects net exports positively. The eventual adjustment of net exports is consistent with the predictions arising from expenditure switching models. Because these adjustments take place over a longer horizon, their influence on the short term dynamics is rather limited.

Figure 5 reports the FDI-weighted nominal effective depreciation rate from 1 to 12 quarters ahead against its fitted values with nxa and independently with our three regressors. The improvement in fit is striking as the horizon increases. Our predicted variable does well at picking the general tendencies in future rates of depreciation as well as the turning points, even one to four quarters ahead.

[Figure 5]

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[37] Again, the persistence of nxa in the predictive regressions is not an issue. Performing the pre-test of Campbell and Yogo (2006, forthcoming), we find that there is no problem for the exchange rate nor for the total excess equity returns. In the case of net exports and net returns there is some size distorsion. When we perform Cambpell and Yogo's test however we can reject the hypothesis of no predictability at the 5% level. Once again, this implies that our predictability regressions are robust.

[38] Other factors can also influence the nominal exchange rate at longer horizons. For instance, Mark (1995) demonstrates that the fit of the monetary model improves dramatically beyond 8 quarters. We do not include these determinants in our analysis.

3.6 Out-of-sample forecast

Since the classic paper of Meese and Rogoff (1983), the random walk has been considered the appropriate benchmark to gauge the forecasting ability of exchange rate models. These authors showed that none of the existing exchange rate models could outperform the random walk at short to medium horizons in out-of-sample forecasts, even when the realized values of the fundamental variables were used in the predictions. More than twenty years later, this very strong result still stands.[39]

We perform out-of-sample forecasts by estimating our model using rolling regressions and comparing its performance to the random walk. We start by splitting our sample in two. We refer to the first half, from 1952:1 to 1978:1, as the 'in-sample'. We then construct out-of-sample forecasts in three steps. First, we re-estimate our variable nxa following the methodology of section 2 over the 'in-sample'.[40] This guarantees that our constructed nxa does not incorporate *any* future information. Second, still over the 'in-sample', we estimate the forecasting relationship between future returns and lagged nxa. Finally, we use this estimated relation to form a forecast of the first non-overlapping return or depreciation rate *entirely outside* the estimation sample. We then roll over the sample by one observation and repeat the process. This provides us with up to 104 out-of-sample observations.[41] We emphasize that, since we are estimating the trend components and the weights using only data available at the time of prediction, we cannot fall victim to any look-ahead bias.[42] This exercise is very stringent: given the reduced size of the sample, nxa cannot be as precisely estimated as if we used the whole sample each time.

We compare the mean-squared errors (MSE) of a model featuring only nxa and a constant to the MSE of a driftless random walk. We construct the forecasts involving nxa as described above, using only data available up to the date of the forecast.[43] To assess the statistical significance of our results we use the MSE-adjusted statistic described in Clark and West (2006, forthcoming).

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[39] See Chinn, Cheung and Garcia (2005). At very short horizons however (between one and twenty trading days), Evans and Lyons (2005) show that a model of exchange rate based on disaggregated order flow outperforms the random walk.

[40] We also construct the sample weights μ^z using data from the 'in-sample' only and the restriction that the discount factor be constant and equal to its steady state value, as in section 3. We use our benchmark value of $\rho = 0.95$ in those calculations.

[41] See Appendix C of Gourinchas and Rey (2005) for details. Changes in the cut-off point t_o do not seem to make any difference for our results, provided the number of observations used to perform the estimation is sufficient.

[42] Furthermore, for this exercise we use non-seasonally adjusted exports and imports data. We understand from conversation with BEA staffers that the BEA's seasonal adjustment procedure makes use of some future data.

[43] Our test is more stringent than Meese and Rogoff (1983) who fed realized fundamental variables to form their forecast.

This statistic is appropriate to compare the mean squared prediction errors of two nested models estimated over rolling samples. It adjusts for the difference in mean-squared prediction errors stemming purely from spurious small sample fit. The test compares the MSE from the random walk (MSE_r) to the MSE for the unrestricted model (MSE_u), where the latter is adjusted for a noise term that pushes it upwards in small sample ($MSE_u - adj$). The difference between the two MSE is asymptotically normally distributed. We use a Newey-West estimator for the variance of the difference in MSE in order to take into account the serial correlation induced by overlapping observations when the forecast horizon exceeds one quarter.

Table 5 presents the results. A positive ΔMSE-Adjusted statistic indicates that our model outperforms the random walk in predicting exchange rate depreciations. For the FDI-weighted exchange rate, our model outperforms significantly the random walk, including one quarter ahead. The $p-$values are always very small except at 16 quarters. Results for the trade-weighted exchange rate are very similar. The table also reports the ratio of the (unadjusted) MSE. This ratio is smaller than one at all horizons and for both exchange rates. The curse of the random walk seems therefore to be broken for the dollar exchange rate.[44]

[Table 5 about here]

4 Conclusion

This paper presents a general framework to analyze international adjustment, in deviation from slow moving trends due to very long structural changes such as financial and trade integration. We model jointly the dynamic process of net exports, foreign asset holdings and the return on the portfolio of net foreign assets. For the intertemporal budget constraint to hold, today's current external imbalances must predict either future net export growth or future movements in returns of the net foreign asset portfolio, or both. Using a newly constructed quarterly dataset on US foreign gross asset and liability positions at market value, we construct a well-defined measure of cyclical external imbalances.

Historically, we find a substantial part of cyclical external imbalances (27%) are eliminated via predictable changes in asset returns. These valuation effects occur at short to medium horizons

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[44] Gourinchas and Rey (2005) presents results from a horse race against models that include lagged returns, lagged dividend price ratios and -for the exchange rate- lagged interest rate differentials and lagged rates of depreciation. In all cases, we can decisively reject the null that including nxa does not improve the accuracy of the net return and exchange rate forecasts at one quarter and beyond.

while adjustments of the trade balance come into play at longer horizons (mostly after two years). The exchange rate has an important dual role in our analysis. In the short run, a dollar depreciation raises the value of foreign assets held by the US relative to the liabilities, hence contributing to the process of international adjustment via the *valuation channel*. In the longer run, a depreciated dollar favors trade surpluses, hence contributing to the adjustment via the *trade channel*. The counterpart of the effect of exchange rate movements as an adjustment tool is that today's external imbalance contains significant information on future exchange rate changes. We are able to predict in sample 9% of the variance of the exchange rate one quarter ahead, 31% a year ahead and 41% three years ahead. Our model has also significant out-of-sample forecasting power, so that we are able to beat the random walk at all horizons between one and sixteen quarters.

