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International Financial Adjustment

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### **International Financial Adjustment**

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# International Financial Adjustment

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## Abstract

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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.' 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 US 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.<sup>1</sup> 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 are affected by fluctuations in asset prices. The upsurge in cross-border holdings has therefore opened the door to potentially large wealth transfers across countries, which alter net foreign asset dynamics. 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 unprecedentedly high US current account deficits. The US foreign liability to GDP ratio has quadrupled since the beginning of the 1980s to reach 96% of GDP (\$10.5 trillion) in December 2003.<sup>2</sup> Its foreign asset to GDP ratio was then 71% (\$7.9 trillion) and its net foreign asset to GDP ratio was -24% (-\$2.7 trillion). The intertemporal approach to the current account suggests that the US will need to run trade

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<sup>1</sup>Some papers have introduced time-varying interest rates (e.g. Bergin and Sheffrin (2000)) or risky assets (Lucas (1982)). But most of these models either reproduce complete markets –which has many counterfactual implications and reduces the current account to an accounting device– or assume away predictable returns and wealth effects. Kehoe and Perri (2002) is an interesting exception that introduces specific forms of endogenous market incompleteness. See also Kraay and Ventura (2000) and Ventura (2001) for models that allow investment in risky foreign assets with interesting empirical predictions.

<sup>2</sup>Source: Bureau of Economic Analysis (BEA).

surpluses to reduce this imbalance. We show 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. Importantly, this wealth transfer may occur via a depreciation of the dollar. 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% of US GDP from the rest of the world to the US. For comparison, the US trade deficit on goods and services was ‘only’ 4.4% of GDP in 2003. With large gross asset and liability positions, a change in the dollar exchange rate can transfer large amounts of wealth across countries.

Our approach emphasizes this international financial adjustment mechanism. We start from a country’s intertemporal budget constraint and show it has two implications. The first is the link between a current shortfall in net savings and future trade surpluses. If total returns on the 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 adjustment 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 significantly alter the need to run future trade surpluses or deficits. These valuation effects constitute a hitherto unexplored ‘*financial adjustment 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.

Put simply, a fall in today’s net exports or in today’s net external asset position has to be matched either by future net export growth or by future increases in the returns of the net foreign asset portfolio. In the data, we find that historically, 31% of the international adjustment of the US is realized through valuation effects on average.

Our model also has 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 4 that the ratio of net exports to net foreign assets contains significant information about future returns on the US net foreign portfolio from a quarter out and up to two years. A one standard deviation decrease of the ratio of net exports to net foreign assets predicts an annualized excess return on foreign assets relative to US assets of 19% 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 in our set up 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 4 that today's ratio of net exports to net foreign assets forecasts exchange rate movements at *short, medium and long horizons both in and out-of-sample*. A one standard deviation decrease of the ratio of net exports to net foreign assets predicts an annualized 4% depreciation of the exchange rate over the next quarter.

Our methodology builds on the seminal work of Campbell and Shiller (1988) and, more recently, of Lettau and Ludvigson (2001) on the implication of a closed economy consumption wealth ratio for predicting future equity returns. Few papers have thought of the importance of valuation effects in the process of international adjustment. Lane and Milesi-Ferretti (2001), (2002) have pointed out that the correlation between the change in net foreign asset position at market value and the current account is low or even negative. They also noted 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. Bergin and Sheffrin (2000) have enriched the intertemporal approach to the current account by introducing a variable interest rate and a real exchange rate, which helps to model the volatility of the change in the net foreign asset positions. Mercereau (2003) introduces a stock market in a standard intertemporal approach set up and shows that the current account may help predict future stock market performance. 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. In section 2 we present the theoretical framework that guides our empirical investigation of the mechanisms of international financial adjustment. We discuss the construction of our quarterly dataset of the US disaggregated gross foreign asset and liability positions at market value in section 3. Empirical results are presented in section 4. 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 5 concludes.

## 2 International financial adjustment.

This section lays down the first building block of an intertemporal approach to the financial account: an intertemporal budget constraint and a long run stability condition.

Consider the accumulation identity for net foreign assets between  $t$  and  $t + 1$  :

$$NA_{t+1} = R_{t+1}(NA_t + NX_t) \tag{1}$$

$NX_t$  represents net exports, defined as the difference between exports  $X_t$  and imports  $M_t$ , and net foreign assets  $NA_t$  are defined as the difference between gross foreign assets  $A_t$  and gross foreign liabilities  $L_t$ , measured in the domestic currency.<sup>3</sup> Equation (1) states that the net foreign position increases with net exports and with the *total* return on the net foreign asset portfolio  $R_{t+1}$ .<sup>4</sup>

We work with net exports  $NX_t$  instead of the current account  $CA_t$ . From a national income point of view, the current account records net factor payments, i.e. net dividend payments and net interest income, that are part of the *total* return  $R_{t+1}$ . If these were the only sources of capital income, then the current account —usually defined— would equal changes in net foreign assets. In presence of capital gains and exchange rate fluctuations, however, neither the Balance of Payment nor National Income and Product Account definitions of the current account coincide with the change in net foreign assets evaluated at market value. The reason is that both accounting systems omit unrealized capital gains coming from changes in asset prices or exchange rates. These valuation effects can be important when the net foreign portfolio is leveraged, and they are incorporated in the return  $R_{t+1}$ .

To explore further the implications of equation (1), we follow the methodology of Campbell and Mankiw (1989) and Lettau and Ludvigson (2001) and log-linearize. The log-linearization requires four assumptions (the details are provided in appendix A):

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<sup>3</sup>Accumulation equation (1) implies that 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  $t - 1$ , i.e.  $NA_t = R_t NA'_t$ . The accumulation equation becomes:  $NA'_{t+1} = R_t NA'_t + NX_t$ .

<sup>4</sup>In practice, net foreign assets could also change because of unilateral transfers or because of transactions not recorded in the trade balance or the financial account (errors and omissions). Unilateral transfers are typically small, while errors and omissions are omitted in the BEA's International Investment Position. We abstract from these additional terms. See Gourinchas and Rey (2005, in progress) for details.

**Assumption 1:** (a) The ratios  $A_t/W_t$ ,  $L_t/W_t$ ,  $X_t/W_t$  and  $M_t/W_t$  are stationary, where  $W_t$  represents total household wealth. (b) the steady state values of the ratios, denoted  $\mu_{aw}$ ,  $\mu_{lw}$ ,  $\mu_{xw}$  and  $\mu_{mw}$  respectively, satisfy  $\mu_{aw} \neq \mu_{lw}$  and  $\mu_{xw} \neq \mu_{mw}$ .

**Assumption 2:** The growth rate of household wealth  $W_{t+1}/W_t$  is stationary with steady state value  $\gamma$ .

**Assumption 3:** The return to the net foreign asset portfolio  $R_t$  is stationary with a steady state value  $R$  that satisfies  $\gamma < R$ .

Assumption 1 is not particularly restrictive. The first part of the assumption is verified in any model where exports, imports, external assets, liabilities and household wealth grow at the same rate along a balanced growth path. This will be the case in a wide variety of models, as long as assets and liabilities are not perfect substitutes. For instance, in a Merton-type portfolio allocation model, the portfolio shares  $A_t/W_t$  and  $L_t/W_t$  are stationary. Part (b) of Assumption 1 guarantees that some ratios are well defined. We do not view it as restrictive: it will be verified in most general open economy model except under very specific assumptions restricting the net foreign asset position and the trade balance to be zero in steady state.<sup>5</sup>

Assumption 2 is also an implication of the existence of a well-defined balanced growth path. It will obtain if both the consumption/wealth ratio and the rate of return to total wealth are stationary (see Lettau and Ludvigson (2001) for details).

The assumption that the long-term growth rate of the economy is lower than the equilibrium rate of return on the net foreign asset portfolio (Assumption 3) is a common equilibrium condition in many growth models. In our context, it has an intuitive interpretation: manipulating equation (1), one can check that if Assumption 3 holds, the steady state ratio of net exports to net foreign assets is stationary with an unconditional mean  $NX/NA$  that satisfies

$$NX/NA = \rho - 1 < 0 \tag{2}$$

where  $\rho = \gamma/R < 1$ . In other words, countries with steady state creditor positions ( $NA > 0$ ) should run trade deficits ( $NX < 0$ ); countries with steady state debtor positions ( $NA < 0$ ) should run trade surpluses ( $NX > 0$ ).

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<sup>5</sup>See, e.g., Corsetti and Pesenti (2001).

Equipped with Assumptions 1-3, we log-linearize the law of motion of net assets to obtain:

$$\Delta na_{t+1} = r_{t+1} + \left(\frac{1}{\rho} - 1\right)(nx_t + na_t) \quad (3)$$

where  $\Delta$  denotes the difference operator:  $\Delta z_{t+1} \equiv z_{t+1} - z_t$ .

$nx_t = |\mu_x| x_t - |\mu_m| m_t$  is a linear combination of log exports and imports that we call, with some abuse of language, ‘net exports’. The weights  $\mu_x$  and  $\mu_m$  have the same sign and reflect the relative importance of exports and imports in the trade balance in steady state. They are defined as:

$$\mu_x = \frac{\mu_{xw}}{\mu_{xw} - \mu_{mw}}; \mu_m = \mu_x - 1 \quad (4)$$

Similarly,  $na_t = |\mu_a| a_t - |\mu_l| l_t$  is a linear combination of log-gross assets and gross liabilities that we call, also with some abuse of language, ‘net foreign assets’. The weights  $\mu_a$  and  $\mu_l$  have the same sign and are defined analogously to  $\mu_x$  and  $\mu_m$ :

$$\mu_a = \frac{\mu_{aw}}{\mu_{aw} - \mu_{lw}}; \mu_l = \mu_a - 1 \quad (5)$$

Part (b) of Assumption 1 guarantees that these weights are well-defined. Under the assumption that the steady state returns on gross assets and liabilities are the same,  $r_{t+1}$  can be written as:<sup>6</sup>

$$r_{t+1} \approx |\mu_a| r_{t+1}^a - |\mu_l| r_{t+1}^l \quad (6)$$

The net foreign asset portfolio return  $r_{t+1}$  increases with  $r_{t+1}^a$  (return on assets) and decreases with  $r_{t+1}^l$  (return on liabilities). Equation (3) carries the same interpretation as equation (1): a country can improve its net foreign asset position ( $\Delta na_{t+1} > 0$ ) either through a trade surplus ( $nx_t > 0$ ) or a high portfolio return ( $r_{t+1} > 0$ ).

We define the linear combination of net exports and net assets  $nxa_t$  as  $nx_t + na_t = |\mu_x| x_t - |\mu_m| m_t + |\mu_a| a_t - |\mu_l| l_t$ . By construction, it increases with exports and assets and decreases with imports and liabilities. With some further abuse of language, the variable  $nxa_t$  can be interpreted as the deviation from trend of the ratio of net exports to net foreign assets. It is a theoretically grounded measure of external imbalances.

