International Financial Adjustment

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We explore the implications of a country's external constraint for the dynamics of net foreign assets, returns, and exchange rates. Deteriorations in external accounts imply future trade surpluses (trade channel) or excess returns on the net foreign portfolio (valuation channel). Using a new data set on U.S. gross external positions, we find that stabilizing valuation effects contribute 27 percent of the cyclical external adjustment. Our approach has asset-pricing implications: external imbalances predict net foreign portfolio returns one quarter to two years ahead and net export growth at longer horizons. The exchange rate is forecastable in and out of sample at one quarter and beyond.

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I. 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, 187). These questions remain as important today as then. The modern theory focusing on those issues is the "intertemporal approach to the current account" (see Sachs 1982; Obstfeld and Rogoff 1995). It views the current account balance as the result of forward-looking intertemporal saving decisions by households and investment decisions by firms. As Obstfeld (2001, 11) 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 1970s and the large U.S. fiscal deficits of the early 1980s. Yet in many instances, its key empirical predictions are rejected by the data. Our paper suggests that this approach falls short of explaining the dynamics of the current account because it fails to incorporate capital gains and losses on the net foreign asset position.[1] The recent wave of financial globalization has come with a sharp increase in gross cross holdings of foreign assets and liabilities. Such leveraged country portfolios open the door to potentially large wealth transfers across countries as asset and currency prices fluctuate. These valuation effects are absent not only from the theory but also from official statistics. The National Income and Product Accounts and the Balance of Payments report the current account at historical cost. Hence they give a very approximate and potentially misleading reflection of the change of a country's net foreign asset position.

These considerations are essential to discuss the sustainability of the unprecedently high U.S. current account deficits. According to our calculations, the United States experienced a strong deterioration of its net foreign asset position, from a sizable creditor position in 1952 (15 percent of GDP) to a large debtor position by the end of 2003 (-24 percent of GDP) (see fig. 1). Moreover, the U.S. foreign liability to GDP ratio has more than quadrupled since the beginning of the 1980s to reach 99 percent of GDP in 2003, and its foreign asset to GDP ratio

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

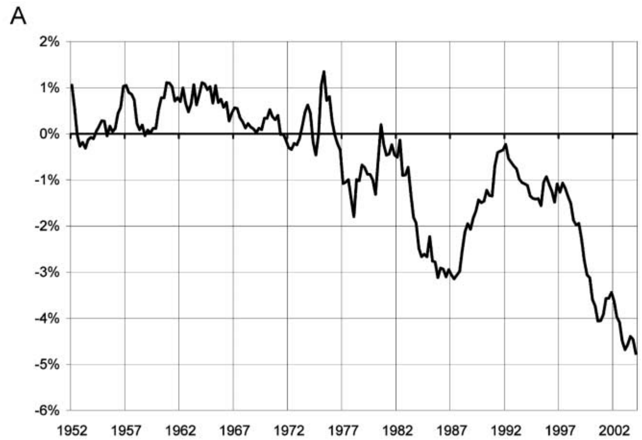

FIG. 1.—U.S. net exports and net foreign assets (percentage of GDP, 1952–2004). *A*, Ratio of U.S. net exports to U.S. GDP. *B*, Ratio of U.S. net foreign assets to U.S. GDP. Sample: 1952:1–2004:1. Source: BEA, Flow of Funds, and authors' calculations.

increased to 75 percent of GDP. The intertemporal approach to the current account suggests that the United States will need to run trade surpluses to reduce this imbalance. We argue instead that part of the adjustment can take place through a change in the returns on U.S. assets held by foreigners relative to the return on foreign assets held by U.S. residents. Importantly, this wealth transfer may occur via a depreciation of the dollar. Since almost all U.S. foreign liabilities are in dollars and approximately 70 percent of U.S. foreign assets are in foreign currencies, a back-of-the-envelope calculation indicates that a 10 percent depreciation of the dollar represents, ceteris paribus, a transfer of 5.3

percent of U.S. GDP from the rest of the world to the United States. For comparison, the U.S. trade deficit on goods and services was "only" 4.5 percent of GDP in 2003.

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

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

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

The remainder of the paper is structured as follows. Section II presents the theoretical framework that guides our analysis. Empirical results are presented in Section III. 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 IV presents conclusions.

II. International Financial Adjustment

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

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

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

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

To explore further the implications of equation (1), a natural strategy consists in observing that, along a balanced-growth path, the ratios of exports, imports, external assets, and liabilities to wealth are all statistically stationary.[4] In that case, one could follow the methodology of Campbell and Shiller (1988) and Lettau and Ludvigson (2001) and log-linearize equation (1) around the steady-state mean ratios to obtain an approximate external constraint (see Gourinchas and Rey [2005] for details). For the United States, however, we face the immediate problem that the ratios of exports, imports, external assets, and liabilities to wealth are not stationary over the postwar period. As figure 2 indicates, the variables Z_t/W_t, where $Z_t \in \{X_t, M_t, A_t, L_t\}$ and W_t denotes domestic wealth, exhibit a strong upward trend.[5] Where are these trends coming from? A natural explanation is that they represent structural changes in the world economy, such as financial and trade globalization. International financial interdependence has grown tremendously among industrial countries. In the past 20 years, for example, gross assets and liabilities have tripled as a share of GDP.[6] This increased financial integration has been brought about in particular by the phasing out of the Bretton Woods–inherited restrictions on international capital mobility and by fast progress in telecommunication and trading technologies. In parallel, trade flows have also sizably increased, spurred by declines in unit transport costs and the development of multinational

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

[3] In practice, net foreign assets could also change because of unilateral transfers, capital account transactions, or errors and omissions. Transfers and capital account transactions are typically small for the United States; errors and omissions are excluded from the financial account in the Bureau of Economic Analysis's (BEA's) estimates of the U.S. international investment position. We abstract from these additional terms. See Gourinchas and Rey (2007) for details.

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

[5] Formal tests confirm the visual impression. Simple augmented Dickey-Fuller tests of the nonstationarity of $\ln Z_t/W_t$ fail to reject the null of unit root for all four variables, and the Kwiatkowski et al. (1992) test of stationarity rejects mean stationarity at the 1 percent level.

[6] For the United Statse, gross external assets (liabilities) increased from 30 percent (22 percent) of GDP in 1982 to 75 percent (99 percent) in 2003.

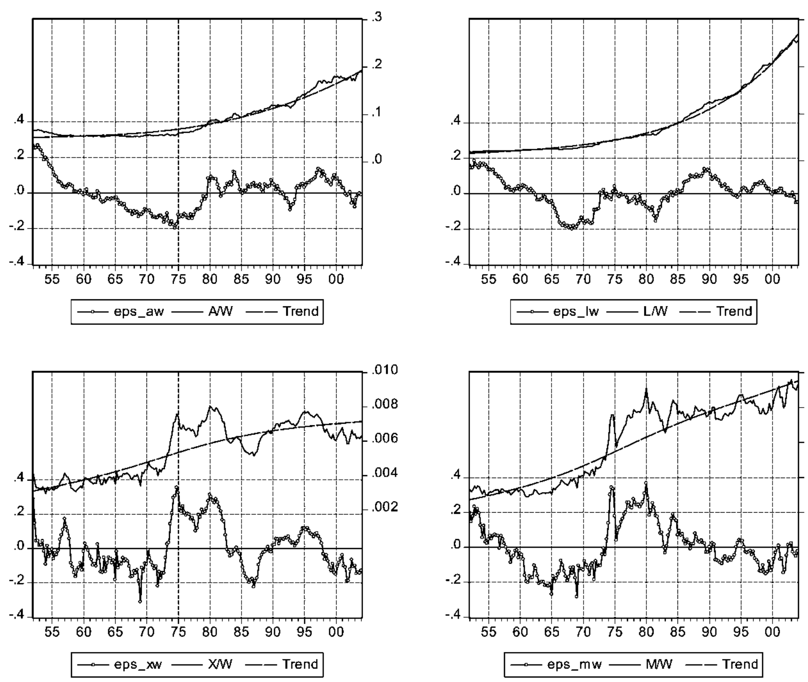

FIG. 2.—Cycle and trend components for A/W, L/W, X/W, and M/W. The top two panels pertain to U.S. gross external assets A/W (left) and U.S. gross external liabilities L/W (right); the bottom two panels pertain to U.S. exports X/W (left) and U.S. imports M/W (right). Each panel reports the series Z/W (ratio to household wealth), the trend component $\bar{Z}$, labeled trend (right axis), and the cyclical component ϵ^z (left axis). Sample: 1952:1–2004:1.