Our approach implies a very different channel through which exchange rates affect the dynamic process of external adjustment. In traditional frameworks, fiscal and monetary policies are seen as affecting relative prices on the goods markets (competitive devaluations are an example) or as affecting saving and investment decisions. But, fiscal and monetary policies should also be thought of as mechanisms affecting the relative price of assets and liabilities, in particular through interest rate and exchange rate changes. This means that monetary and fiscal policies may affect the economy differently than in the standard New Open Economy Macro models à la Obstfeld and Rogoff.[45]

We used accounting identities and a minimal set of assumptions to derive our results. Any intertemporal general equilibrium model can therefore be nested in our framework. More specific theoretical mechanisms can be introduced and tested as restrictions within our set-up. They will have to be compatible with our empirical findings regarding the quantitative importance of the two adjustment mechanism and the horizons at which they operate. Thus our results provide useful information to guide more specific theories. The challenge consists in constructing models with fully-fledged optimizing behavior compatible with the patterns we have uncovered in the data. A natural question arises as to why the rest of the world would finance the US current account deficit and hold US assets, knowing that those assets will underperform. In the absence of such model, one should be cautious about any policy seeking to exploit the valuation channel since to operate, it requires that foreigners be willing to accumulate further holdings of (depreciating) dollar denominated assets.

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[45] See Tille (2004) for a recent new open economy model allowing for valuation effects. His model, however, does not pin down the path of foreign assets and liabilities.

Several economic mechanisms could a priori be consistent with our empirical results. First and foremost, the portfolio balance theory, which emphasizes market incompleteness and imperfect substitutability of assets, seems well-suited to formalize our findings. In a world where home bias in asset holdings is prevalent, shocks may have very asymmetric impacts on asset demands, leading to large relative price adjustments on asset markets. Suppose for example that the world demand for US goods falls, thereby increasing the current account deficit of the United States. The wealth of the US goes down relative to its trading partners. But since the rest of the world invests mostly at home, the dollar has to fall to clear asset markets. Hence a negative shock to the current account leads to an exchange rate depreciation at short horizons. Standard portfolio rebalancing requires a subsequent expected depreciation to restore long run equilibrium.[46] This depreciation increases the return of the net foreign asset portfolio of the US and thereby contributes to close the gap due to the shortfall in net exports.[47] Another interesting avenue to explore are models generating time-varying risk premia such as Campbell and Cochrane (1999).

A deeper theoretical understanding of the valuation channel seems unavoidable, in order to fully grasp external adjustment dynamics.

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[46] See Kouri (1982), Henderson and Rogoff (1982) and Blanchard, Giavazzi and Sa (2005).

[47] Obstfeld (2004) provides an illuminating discussion of those theoretical mechanisms.

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Appendix A
The Stationary Case

This appendix derives the approximate intertemporal external constraint when the economy is close to a balanced growth path. We require the following assumptions.

Assumption 7 *The ratios* Z_t/W_t *where* $Z_t \in \{X_t, M_t, A_t, L_t\}$ *are statistically stationary. Denote by* μ^{zw} *the steady state mean value of these ratios.*

Assumption 8 *The growth rate of domestic wealth* Δw_{t+1} *is stationary with steady state mean value* $\ln \Gamma$.

Assumption 9 *The return on gross assets* R^a_{t+1}*, gross liabilities* R^l_{t+1} *and the net foreign asset portfolio* R_{t+1} *are stationary and admit a common steady state mean value* R *that satisfies* $R > \Gamma$.

Define the weight μ^x (resp. μ^m) as the steady state share of exports (resp. imports) in the trade balance:

$$\mu^x = \frac{\mu^{xw}}{\mu^{xw} - \mu^{mw}};\ \mu^m = \frac{\mu^{mw}}{\mu^{xw} - \mu^{mw}} \tag{A.1}$$

Similarly, the weight μ^a (resp. μ^l) is the steady state share of gross assets (resp. liabilities) in net foreign assets:[48]

$$\mu^a = \frac{\mu^{aw}}{\mu^{aw} - \mu^{lw}};\ \mu^l = \frac{\mu^{lw}}{\mu^{aw} - \mu^{lw}} \tag{A.2}$$

We obtain the following result:

Lemma 3 *Under assumptions 7-9 the law of motion of external assets (1) can be approximated as:*

$$na_{t+1} \approx \frac{1}{\rho} na_t + r_{t+1} + \left(\frac{1}{\rho} - 1\right) nx_t \tag{A.3}$$

where $\rho = \Gamma/R < 1$, *and:*

$$\begin{aligned} na_t &= |\mu^a| \centerdot a_t - \left|\mu^l\right| \centerdot l_t \\ nx_t &= |\mu^x| \centerdot x_t - |\mu^m| \centerdot m_t \\ r_t &= |\mu^a| \centerdot r^a_t - \left|\mu^l\right| \centerdot r^l_t \end{aligned}$$

Proof. The law of asset accumulation is given by:

$$NA_{t+1} = R_{t+1} \left(NA_t + NX_t\right) \tag{A.4}$$

Divide through by household total wealth W_t to obtain:

$$\left(\frac{A_{t+1}}{W_{t+1}} - \frac{L_{t+1}}{W_{t+1}}\right) \frac{W_{t+1}}{W_t} = R_{t+1} \left(\frac{A_t}{W_t} - \frac{L_t}{W_t} + \frac{X_t}{W_t} - \frac{M_t}{W_t}\right) \tag{A.5}$$

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[48] Implicitly, we are assuming that $\mu^a \neq \mu^l$ and $\mu^x \neq \mu^m$. We do not view this assumption as restrictive: it will be verified in most general open economy models except under very specific assumptions restricting the net foreign asset position and the trade balance to be zero in steady state.

Under assumption 7, write the following first order approximation:

$$\begin{aligned} \frac{Z_t}{W_t} &\approx \mu^{zw}\left(1+\epsilon_t^z\right) \\ \frac{W_{t+1}}{W_t} &\approx \Gamma\left(1+\epsilon_{t+1}^{\Delta w}\right) \\ R_{t+1} &\approx R\left(1+r_{t+1}\right) \end{aligned}$$

where $\epsilon_t^z = \ln\left(Z_t/W_t\right) - \ln \mu^{zw}$, $\epsilon_{t+1}^{\Delta w} = \ln\left(W_{t+1}/W_t\right) - \ln \Gamma$ and $r_{t+1} = \ln\left(R_{t+1}\right) - \ln R$ are (log) deviations from steady state. Substitute into the left hand side and the right hand side of (A.4) and re-arrange to obtain:

$$\begin{aligned} &\left(\mu^{aw} - \mu^{lw}\right)\Gamma\left(1 + \frac{\mu^{aw}\epsilon_{t+1}^a - \mu^{lw}\epsilon_{t+1}^l}{\mu^{aw} - \mu^{lw}} + \epsilon_{t+1}^{\Delta w}\right) \\ \approx \quad & R\left(\mu^{aw} - \mu^{lw} + \mu^{xw} - \mu^{mw}\right)\left(1 + r_{t+1} + \frac{\mu^{aw}\epsilon_t^a - \mu^{lw}\epsilon_t^l + \mu^{xw}\epsilon_t^x - \mu^{mw}\epsilon_t^m}{\mu^{aw} - \mu^{lw} + \mu^{xw} - \mu^{mw}}\right) \end{aligned}$$

By definition of the steady state, we must have:

$$\left(\mu^{aw} - \mu^{lw}\right)\Gamma = R\left(\mu^{aw} - \mu^{lw} + \mu^{xw} - \mu^{mw}\right)$$