Our last assumption is a no-ponzi condition that guarantees that  $nxa$  does not grow faster than the growth-adjusted interest rate:

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<sup>6</sup>See Campbell (1996). The approximation also includes an unimportant constant.

**Assumption 4:**  $nxa_t$  satisfies the no-ponzi condition

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

Under Assumption 4, the budget constraint (3) can be solved forward and rearranged as follows:

$$nxa_t = - \sum_{j=1}^{+\infty} \rho^j [r_{t+j} + \Delta n x_{t+j}] \quad (7)$$

Equation (7) is simply a restatement of the intertemporal budget constraint. It must hold ex-post as well as ex-ante along every sample path. Accordingly, it must also hold in expectations:

$$nxa_t = - \sum_{j=1}^{+\infty} \rho^j E_t [r_{t+j} + \Delta n x_{t+j}] \quad (8)$$

This equation plays a central role in our approach. We will use it to assess quantitatively the relative importance of the valuation and trade channels in the process of international adjustment. 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 again the case of the US with both a large trade deficit and negative net foreign assets, implying a very negative  $nxa_t$ . Suppose first that returns on US net foreign assets are expected to be constant:  $E_t r_{t+j} = r$ . In that case, equation (8) posits that any adjustment *must* come through future improvements in US net exports ( $E_t \Delta n x_{t+j} > 0$ ). This is the standard implication of the intertemporal approach to the current account.<sup>7</sup> We call this channel the *trade adjustment channel*.

We emphasize instead that the adjustment may also come from *predictable* net foreign portfolio returns  $E_t r_{t+j} > 0$ .<sup>8</sup> We call this channel the *financial adjustment channel*. Importantly such predictable returns can occur via a *depreciation* of the dollar. While such depreciation certainly also helps to improve future net exports, the important point is that it operates through an entirely

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<sup>7</sup>See Obstfeld and Rogoff (2001) for an analysis along these lines. 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 (8). Our empirical part does not focus on such surprises.

<sup>8</sup>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. and abroad: the dividend-price and price-earning ratios (Fama and French (1988), Campbell and Shiller (1988)), the detrended T-bill rate (Hodrick (1992)), the term spread—the difference between the 10-year and one-year T-bill yields—and the default spread—the difference between the BAA and AAA corporate bond rates (Fama and French (1989)), the aggregate book-market ratio (Vuolteenaho (2000)), the investment/capital ratio (Cochrane (1991)) and more recently, the aggregate consumption/wealth ratio (Lettau and Ludvigson (2001)). To our knowledge, our approach is the first to produce a predictor of the return on domestic assets relative to foreign assets.

different channel: a predictable wealth transfer from foreigners to US residents. The role of the exchange rate can be illustrated by considering the case where gross liabilities are denominated in domestic currency while gross assets are in foreign currencies. We can then rewrite  $r_{t+1}$  as:

$$r_{t+1} = |\mu_a| (\tilde{r}_{t+1}^a + \Delta e_{t+1}) - |\mu_l| \tilde{r}_{t+1}^l - \pi_{t+1} \quad (9)$$

where  $\tilde{r}_{t+1}^a$  and  $\tilde{r}_{t+1}^l$  represent the gross *nominal* returns *in local currency*,  $\Delta e_{t+1}$  the rate of depreciation of the domestic currency and  $\pi_{t+1}$  the realized rate of domestic inflation between periods  $t$  and  $t + 1$ . Holding local currency returns constant, a currency depreciation increases the return on gross assets (held in foreign currency), an effect that is magnified by the degree of leverage of the net foreign asset portfolio when  $|\mu_a| > 1$ .

It is important to emphasize that equation (8) is an identity. It holds in expectations, but also along every sample path. Accordingly, one cannot hope to ‘test’ it.<sup>9</sup> 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 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 a long run stability condition, 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 compatible 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.

### 3 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.

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<sup>9</sup>Technically, only equation (1) is an identity. Equation (8) holds up to the loglinearization approximations if (a) Assumptions 1-4 hold and (b) expectations are formed rationally.

In this section, we describe briefly the construction of our data set. A complete description of the data is presented in Gourinchas and Rey (2005, in progress).

### 3.1 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).<sup>10</sup> 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.<sup>11</sup> 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  $r_t^x X'_{t-1}$  where  $r_t^x$  represents the estimated dollar capital gain on asset  $X$  between time  $t - 1$  and time  $t$ . This requires that we specify market returns  $r_t^x$  for each sub-category of the financial account.

### 3.2 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.<sup>12</sup>

We construct total returns for each class of financial assets as follows. For equity and FDI, we

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<sup>10</sup>See Hooker and Wilson (1989) for a detailed comparison of the FFA and BEA data.

<sup>11</sup>We include international gold flows in our analysis, since during Bretton Woods (the only period where they were quantitatively non-negligible) they were by design perfect substitutes to dollar flows and central to the process of international adjustment.

<sup>12</sup>Due to data availability, we assume away any spread between corporate and government debt.

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 (2005, in progress) 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.

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 (9). There is little available evidence on the currency and country composition of total foreign assets. In practice, the benchmark 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.<sup>13</sup> We also make the realistic assumption that most foreign asset positions are not hedged for currency risk (see Hau and Rey (2005, forthcoming)).

Our constructed series of the net foreign asset position for the US is shown in Figure 1, relative to household net worth. We see a strong deterioration of the US net foreign asset position after 1982. The US switched from being a net creditor to being a net debtor around 1988 and its net foreign asset position has kept on deteriorating ever since.

**[Figure 1 about here]**

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<sup>13</sup>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. This is perhaps not surprising. To the extent that the geographical determinants of trade flows also influence financial flows, as argued for instance by Portes and Rey (2005), the trade-weighted exchange rate may be a better approximation of the true implicit financial exchange rate than  $e_t$ , which reflects only FDI weights at historical value.

## 4 Empirical results.

Section 3 showed that under some stationarity assumptions,  $nxa$ , a linear combination of (log) exports ( $x_t$ ), imports ( $m_t$ ), gross foreign assets ( $a_t$ ) and liabilities ( $l_t$ ) is a theoretically well-defined measure of external imbalances. Our empirical implementation proceeds in three steps. First we test for unit roots in (log) exports, imports, assets and liabilities. Augmented Dickey Fuller tests overwhelmingly support the presence of unit roots in each of the series.<sup>14</sup>

Second, we check the empirical validity of our stationarity assumptions. Assumption 1 implies that  $xm_t \equiv x_t - m_t$ ;  $al_t \equiv a_t - l_t$ ;  $xa_t \equiv x_t - a_t$  are stationary. In fact, this implication is all we need for the loglinearization (see Appendix A). Hence, this is what we check in the data.<sup>15</sup> Exports, imports, assets and liabilities are likely to be measured with error. Accordingly, we estimate  $xm_t = x_t - \beta_m m_t$ ,  $al_t = a_t - \beta_l l_t$  and  $xa_t = x_t - \beta_a a_t$  where the  $\beta_i$ s are unobservable coefficients. Fortunately, cointegration techniques provide an efficient method to estimate the  $\beta_i$ s that is robust to regressor endogeneity. This implies that we should find three cointegrating relations among  $x_t$ ,  $m_t$ ,  $a_t$  and  $l_t$ .

We test for the number of cointegrating relations among these four variables using full information likelihood methods (see Johansen (1988), (1991)). As is well-known, the results regarding the number of cointegration vectors are sensitive to the lag length in the VAR. The sequential modified likelihood ratio and the Akaike information criteria suggest using a large number of lags (above twenty-eight). Indeed, for smaller number of lags, the test gives unstable results. When twenty-eight lags and above are included, results stabilize. The maximum eigenvalue statistic, presented in the first block of Table 1, tests the null hypothesis of  $r$  linearly independent cointegrating vectors against  $r + 1$  cointegration vectors. The trace statistic, reported in the second block of Table 1, tests the null hypothesis of  $r$  linearly independent cointegrating vectors against  $k$  cointegrating relations, where  $k$  is the number of endogenous variables. Both tests indicate the presence of three cointegrating vectors at the 5% confidence level. Thus assumptions underlying equation (8) are satisfied.<sup>16</sup>

The third step is to estimate our three cointegrating vectors. We use Stock and Watson's (1993) dynamic least square technique, since it generates optimal estimates of the cointegrating coefficients

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<sup>14</sup>Results are not reported here due to space constraints and are available upon request.

<sup>15</sup>We introduced  $W_t$  in section 2 only to write the stationarity assumptions in a way that could easily be mapped into familiar theoretical models.

<sup>16</sup>Note that assumptions 1-3 also ensure that  $r_{t+j}$  and  $\Delta n x_{t+j}$  are stationary. It is not the case, however, contrary to a frequent claim in the literature, that stationarity of  $r_{t+j}$  and  $\Delta n x_{t+j}$  guarantees stationarity of the left hand side of equation (8), even when  $\rho < 1$ . See Cochrane (1992) for a counterexample.



in a multivariate setting, and it performs well relative to other asymptotically efficient estimators in finite samples. Specifically, we estimate the following equations by OLS:

$$\begin{aligned}
 x_t &= \alpha_m + \beta_m m_t + \sum_{i=-k}^k b_{m,i} \Delta m_{t-i} + \epsilon_{mt} \\
 a_t &= \alpha_l + \beta_l l_t + \sum_{i=-k}^k b_{l,i} \Delta l_{t-i} + \epsilon_{lt} \\
 x_t &= \alpha_a + \beta_a a_t + \sum_{i=-k}^k b_{a,i} \Delta a_{t-i} + \epsilon_{at}
 \end{aligned} \tag{10}$$

The OLS estimates  $\hat{\beta}_m$ ,  $\hat{\beta}_a$  and  $\hat{\beta}_l$  provide consistent estimates of the cointegrating coefficients  $\beta_m$ ,  $\beta_a$  and  $\beta_l$ . The leads and lags of the first differences of the right hand side variables eliminate the effect of regressor endogeneity on the distribution of the OLS estimator.<sup>17</sup>

We estimate the regressions in equation (10) using quarterly data from the first quarter of 1952 to the first quarter of 2004 with four leads and lags. The estimates of the cointegrating parameters are very similar when the number of leads and lags is increased. We choose to limit the number of leads and lags to four in order to keep as many points as possible for the out-of-sample exercises presented in section 4.6.<sup>18</sup> We obtain the following point estimates, with robust standard errors in parenthesis:

$$\begin{aligned}
 x_t &= 0.98 + 0.83 m_t \\
 &\quad (0.06) \quad (0.01) \\
 a_t &= 3.28 + 0.65 l_t \\
 &\quad (0.05) \quad (0.01) \\
 x_t &= -0.36 + 0.72 a_t \\
 &\quad (0.19) \quad (0.02)
 \end{aligned}$$

Appendix A shows that  $nxa$  can be constructed directly from  $xm$ ,  $al$  and  $xa$ , as  $nxa_t = |\mu_m| xm_t + |\mu_l| al_t + xa_t$ . In practice, we normalize  $nxa$  so that the weight on exports is unity. This is a natural normalization: it implies that  $nxa$  is expressed ‘in the same units’ as exports, so  $nxa$  measures approximately the percentage increase in exports necessary to restore external balance (i.e. compensate for the deviation from trend of the net exports to net foreign asset ratio).