companies.[7] Indeed, when one looks at international financial integration from a historical perspective (see, e.g., Obstfeld and Taylor 2004), capital mobility increased between 1880 and 1914, decreased between the First World War and the end of the Second World War, and has been increasing since then.

The approach we develop in this paper has nothing to say about these structural changes. Henceforth, we study the process of international adjustment *around* these slow-moving trends. To do so, we model the world economy as a stochastic economy with deterministic trends. Under reasonable assumptions, we show in the next subsection that we can "purge" the data from the trend component in Z_t/W_t and concentrate

[7] For the United States, the ratio of exports (imports) over GDP increased from 5.3 percent (4.3 percent) in 1952 to 9.8 percent (14.1 percent) in 2004.

on the fluctuations of the net asset and net export variables in *deviation* from these trends.[8]

A. *Log-Linearization of the External Constraint*

Let us start by dividing the accumulation equation (1) through by W_t. Defining $\hat{Z}_t = Z_t/W_t$, we obtain

$$\hat{A}_{t+1} - \hat{L}_{t+1} = \frac{R_{t+1}}{\Gamma_{t+1}}(\hat{A}_t - \hat{L}_t + \hat{X}_t - \hat{M}_t), \tag{2}$$

where $\Gamma_{t+1} = W_{t+1}/W_t$ is the growth rate of wealth between t and $t+1$. By definition, this budget constraint holds in all periods and all states of the world.

Consider now an alternative, *deterministic*, economy, facing the same secular change in international trade and financial frictions—interpreted as the process of trade and financial globalization. In that economy, define $\bar{Z}_t$ as the equilibrium value of the ratio Z_t/W_t at time t. This alternative economy also satisfies an external accumulation equation of the following form:

$$\bar{A}_{t+1} - \bar{L}_{t+1} = \frac{\bar{R}_{t+1}}{\bar{\Gamma}_{t+1}}(\bar{A}_t - \bar{L}_t + \bar{X}_t - \bar{M}_t), \tag{3}$$

where $\bar{R}_{t+1}$ and $\bar{\Gamma}_{t+1}$ denote the equilibrium return on the net foreign assets portfolio and the growth rate of wealth, respectively, *in the deterministic economy*. By definition, this budget constraint also holds in all periods.

The budget constraint "in deviation from trends" is simply the difference between (2) and (3). When the actual realizations of the variables of interest ($\hat{Z}_t$, R_{t+1}, Γ_{t+1}) are not too far from their deterministic counterpart ($\bar{Z}_t$, $\bar{R}_{t+1}$, $\bar{\Gamma}_{t+1}$), this cyclical external constraint simplifies substantially. Formally, we make the following assumption.

Assumption 1. Define $\epsilon_t^z \equiv \ln(\hat{Z}_t/\bar{Z}_t)$, $\hat{r}_{t+1} = \ln(R_{t+1}/\bar{R}_{t+1})$, and $\epsilon_{t+1}^{\Delta w} = \ln(\Gamma_{t+1}/\bar{\Gamma}_{t+1})$. We assume that ϵ_t^z, $\hat{r}_{t+1}$, and $\epsilon_{t+1}^{\Delta w}$ are stationary and small: $|\epsilon_t^z|$, $|\hat{r}_t|$, and $|\epsilon_t^{\Delta w}| \ll 1$.

Under assumption 1, we can write $\ln \hat{Z}_t$ as the sum of a deterministic component ($\ln \bar{Z}_t$) and a stationary one (ϵ_t^z). Figure 2 reports our estimates of the trends $\bar{Z}_t$ as well as the stationary components ϵ_t^z. The following lemma establishes a simple and intuitive log-linear approximation of the external constraint.

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

LEMMA 1. Define $nx_t \equiv \mu_t^x \epsilon_t^x - \mu_t^m \epsilon_t^m$ and $na_t \equiv \mu_t^a \epsilon_t^a - \mu_t^l \epsilon_t^l$. Under assumption 1, a first-order approximation of the external constraint (2) around its trend (3) satisfies

$$na_{t+1} \approx \frac{1}{\rho_t} na_t + (\hat{r}_{t+1} - \epsilon_{t+1}^{\Delta w}) - \left(\frac{1}{\rho_t} - 1\right) nx_t, \tag{4}$$

where

$$\mu_t^x = \frac{\bar{X}_t}{\bar{X}_t - \bar{M}_t}; \quad \mu_t^m = \mu_t^x - 1;$$

$$\mu_t^a = \frac{\bar{A}_t}{\bar{A}_t - \bar{L}_t}; \quad \mu_t^l = \mu_t^a - 1;$$

$$\rho_t \equiv 1 + \frac{\bar{X}_t - \bar{M}_t}{\bar{A}_t - \bar{L}_t}.$$

Proof. See Appendix A.

The term μ_t^x represents the (trend) share of exports in the trade balance. Similarly, μ_t^a denotes the (trend) share of assets in the net foreign assets.[9] The variable nx_t is a linear combination of the stationary components of (log) exports and imports to wealth ratios, which we shall call "detrended net exports." In the same fashion, na_t is a linear combination of the stationary components of (log) assets and liabilities to wealth ratios, which we call "detrended net foreign assets." Equation (4) carries the same interpretation as equation (2) with a few differences. First, it involves only the stationary component ϵ_t^z of the ratios $\ln \hat{Z}_t$; second, these stationary components are multiplied by time-varying weights μ_t^z that reflect the trends in the data; finally, everything is normalized by wealth; hence the rate of return $\hat{r}_{t+1}$ is adjusted for the cyclical component of the growth rate of wealth ($\epsilon_{t+1}^{\Delta w}$).

Assumption 1 specifies that the stochastic economy remains close to its deterministic counterpart. Under what conditions should we expect this assumption to hold? Online Appendix D shows that this is satisfied under general conditions in the neoclassical growth model. This class of models provides an example of a stochastic economy that remains close to its deterministic counterpart even for relatively large sequences of shocks. In those models, uncertainty leads to precautionary savings and extra accumulation of capital. This lowers the equilibrium rate of return on capital, giving households incentives to unwind their capital

[9] These trend weights are well defined since $\bar{A}_t \neq \bar{L}_t$ and $\bar{X}_t \neq \bar{M}_t$ almost everywhere in our sample.

holdings back to the deterministic path. It is beyond this paper to provide a full model of international consumption and portfolio allocations that is consistent with assumption 1. We simply note that the conditions behind lemma 1 are satisfied in a wide class of models and assume that they are satisfied in our particular application. Nonetheless, we directly check the empirical validity of our approach in Section III.