Re-arranging we obtain

$$\frac{\mu^{aw}\epsilon_{t+1}^a - \mu^{lw}\epsilon_{t+1}^l}{\mu^{aw} - \mu^{lw}} + \epsilon_{t+1}^{\Delta w} = r_{t+1} + \frac{\mu^{aw}\epsilon_t^a - \mu^{lw}\epsilon_t^l + \mu^{xw}\epsilon_t^x - \mu^{mw}\epsilon_t^{mw}}{\mu^{aw} - \mu^{lw} + \mu^{xw} - \mu^{mw}}$$

We now use the fact that $\epsilon_t^z = z_t - w_t - \ln \mu^{zw}$ and $\epsilon_{t+1}^{\Delta w} = w_{t+1} - w_t - \ln \Gamma$, to obtain (up to unimportant constants):

$$\frac{\mu^{aw} a_{t+1} - \mu^{lw} l_{t+1}}{\mu^{aw} - \mu^{lw}} = r_{t+1} + \frac{\mu^{aw} a_t - \mu^{lw} l_t + \mu^{xw} x_t - \mu^{lw} m_t}{\mu^{aw} - \mu^{lw} + \mu^{xw} - \mu^{mw}}$$

Finally, using the definition of ρ, na_t and nx_t (consider separately the cases $\mu^a < 0$, $\mu^x > 0$ and $\mu^a > 0$, $\mu^x < 0$) this collapses to:

$$na_{t+1} = r_{t+1} + \frac{1}{\rho} na_t + \left(\frac{1}{\rho} - 1\right) nx_t$$

■

Define now the linear combination of net exports and net foreign assets nxa_t as

$$nxa_t \equiv na_t + nx_t = \left|\mu^a\right| \cdot a_t - \left|\mu^l\right| \cdot l_t + \left|\mu^x\right| \cdot x_t - \left|\mu^m\right| \cdot m_t.$$

Substituting into (A.3), we obtain:

$$nxa_{t+1} = \frac{1}{\rho} nxa_t + r_{t+1} + \Delta nx_{t+1} \tag{A.6}$$

Assumption 10 *nxa_t satisfies the no-ponzi condition*

$$\lim_{j \longrightarrow \infty} \rho^j nxa_{t+j} = 0 \ a.s.$$

If we impose the no-ponzi condition that nxa cannot grow faster than the growth adjusted interest rate, equation (A.6) can be solved forward, which leads to:

Proposition 2 *Under assumptions 7-10, the external budget constraint (1) satisfies approximately:*

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j \left[r_{t+j} + \Delta nx_{t+j}\right] \tag{A.7}$$

Proof. Iterate forward and impose assumption 10. ■

Finally, since equation (A.7) must hold along every sample path, it must hold in expectations:

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j E_t \left[r_{t+j} + \Delta nx_{t+j}\right] \tag{A.8}$$

Appendix B
Proofs for the trending case

Proof of Lemma 1
Proof. The law of asset accumulation is given by:

$$NA_{t+1} = R_{t+1}\left(NA_t + NX_t\right) \tag{B.1}$$

Divide through by household total wealth W_t to obtain:

$$\left(\frac{A_{t+1}}{W_{t+1}} - \frac{L_{t+1}}{W_{t+1}}\right)\frac{W_{t+1}}{W_t} = R_{t+1}\left(\frac{A_t}{W_t} - \frac{L_t}{W_t} + \frac{X_t}{W_t} - \frac{M_t}{W_t}\right) \tag{B.2}$$

Under assumptions 1-3, write the following first order approximations:

$$\begin{aligned} \frac{Z_t}{W_t} &\approx \mu_t^{zw}\left(1+\epsilon_t^z\right) \\ \frac{W_{t+1}}{W_t} &\approx \Gamma\left(1+\epsilon_{t+1}^{\Delta w}\right) \\ R_{t+1}^a &\approx R\left(1+r_{t+1}^a\right) \\ R_{t+1}^l &\approx R\left(1+r_{t+1}^l\right) \end{aligned}$$

Substitute into the external budget constraint (B.2). The left hand side of the constraint becomes approximately (and up to a constant)

$$\left(\mu_{t+1}^{aw} - \mu_{t+1}^{lw}\right)\Gamma\left(1 + \frac{\mu_{t+1}^{aw}\epsilon_{t+1}^a - \mu_{t+1}^{lw}\epsilon_{t+1}^l}{\mu_{t+1}^{aw} - \mu_{t+1}^{lw}} + \epsilon_{t+1}^{\Delta w}\right) \tag{B.3}$$

The term between brackets of the right hand side of the budget constraint becomes approximately (and up to a constant):

$$\left[\mu_t^{aw} - \mu_t^{lw} + \mu_t^{xw} - \mu_t^{mw}\right] \left(1 + \frac{\mu_t^{aw}\epsilon_t^a - \mu_t^{lw}\epsilon_t^l + \mu_t^{xw}\epsilon_t^x - \mu_t^{mw}\epsilon_t^m}{\mu_t^{aw} - \mu_t^{lw} + \mu_t^{xw} - \mu_t^{mw}}\right) \tag{B.4}$$

We now loglinearize the total return R_{t+1}. Since A_t and L_t are defined as the beginning of period assets and liabilities, we have:

$$R_{t+1} = \frac{A_{t+1} - L_{t+1}}{A_{t+1}/R^a_{t+1} - L_{t+1}/R^l_{t+1}}$$

Expand this expression (divide by W_{t+1} etc...) to obtain, given the definitions $\mu^a_t = \mu^{aw}_t / \left(\mu^{aw}_t - \mu^{lw}_t\right)$ and $\mu^l_t = 1 - \mu^a_t$:

$$\begin{aligned}
R_{t+1} &\approx R\left(1 + r^a_{t+1} + r^l_{t+1}\right) \frac{\mu^{aw}_{t+1}\left(1+\epsilon^a_{t+1}\right) - \mu^{lw}_{t+1}\left(1+\epsilon^l_{t+1}\right)}{\mu^{aw}_{t+1}\left(1+\epsilon^a_{t+1}+r^l_{t+1}\right) - \mu^{lw}_{t+1}\left(1+\epsilon^l_{t+1}+r^a_{t+1}\right)} \\
&\approx R\left(1 + \mu^a_{t+1} r^a_{t+1} - \mu^l_{t+1} r^l_{t+1}\right) \\
&\equiv R\left(1 + \hat{r}_{t+1}\right) \qquad \text{(B.5)}
\end{aligned}$$

Now reconstruct (B.2) putting together (B.3), (B.4) and (B.5) and using assumption 4 (the trend budget constraint):

$$\frac{\mu^{aw}_{t+1}\epsilon^a_{t+1} - \mu^{lw}_{t+1}\epsilon^l_{t+1}}{\mu^{aw}_{t+1} - \mu^{lw}_{t+1}} + \epsilon^{\Delta w}_{t+1} = \hat{r}_{t+1} + \frac{\mu^{aw}_t\epsilon^a_t - \mu^{lw}_t\epsilon^l_t + \mu^{xw}_t\epsilon^x_t - \mu^{mw}_t\epsilon^m_t}{\mu^{aw}_t - \mu^{lw}_t + \mu^{xw}_t - \mu^{mw}_t}$$