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<sup>17</sup>See Stock and Watson (1993) for details.

<sup>18</sup>For most lags, the estimates of the cointegrating vectors using Johansen’s FIML method are very close to the DOLS estimates. This is reassuring and indicates that there is no rotation of the cointegrating space as the number of lags varies. These additional results are available from the authors upon request.

Our normalized  $nxa_t$  is:

$$nxa_t = \left| \frac{\mu_m}{\mu_x} \right| xm_t - \left| \frac{\mu_l}{\mu_x} \right| al_t + \frac{1}{|\mu_x|} xa_t$$

The sample weights  $\mu_i$  are constructed as follows. We calculate  $\mu_{iw}$  as the average ratio of variable  $i$  to household financial wealth over the entire sample.<sup>19</sup> We then use equations (4) and (5) to construct  $\mu_x$ ,  $\mu_m$ ,  $\mu_a$  and  $\mu_l$ . The estimated weights are  $\mu_x = -10.1$ , and  $\mu_a = 8.2$ .<sup>20</sup> As expected, this indicates a substantial degree of leverage: small movements in asset returns can have a large impact on the net foreign asset position. From equation (2), this implies a steady state discount factor  $\rho = 0.95$ .

Given these weights, the implied deviation from trend is:

$$nxa_t = x_t - 0.91m_t + 0.79a_t - 0.47l_t$$

We observe that the coefficients satisfy the sign restrictions discussed above:  $nxa_t$  increases with exports and gross assets and decreases with imports and gross liabilities.

For comparison, we construct  $nxa$  using the average shares over the sample. We obtain  $nxa_t = x_t - 1.10m_t + 0.81a_t - 0.72l_t$ . These coefficients are quite close to the estimated ones, with a higher loading on imports and gross foreign liabilities. Since the data on positions is likely to be measured with error, we use the Dynamic OLS estimates as our preferred estimate. The resulting  $nxa$  is reported on Figure 2.

Several features are noteworthy. First, we observe a pattern of growing cyclical imbalances, starting in 1976-79, then 1983-89 and 2001 to the present. Second, the imbalance of the second half of the 1980s was in fact more pronounced than that of 2001-2004, due to the positive impact of the depreciation of the dollar since 2002 on US gross foreign assets. According to the figure, the external imbalance represented about 27.6% of exports in 1985:4. By contrast, the external imbalance represented ‘only’ 18.8% of exports in 2003:1 and has since shrunk by more than half to 7.1% as of 2004:1.<sup>21</sup>

We construct the financial returns on the net foreign asset portfolio as follows. First, we use

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<sup>19</sup>Household wealth is measured as Household Net Worth from the Flow of Funds.

<sup>20</sup>The sample weights are  $\mu_{xw} = 0.55\%$ ,  $\mu_{mw} = 0.60\%$ ,  $\mu_{aw} = 9.21\%$  and  $\mu_{lw} = 8.10\%$ .

<sup>21</sup>This is so, despite the fact that both net exports and the net foreign asset position of the US have worsened since the mid-80s, because the simultaneous increase in gross assets and gross liabilities since then gives more room for stabilizing valuation effects. Formally, this is captured by the fact that the coefficient on gross assets in  $nxa$  is larger than the one on gross liabilities.

the definition of  $r_t = |\mu_a| r_t^a - |\mu_l| r_t^l$ .  $r_t^a$  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  $i$ ). We use the historical weights to construct  $w_i^a$  and  $w_i^l$ .

Table 2 reports some summary statistics on  $nxa_t$ , as well as different asset returns and the rate of depreciation of our multilateral exchange rate. All the returns are total quarterly returns, including capital gains and losses.<sup>22</sup> Table 2 indicates that  $nxa$  and the return on the portfolio on net foreign assets are quite volatile. The volatility of export and import growth (4.28 and 3.81) is much smaller than the volatility of the net portfolio return (14.90). The return on gross assets is slightly larger than the return on gross liabilities (about 4 basis points for quarterly returns). Given the leverage of the net foreign asset portfolio, this translates into a sizable real overall return for net foreign assets, of 1.22% over a quarter.

Looking at the subcomponents, we find that 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).

[Tables 1-2 about here]

#### 4.1 The financial and trade channels of external adjustment

Our variable  $nxa_t$  is a theoretically well-defined measure of 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.

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<sup>22</sup>For a description of dividend and interest income and the role of the US as a banker of the world see Gourinchas and Rey (2005, in progress).

Equation (8) imposes the following restriction:

$$\begin{aligned} nxa_t &= -\sum_{j=1}^{+\infty} \rho^j E_t r_{t+j} - \sum_{j=1}^{+\infty} \rho^j E_t \Delta n x_{t+j} \\ &\equiv nxa_t^r + nxa_t^{\Delta nx} \end{aligned} \quad (11)$$

$nxa_t^r$  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 the VAR( $p$ ) representation for the vector  $(r_t, \Delta n x_t, nxa_t)'$ . Appropriately stacked, this VAR has a first order companion representation:  $\bar{\mathbf{z}}_{t+1} = \mathbf{A} \bar{\mathbf{z}}_t + \boldsymbol{\epsilon}_{t+1}$ . Equation (11) implies that we can construct  $nxa_t^r$  and  $nxa_t^{\Delta nx}$  as:

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

where  $\mathbf{e}'_r$  (resp.  $\mathbf{e}'_{\Delta nx}$ ) is a dummy vector that ‘selects’  $r_t$  (resp.  $\Delta n x_t$ ).<sup>23</sup> We represent the time paths of  $nxa_t^r$  and  $nxa_t^{\Delta nx}$  in figure 2.<sup>24</sup>

Several features are noteworthy. First,  $nxa_t^r$  and  $nxa_t^{\Delta nx}$  are highly positively correlated: the valuation and trade effects are mutually reinforcing, underlining the stabilizing role of capital gains in the external adjustment of the US.<sup>25</sup> Given our normalization of  $nxa$ , valuation effects represent the equivalent of a 8.6% contemporaneous increase in exports in 1985:4 (out of 27.6%) and 5.8% in 2003:1 (out of 18.8%).

Finally, 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. To check whether this last equality holds, we use a Wald test and find a  $\chi^2$  equal to 0.325. With three restrictions, the p-value is 0.955, so we cannot reject the intertemporal equation.<sup>26</sup> This, and the fact that  $nxa_t(\text{predict}) = nxa_t^r + nxa_t^{\Delta nx}$  is very close to  $nxa_t$  (see Figure 2) show the excellent quality of our approximation.

Following the same methodology, Figure 3 further 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

<sup>23</sup>See Appendix B for a derivation.

<sup>24</sup>We use  $p = 1$ , according to standard lag selection criteria.

<sup>25</sup>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.

<sup>26</sup>The predicted coefficients for  $\mathbf{e}'_{nxa} = [1, 0, 0]$  are  $[0.87, -0.009, -0.04]$ .

comes mostly from excess returns on gross assets; the contribution of expected returns on gross liabilities is negligible.

[Figures 2-3 about here]

We are also interested in the long run or low frequency properties of  $nxa$ . Following Cochrane (1992), we use equation (8) 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  $nxa^{\Delta nx}$ . 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:

$$\begin{aligned} 1 &= \frac{\text{cov}(nxa, nxa)}{\text{var}(nxa)} = \frac{\text{cov}(nxa^r, nxa)}{\text{var}(nxa)} + \frac{\text{cov}(nxa^{\Delta nx}, nxa)}{\text{var}(nxa)} \\ &= \beta_r + \beta_{\Delta nx} \end{aligned} \tag{12}$$

This decomposition is equivalent to looking at the coefficients from regressing independently  $nxa^r$  and  $nxa^{\Delta nx}$  on  $nxa$ . The resulting coefficients,  $\beta_r$  and  $\beta_{\Delta nx}$  represent the share of the unconditional variance of  $nxa$  explained by future returns or future net export growth.<sup>27</sup> Table 3 reports the decomposition for values of  $\rho$  between 0.94 and 0.96.

For our benchmark value  $\rho = 0.95$ , we get a breakdown of 56% (net exports) and 31% (portfolio returns) accounting for 87% of the variance in  $nxa$ .<sup>28</sup> The results are sensitive to the assumed discount factor. Lower (higher) values of  $\rho$  increase (decrease) the contribution of portfolio returns.<sup>29</sup> For  $\rho = 0.94$ , we find that portfolio returns account for 32% of the total variance while for  $\rho = 0.96$  their contribution decreases to 29%. The general flavor of our results is not altered by those robustness checks.

These findings have important implications. First, financial adjustment accounts for about 31% of total external adjustment, even at long horizons, while 56% comes from movements in future net exports. Thus, our findings indicate that valuation effects do not replace the need for an

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<sup>27</sup>This is not an orthogonal decomposition, so terms less than 0 or greater than 1 are possible. Empirically, the sum of  $\beta_r$  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.

<sup>28</sup>As explained in (4), our benchmark  $\rho$  is imputed from the data. It is obtained from sample weights  $\mu_{xw}$ ,  $\mu_{mw}$ ,  $\mu_{aw}$ ,  $\mu_{lw}$  and equation (2).

<sup>29</sup>Whenever we perform comparative statics on the discount rate  $\rho$  we insure that equation (2) holds by adjusting  $\mu_a$ . The corresponding values are presented in line 6 of Table 3.

ultimate adjustment in net exports via expenditure switching or expenditure reducing mechanisms, a point developed in detail in Obstfeld and Rogoff (2004). What our estimates indicate, however, is that valuation effects profoundly transform the nature of the external adjustment process. By absorbing about 31% of the external imbalances, valuation effects substantially relax the external budget constraint of the US. As financial globalization -and the scope for wealth transfers- increase, one implication is that the US will be able to run larger and more substantial external imbalances, provided foreigners are willing to accumulate further holdings of (depreciating) dollar-denominated US liabilities. This seems to be borne out in the data, where the fluctuations in  $nxa$  have taken increasingly larger amplitude over the last thirty years.

Using the same methodology, lines 3 and 4 of Table 3 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 29% ( $nxa^{ra}$ ) and 2% ( $nxa^{rl}$ ) making up the 31% total contribution of the returns to external adjustment. These findings confirm Figure 3: gross asset returns account for the bulk of the variance, while returns on gross liabilities, which are all in dollars, are largely unresponsive.

[Table 3 about here]

## 4.2 Predictability of returns, exchange rate and net exports

In this section, we investigate the predictive power of the deviation from trend of the ratio of net exports to net foreign assets. Equation (8) indicates that  $nxa_t$  should help predict either future returns on the net foreign asset portfolio  $r_{t+j}$ , or future net export growth  $\Delta nx_{t+j}$ , or both.