B. A Measure of External Imbalances

Equation (4) simplifies drastically in the special case in which the trend components $\bar{Z}_t$ have a common—possibly time-varying—growth rate. In that case, the weights μ_t^z and ρ_t are constant. This is an important case for two reasons. First, as we will see shortly, this is the relevant case asymptotically. Second, and more important, we show in Section III that assuming constant weights provides a robust and accurate approximation of the general case.[10] Hence we make the following assumption.

Assumption 2. The trend components $\bar{Z}_t$ admit a common, possibly time-varying, growth rate: for $Z_t \in \{X_t, M_t, A_t, L_t\}$, $\bar{Z}_t = \bar{Z}\mu_t$.

Using Δ to denote first-differences ($\Delta z_{t+1} \equiv z_{t+1} - z_t$), we obtain the following result.

Lemma 2. Under assumptions 1 and 2, a first-order approximation of the external constraint (2) around its trend (3) satisfies

$$nxa_{t+1} \approx \frac{1}{\rho} nxa_t + r_{t+1} + \Delta nx_{t+1}, \tag{5}$$

where

$$\begin{aligned} nxa_t &\equiv |\mu^a|\epsilon_t^a - |\mu^l|\epsilon_t^l + |\mu^x|\epsilon_t^x - |\mu^m|\epsilon_t^m, \\ \Delta nx_{t+1} &\equiv |\mu^x|\Delta\epsilon_{t+1}^x - |\mu^m|\Delta\epsilon_{t+1}^m - \epsilon_{t+1}^{\Delta w}, \\ r_{t+1} &\equiv \frac{\mu^a}{|\mu^a|}\hat{r}_{t+1}, \\ \rho &\equiv 1 + \frac{\bar{X} - \bar{M}}{\bar{A} - \bar{L}}. \end{aligned} \tag{6}$$

Proof. See Appendix A.

The term nxa_t combines linearly the stationary components of exports, imports, assets, and liabilities. It is a well-defined measure of *cyclical external imbalances*. Unlike the current account, it incorporates infor-

[10] It is important to realize that the assumption that the weights are constant does not imply that $\ln \hat{Z}_t$ is stationary. It imposes only a common—and time-varying—trend growth rate for X, M, A, and L.

mation from both the trade balance (the flow) and the foreign asset position (the stock). Since it is defined using the absolute values of the weights μ^z, nxa always increases with assets and exports and decreases with imports and liabilities.

The term Δnx_{t+1} represents detrended net export growth between t and $t+1$. It increases with cyclical export growth $\Delta\epsilon^x_{t+1}$ and decreases with cyclical import growth $\Delta\epsilon^m_{t+1}$, whereas the return r_{t+1} is defined so as to increase with the return on foreign assets and decrease with the return on foreign liabilities.[11] Just like (2) and (4), equation (5) shows that a country can improve its net foreign asset position either through a trade surplus ($\Delta nx_{t+1} > 0$) or through a high return on its net foreign asset portfolio ($r_{t+1} > 0$).

C. *The Intertemporal External Constraint*

We next move from the dynamic external constraint to the intertemporal one. To do so, we add two mild assumptions. Assumption 3 imposes that the economy eventually settles into a balanced-growth path.

ASSUMPTION 3. The deterministic economy eventually settles into a balanced-growth path:

a. Asymptotically, $\lim_{t\to\infty}\mu_t = 1$.

b. The trend return $\bar{R}_{t+1}$ and growth rate $\bar{\Gamma}_{t+1}$ converge to R and Γ such that $R > \Gamma$.

Under assumption 3*a*, all the Z_t variables in the deterministic economy eventually grow at a common trend growth rate Γ; that is, the deterministic economy settles along a balanced-growth path. We view these restrictions as very mild: they simply rule out the implausible situation in which, for example, the rate of growth of external assets would *permanently* exceed the rate of growth of the economy. On the other hand, they allow for a permanent increase in the ratio of gross assets to wealth, as observed in the data. The assumption that the long-term growth rate of the economy is lower than the steady-state rate of return (assumption 3*b*) is a common equilibrium condition in many growth models. In our context, it has an intuitive interpretation: manipulating equation (1), one can show that if assumption 3 holds, the steady-state mean ratio of net exports to net foreign assets, NX/NA, satisfies

$$NX/NA = \rho - 1 < 0, \tag{7}$$

where $\rho = \Gamma/R < 1$. In words, countries with long-run creditor positions

[11] The term in $\epsilon^{\Delta w}_{t+1}$ enters the definition of Δnx_{t+1} because ϵ^x_t (ϵ^m_t) measures the stationary component of the ratio of exports (imports) to wealth.

($NA > 0$) should run trade deficits ($NX < 0$), whereas countries with steady-state debtor positions ($NA < 0$) should run trade surpluses ($NX > 0$).

We can solve equation (5) forward under the no-Ponzi condition that *nxa* cannot grow faster than the steady-state growth adjusted interest rate.

ASSUMPTION 4. nxa_t satisfies the no-Ponzi condition

$$\lim_{j \to \infty} \rho^j nxa_{t+j} = 0 \quad \text{with probability one.}$$

We obtain the following proposition.

PROPOSITION 1. Lemma 2 and assumptions 3 and 4 imply the following intertemporal external constraint in deviation from trend:

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j (r_{t+j} + \Delta nx_{t+j}). \tag{8}$$

Proof. See Appendix A.

Since equation (1) is an identity, equation (8) must hold along every sample path if assumptions 1–4 hold, up to the log-linearization approximations. It will therefore also hold in expectations.

COROLLARY 1. Under the conditions for proposition 1 the intertemporal external constraint satisfies approximately

$$nxa_t \approx -\sum_{j=1}^{+\infty} \rho^j E_t[r_{t+j} + \Delta nx_{t+j}]. \tag{9}$$

Equation (9) is central to our analysis. It shows that movements in the detrended trade balance and net foreign asset position must forecast either future portfolio returns or future net export growth, or both. Consider the case of a country with a negative value for *nxa*, because of either a deficit in the cyclical component of the trade balance or a cyclical net debt position, or both. Suppose first that returns on net foreign assets are expected to be constant: $E_t r_{t+j} = r$. In that case, equation (9) posits that any adjustment *must* come through future increases in net exports: $E_t \Delta nx_{t+j} > 0$. This is the standard implication of the intertemporal approach to the current account.[12] We call this channel the "trade channel."

We emphasize instead that the adjustment may also come from high expected net foreign portfolio returns: $E_t r_{t+j} > 0$.[13] We call this channel the "valuation channel." Importantly, such predictable returns can occur

[12] See Obstfeld and Rogoff (2007) for an analysis along these lines.

[13] 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 sides of eq. (8). We do not focus on such surprises.

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

The role of the exchange rate can be illustrated by considering the case—relevant for the United States—in which foreign liabilities are denominated in domestic currency and foreign assets are denominated in foreign currency. We can then rewrite real returns r_{t+1} as

$$r_{t+1} = |\mu^a|(\tilde{r}^{*a}_{t+1} + \Delta e_{t+1}) - |\mu^l|\tilde{r}^l_{t+1} - \pi_{t+1}, \tag{10}$$

where $\tilde{r}^{*a}_{t+1}$ (respectively $\tilde{r}^l_{t+1}$) represents the (log) *nominal* returns on foreign assets *in foreign currency* (respectively the [log] nominal return on gross liabilities in domestic currency), Δe_{t+1} is the rate of depreciation of the nominal exchange rate (measured as the domestic price of the foreign currency), and π_{t+1} is the realized domestic inflation rate between periods t and $t+1$.[14] With local currency returns held constant, a currency depreciation increases the domestic return on foreign assets, an effect that can be magnified by the degree of leverage of the net foreign asset portfolio when $|\mu^a| > 1$.