Finally, define, as in the text $na_t = \mu^a_t\epsilon^a_t - \mu^l_t\epsilon^l_t$ and $nx_t = \mu^x_t\epsilon^x_t - \mu^m_t\epsilon^m_t$ and rewrite the budget constraint (up to a constant) as:

$$na_{t+1} + \Delta w_{t+1} \approx \hat{r}_{t+1} + \frac{1}{\rho_t} na_t - \left(\frac{1}{\rho_t} - 1\right) nx_t$$

which is equation (5) of the paper. ■

Proof of Lemma 2

Proof. When the trends μ^{zw}_t have a common growth rate, the weights μ^z_t are constant and equal to μ^z and $\rho_t = \rho$. Assume that $\mu^a > 0$ and $\mu^x < 0$ (the symmetric case is immediate) and observe that $nxa_t = na_t - nx_t$, $\Delta nx_{t+1} = nx_t - nx_{t+1} - \Delta w_{t+1}$ and $r_{t+1} \equiv \hat{r}_{t+1}$. From 1**,** we can write:

$$\begin{aligned}
na_{t+1} &= r_{t+1} + \frac{1}{\rho_t} na_t - \left(\frac{1}{\rho_t} - 1\right) nx_t - \Delta w_{t+1} \\
nxa_{t+1} &= r_{t+1} + \frac{1}{\rho}\left(nxa_t + nx_t\right) - \left(\frac{1}{\rho} - 1\right) nx_t - \Delta w_{t+1} - nx_{t+1} \\
&= r_{t+1} + \frac{1}{\rho} nxa_t + nx_t - \Delta w_{t+1} - nx_{t+1} \\
&= r_{t+1} + \frac{1}{\rho} nxa_t + \Delta nx_{t+1}
\end{aligned}$$

which is equation (6) of the paper. ■

Proof of Proposition 1

Proof. Iterate forward equation (6) and impose assumption 6 to get equation (10) of the paper.
■

Appendix C
US net foreign assets, net exports and exchange rates.

We apply our theoretical framework to the external adjustment problem of the United States. Our methodology requires constructing net and gross foreign asset positions at market value over relatively long time series and computing capital gains and returns on global country portfolios. In this section, we describe briefly the construction of our data set. A complete description of the data is presented in Gourinchas and Rey (forthcoming 2006).

C.1 Positions.

Data on the net and gross foreign asset positions of the US are available from two sources: the US Bureau of Economic Analysis (BEA) and the Federal Reserve Flows of Funds Accounts for the rest of the world (FFA).[49] Following official classifications, we split US net foreign portfolio into four categories: Debt (corporate and government bonds), Equity, Foreign Direct Investment (FDI) and Other. The 'other' category includes mostly bank loans and trade credits. It also contains gold reserves.[50] Our strategy consists in re-constructing market value estimates of the gross external assets and liabilities of the US that conform to the BEA definitions by using FFA flow and position data and valuation adjustments.

Denote by X'_t the end of period t position for some asset X. We use the following updating equation:

$$X'_t = X'_{t-1} + FX_t + DX_t$$

where FX_t denotes the flows corresponding to asset X that enter the balance of payments, and DX_t denotes a discrepancy reflecting a market valuation adjustment or (less often) a change of coverage in the series between periods $t-1$ and t.

Using existing sources, we construct an estimate of DX_t as $r^x_t X'_{t-1}$ where r^x_t represents the estimated dollar capital gain on asset X between time $t-1$ and time t. This requires that we specify market returns r^x_t for each sub-category of the financial account.

C.2 Capital gains, total returns and exchange rates.

We construct capital gains on the subcategories of the financial account as follows. For equity and FDI, we use the broadest stock market indices available in each country. For long term debt, we construct quarterly holding returns and subtract the current yield, distributed as income, to compute the net return. We assume no capital gain adjustment for short-term debt and for 'other' assets and liabilities, since these are mostly trade credit or illiquid bank loans.[51]

We construct total returns for each class of financial assets as follows. For equity and FDI, we use quarterly total returns on the broadest stock market indices available in each country. The total return on debt is a weighted average of the total quarterly return on 10-year government bonds and the three-month interest rate on government bills, with weights reflecting the maturity structure of debt assets and liabilities. The total return on 'other' assets and liabilities is computed using three-month interest rates. All returns are adjusted for US inflation by subtracting the quarterly change in the Personal Consumer Expenditure deflator.

In all cases, we use end of period exchange rates to convert local currency capital gains and total returns into dollars. Gourinchas and Rey (forthcoming 2006) gives a precise description of the currency weights and maturity structure (for debt) and of the country weights (for equity and FDI assets) that we use in our calculations.

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[49] See Hooker and Wilson (1989) for a detailed comparison of the FFA and BEA data.

[50] It is natural to include international gold flows in our analysis since during Bretton Woods (the only period where they were quantitatively non-negligible) they were designed to be perfect substitutes to dollar flows and central to the process of international adjustment.

[51] Due to data availability, we assume away any spread between corporate and government debt.

We construct total returns on the net foreign asset portfolio as follows. First, we use the definition of $r_t = |\mu_a| \, r_t^a - |\mu_l| \, r_t^l$. Second, by analogy, r_t^a and r_t^l are weighted averages of the returns on the four different subcategories of the financial account: equity, foreign direct investment, debt and 'other'. For instance, we write the total return on gross assets r_t^a as:

$$r_t^a = w_e^a r_t^{ae} + w_f^a r_t^{af} + w_d^a r_t^{ad} + w_o^a r_t^{ao}$$

where r_t^{ai} denotes the real (dollar) total return on asset category i (equity, FDI, debt or other) and w_i^a denotes the average weight of asset category i in gross assets. A similar equation holds for the total return on gross liabilities r_t^l (with corresponding returns r_t^{li} on asset category i).

It is difficult to construct precise estimates of the financially-weighted nominal effective exchange rate, needed in particular to compute net portfolio returns in equation (12). There is little available evidence on the currency and country composition of total foreign assets. In practice, the Treasury Survey (2000) reports country and currency composition for long-term holdings of foreign securities in benchmark years. Because few data are available before 1994, the weights are likely to be substantially off-base at the beginning of our sample. Instead, we construct a multilateral financial exchange rate using time-varying FDI historical position country weights. This exchange rate proxies the true financially weighted exchange rate that affects the dollar return on gross foreign assets.[52] We also make the realistic assumption that most foreign asset positions are not hedged for currency risk (see Hau and Rey (2006)). For the period 1982-2004, our estimates are very close to the BEA International Investment Position at market value (see Gourinchas and Rey (forthcoming 2006)).