Figure 4 plots the quarterly return on the net foreign asset portfolio  $r_t$  -a positive number on the graph means that assets owned by US residents outperform US assets held by foreigners- together with the (opposite of) the lagged deviation from trend  $nxa$  (both variables are standardized). The figure shows that  $nxa$  captures the broad pattern of returns on the US net foreign position. For instance, starting in 1983,  $nxa_t$  predicted a relatively high return on the net foreign asset portfolio of the US. The excess return on US external assets became large and positive in 1984 and remained so until 1987. More recently,  $nxa$  has predicted high returns on US net external assets since 2001. Net portfolio returns stayed low until the end of 2002, then increased sharply.

[Figures 4-5 about here]

It is no coincidence that these two episodes were marked by large movements in the dollar. Figure 5 reports the quarterly rate of depreciation of the dollar  $\Delta e_t$  (a positive value means a dollar depreciation) together with (the opposite of)  $nxa_{t-1}$  over the post Bretton-Woods period. Again, the variables are standardized. The figure reveals a substantial degree of correlation between  $nxa$  and the subsequent rate of depreciation of the currency. In the mid-1980s and again in the late 1990s,  $nxa$  indicated that a depreciation of the dollar was necessary to restore long term solvency. The dollar subsequently depreciated.

### 4.3 Forecasting quarterly returns: the role of valuation effects

This section explores in more details the ability of  $nxa$  to forecast future net foreign asset portfolio returns and exchange rates at the quarterly horizon. Tables 4-7 report a series of results using the lagged deviations  $nxa_{t-1}$  as a predictive variable. Each line of the tables reports a regression of the form:

$$y_t = \alpha + \beta nxa_{t-1} + \gamma z_{t-1} + \epsilon_t$$

where  $y_t$  denotes a quarterly return between  $t-1$  and  $t$  while  $z_t$  denotes additional controls shown elsewhere in the literature to contain predictive power for asset returns or exchange rates.

Looking first at Panel A of Table 4, we see that  $nxa$  has significant forecasting power for the net portfolio return  $r_t$  one quarter ahead (line 1). The  $\bar{R}^2$  of the regression 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 (8). We observe also that there is essentially no forecasting power from either lagged values of the net portfolio return, or lagged domestic and foreign dividend-price ratios (lines 2-3). We note that  $xm_{t-1}$ , the deviation from trend of net exports, does have some predictive power on its own (line 4). It does not however enter the regression if we use the theoretically correct variable  $nxa_{t-1}$  (lines 5-6).

We emphasize that the predictive power of the regression is economically large: the coefficient of 0.41, coupled with a standard deviation of  $nxa$  of 11.72% indicates that a one-standard deviation increase in  $nxa$  predicts a decline in the net portfolio return of about 481 basis points over the next quarter, equivalent to about 19.22 percent at an annual rate.

Panel B of Table 4 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.<sup>30</sup> To the extent that the weights  $\mu_a$  and  $\mu_l$  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. The  $\bar{R}^2$  of the regression is equal to 0.06 (line 1) and the sign of the statistically significant coefficient is negative, as expected. The domestic and foreign dividend-price ratios are not significant on their own (line 3), but the domestic dividend-price ratio becomes significant once associated with  $nxat_{-1}$  (line 6). The  $\bar{R}^2$  of this regression is an impressive 0.16. It is important to emphasize that we are predicting one-quarter ahead *relative* stock market performance!

The predictive impact of  $nxat_{-1}$  on  $r_t^{ae} - r_t^{le}$  is smaller than on  $r_t$ , yet it is still highly economically significant. With a coefficient of -0.12, a one-standard deviation increase in  $nxat_{-1}$  predicts a decline in excess returns of 141 basis points, or 5.63 percent annualized. These results accord well with the intuition behind equation (8) and show that changes in return on domestic relative to foreign assets are a powerful mechanism for international financial adjustment.

[Tables 4-7 about here]

We now turn to the components of the total portfolio return  $r_t$ . Recall that we can write  $r_t = |\mu_a|r_t^a - |\mu_l|r_t^l$ . Does our variable  $nxat_{-1}$  predict the return on gross liabilities or gross assets? In Panel C of Table 5, we investigate the predictive ability of  $nxat_{-1}$  for  $r_t^l$ , the return on US gross liabilities. Panel D investigates the predictability of US total equity return  $r_t^{le}$ . It is immediate that the predictive ability of  $nxat_{-1}$  for both variables is nonexistent: the coefficients on  $nxat_{-1}$  are never significant and the  $\bar{R}^2$  is essentially zero. By contrast, we confirm the results of Lettau and Ludvigson (2001) and find that the deviation from trend of the ratio of nondurable consumption to total wealth  $cay_{t-1}$  contains predictive power for US stock returns (and US liabilities).

Panels E and F of the same Table look at the predictive power for the total return on gross assets  $r_t^a$  and the foreign total equity return in dollars respectively. Both panels indicate that there is significant predictive power at one quarter, even though it is weaker than for the net foreign

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<sup>30</sup>The correlations are 0.93 and 0.95 respectively.



asset portfolio return. The  $\bar{R}^2$  is small, around 0.03 (line 1 and line 6) but is robust to the addition of the foreign dividend price ratio.<sup>31</sup> An increase in  $nxa_{t-1}$  predicts a decline in future dollar returns on foreign assets, in line with the intuition behind equation (8). Comparing panels A, C and E indicates that the correlation structure between returns on gross assets and liabilities plays an important role for understanding the adjustment of net foreign asset returns  $r_t$ .

#### 4.4 Exchange rate predictability a quarter ahead

The results from Table 5 raise an obvious and tantalizing question: could it be that the predictability in the dollar return on gross assets arises from predictability in the exchange rate? After all, the return on gross foreign assets can be written as  $r_t^a = \tilde{r}_t^a + \Delta e_t - \pi_t$  where  $e_t$  represents (the log of) a financially-weighted US nominal effective exchange rate and  $\tilde{r}_t^a$  represents the return on gross assets in some compound foreign currency. Panel G of Table 6 presents estimates using our FDI-weighted effective exchange rate while Panel H reports the results using the Federal Reserve trade-weighted multilateral exchange rate for major currencies. The sample covers the post Bretton Woods period, from 1973:1 to 2004:1.

We observe first that  $nxa_{t-1}$  contains strong predictive power for both exchange rate series (line 1 of Panels G and H). The coefficient is negative (-0.08 and -0.09 respectively) and significant, implying that a current negative deviation from the trend of net exports to net assets predicts a subsequent depreciation of the dollar against major currencies that increases the returns on gross assets and helps restore long-term solvency. The  $\bar{R}^2$  are high (0.08 and 0.11 respectively). The effects are also economically large: a one-standard deviation decrease in  $nxa$  predicts a 3.75% to 4.23% (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. Line 3 tests the Uncovered Interest Parity condition. As is abundantly documented in the literature (see Gourinchas and Tornell (2004) for recent estimates), the coefficient on the forward premium  $i_t - i_t^*$  is often insignificant or negative. We find a similar result (line 3 and 6): if anything, an increase in US interest rates is associated with a future expected appreciation of the dollar.<sup>32</sup> As before, we also

<sup>31</sup>Unfortunately there is no available measure of the foreign consumption wealth ratio.

<sup>32</sup>Our results imply that the risk premium (defined as the difference between the three-month forward rate and the depreciation rate) is explained by our cointegrating residual.

find that the predictive power of  $xm_{t-1}$  on the exchange rate does not survive the inclusion in the regression of our variable  $nxa_{t-1}$ .

Finally, Table 7 tests the quarter-ahead predictive power of  $nxa_{t-1}$  for bilateral nominal rates of depreciation of the dollar against the Sterling, the Japanese yen, the Canadian dollar the German DMark (Euro after 1999) and the Swiss Franc. We find a modest predictive power for all currencies except the Canadian dollar, with  $\bar{R}^2$  ranging from 0.03 to 0.10. The largest significant effect is on the DM/Euro and the weakest on the British pound.

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. Our cointegrating residual variable enters with the predicted sign and is strongly significant: a large ratio of net exports to net foreign assets predicts a subsequent appreciation of the dollar, which generates a capital loss on foreign assets.<sup>33</sup>

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

A natural question is whether the predictive power of the deviations of the ratio of net exports to net foreign assets from trend increases with the forecasting horizon. According to equation (8),  $nxa$  could forecast any combination of  $r_t$  and  $\Delta nx_t$  at long horizons.

We investigate this question by regressing  $k$ -horizon returns  $y_{t,k} \equiv \left( \sum_{i=0}^{k-1} y_{t+i} \right) / k$  between  $t-1$  and  $t+k-1$  on  $nxa_{t-1}$ . Table 8 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 as before  $nxa_{t-1}$  as the regressor. Its explanatory power is summarized by  $\bar{R}^2(1)$ . In the second one, we used  $xm_{t-1}$ ,  $al_{t-1}$  and  $xa_{t-1}$  independently as regressors (their linear combination constitutes  $nxa_{t-1}$ ), to allow for the fact that

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<sup>33</sup>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 (2003) 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 (2003)'s test leads us to reject the hypothesis of no predictability at the 5% level. Therefore all our predictability regressions are robust.

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,  $\bar{R}^2(2)$ .

Table 8 indicates that the in-sample predictability increases up to an impressive 0.27 (0.35 with three regressors) for net foreign portfolio returns at a four-quarter horizon, then declines to 0.02 or 0.04 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 (4.1), its overall contribution to external adjustment amounts to roughly 31%.

[Table 8 about here]

The picture is very different when we look at net export growth. We find that  $nxat_{-1}$  predicts a substantial fraction of future net export growth in the long run: the  $\bar{R}^2$  is 0.36 at 24 quarters, and 0.77 with three regressors! This result is consistent with a long run adjustment via the trade balance. A large positive deviation of net exports relative to net foreign assets 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 0.36 (0.61 with three regressors) at 12 quarters. There is significant predictive power at short, medium and long horizons.<sup>34</sup>

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 external imbalances. At horizons larger 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.<sup>35</sup>

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<sup>34</sup>Again, the persistence of  $nxa$  in the predictive regressions is not an issue. Performing the pre-test of Campbell and Yogo (2003), 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 distortion. When we perform Campbell and Yogo (2003)'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.

<sup>35</sup>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.

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 6 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. First, we observe that the improvement in fit is striking as the horizon increases. Second, we emphasize that 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 6]

#### 4.6 Out-of-sample forecast

We perform out-of-sample forecasts by estimating our model using rolling regressions and comparing its performance to simple forecasting models.<sup>36</sup> This enables us in particular to revisit the classic Meese and Rogoff (1983) result. 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.<sup>37</sup>

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 estimate our three cointegration vectors over the ‘in-sample’.<sup>38</sup> 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

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<sup>36</sup>Interestingly, some recent work by Kilian and Inoue (2002) notes that because out-of-sample tests lose power due to the sample splitting, they may fail to detect predictability where in-sample test would find it. According to these authors, both in-sample and out-of-sample tests are valid, provided that correct critical values are used.