It is important to emphasize that since equation (8) holds in expectations but also along every sample path, one cannot hope to "test" it. Yet it presents several advantages that guide our empirical strategy. First, this identity contains useful information: a combination of exports, imports, gross assets, and liabilities—properly measured—can move *only if it forecasts either future returns on net foreign assets or future net export growth.* The remainder of the paper evaluates empirically the relative importance of these two factors in the dynamics of adjustment and investigates at what horizons they operate. Second, our modeling relies only on the intertemporal budget constraint and some long-run stability conditions. Hence, it is consistent with most models. We see this as a strength of our approach since it nests any model that incorporates an intertemporal budget constraint. More specific theoretical mechanisms can be introduced and tested as restrictions within our setup. They will have to be consistent with our empirical findings regarding the quantitative importance of the two mechanisms of adjustment and the horizons at which they operate. Thus our findings provide useful information to guide more specific theories.

[14] We subtract the inflation rate since we study real returns.

III. Empirical Results

A. Measuring External Imbalances

In Section II we used the intertemporal budget constraint to construct a measure of external imbalances, nxa_t, defined as a linear combination of detrended (log) exports (ϵ_t^x), imports (ϵ_t^m), gross foreign assets (ϵ_t^a), and liabilities (ϵ_t^l) relative to wealth. In this section, we estimate nxa_t and quantify the share of the adjustment coming from net exports and from valuation effects using a vector autoregression (VAR). We then investigate the forecasting properties of our measure of external imbalance. To implement our methodology empirically, we use newly constructed quarterly estimates of the U.S. net and gross foreign asset positions at market value between 1952:1 and 2004:1, as well as estimates of the capital gains and total returns on these global country portfolios. Figure 1 reports net foreign assets and net exports, relative to GDP. A brief description of the data is relegated to Appendix B.[15]

Assumption 1 decomposes the variables $\ln \hat{Z}_t$ into a deterministic trend $\ln \bar{Z}_t$ and a stationary component ϵ_t^z. To proceed, we need to estimate the trends $\bar{Z}_t$, $\bar{R}_{t+1}$, and $\bar{\Gamma}_{t+1}$ of the deterministic economy. These trends are not directly observable. However, under the conditions for lemma 1, we know that they are not far from the data themselves. The term $\bar{Z}_t$ reflects low-frequency structural changes in the world economy due to trade and financial integration. If the twentieth century has been characterized by one wave of decreasing globalization (from 1913 to 1945), followed by one—unfinished—period of increased globalization, it seems appropriate to define the trend component as a low-pass filter with a relatively low-frequency cutoff. In practice, we choose to implement this with a Hodrick-Prescott filter set to filter out cycles of more than 50 years.[16] We note three important features of our filtering procedure. First, by construction, the HP filter removes unit roots from the data (see King and Rebelo 1993). Second, since we eliminate only very low frequencies, the variables ϵ_t^z still contain most frequency components. In other words, our approach enables us to render the data stationary while keeping most of the information from the time series. Third, filtering out only very low frequencies mitigates end point prob-

[15] See Gourinchas and Rey (2007) for a detailed description of the data.

[16] To select the smoothing parameter of the HP filter, we impose that the frequency gain of the filter be equal to 70 percent at the frequency corresponding to a 50-year cycle. In standard business cycle applications with quarterly data, the gain is 70 percent at 32 quarters (eight years).

lems common with two-sided filters.[17] We performed numerous robustness checks by considering shorter cycles (30 and 40 years), longer cycles (100 years), and the extreme case of linear trends. The exact filter used does not matter provided that it takes out only slow-moving trends.[18] Figure 2 reports the constructed values for the trend and cycle components. Following the derivation of (1), we also detrend the return series R_{t+1} and the growth rate Γ_{t+1}. As shown in figure 3, the trends for these series are flat: we cannot reject the equality of these trends to their sample mean at the 5 percent level.[19] In practice, this implies that it is equivalent to work with the original or the detrended returns. Since the results of the paper are easier to interpret with the original returns, this is the approach we adopt.[20]

It is worth pausing here to discuss in more details how our detrending procedure might affect our empirical results. First of all, a legitimate question is whether the trends obtained using this method are a good approximation of the deterministic trend of our economy. Online Appendix D shows that for a large class of models, the trends extracted by our HP filter and the true deterministic trends of the economy are indeed so close that the linearized budget constraint is virtually the same whether we use the HP trends or the true ones. We assume that this carries through in the present application. But we also check directly the empirical validity of our approach below.

Second, by measuring the U.S. external constraint in deviations from trend, we purposely abstract from the mechanisms that ensure that the trend external constraint holds. Our interpretation is that these mechanisms are irrelevant for the process of adjustment, which we do study in this paper, that is, the cyclical adjustment. Clearly, in the sample some

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

[18] The different estimates of *nxa* are essentially identical. This indicates that sampling uncertainty is not a relevant issue when *nxa* is used as a regressor. We also experimented with Christiano and Fitzgerald's (2003) asymmetric filter. Our results are very robust to these changes and are reported in online App. C.

[19] We establish confidence intervals for the trend by bootstrapping. We draw with replacement from the sample (10,000 iterations). Figure 3 reports the upper and lower confidence bounds. Augmented Dickey-Fuller tests reject the null of a unit root for all three series.

[20] The results are virtually identical with detrended returns and are reported in online App. C.

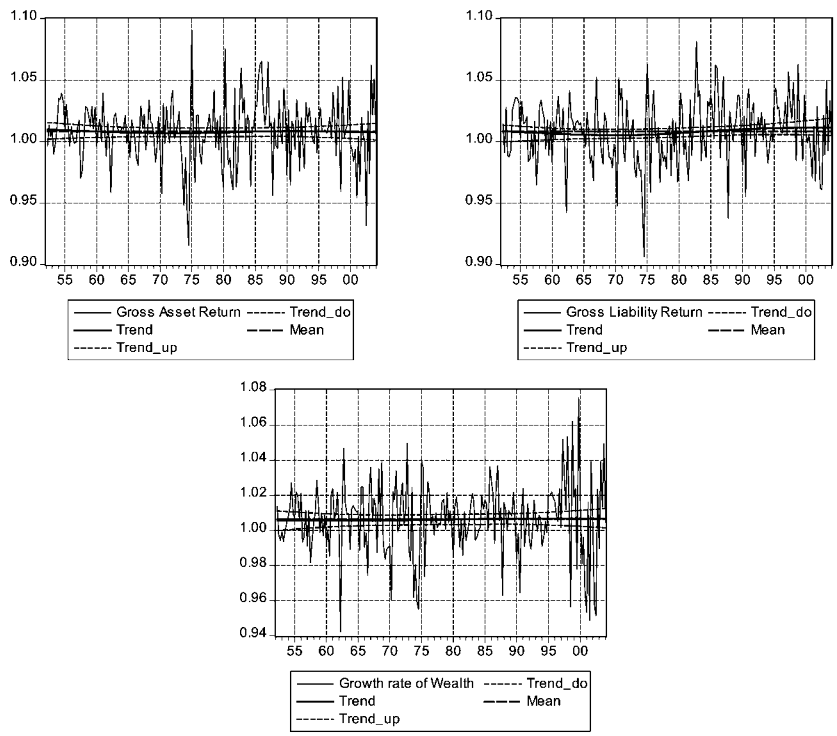

FIG. 3.—Cycle and trend components for R^a, R^l, and W_{t+1}/W_t. The top two panels pertain to the return on gross external assets R^a (left) and gross external liabilities R^l (right); the bottom panel pertains to the growth rate of real U.S. financial wealth per capita W_{t+1}/W_t. Each panel reports 10 percent bootstrap confidence intervals. Sample: 1952:1–2004:1.