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[52] We checked the robustness of our results by using alternate definitions of the multilateral exchange rate, based on fixed equity or debt weights. The results are qualitatively unchanged. We note also that the correlation between the rate of depreciation of our multilateral exchange rate and the rate of depreciation of the Federal Reserve 'major currencies' trade weighted multilateral nominal rate is high at 0.86.

Table 1: Descriptive Statistics

	Summary Statistics								
	Δx_t	Δm_t	Δa_t	Δl_t	r_t	r_t^a	r_t^l	Δe_t	nxa_t
Mean (%)	0.82	1.11	1.11	1.87	0.72	0.78	0.78	-0.03	0
Standard deviation (%)	4.28	3.81	3.08	2.87	13.16	2.50	2.57	3.55	11.94
Autocorrelation	-0.08	0.04	0.06	0.13	0.16	0.12	0.19	0.05	0.92
	r_t^{ae}	r_t^{le}	r_t^{ad}	r_t^{ld}	r_t^{af}	r_t^{lf}	r_t^{ao}	r_t^{lo}	
Mean (%)	1.87	1.86	0.72	0.56	1.08	1.09	0.48	0.39	
Standard deviation (%)	7.19	8.02	2.94	3.17	5.93	5.81	0.76	0.53	
Autocorrelation	0.15	0.09	0.16	0.13	0.09	0.10	0.19	0.73	

Note: Sample period is 1952:1-2004:1, except for Δe, 1973:1-2004:1.

Table 2: Unconditional Variance Decomposition of nxa

		Discount factor ρ		
#	percent	0.96	0.95	0.94
1	$\beta_{\Delta nx}$	71.77	63.96	57.05
2	β_r	23.76	26.99	28.85
	of which:			
3	β_{ra}	19.91	20.78	20.65
4	β_{rl}	3.87	6.22	8.21
5	Total (lines 1+2)	95.53	90.95	85.89
6	μ_a	6.72	8.49	10.08

Note: The sum of coefficients $\beta_{ra} + \beta_{rl}$ is not exactly equal to β_r due to numerical rounding in the VAR estimation. Sample: 1952:1 to 2004:1.

Table 3: Forecasting Quarterly Returns

Column:	1	2	3	4	5	6	7	8
Panel A: Returns								
	Total real return (r_{t+1})				Real Equity Differential (Δr^e_{t+1})			
z_t:		r_t	$\frac{d_t}{p_t} - \frac{d^*_t}{p^*_t}$	xm_t		Δr^e_t	$\frac{d_t}{p_t} - \frac{d^*_t}{p^*_t}$	xm_t
$\hat{\beta}$	**-0.36**	**-0.33**	**-0.46**	**-0.37**	**-0.13**	**-0.14**	−**0.17**	-0.07
(s.e.)	(0.07)	(0.07)	(0.08)	(0.16)	(0.03)	(0.03)	(0.03)	(-0.06)
$\hat{\delta}$		0.09	-1.43	0.01		-0.07	-0.63	-0.09
(s.e.)		(0.07)	(1.60)	(0.19)		(0.07)	(0.61)	(0.07)
$\bar{R}^2$	0.10	0.10	0.15	0.10	0.07	0.07	0.12	0.07
# obs	208	207	136	208	208	207	136	208
Panel B: Depreciation Rates								
	FDI-weighted (Δe_{t+1})				Trade-weighted (Δe^T_{t+1})			
z_t :		Δe_t	xm_t	$i_t - i^*_t$		Δe^T_t	xm_{t-1}	$i_t - i^*_t$
$\hat{\beta}$	**-0.08**	**-0.09**	**-0.10**	**-0.09**	**-0.09**	**-0.09**	**-0.08**	**-0.08**
(s.e.)	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
$\hat{\delta}$		-0.04	0.02	0.32		0.02	-0.01	-0.67
(s.e.)		(0.07)	(0.05)	(0.32)		(0.07)	(0.05)	(0.34)
$\bar{R}^2$	0.09	0.08	0.08	0.08	0.11	0.10	0.10	0.13
#obs	125	124	125	125	124	123	124	124

Note: Regressions of the form: $y_{t+1} = \alpha + \beta nxa_t + \delta z_t + \epsilon_{t+1}$ where y_{t+1} is the total real return (r_{t+1}); the equity return differential ($\Delta r^e_{t+1} = r^{ae}_{t+1} - r^{le}_{t+1}$) (panel A); the FDI-weighted depreciation rate (Δe_{t+1}) or the trade weighted depreciation rate (Δe^T_{t+1}) (panel B). $\frac{d_t}{p_t} - \frac{d^*_t}{p^*_t}$ is the relative dividend price ratio (available since 1970:1); $i_t - i^*_t$ is the short term interest rate differential; xm_t is the stationary component from the trade balance, defined as $\epsilon^x_t - \epsilon^m_t$. Sample: 1952:1 to 2004:1 for total returns and 1973:1 to 2004:1 for depreciation rates. Robust standard errors in parenthesis.

Table 4: Long Horizon Regressions

	Forecast Horizon (quarters)							
	1	2	3	4	8	12	16	24
	Real Total Net Portfolio Return $r_{t,k}$							
nxa	**-0.36**	**-0.35**	**-0.35**	**-0.33**	**-0.22**	**-0.14**	**-0.09**	**-0.04**
	(0.07)	(0.05)	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
$\bar{R}^2(1)$	[0.11]	[0.18]	[0.24]	[0.26]	[0.21]	[0.13]	[0.09]	[0.02]
$\bar{R}^2(2)$	[0.14]	[0.25]	[0.34]	[0.38]	[0.35]	[0.24]	[0.19]	[0.16]
	Real Total Excess Equity Return $r^{ae}_{t,k} - r^{le}_{t,k}$							
nxa	**-0.14**	**-0.13**	**-0.12**	**-0.11**	**-0.06**	**-0.03**	-0.02	0.01
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
$\bar{R}^2$ (1)	[0.07]	[0.13]	[0.17]	[0.18]	[0.10]	[0.03]	[0.01]	[0.00]
$\bar{R}^2$ (2)	[0.11]	[0.20]	[0.28]	[0.31]	[0.26]	[0.15]	[0.10]	[0.17]
	Net Export growth $\Delta nx_{t,k}$							
nxa	**-0.08**	**-0.08**	**-0.07**	**-0.07**	**-0.07**	**-0.06**	**-0.06**	**-0.04**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\bar{R}^2$ (1)	[0.05]	[0.10]	[0.13]	[0.17]	[0.31]	[0.44]	[0.53]	[0.58]
$\bar{R}^2$ (2)	[0.04]	[0.08]	[0.12]	[0.17]	[0.38]	[0.55]	[0.66]	[0.79]
	FDI-weighted effective nominal rate of depreciation $\Delta e_{t,k}$							
nxa	**-0.08**	**-0.08**	**-0.08**	**-0.08**	**-0.07**	**-0.06**	**-0.04**	**-0.02**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\bar{R}^2$ (1)	[0.09]	[0.16]	[0.28]	[0.31]	[0.41]	[0.41]	[0.33]	[0.12]
$\bar{R}^2$ (2)	[0.10]	[0.21]	[0.35]	[0.40]	[0.52]	[0.55]	[0.55]	[0.38]