<sup>37</sup>See Chinn, Cheung and Garcia (forthcoming). 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.

<sup>38</sup>We also construct the sample weights  $|\mu_i|$  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 4. We use our benchmark value of  $\rho = 0.95$  in those calculations.

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.<sup>39</sup> We emphasize that, since we are estimating the cointegration vectors and the weights using only data available at the time of prediction, we cannot fall victim to any look-ahead bias.<sup>40</sup>

This exercise is very stringent because, due to sampling uncertainty, the parameters of the cointegrating equations cannot be as precisely estimated on the shorter sample as if we were to use the whole sample each time. Horse races of our variables against a general AR(1) and the random walk model are presented in Tables 9 and 10 respectively.

#### 4.6.1 Horse race against an AR(1)

We assess the predictive power of our cointegrating residuals by comparing the mean-squared forecasting error of two nested models. We use a regression that includes just lagged returns (resp. depreciation rate) as a predictive variable (restricted model) and compare it with a regression that includes both the lagged return and  $nxat_{-1}$  (unrestricted model) at various horizons. We compute the ratio of the mean-squared errors of the unrestricted model to the restricted model  $MSE_u/MSE_r$  and test whether it is significantly smaller than one using the modified Harvey, Leybourne, and Newbold test statistic (Clark and McCracken (2001));<sup>41</sup> the null hypothesis is that of equality of the  $MSE$  for the restricted and the unrestricted model. The alternative is that  $MSE_r > MSE_u$ .

Panels A and B of Table 9 report results for the total return on the net asset portfolio  $r_{t,k} = \left(\sum_{i=0}^{k-1} r_{t+i}\right)/k$  as well as for the excess equity return  $r_{t,k}^{ae} - r_{t,k}^{le}$  where  $r_{t,k}^{ae}$  and  $r_{t,k}^{le}$  are defined analogously. We find that  $nxat_{-1}$  improves the out-of-sample forecastability of net foreign returns and excess equity return at all horizons from one to sixteen quarters.<sup>42</sup> The improvement in fit is significant. We repeat the exercise augmenting the model with dividend price ratios, known to predict equity returns in conjunction with the lagged variable. In all cases the results are similar and support the importance of our cointegration variable for out-of-sample forecasts.

Panel C of Table 9 reports our results for the rate of depreciation of the exchange rate. Most tests

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<sup>39</sup>See Appendix C for details.

<sup>40</sup>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.

<sup>41</sup>This statistic is correct only for one-step ahead forecasts. We perform rolling regressions and use accordingly the critical values presented in Table 4 of Clark and McCracken (2000). The results are similar if we use recursive estimates instead.

<sup>42</sup>We cannot investigate the out-of-sample predictability for longer horizons because we do not have enough observations.

of exchange rate out-of-sample predictability estimate the forecasting equations over the floating period only. In contrast, we estimate our forecasting equations since 1952 and construct out-of-sample forecasts from 1978 onward. This gives us more observations to re-estimate the cointegration relation each period to construct  $nxa$ , which represents our best estimate of external imbalances, both in the Bretton Woods and in the floating period. Since our out-of-sample forecasts start in 1978, well into the floating period, the goodness of our fit cannot be ascribed to the fact that we forecast the constant exchange rates of the Bretton Woods era!<sup>43</sup> The improvement in fit when using our cointegrating variables is important at all horizons, even at the short end. Augmenting the equation with interest rate differentials does not affect our results.

[Table 9 about here]

#### 4.6.2 Random Walk versus Cointegrating Vector: Meese-Rogoff revisited

Since the classic paper of Meese and Rogoff (1983), the random walk has often been considered the appropriate benchmark to gauge the forecasting ability of exchange rate models. We follow the tradition and perform nested comparison exercises. We compare the mean-squared errors ( $MSE$ ) of a model featuring only our cointegrating residual  $nxa$  and a constant to the  $MSE$  of a driftless random walk. We construct the forecasts involving our cointegrating vector as above. We re-estimate the cointegrating vectors and weights each time we add one observation to our sample and thus use *only* data available up to the date of forecast.

To assess the statistical significance of our results we use the  $MSE$ -adjusted statistic described in Clark and West (2004) and developed to perform an exercise similar to ours. 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.

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<sup>43</sup>In any case, we also performed the out of sample analysis over the floating period only. The estimating requirements for  $nxa$  impose that we start the out-of-sample period in 1994:1, leaving only 40 observations out of sample. The results, however, were mostly unchanged and are available from the authors.

As discussed in the previous section, we perform the out-of-sample analysis over the entire sample. Results are similar if we restrict the estimation to the floating period, provided we allow for enough observations in-sample. Table 10 presents the results. A  $\Delta MSE$ -Adjusted statistic larger than one 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 at all horizons, including one quarter ahead.<sup>44</sup> The  $p$ -values are always very small. 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.

[Table 10 about here]

## 5 Conclusion

This paper presents a general framework to analyze international adjustment. 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 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 theoretically grounded measure of external imbalances. That measure challenges the conventional wisdom concerning the extent of the US external imbalances. For example the 2001-04 imbalance is less pronounced than that of the second half of the 1980s (see Figure 2), due to the positive impact of the depreciation of the dollar in 2002-2004 on US gross foreign assets and increased cross border holdings.

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

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<sup>44</sup>Changes in the cut-off point  $t_o$  do not seem to make any difference for these results, provided the number of observations used to perform the estimation is sufficient.

contributing to the process of international adjustment via the *financial 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 observing today's ratio of net exports to net assets contain significant information on future exchange rate changes. We are able to predict in sample 11% of the variance of the exchange rate one quarter ahead, 44% a year ahead and 61% 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 to twelve quarters. In our out-of-sample exercises, we eliminated any possibility of look-ahead bias by using exclusively data of the first part of the sample for all the estimation phase.

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. In our model, 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. While early contributions to the intertemporal approach did study intertemporal effects (on real interest rates) of terms of trade or exchange rate movements (see Razin and Svensson (1983)), we emphasize a different mechanism through asset revaluations.<sup>45</sup>

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. 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.

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

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<sup>45</sup>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.



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.<sup>46</sup> 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.<sup>47</sup> Another interesting avenue to explore are models generating time-varying risk premia such as Campbell and Cochrane (1999). Finally, a finer study of the role of foreign official sectors in financing the US current account deficits, particularly when global imbalances are high, is also certainly warranted.

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<sup>46</sup>See Kouri (1982) and Henderson and Rogoff (1982).

<sup>47</sup>Obstfeld (2004) provides an illuminating discussion of those theoretical mechanisms.

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## Appendix A Loglinearization

The law of asset accumulation is given by:

$$NA_{t+1} = R_{t+1}(NA_t + NX_t) \quad (\text{A.1})$$

Divide through by household total wealth (including human wealth) denoted by  $W_{t+1}$ :

$$\frac{NA_{t+1}}{W_{t+1}} \frac{W_{t+1}}{W_t} = R_{t+1} \left( \frac{NA_t}{W_t} + \frac{NX_t}{W_t} \right) \quad (\text{A.2})$$

From assumptions 1 and 2,  $A_t/W_t$ ,  $L_t/W_t$ ,  $X_t/W_t$ ,  $M_t/W_t$  and  $W_{t+1}/W_t$  are stationary.<sup>48</sup>

Denote by  $\mu_{yz}$  the steady state value of the ratio  $Y_t/Z_t$  for some variables  $Y_t$  and  $Z_t$ , and define  $y_t = \ln(Y_t)$ . We define  $yz_t$  such that  $Y_t/Z_t = \mu_{yz} \exp(yz_t)$ . A first-order Taylor expansion of the right hand side of (A.2) gives:

$$\begin{aligned} & (\mu_{aw} - \mu_{lw}) \gamma \\ & (1 + \mu_a r_{t+1}^a - \mu_l r_{t+1}^l + \frac{\mu_{aw} - \mu_{lw}}{\mu_{aw} - \mu_{lw} + \mu_{xw} - \mu_{mw}} [\mu_a aw_t - \mu_l lw_t] \\ & + \frac{\mu_{xw} - \mu_{mw}}{\mu_{aw} - \mu_{lw} + \mu_{xw} - \mu_{mw}} [\mu_x xw_t - \mu_m mw_t]) \end{aligned}$$

where  $\mu_a = \mu_{aw}/(\mu_{aw} - \mu_{lw})$ ,  $\mu_l = \mu_a - 1$ ,  $\mu_x = \mu_{xw}/(\mu_{xw} - \mu_{mw})$ ,  $\mu_m = \mu_x - 1$  and we used the steady state condition  $(\mu_{aw} - \mu_{lw}) \gamma = R(\mu_{aw} - \mu_{lw} + \mu_{xw} - \mu_{mw})$ .

The left hand side of (A.2) is approximately equal to:

$$(\mu_{aw}(1 + aw_{t+1}) - \mu_{lw}(1 + lw_{t+1})) \gamma (1 + \Delta w_{t+1})$$

Equating, rearranging and substituting  $yz_t = y_t - z_t - \ln(\mu_{yz})$ , and  $\Delta w_{t+1} = w_{t+1} - w_t - \ln \gamma$ , we obtain (omitting irrelevant constants):

$$(\mu_a a_{t+1} - \mu_l l_{t+1}) - (\mu_a a_t - \mu_l l_t) = \mu_a r_{t+1}^a - \mu_l r_{t+1}^l + \left(1 - \frac{1}{\rho}\right) [(\mu_x x_t - \mu_m m_t) - (\mu_a a_t - \mu_l l_t)]$$

where  $\rho = \gamma/R$ .

If we define  $na_t = |\mu_a| a_t - |\mu_l| l_t$ ,  $nx_t = |\mu_x| x_t - |\mu_m| m_t$ , and  $r_{t+1} = |\mu_a| r_{t+1}^a - |\mu_l| r_{t+1}^l$ , we obtain:<sup>49</sup>

$$\Delta na_{t+1} = r_{t+1} + \left(\frac{1}{\rho} - 1\right) [nx_t + na_t] \quad (\text{A.3})$$

$nx_t$  has the interpretation of the log-linearized trade balance, while  $na_t$  has the interpretation of the log-linearized net foreign asset position. We observe that  $w_t$  and  $w_{t+1}$  drop out of the linearization.

Subtracting and adding  $nx_{t+1} - nx_t$  to the left hand side of equation (A.3):

$$nxa_{t+1} = r_{t+1} + \Delta nx_{t+1} + \frac{1}{\rho} nxa_t$$

where  $nxa_t = nx_t + na_t$ . This is a difference equation in  $nxa_t$ . Under assumption 4, this difference equation can be solved forward since  $\rho < 1$ :

<sup>48</sup>Note that all the stationary ratios around which we loglinearize are always positive.

<sup>49</sup>Recall that  $\mu_a$  and  $\mu_x$  have opposite signs.

$$nxa_t = - \sum_{j=1}^{+\infty} \rho^j [r_{t+j} + \Delta nx_{t+j}] \quad (\text{A.4})$$

which is equation (7).