significant imbalances are building along these trends (see fig. 2). This raises a number of important questions. Shouldn't the exchange rate or other asset returns play a role in the rebalancing of these "trend imbalances"? If so, isn't a trend estimated on the entire sample period already capturing part of the impact of exchange rates on net foreign asset positions? These are important points to address. Indeed, U.S. trend imbalances will need to stabilize at some point in the future. Does this imply that we are throwing away relevant information with our detrending procedure? There are two reasons why this issue is not a concern for our empirical work.

First, suppose that there is indeed a link between trend imbalances and future exchange rate or asset price movements. For instance, suppose that—given the large current U.S. trend imbalances—the U.S. dollar does need to depreciate in the future. If anything, this should *reduce* the predictive power of our variable *nxa*, since it is constructed from detrended variables. This is especially so given that we find no significant trends in the gross returns, so our approach predicts equally well the actual depreciation rate of the currency and the actual returns on the net portfolio, equities, and so forth (see the discussion above). Therefore, if there is any information in the trends that is relevant for *any* of these variables, by taking the trends out, we are biasing the exercise toward finding *no* predictability.[21]

Second, we take out only very slow-moving trends (with cycles of 50 years and more in our benchmark estimates). This could still be a problem to the extent that real exchange rates too may exhibit low-frequency trends. But theories of long-run trends in real exchange rates, such as Balassa-Samuelson, emphasize the role of productivity differentials. These models do not have any particular implication for long-run trade balances. The key insight is that Balassa-Samuelson effects come from the supply side, independently from the demand structure. In turn, the demand structure controls what happens to the trade balance. Hence it is possible to have trending real exchange rates due to productivity differentials and worsening, improving, or unchanged long-run trade imbalances, depending on the specification of preferences. A real-world example of this is the appreciation of the Japanese real exchange rate between the 1950s and the 1990s, which has not been matched by any secular trend in the bilateral Japanese-U.S. trade.

While, as just argued, trends in real exchange rates may have no effect on trade balances, they may, in theory, still contribute to the valuation channel by changing the relative value of gross assets and gross liabilities. This would have two implications for our analysis. First, it would imply that our detrending procedure tilts the results in favor of the trade channel of adjustment and against the valuation channel: removing the trend part of A and L, we also eliminate their potential contributions to explaining the "trend exchange rate." Again, this would bias the exercise against finding predictability in returns. To the extent that we want to establish the importance of the valuation channel, our results should then be interpreted as lower bounds on the contribution of that channel. Second, a "trend valuation channel" would require that predictable excess returns persist over very long horizons (basically, at the horizon at which we are detrending: 50 years and above). We find this hard to believe. If, as seems more reasonable, predictable excess returns

[21] Another possibility is that our predictability results are spurious. For this to be the case, it would have to be that the predictive power in our regressions does not come from our variable *nxa*, as we think it does, but instead that *nxa* is correlated with these trends. Yet we find no correlation between the trend and cyclical imbalances: trend imbalances have been increasing more or less monotonically throughout the sample. By contrast, *nxa* is large and negative in 1983–90 and then large and positive in 1990–2000 (see fig. 4).

disappear at these very long horizons, then the logical implication is that valuation effects cannot be playing a role in the trend rebalancing, and the trend in real or nominal exchange rates does not play any role in the valuation channel either. Either way, we feel that our results are quite robust to trends in the exchange rate.

In summary, the null we maintain is one in which we remain agnostic about the role of the exchange rate in eliminating U.S. trend imbalances. The alternative—where exchange rates would have a role in the trend adjustment at the horizons we investigate—would bias our exercise against finding forecastability since by detrending, we would be throwing away relevant information.

To construct the detrended net foreign assets na_t and detrended net exports nx_t (see lemma 1), we need estimates of the time-varying weights μ^z_t. Doing so raises two important empirical issues. First, since the United States goes from being a net creditor/net exporter to being a net debtor/net importer, these weights exhibit large nonlinear variations, especially in the neighborhood of $\bar{A}_t = \bar{L}_t$ and $\bar{X}_t = \bar{M}_t$. Clearly, these fluctuations dominate the movements in na and nx but have little to do with the adjustment process. Second, our variables (especially A_t, L_t, and W_t; less so X_t and M_t) are measured imprecisely. These measurement errors get magnified by the nonlinearity in the weights. In order to get around these issues, we replace the time-varying weights by their sample average. With constant weights, corollary 1 applies, and we can construct an approximate measure of external imbalances as $nxa_t = |\mu^a|\epsilon^a_t - |\mu^l|\epsilon^l_t + |\mu^x|\epsilon^x_t - |\mu^m|\epsilon^m_t$ (see eq. [6]). There are three benefits of doing so. First, by fixing the weights, we reduce the impact of measurement errors. This makes our empirical exercise much more robust. Second, constant weights are consistent with our approach, which focuses on the adjustment in the deviations from trend (ϵ^z_t) as opposed to the internal dynamics imparted by the trends themselves ($\bar{Z}_t$). Third, our constructed nxa is robust to the changes in the sign of the net foreign assets and net exports variables. The drawback is that we are losing some information. We diagnose how serious this loss is in three steps. First, we directly check the accuracy of equation (5) and find a small and stationary approximation error (see below). Second, using our VAR estimates, we show that this approximation error is conditionally uncorrelated with the variables of interest (see Sec. III.*B*). Third, we show that, even with constant weights, our measure of external imbalances performs very well and predicts future returns and exchange rates in and out of sample (Secs. III.*C*–III.*F*). Hence, it seems that little relevant information is omitted by setting the weights to their sample average.[22]

[22] As a robustness check, we also computed different weights for the first part of the

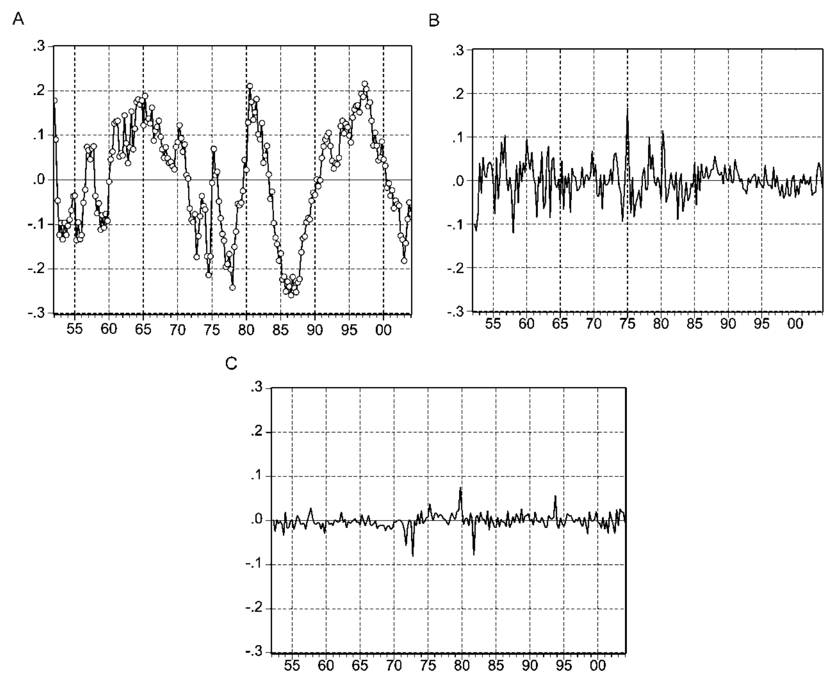

FIG. 4.—*A*, *nxa*, *B*, flow $r + \Delta nx$, and *C*, residual term ε from eq. (5)