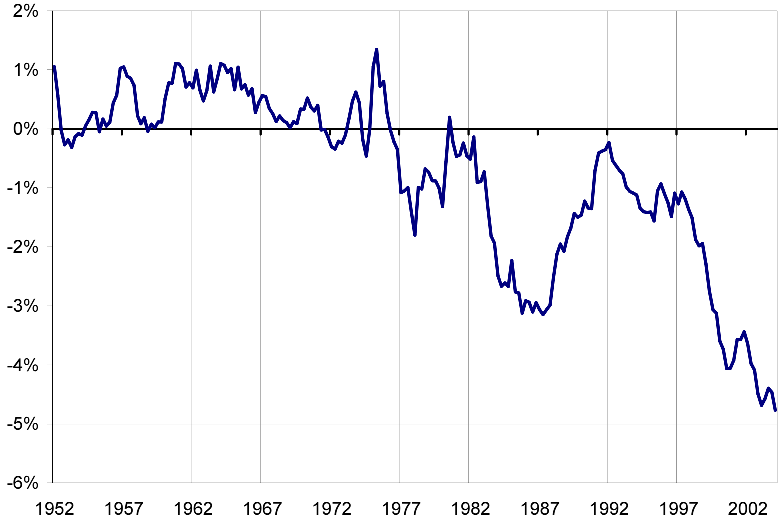
Note: Regressions of the form: $y_{t,k} = \alpha + \beta nxa_t + \epsilon_{t+k}$ where $y_{t,k}$ is the k-period real total net portfolio return ($r_{t,k}$); total excess equity return ($r^{ae}_{t,k} - r^{le}_{t,k}$); net export growth ($\Delta nx_{t,k}$) or the FDI-weighted depreciation rate ($\Delta e_{t,k}$). Newey-West robust standard errors in parenthesis with $k-1$ Bartlett window. Adjusted R^2 in brackets. $\bar{R}(1)$ reports the adjusted R-squared of the regression on nxa_t; $\bar{R}(2)$ reports the adjusted R-squared of the regression on ϵ^x_t, ϵ^m_t, ϵ^a_t and ϵ^l_t. Sample: 1952:1 to 2004:1 (1973:1 to 2004:1 for exchange rate).

Table 5: Out of Sample Tests for Exchange Rate Depreciation against the Martingale Hypothesis

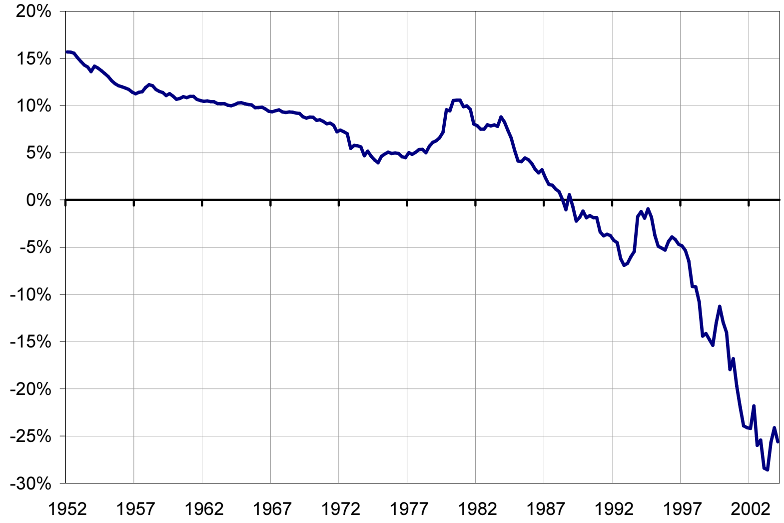
Horizon: (quarters)	1	2	3	4	8	12	16
	FDI-weighted depreciation rate						
MSE_u/MSE_r	0.960	0.920	0.858	0.841	0.804	0.818	0.903
ΔMSE-adjusted ($MSE_r - MSE_u$-adj)	1.48	1.53	1.61	1.51	1.20	0.74	0.35
(s.e.)	(0.68)	(0.60)	(0.57)	(0.53)	(0.37)	(0.24)	(0.23)
p-val	[0.01]	[0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[0.06]
	Trade-weighted depreciation rate						
MSE_u/MSE_r	0.949	0.900	0.830	0.788	0.733	0.929	0.961
ΔMSE-adjusted ($MSE_r - MSE_u$-adj)	2.76	3.03	2.94	2.78	1.91	0.67	0.29
(s.e.)	(1.03)	(1.03)	(1.02)	(0.98)	(0.69)	(0.38)	(0.24)
p-val	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[<0.01]	[0.03]	[0.11]

Note: $\Delta MSPE - adjusted$ is the Clark-West (2004) test-statistic based on the difference between the out of sample MSE of the driftless random-walk model and the out-of-sample MSE of a model that regresses the rate of depreciation $\Delta e_t + 1$ against nxa_t. Rolling regressions are used with a sample size of 105. t-statistic in parenthesis. p-value of the one-sided test using critical values from a standard normal distribution in brackets. Under the null, the random-walk encompasses the unrestricted model. Sample: 1952:1-2004:1. Cut-off: 1978:1.

Figure 1: US Net Exports and Net Foreign Assets (% of GDP, 1952-2004)