Finally, using the restriction  $\mu_x - \mu_m = \mu_a - \mu_l = 1$ ,  $nxa$  can be decomposed as follows:<sup>50</sup>

$$\begin{aligned} nxa &= |\mu_x| x_t - |\mu_m| m_t + |\mu_a| a_t - |\mu_l| l_t \\ &= |\mu_m| xm_t + |\mu_l| al_t + xa_t \end{aligned}$$

## Appendix B VAR decomposition

Consider a VAR( $p$ ) representation for the vector  $z_t = (r_t, \Delta nx_t, nxa_t)'$ . This VAR has the following representation:

$$z_t = A(L) z_{t-1} + \epsilon_t$$

Appropriately stacked, this VAR has a first order companion representation:

$$\bar{z}_{t+1} = \bar{\mathbf{A}} \bar{z}_t + \bar{\epsilon}_{t+1} \quad (\text{B.1})$$

where  $\bar{z}_t = (z'_t, \dots, z'_{t-p+1})'$  and  $\bar{\epsilon}_t = (\epsilon'_t, 0)'$ . Define the indicator vectors  $\mathbf{e}_{\Delta nx}$ ,  $\mathbf{e}_r$  and  $\mathbf{e}_{nxa}$  that ‘pick’ the corresponding elements of  $\bar{z}_t$  (i.e.  $\mathbf{e}'_r \bar{z}_t = r_t$  for instance). Equation (8) implies the following restriction on the VAR representation:

$$\begin{aligned} nxa_t &= - \sum_{j=1}^{+\infty} \rho^j \bar{E}_t (r_{t+j} + \Delta nx_{t+j}) \\ \mathbf{e}'_{nxa} \bar{z}_t &= - (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx}) \sum_{j=1}^{+\infty} \rho^j \bar{E}_t \bar{z}_{t+j} \end{aligned} \quad (\text{B.2})$$

where  $\bar{E}_t$  denotes expectations according to the information contained in the VAR representation (B.1).<sup>51</sup> According to equation (B.1), the conditional expectations of  $\bar{z}_{t+j}$  satisfy:  $\bar{E}_t \bar{z}_{t+j} = \mathbf{A}^j \bar{z}_t$ . Substituting into equation (B.2) we obtain:

$$\begin{aligned} \mathbf{e}'_{nxa} \bar{z}_t &= - (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx}) \sum_{j=1}^{+\infty} \rho^j \mathbf{A}^j \bar{z}_t \\ &= - (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx}) \rho \mathbf{A} (\mathbf{I} - \rho \mathbf{A})^{-1} \bar{z}_t \\ &= nxa_t^r + nxa_t^{\Delta nx} \end{aligned} \quad (\text{B.3})$$

where  $nxa_t^r = -\mathbf{e}'_r \rho \mathbf{A} (\mathbf{I} - \rho \mathbf{A})^{-1} \bar{z}_t$  and  $nxa_t^{\Delta nx} = -\mathbf{e}'_{\Delta nx} \rho \mathbf{A} (\mathbf{I} - \rho \mathbf{A})^{-1} \bar{z}_t$ . Moreover, since (B.3) needs to hold for all values of  $\bar{z}_t$ , it implies the following restriction on the companion matrix  $\mathbf{A}$ :

$$\mathbf{e}'_{nxa} = - (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx}) \rho \mathbf{A} (\mathbf{I} - \rho \mathbf{A})^{-1} \quad (\text{B.4})$$

<sup>50</sup>When  $\mu_a < 0$  and  $\mu_x > 0$ . The symmetric case is immediate.

<sup>51</sup>We do not impose that economic agents form expectations according to  $\bar{E}_t$ . We only require that the information contained in (B.1) is a subset of the information available to economic agents. See Campbell and Shiller (1988) for a discussion.

(B.4) constitutes a present value test (see Campbell and Shiller (1987)). Post-multiplying by  $(\mathbf{I} - \rho\mathbf{A})$ , this is equivalent to:

$$\mathbf{e}'_{nxa}\mathbf{I} + (\mathbf{e}'_r + \mathbf{e}'_{\Delta nx} - \mathbf{e}'_{nxa})\rho\mathbf{A} = \mathbf{0}$$

Campbell and Shiller (1987) show that this test is numerically identical to the one-step ahead test  $\bar{E}_t(Q_{t+1}) = 0$  where  $Q_{t+1} = nxa_{t+1} - nxa_t/\rho - (r_{t+1} + \Delta nxa_{t+1})$ . Mercereau (2001) argues that the one-step-ahead test is preferable when some of the variables are persistent, as is the case here with  $nxa$ .

Table 3 also presents the results of a decomposition into a gross return, gross liability, export and import components using a five variable VAR  $z_t = (r_t^a, r_t^l, \Delta x_t, \Delta m_t, nxa_t)$ . Following the same methodology, we define

$$\begin{aligned} nxa_t^{ra} &= -|\mu_a|\mathbf{e}'_{ra}\rho\mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\mathbf{z}}_t \\ nxa_t^{rl} &= |\mu_l|\mathbf{e}'_{rl}\rho\mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\mathbf{z}}_t \\ nxa_t^{\Delta x} &= -|\mu_x|\mathbf{e}'_{\Delta x}\rho\mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\mathbf{z}}_t \\ nxa_t^{\Delta m} &= |\mu_m|\mathbf{e}'_{\Delta m}\rho\mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\mathbf{z}}_t \end{aligned}$$

## Appendix C Out-of-Sample estimates

We construct the out-of-sample forecasts for a given horizon  $k$  by running:

$$y_{t,k} = \alpha_k + \beta_k nxa_t + \gamma_k X_t + \varepsilon_{t,k} \tag{C.1}$$

where  $y_{t,k}$  represents the  $k$ -quarter ahead return (resp. depreciation rate) between period  $t$  and  $t+k$ ,  $X_t$  represents other variables that are known to predict  $y_{t,k}$ , including lagged returns  $y_{t-k,k}$ . We use the information available until date  $t_o$  to run equation (C.1). The last observation used is therefore  $(y_{t_o-k,k}, \widehat{nxa}_{t_o-k}^{t_o}, X_{t_o-k})$ . Our notations indicate that  $\widehat{nxa}_{t_o-k}^{t_o}$  is the value at date  $t_o-k$  of the cointegrating residual estimated using data available up to date  $t_o$ . Once the coefficients  $\hat{\alpha}_k(t_o)$ ,  $\hat{\beta}_k(t_o)$  and  $\hat{\gamma}_k(t_o)$  have been estimated, we use them to predict the first  $k$ -horizon forecast:

$$\hat{y}_{t_o,k} = \hat{\alpha}_k + \hat{\beta}_k \widehat{nxa}_{t_o}^{t_o} + \hat{\gamma}_k X_{t_o} \tag{C.2}$$

We then add one period to our sample. We include information of date  $t_o$  in our estimating equation and produce a forecast for  $\hat{y}_{t_o+1,k}$ . The whole procedure is repeated again in  $t_o+1, \dots$  until we reach observation  $T$ , where  $T$  is the total number of observations in our sample. We set  $t_o = 1978 : 1$  to split the sample in half with 105 observations in sample and 104 observations out of sample.

L-Max	Test Statistic				95% CV	$H_0 = r$
Lags in VAR Model:	28	29	30	38		$r =$
	48.10	72.58	74.79	255.74	27.58	0
	30.45	40.75	37.71	80.11	21.13	1
	17.50	20.71	19.61	28.81	14.26	2
	0.46	0.06	0.83	0.77	3.84	3
Trace	Test Statistic					$H_0 = r$
Lags in VAR Model:	28	29	30	38		$r =$
	96.50	134.09	132.95	365.42	47.86	0
	48.40	61.52	58.15	109.68	29.80	1
	17.95	20.76	20.44	29.57	15.49	2
	0.46	0.06	0.83	0.77	3.84	3

Table 1: Johansen Cointegration Tests with linear trend in the data. All variables are in logs. Exports and imports are corrected for seasonal effects. A constant is included in the cointegrating relation.

	Summary Statistics								
	$\Delta x_t$	$\Delta m_t$	$\Delta a_t$	$\Delta l_t$	$r_t$	$r_t^a$	$r_t^l$	$\Delta e_t$	$nxa_t$
Mean (%)	0.82	1.11	1.11	1.86	1.22	0.95	0.91	-0.03	0
Standard deviation (%)	4.28	3.81	3.05	2.82	14.90	3.00	2.91	3.55	11.72
Autocorrelation	-0.08	0.04	0.06	0.13	0.15	0.11	0.17	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	1.67	1.86	0.48	0.39	
Standard deviation (%)	7.19	8.02	2.94	3.17	7.69	8.02	0.76	0.53	
Autocorrelation	0.15	0.09	0.16	0.13	0.08	0.09	0.19	0.73	

Table 2: Descriptive Statistics. Sample period is 1952:1-2004:1, except for  $\Delta e$ , 1973:1-2004:1

#	percent	Discount factor $\rho$		
		0.96	0.95	0.94
1	$\beta_{\Delta nx}$	64.91	56.13	45.77
2	$\beta_r$	28.97	30.87	31.59
	of which:			
3	$\beta_a$	28.79	28.94	27.51
4	$\beta_l$	0.28	2.02	4.17
5	Total	93.88	87.00	77.36
	(lines 1+2)			
6	$\mu_a$	6.77	8.24	10.16

Table 3: Unconditional Variance Decomposition for  $nxa$  for various discount rates. Sample: 1952:1 to 2004:1. The sum of coefficients  $\beta_a + \beta_l$  is not exactly equal to  $\beta_r$  due to numerical rounding in the VAR estimation.



#	$nxa_{t-1}$ (s.e.)	lag (s.e.)	$dp_{t-1}$ (s.e.)	$dp_{t-1}^*$ (s.e.)	$xm_{t-1}$ (s.e.)	$R^2$	$nxa_{t-1}$	lag	$dp_{t-1}$	$dp_{t-1}^*$	$xm_{t-1}$	$R^2$
Panel A: Real Total Net Foreign Portfolio Return $r_t$						Panel B: Real Equity Return differential $r_t^{ae} - r_t^{le}$						
1	<b>-0.41</b> (0.08)					0.10	<b>-0.12</b> (0.03)					0.06
2		0.15 (0.08)				0.02		0.06 (0.07)				0.00
3			-0.37 (2.43)	0.90 (2.02)		0.00			-0.70 (0.74)	0.39 (0.67)		0.00
4					<b>-0.42</b> (0.10)	0.07					<b>-0.17</b> (0.04)	0.08
5	<b>-0.32</b> (0.11)				-0.17 (0.13)	0.10	-0.05 (0.04)				<b>-0.13</b> (0.05)	0.08
6	<b>-0.58</b> (0.21)	0.06 (0.08)	-3.18 (2.06)	1.28 (1.75)	0.01 (0.29)	0.15	<b>-0.15</b> (0.07)	-0.04 (0.09)	<b>-1.76</b> (0.69)	0.89 (0.68)	-0.10 (0.09)	0.16

Table 4: Forecasting Quarterly Net Portfolio Returns. Sample: 1952:1 to 2004:1. Robust standard errors in parenthesis.