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

$$\mu^a = 8.49;\ \mu^l = 7.49;\ \mu^x = -9.98;\ \mu^m = -10.98;\ \rho = 0.95, \quad (11)$$

and we construct *nxa* using equation (6) to obtain[23]

$$nxa_t = 0.85\epsilon_t^a - 0.75\epsilon_t^l + \epsilon_t^x - 1.1\epsilon_t^m. \quad (12)$$

We observe that *nxa* puts similar weights on gross assets, gross liabilities, gross exports, and gross imports. The resulting *nxa* is reported in figure 4*A*. Several features are noteworthy. First, we observe a pattern of growing cyclical imbalances, starting in 1976–79, then 1983–89 and 2001 to the present, with substantial serial correlation (0.92). Second, the cyclical imbalance of 2003 (18.1 percent of exports) was in fact slightly smaller than the one of the mid-1980s (25.0 percent of exports) despite

sample (between 1952 and 1973) and the second part of the sample (post–Bretton Woods). The results are similar and are reported in online App. C.

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

growing trade deficits and net foreign liabilities since the beginning of the 1990s. This may seem paradoxical at first: surely total U.S. external imbalances are larger in 2004 than in 1985, with larger trade deficits and net foreign liabilities. What our decomposition indicates is that a substantial part of these imbalances may be trend imbalances. This illustrates why one should be cautious not to interpret *nxa* as an overall measure of U.S. external imbalances. It only characterizes that component of imbalances related to the stochastic deviations from trend. Our paper makes no claim toward explaining the overall rebalancing of the U.S. external position.

Let us now revisit the validity of equation (5) as an approximation to the external constraint (1). We provide direct evidence that the assumptions behind lemma 2 and our empirical implementation using HP filters do not do much violence to the data by looking at the approximation error from equation (5). Since the stationary components ϵ_t^z are constructed separately for each variable z, there is no reason, a priori, to expect equation (5) to hold exactly unless it represents an accurate characterization of the external dynamics around the trends. Figure 4 reports this "approximation term," $\varepsilon_t = nxa_t - (1/\rho)nxa_{t-1} - r_t - \Delta nx_t$, defined as the difference between the left- and right-hand sides of (5) (panel *C*), together with nxa_t (panel *A*) and the "flow term" $r_t + \Delta nx_t$ (panel *B*). As can be seen immediately from the figure, this error term is quite small relative to both *nxa* and the flow component, for most of the sample period.[24] We emphasize that nothing in our empirical approach ensures that this term remains small. That it is so validates our empirical procedure. A second check on the validity of our assumptions relies on the VAR estimates presented in the next subsection. There, we test directly the restriction that the error term is conditionally uncorrelated with the variables of interest: $E_{t-1}[\varepsilon_t] = 0$.

B. *The Financial and Trade Channels of External Adjustment*

The term nxa_t is a theoretically well-defined measure of cyclical external imbalances. By decomposing it into a return and a net export component and observing their variation over time, we can gain clear insights regarding the relative importance of the trade and financial adjustment channels. We rewrite equation (9) as

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

[24] With a zero mean and a standard deviation of 1.67 percent, ε_t is seven times less volatile than *nxa* and 2.5 times less volatile than $r + \Delta nx$ (standard deviation 4.20 percent). The correlation between the error term and the flow term $r + \Delta nx$ is also very small (0.05).

where nxa_t^r is the component of nxa_t that forecasts future returns, and $nxa_t^{\Delta nx}$ is the component that forecasts future net exports growth. We follow Campbell and Shiller (1988) and construct empirical estimates of nxa_t^r and $nxa_t^{\Delta nx}$ using a VAR formulation. Specifically, consider a VAR(p) representation for the vector $\boldsymbol{y}_t = (r_t, \Delta nx_t, nxa_t)'$. Appropriately stacked, this VAR has a first-order companion representation: $\bar{\boldsymbol{y}}_{t+1} = \mathbf{A}\bar{\boldsymbol{y}}_t + \epsilon_{t+1}$.[25] Equation (13) implies that we can construct nxa_t^r and $nxa_t^{\Delta nx}$ as

$$nxa_t^r = -\rho \boldsymbol{e}_r' \mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\boldsymbol{y}}_t,$$

$$nxa_t^{\Delta nx} = -\rho \boldsymbol{e}_{\Delta nx}' \mathbf{A}(\mathbf{I} - \rho\mathbf{A})^{-1}\bar{\boldsymbol{y}}_t,$$

where $\boldsymbol{e}_r'$ ($\boldsymbol{e}_{\Delta nx}'$) is a dummy vector that "selects" r_t (Δnx_t) and $\mathbf{I}$ is the identity matrix. We represent the time paths of nxa_t^r and $nxa_t^{\Delta nx}$ in figure 5*A*.[26]

Several features are noteworthy. First, nxa_t^r and $nxa_t^{\Delta nx}$ are positively correlated: the valuation and trade effects are mutually reinforcing, underlining the stabilizing role of capital gains in the external adjustment of the United States.[27] Given our normalization of *nxa*, valuation effects represent the equivalent of a 7.04 percent contemporaneous increase in exports in 1986:3 (out of 25.89 percent) and 4.85 percent in 2003:1 (out of 18.17 percent).

Second, the testable restriction $\boldsymbol{e}_{nxa}'\mathbf{I} + (\boldsymbol{e}_r' + \boldsymbol{e}_{\Delta nx}' - \boldsymbol{e}_{nxa}')\rho\mathbf{A} = 0$ should be satisfied.[28] This restriction is equivalent to a test that the error term ε_{t+1} is conditionally uncorrelated with the variables of interest: $E_t[\varepsilon_{t+1}] = 0$. As discussed above, this provides a second test of the validity of our assumptions and the quality of the approximation (5). We use a Wald test and find a χ^2 equal to 0.148. With three restrictions, the p-value is 0.986, so we cannot reject the intertemporal equation (13).[29] This and the fact that $nxa_t(\text{predict}) \equiv nxa_t^r + nxa_t^{\Delta nx}$ is very close to nxa_t (see fig. 5*A*) show the excellent overall quality of our approximation.

Finally, following the same methodology, figure 5*B* decomposes nxa_t^r into gross asset and gross liability return components (nxa_t^{ra} and nxa_t^{rl}). The figure illustrates that financial adjustment comes mostly from excess returns on gross assets; the contribution of expected returns on gross liabilities—while positive—is always much smaller.

[25] Where $\bar{\boldsymbol{y}}_t = (\boldsymbol{y}_t', \boldsymbol{y}_{t-1}', \ldots, \boldsymbol{y}_{t-p+1}')'$. See app. B of Gourinchas and Rey (2005) for a detailed derivation.