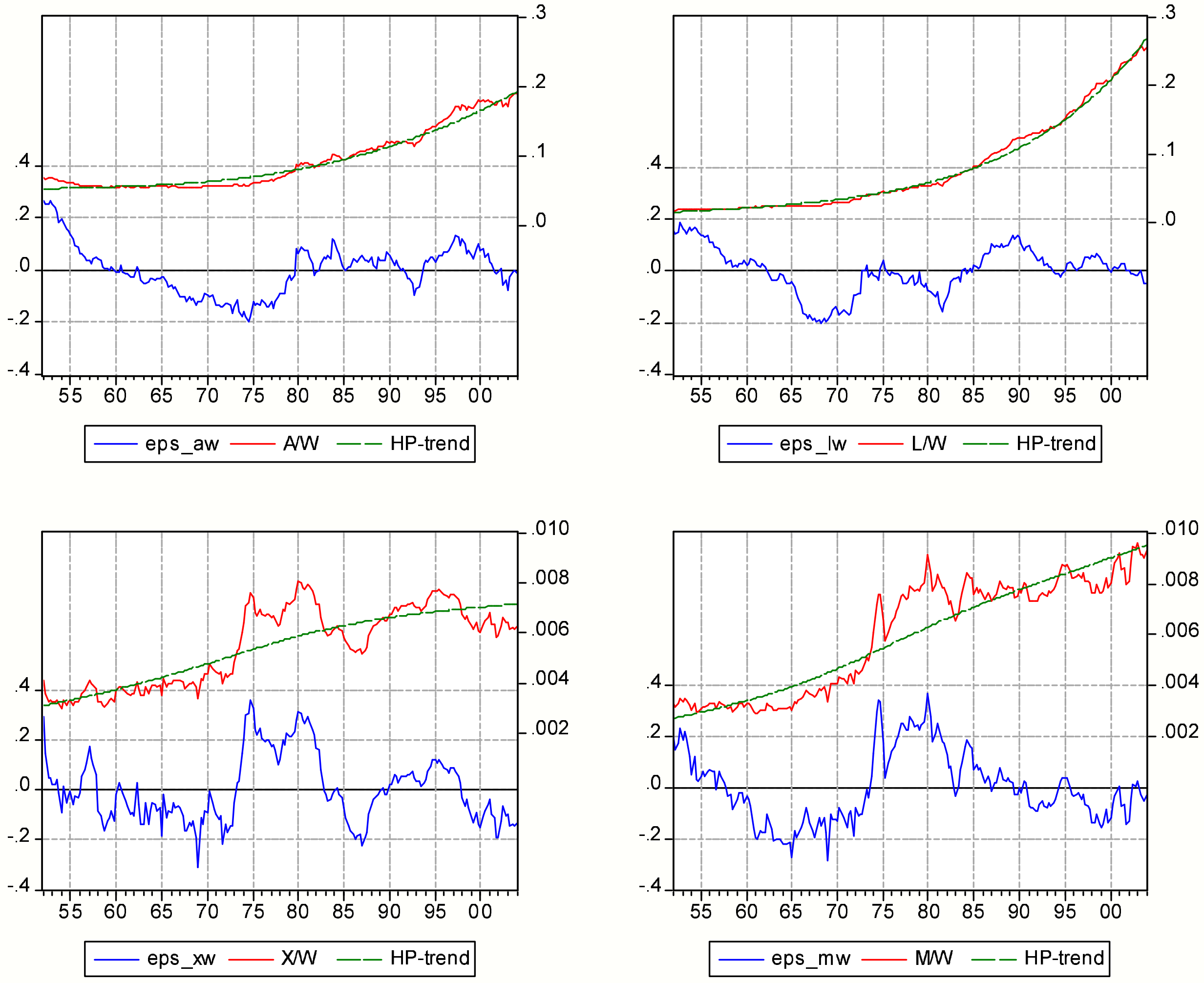
(a) Net Exports/GDP



(b) Net Foreign Assets/GDP

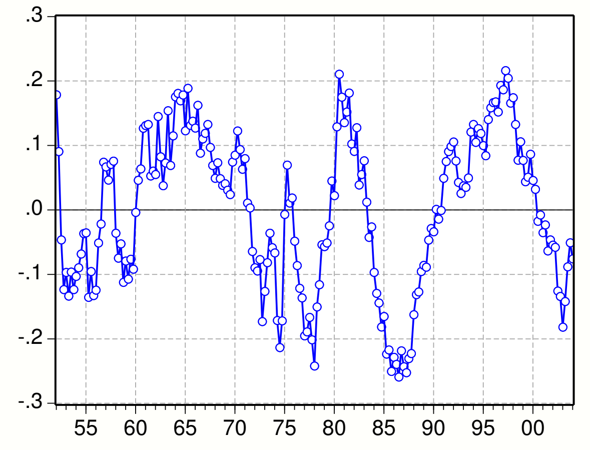
Note: The top panel shows the ratio of US net exports to US GDP. The bottom panel shows the ratio of US net foreign assets to US GDP. Sample: 1952:1-2004:1. Source: Bureau of Economic Analysis, Flow of Funds and Authors calculations.

Figure 2: Cycle and Trend Components for A/W, L/W, X/W and M/W.

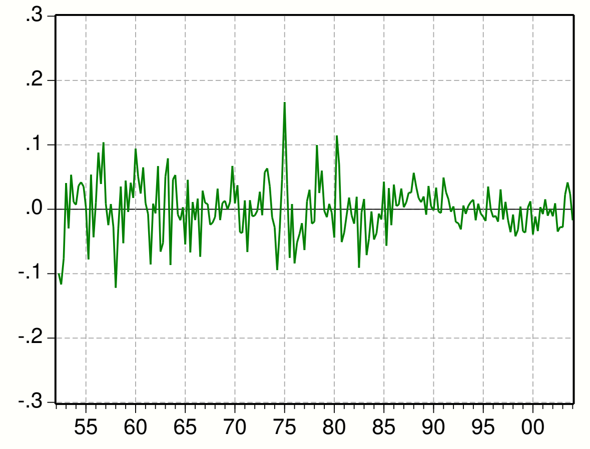


Note: Top two panels for US gross external assets A/W (left) and US gross external liabilities L/W (right); Bottom two panels for US exports X/W (left) and US imports M/W (right). Each panel reports the series Z/W (ratio to household wealth), the trend component μ_t^{zw}, labelled HP-trend, (right-axis) and the cyclical component ϵ_t^{zw} (left-axis). Sample: 1952:1-2004:1.

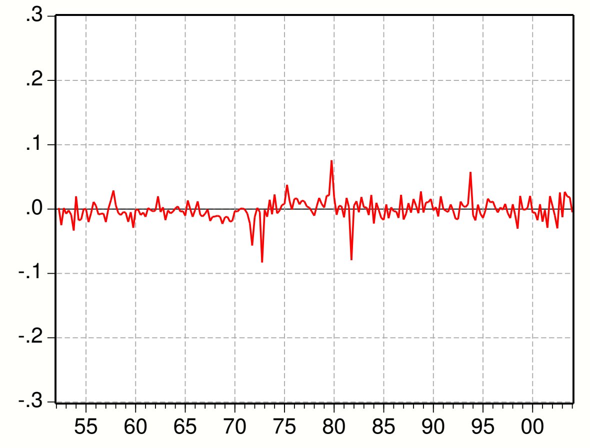
Figure 3: nxa, flow $r + \Delta nx$ and residual term ε from equation (6).