#	$nxa_{t-1}$ (s.e.)	lag (s.e.)	$dp_{t-1}$ (s.e.)	$cay_{t-1}$ (s.e.)	$R^2$	$nxa_{t-1}$ (s.e.)	lag (s.e.)	$dp_{t-1}^*$ (s.e.)	$R^2$
Panel C: Real Total Return on Gross Liabilities					Panel E: Real Total Return on Gross Assets				
1	0.00 (0.02)				0.00	<b>-0.04</b> (0.02)			0.03
2		<b>0.17</b> (0.07)			0.03		0.11 (0.09)		0.01
3			0.37 (0.23)		0.01			0.08 (0.24)	0.00
4				<b>0.78</b> (0.18)	0.10	<b>-0.05</b> (0.03)	0.07 (0.10)	-0.02 (0.24)	0.02
5	0.01 (0.02)	<b>0.18</b> (0.06)	0.20 (0.23)	<b>0.72</b> (0.17)	0.13				
Panel D: Real US Total Equity Return					Panel F: Real Total Return on Foreign Equity				
6	0.02 (0.05)				0.00	<b>-0.11</b> (0.05)			0.03
7		0.09 (0.06)			0.00		0.15 (0.08)		0.02
8			1.11 (0.59)		0.02			0.53 (0.59)	0.00
9				<b>2.03</b> (0.45)	0.09	<b>-0.13</b> (0.06)	0.12 (0.09)	0.28 (0.56)	0.05
10	0.05 (0.05)	0.10 (0.06)	0.66 (0.57)	<b>1.90</b> (0.43)	0.10				

Table 5: Forecasting Quarterly Returns on Gross Assets and Liabilities. Sample: 1952:1 to 2004:1. Robust standard errors in parenthesis.

#	$nxa_{t-1}$ (s.e.)	lag (s.e.)	$i_{t-1} - i_{t-1}^*$ (s.e.)	$xm_{t-1}$ (s.e.)	$R^2$	$nxa_{t-1}$	lag	$i_{t-1} - i_{t-1}^*$	$xm_{t-1}$	$R^2$
Panel G: FDI-weighted depreciation rate					Panel H: Trade weighted depreciation rate					
1	<b>-0.08</b> (0.02)				0.08	<b>-0.09</b> (0.02)				0.11
2		0.05 (0.07)			0.00		0.13 (0.08)			0.01
3			-0.09 (0.32)		0.00			<b>-1.03</b> (0.36)		0.05
4				<b>-0.09</b> (0.03)	0.06				<b>-0.11</b> (0.04)	0.10
5	<b>-0.06</b> (0.02)			-0.03 (0.04)	0.07	<b>-0.06</b> (0.02)			-0.06 (0.04)	0.11
6	<b>-0.07</b> (0.02)	0.12 (0.16)	0.78 (0.68)	-0.03 (0.04)	0.07	<b>-0.08</b> 0.04	<b>-0.45</b> (0.15)	<b>-2.26</b> (0.57)	-0.04 (0.03)	0.17

Table 6: Forecasting Quarterly Rates of Depreciation. Sample: 1973:1 to 2004:1. Robust standard errors in parenthesis.

Currency	$nxa_{t-1}$ (s.e.)	$R^2$
UK pound	<b>-0.07</b> (0.03)	0.03
Canadian dollar	-0.02 (0.02)	0.01
Swiss franc	<b>-0.16</b> (0.04)	0.08
Japanese yen	<b>-0.12</b> (0.04)	0.06
Deutschmark (Euro)	<b>-0.16</b> (0.04)	0.10

Table 7: Forecasting Bilateral Quarterly Rates of Depreciation. Sample: 1973:1 to 2004:1. Robust standard errors in parenthesis.

	Forecast Horizon (quarters)							
	1	2	3	4	8	12	16	24
Real Total Net Portfolio Return $r_{t,k}$								
$nxa$	<b>-0.41</b>	<b>-0.40</b>	<b>-0.41</b>	<b>-0.39</b>	<b>-0.27</b>	<b>-0.18</b>	<b>-0.12</b>	<b>-0.04</b>
	(0.08)	(0.06)	(0.05)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)
$\bar{R}^2(1)$	[0.10]	[0.17]	[0.24]	[0.27]	[0.24]	[0.15]	[0.10]	[0.02]
$\bar{R}^2(2)$	[0.12]	[0.22]	[0.31]	[0.35]	[0.32]	[0.22]	[0.14]	[0.04]
Real Total Excess Equity Return $r_{t,k}^{ae} - r_{t,k}^{le}$								
$nxa$	<b>-0.12</b>	<b>-0.12</b>	<b>-0.11</b>	<b>-0.11</b>	<b>-0.06</b>	<b>-0.03</b>	-0.01	0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
$\bar{R}^2(1)$	[0.06]	[0.10]	[0.14]	[0.15]	[0.09]	[0.03]	[0.00]	[0.02]
$\bar{R}^2(2)$	[0.09]	[0.17]	[0.23]	[0.26]	[0.20]	[0.11]	[0.07]	[0.13]
Net Export growth $\Delta n x_{t,k}$								
$nxa$	<b>-0.07</b>	<b>-0.07</b>	<b>-0.06</b>	<b>-0.06</b>	<b>-0.05</b>	<b>-0.05</b>	<b>-0.05</b>	<b>-0.03</b>
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\bar{R}^2(1)$	[0.04]	[0.07]	[0.09]	[0.11]	[0.18]	[0.27]	[0.33]	[0.36]
$\bar{R}^2(2)$	[0.03]	[0.07]	[0.10]	[0.15]	[0.35]	[0.56]	[0.66]	[0.77]
FDI-weighted effective nominal rate of depreciation $\Delta e_{t,k}$								
$nxa$	<b>-0.08</b>	<b>-0.08</b>	<b>-0.08</b>	<b>-0.07</b>	<b>-0.07</b>	<b>-0.05</b>	<b>-0.04</b>	<b>-0.02</b>
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\bar{R}^2(1)$	[0.08]	[0.14]	[0.24]	[0.28]	[0.35]	[0.36]	[0.32]	[0.14]
$\bar{R}^2(2)$	[0.11]	[0.22]	[0.37]	[0.44]	[0.57]	[0.61]	[0.61]	[0.35]

Table 8: Long Horizon Regressions, Portfolio Returns on lagged  $nxa$  or  $xm$ ,  $al$  and  $xa$ : 1952:1 to 2004:1 (1973:1 to 2004:1 for exchange rate). Newey-West robust standard errors in parenthesis with  $k - 1$  Bartlett window. Adjusted  $R^2$  in brackets.

Horizon: (quarters)	ENC-NEW	$MSE_u/MSE_r$						
		1	2	3	4	8	12	16
Panel A: Real Total Net Portfolio Return $r_{t,k}$								
$nxa$ vs $AR(1)$	10.30**	0.923	0.829	0.713	0.600	0.536	0.596	0.799
$nxa$ vs $AR(1)$ , $\frac{d}{p}$ and $\frac{d^*}{p^*}$	17.15**	0.919	0.907	0.828	0.693	0.656	0.737	0.801
Panel B: Real Total Excess Equity Return $r_{t,k}^{ae} - r_{t,k}^{le}$								
$nxa$ vs $AR(1)$	21.94**	0.859	0.732	0.589	0.455	0.392	0.480	0.747
$nxa$ vs $AR(1)$ , $\frac{d}{p}$ and $\frac{d^*}{p^*}$	24.74**	0.922	0.882	0.745	0.597	0.413	0.590	0.852
Panel C: FDI-weighted depreciation rate $\Delta e_{t,k}$								
$nxa$ vs $AR(1)$	8.65**	0.943	0.907	0.870	0.796	0.776	0.839	0.869
$nxa$ vs $AR(1)$ , $i_t - i_t^*$	9.03**	0.944	0.898	0.852	0.793	0.772	0.826	0.868

Table 9: Out of Sample Tests for Equity Returns.

$MSE_u$  is the mean-squared forecasting error for an unrestricted model that includes the lagged dependent variable and lagged  $nxa$  (model 1); lagged  $d/p$ ,  $d^*/p^*$  and lagged  $nxa$  (model 2).  $MSE_r$  is the mean-squared error for the restricted models which include the same variables as above but do not include lagged  $nxa$ .  $d/p$  (resp.  $d^*/p^*$ ) is the US (resp. rest of the world) dividend price ratio. Each model is first estimated using the sample 1952:1-1978:1. ENC-NEW is the modified Harvey et al. (1998) statistic, as proposed by Clark and McCracken (2001). Under the null, the restricted model encompasses the unrestricted one. Sample: 1952:1-2004:1. \* (resp. \*\*) significant at the five (resp. one) percent level.

Horizon: (quarters)	1	2	3	4	8	12	16
FDI-weighted depreciation rate							
$MSE_u/MSE_r$	0.956	0.929	0.861	0.822	0.809	0.881	0.932
$\Delta MSE$ -adjusted ( $MSE_r - MSE_u$ -adj)	1.98	1.72	1.90	1.96	1.57	1.01	0.62
	(0.77)	(0.64)	(0.62)	(0.60)	(0.44)	(0.34)	(0.30)
	[0.005]	[0.004]	[0.001]	[0.001]	[<0.001]	[0.001]	[0.018]
Trade-weighted depreciation rate							
$MSE_u/MSE_r$	0.927	0.894	0.823	0.768	0.722	0.902	0.95
$\Delta MSE$ -adjusted ( $MSE_r - MSE_u$ -adj)	3.09	2.97	2.90	2.83	1.97	0.84	0.44
	(1.04)	(0.99)	(0.96)	(0.93)	(0.66)	(0.38)	(0.27)
	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.013]	[0.047]

Table 10: Out of Sample Tests for Exchange Rate Depreciation against the Martingale Hypothesis  
 $\Delta MSPE - adjusted$  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  $\Delta e_t$  against  $nx_{t-1}$ . 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.