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

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

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

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

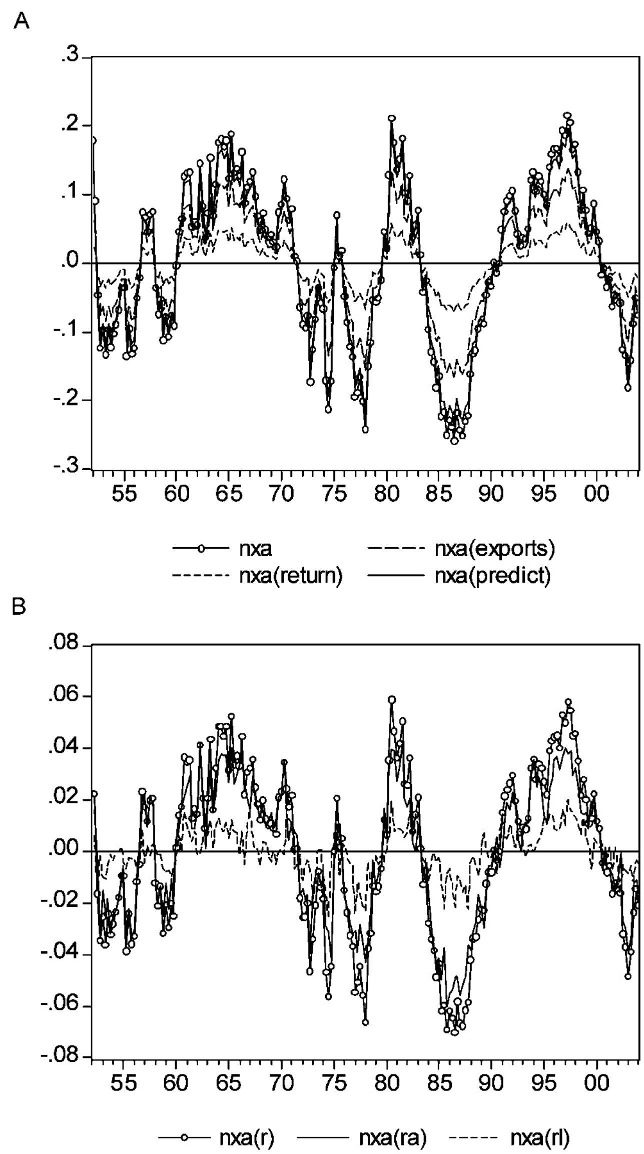

Fig. 5.—*A*, Decomposition of *nxa* into return *nxa*(return), net exports *nxa*(exports), and total predicted *nxa*(predict) components. *B*, Decomposition of *nxa*(return) into asset return *nxa*(*ra*) and liability return *nxa*(*rl*) components.

TABLE 1
UNCONDITIONAL VARIANCE DECOMPOSITION OF *nxa*

		DISCOUNT FACTOR ρ		
LINE	PERCENT	.96	.95	.94
1	$\beta_{\Delta nx}$	71.77	63.96	57.05
2	β_r of which:	23.76	26.99	28.85
3	β_{ra}	19.91	20.78	20.65
4	β_{rl}	3.87	6.22	8.21
5	Total (lines 1+2)	95.53	90.95	85.89
6	μ^a	6.72	8.49	10.08

NOTE.—$\beta_{\Delta nx}$ (β_r) represents the share of the unconditional variance of *nxa* explained by future net export growth (future excess returns); β_{ra} (β_{rl}) represents the share of the unconditional variance of nxa^r explained by future returns on gross external assets (liabilities). The sum of coefficients $\beta_{ra} + \beta_{rl}$ is not exactly equal to β_r because of numerical rounding in the VAR estimation. The sample is 1952:1–2004:1.

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

$$1 = \frac{\mathrm{Cov}\,(nxa,\ nxa)}{\mathrm{Var}\,(nxa)} = \frac{\mathrm{Cov}\,(nxa^r,\ nxa)}{\mathrm{Var}\,(nxa)} + \frac{\mathrm{Cov}\,(nxa^{\Delta nx},\ nxa)}{\mathrm{Var}\,(nxa)}$$
$$\equiv \beta_r + \beta_{\Delta nx}. \tag{14}$$

This decomposition is equivalent to looking at the coefficients from regressing independently nxa^r and $nxa^{\Delta nx}$ on *nxa*. The resulting regression coefficients, β_r and $\beta_{\Delta nx}$, represent the share of the unconditional variance of *nxa* explained by future returns or future net export growth.[30] Table 1 reports the decomposition for different values of ρ between 0.94 and 0.96.

For our benchmark value $\rho = 0.95$, we get a breakdown of 64 percent (net exports) and 27 percent (portfolio returns), accounting for 91 percent of the variance in *nxa*. The results are sensitive to the assumed discount factor. Lower (higher) values of ρ increase (decrease) the contribution of portfolio returns.[31] For $\rho = 0.94$, we find that portfolio returns account for 29 percent of the total variance, whereas for $\rho =$

[30] This is not an orthogonal decomposition, so terms less than zero or greater than one are possible. Empirically, the sum of β_r and $\beta_{\Delta nx}$ can differ from one 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.

[31] Whenever we perform comparative statics on the discount rate ρ, we adjust μ^a accordingly. The corresponding values are presented in line 6 of table 1. Note that ρ also controls the steady-state ratio of net exports to net foreign assets (eq. [7]).

0.96, their contribution decreases to 24 percent. The general flavor of our results is not altered by those robustness checks.

These findings have important implications. First, financial adjustment accounts for approximately 27 percent of cyclical external adjustment, even at long horizons, whereas 64 percent comes from movements in future net exports. Thus our findings indicate that valuation effects do not replace the need for an ultimate adjustment in net exports via expenditure-switching or expenditure-reducing mechanisms, a point developed in detail in Obstfeld and Rogoff (2007). What our estimates indicate, however, is that valuation effects profoundly transform the nature of the external adjustment process. By absorbing 25–30 percent of the cyclical external imbalances, valuation effects substantially relax the external budget constraint of the United States.

With the same methodology, lines 3 and 4 of table 1 further decompose the variance of nxa^r into the contributions of returns on gross assets and liabilities. For the standard specification, we obtain a breakdown of roughly 21 percent (β_{ra}) and 6 percent (β_{rl}), making up the 27 percent total contribution of the returns to the cyclical external adjustment. These findings confirm figure 5*B*: gross asset returns account for the bulk of the variance, whereas returns on gross liabilities, which are all in dollars, are much less responsive.