(a) nxa_t

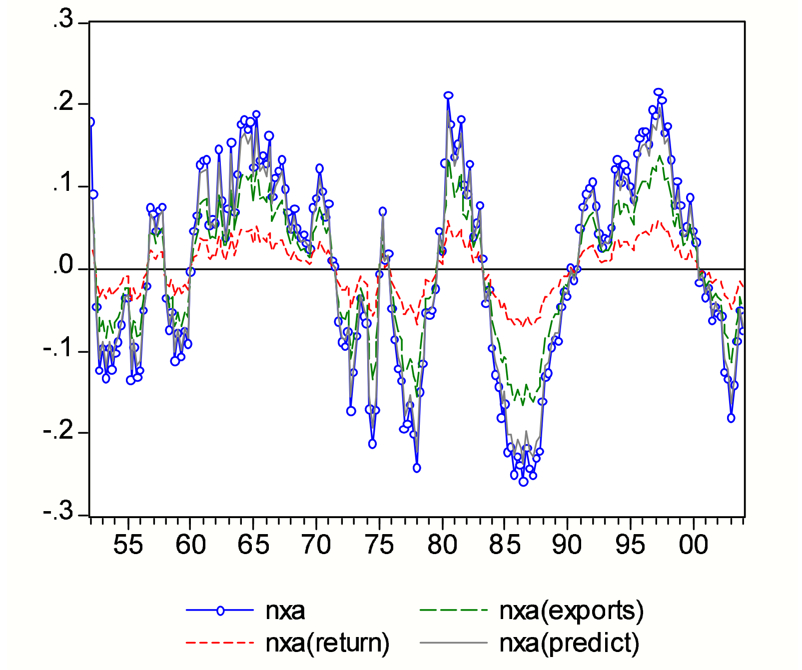


(b) flow $r_t + \Delta nx_t$

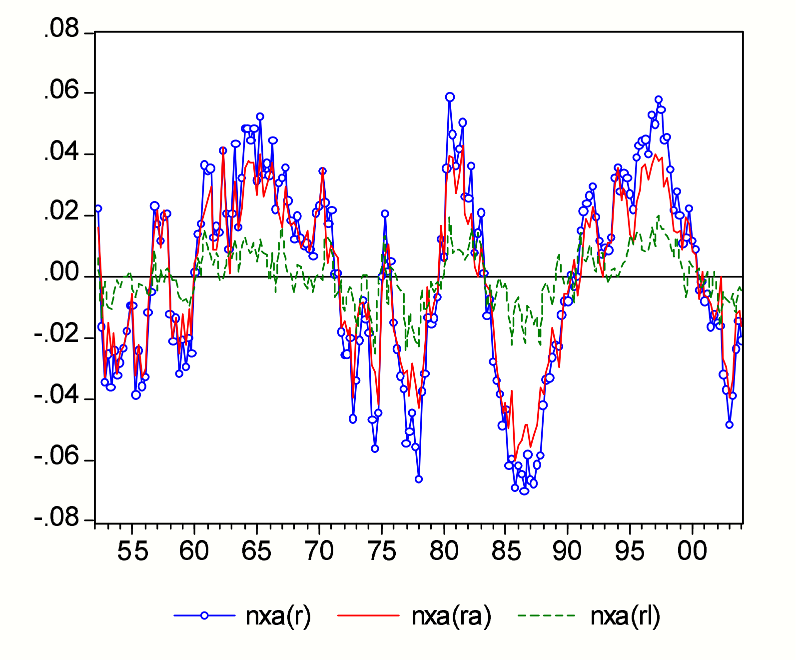


(c) residual ε_t

Figure 4: Decomposition of *nxa* into trade and valuation components.



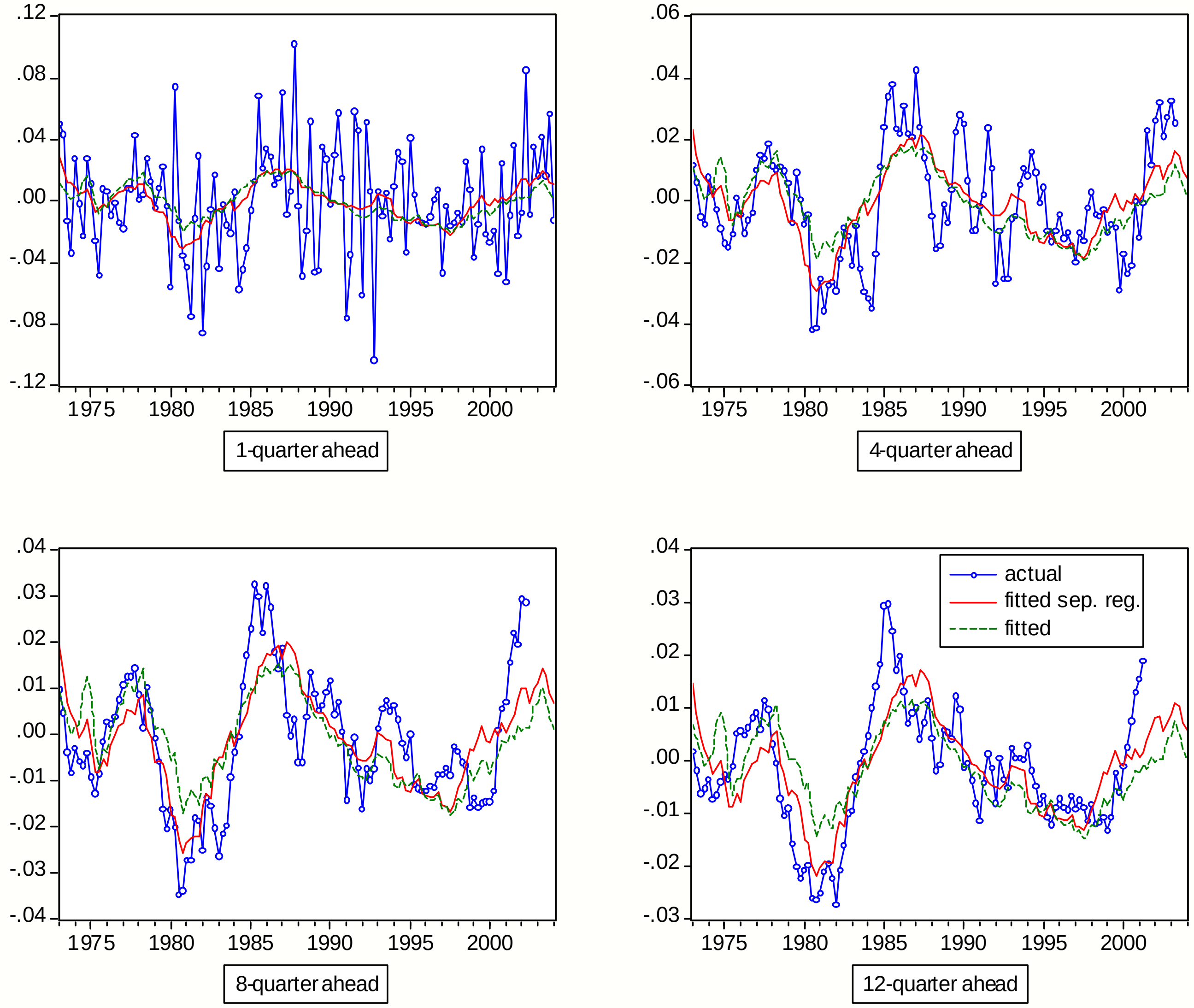
(a) return $nxa(return)$ and net exports $nxa(exports)$ components.



(b) asset return $nxa(ra)$ and liability return $nxa(rl)$ components.

Note: The top panel reports the decomposition of nxa into its return ($nxa(return)$) and net exports ($nxa(exports)$) components. The bottom panel reports the decomposition of the return component ($nxa(return)$) into an asset return ($nxa(ra)$) and a liability return ($nxa(rl)$) components.

Figure 5: Predicted One to 12-quarter ahead depreciation rates.



Note: Each graph reports (a) the realized depreciation rate at 1 to 12 quarter horizon; (b) the fitted depreciation rate using nxa (fitted); (c) the fitted depreciation rate using ϵ^{xw}, ϵ^{mw}, ϵ^{aw} and ϵ^{lw} as separate regressors (fitted sep. reg.).