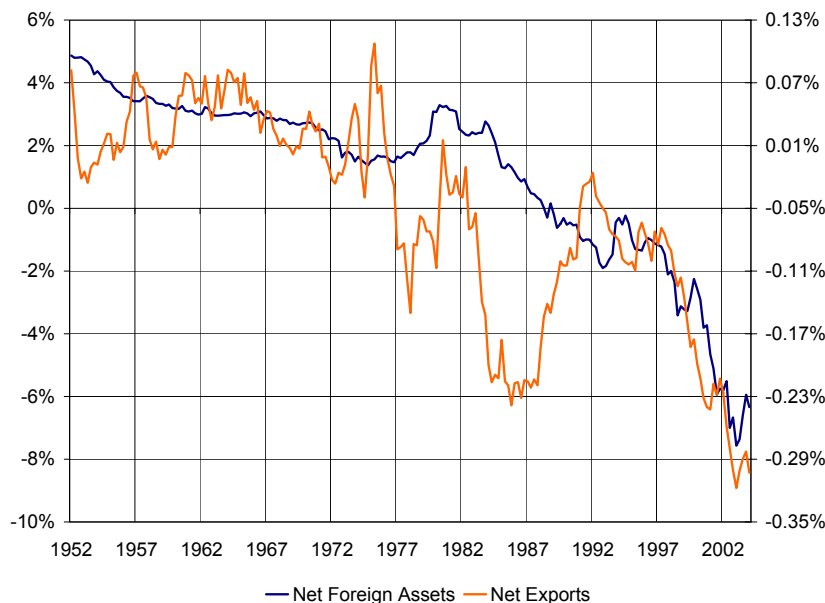


Figure 1: Net Foreign Assets (left scale) and Net Exports (right scale) (% of Household Wealth), U.S., 1952:1-2004:1. Source: Flow of Funds and BEA.

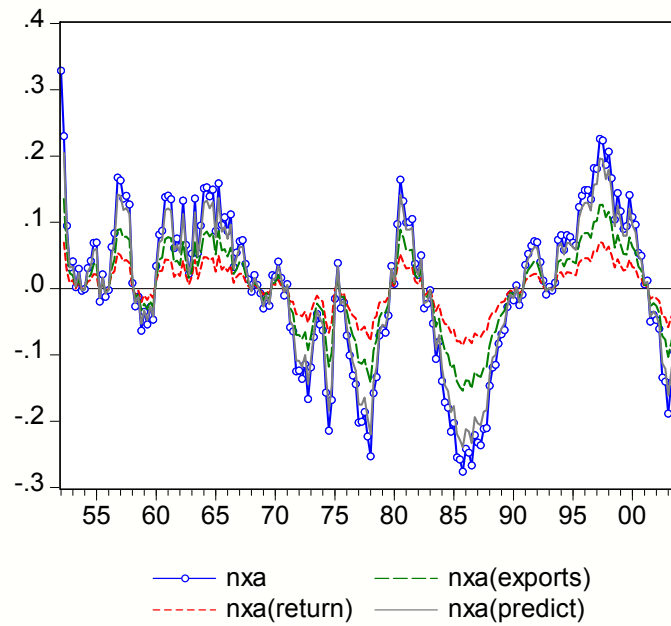


Figure 2: Decomposition of  $nxa$  into a return [ $nxa(\text{return})$ ] and a net exports [ $nxa(\text{exports})$ ] components.

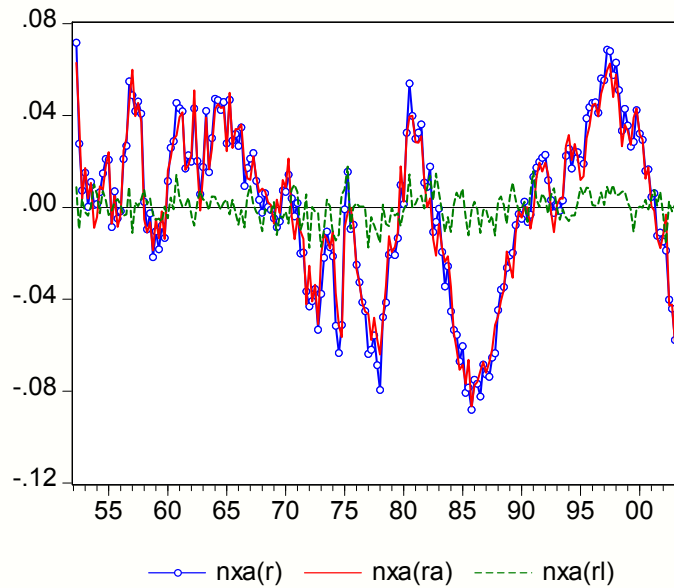


Figure 3: Decomposition of  $nxa(r)$  into a gross asset return [ $nxa(ra)$ ] and a gross liability return [ $nxa(rl)$ ].

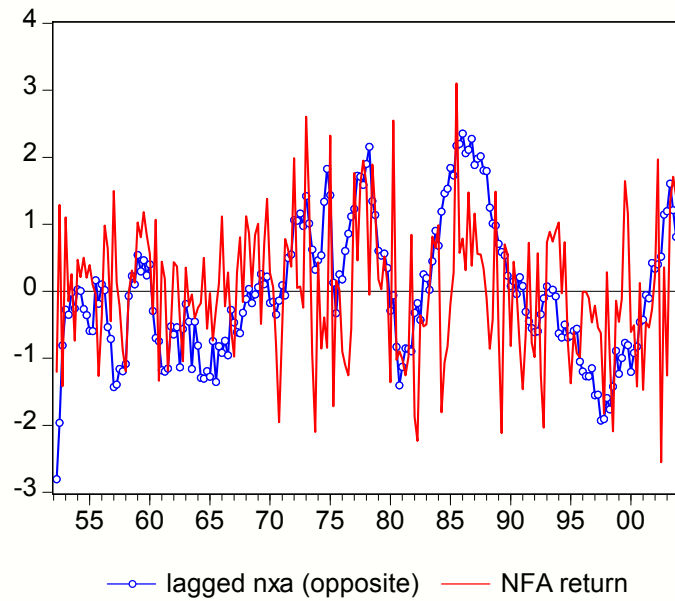


Figure 4: Net foreign portfolio return  $r_t$  (-) and (opposite of) lagged deviation  $nxa_{t-1}$  (o)

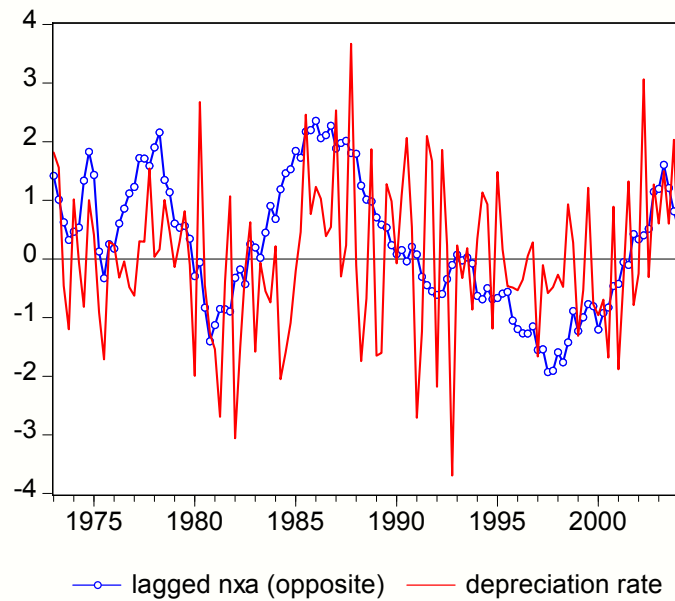


Figure 5: Multilateral rate of depreciation  $\Delta e_t$  (-) and (opposite of) lagged deviation  $nxa_{t-1}$  (o)

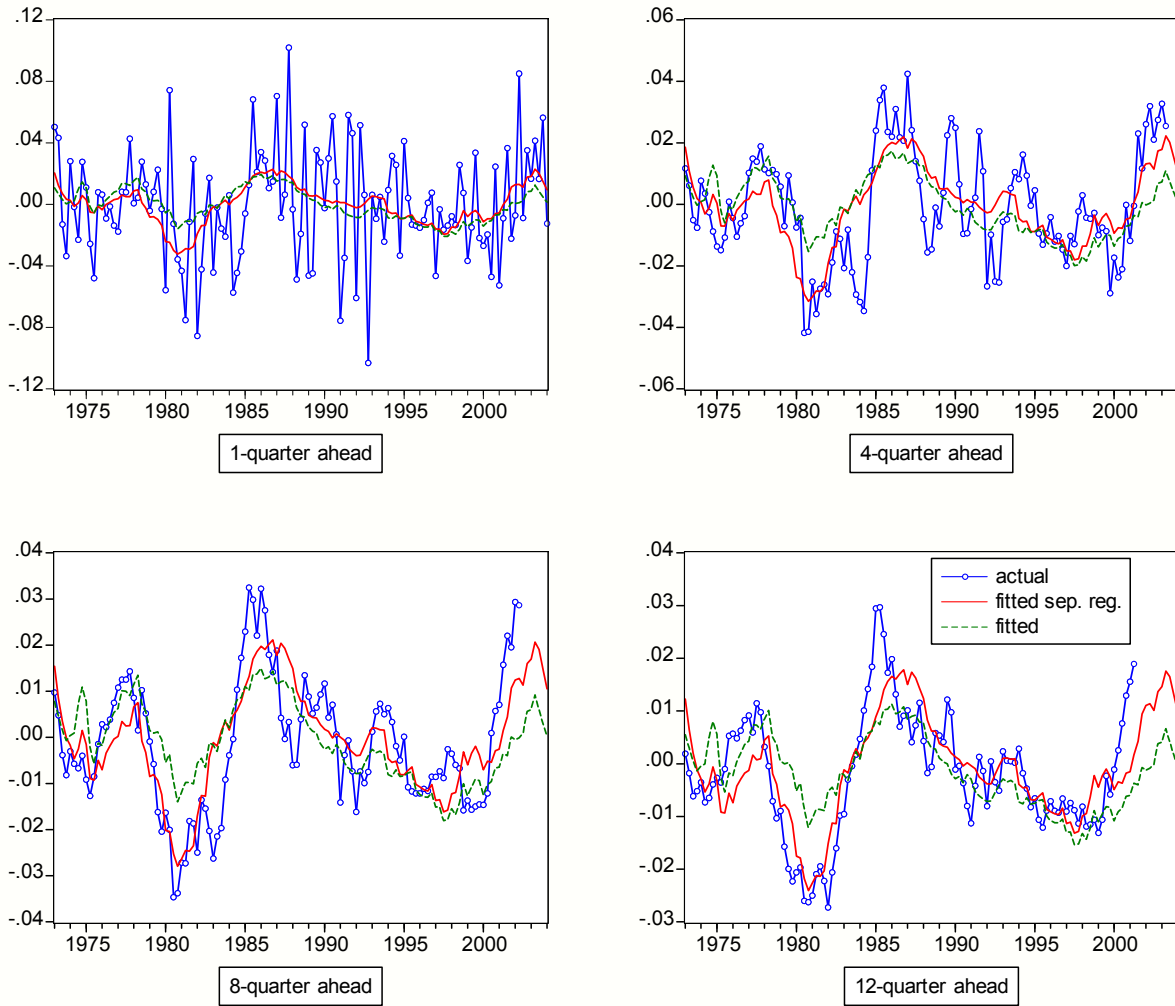


Figure 6: One to 12-quarter ahead depreciation rates. Actual and Fitted using  $nxa$  (fitted) or  $xm$ ,  $al$  and  $xa$  (fitted sep. reg.).