C. *Forecasting Quarterly Returns: The Role of Valuation Effects*

Equation (9) indicates that nxa_t should help predict either future returns on the net foreign asset portfolio r_{t+j} or future net export growth Δnx_{t+j}, or both. This subsection looks specifically at the predictive power of nxa_t for future returns on the net foreign asset portfolio r_{t+j} at the quarterly horizon. Table 2 reports a series of results using nxa_t as a predictive variable. Each column of the table reports a regression of the form

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

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

Looking first at panel A of table 2, we see that nxa has significant forecasting power for the net portfolio return r_{t+1} one quarter ahead (col. 1). The $\bar{R}^2$ of the regressions is 0.10, and the negative and significant coefficient indicates that a positive deviation from trend predicts a decline in net portfolio return that is qualitatively consistent with equation (9). We observe also that there is essentially no forecasting power from either lagged values of the net portfolio return (col. 2), the difference between domestic and foreign dividend-price ratios (col. 3),

TABLE 2
Forecasting Quarterly Returns
A. Returns

	Total Real Return (r_{t+1})				Real Equity Differential (Δr^e_{t+1})			
		r_t	$(d_t/p_t) - (d^*_t/p^*_t)$	xm_t		Δr^e_t	$(d_t/p_t) - (d^*_t/p^*_t)$	xm_t
z_t	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{\beta}$	**−.36**	**−.33**	**−.46**	**−.37**	**−.13**	**−.14**	**−.17**	−.07
	(.07)	(.07)	(.08)	(.16)	(.03)	(.03)	(.03)	(−.06)
$\hat{\delta}$		.09	−1.43	.01		−.07	−.63	−.09
		(.07)	(1.60)	(.19)		(.07)	(.61)	(.07)
$\bar{R}^2$	.10	.10	.15	.10	.07	.07	.12	.07
Observations	208	207	136	208	208	207	136	208

B. Depreciation Rates

	FDI-Weighted (Δe_{t+1})				Trade-Weighted (Δe^T_{t+1})			
		Δe_t	xm_t	$i_t - i^*_t$		Δe^T_t	xm_{t-1}	$i_t - i^*_t$
z_t	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{\beta}$	**−.08**	**−.09**	**−.10**	**−.09**	**−.09**	**−.09**	**−.08**	**−.08**
	(.02)	(.02)	(.04)	(.02)	(.02)	(.02)	(.03)	(.02)
$\hat{\delta}$		−.04	.02	.32		.02	−.01	−.67
		(.07)	(.05)	(.32)		(.07)	(.05)	(.34)
$\bar{R}^2$	.09	.08	.08	.08	.11	.10	.10	.13
Observations	125	124	125	125	124	123	124	124

Note.—Regressions of the form $y_{t+1} = \alpha + \beta nxa_t + \delta z_t + \epsilon_{t+1}$, where y_{t+1} is the total real return (r_{t+1}), the equity return differential ($\Delta r^e_{t+1} = r^{ae}_{t+1} - r^{le}_{t+1}$) (panel A), the FDI-weighted depreciation rate (Δe_{t+1}), or the trade-weighted depreciation rate (Δe^T_{t+1}) (panel B). $(d_t/p_t) - (d^*_t/p^*_t)$ is the relative dividend-price ratio (available since 1970:1); $i_t - i^*_t$ is the short-term interest rate differential; xm_t is the stationary component from the trade balance, defined as $\epsilon^x_t - \epsilon^m_t$. The sample is 1952:1–2004:1 for total returns and 1973:1–2004:1 for depreciation rates. Robust standard errors are in parentheses. Boldface entries are significant at the 5 percent level.

or the deviation from trend of net exports, xm_t, defined as $\epsilon^x_t - \epsilon^m_t$ (col. 4). We emphasize that the predictive power of the regression is economically large: the coefficient of 0.36, coupled with a standard deviation of *nxa* of 11.94 percent, indicates that a one-standard-deviation increase in *nxa* predicts a decline in the net portfolio return of about 430 basis points over the next quarter, equivalent to about 17.19 percent at an annual rate.

Panel A of table 2 also reports the results of similar regressions for the excess equity total return, defined as the quarterly dollar total return on foreign equity r^{ae}_t (a subcomponent of U.S. assets) minus the quarterly total return on U.S. equity r^{le}_t (a subcomponent of U.S. liabilities). Since r^a_t is very correlated with r^{ae}_t and r^l_t is very correlated with r^{le}_t, it is natural to investigate the predictive ability of our variables on this measure of relative stock market performance.[32] To the extent that the average weights μ^a and μ^l are imperfectly measured, the degree of leverage of the net foreign asset portfolio could also be mismeasured, which

[32] The correlations are 0.938 and 0.942, respectively.

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 (col. 5). The $\bar{R}^2$ of the regression is equal to 0.07, and the sign of the statistically significant coefficient is negative, as expected. Again, alternate regressors such as lagged returns (col. 6), dividend-price ratios (col. 7), or deviations of the trade balance from trend (col. 8) do not enter significantly. The predictive impact of nxa_t on $r^{ae}_{t+1} - r^{le}_{t+1}$ is smaller than on r_{t+1}, yet it is still highly economically significant. With a coefficient of -0.13, a one-standard-deviation increase in nxa predicts a decline in excess returns of 155 basis points over the next quarter, or 6.21 percent annualized. It is important to emphasize that these regressions indicate significant predictability for the one-quarter-ahead *relative* stock market performance![33]

D. Exchange Rate Predictability One Quarter Ahead

The results from panel A raise an obvious and tantalizing question: Could it be that the predictability of the dollar return on net assets arises from predictability in the exchange rate? After all, a depreciation of the exchange rate increases the return on gross assets relative to the return on gross liabilities. Panel B of table 2 presents estimates using both our foreign direct investment (FDI)-weighted effective exchange rate (Δe_{t+1}) and the Federal Reserve trade-weighted multilateral exchange rate for major currencies (Δe^T_{t+1}). The sample covers the post–Bretton Woods period, from 1973:1 to 2004:1.

We observe first that nxa_t contains strong predictive power for both exchange rate series (cols. 1 and 5). The coefficient is negative (around -0.09 for both series) and significant, implying that a negative nxa predicts a subsequent depreciation of the dollar against major currencies. The $\bar{R}^2$'s are high (0.09 and 0.11, respectively), and the effects are also economically large: a one-standard-deviation decrease in nxa predicts a 4.30 percent (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 U.S. Treasury survey (cols. 4 and 8). As before,

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

we also find that the predictive power of xm_t on the exchange rate does not survive the inclusion in the regression of our variable nxa_t (cols. 3 and 7).[34]

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.[35]

E. *Long-Horizon Forecasts: The Importance of Net Export Growth and of the Exchange Rate*

A natural question is whether the predictive power of our measure of external imbalances increases with the forecasting horizon. According to equation (9), *nxa* could forecast any combination of r_t and Δnx_t at long horizons. We investigate this question by regressing k-horizon returns, $y_{t,k} \equiv (\sum_{i=1}^{k} y_{t+i})/k$, between t and $t+k$ on nxa_t. Table 3 reports the results for forecasting horizons ranging between one and 24 quarters. When the forecasting horizon exceeds one, the quarterly sampling frequency induces $(k-1)$th-order serial correlation in the error term. Accordingly, we report Newey-West robust standard errors with a Bartlett window of $k-1$ quarters.

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

Table 3 indicates that the in-sample predictability increases up to an impressive 0.26 (0.34 with separate regressors) for net foreign portfolio returns at a four-quarter horizon and then declines to 0.02 or 0.16 at 24 quarters. A similar pattern is observed for total excess equity returns. These results suggest that the financial adjustment channel operates at

[34] Gourinchas and Rey (2005) also reports the quarter-ahead predictive power of nxa_t for bilateral rates of depreciation. We find significant predictability of the U.S. dollar against the yen, the euro (deutsche mark before 1999), and the Swiss franc.

[35] There is one potential caveat to our results: tests of the predictability of returns may be invalid when the predicting variable exhibits substantial serial correlation. The pretesting procedure of Campbell and Yogo (2006) 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 percent nominal t-test has a true size of 7.5 percent at most). For net returns, the coefficient is 0.167, suggesting a potentially larger size distortion. But performing Campbell and Yogo's test leads us to reject the hypothesis of no predictability at the 5 percent level. Therefore, all our predictability regressions are robust.

TABLE 3
LONG-HORIZON REGRESSIONS

	Forecast Horizon (Quarters)							
	1	2	3	4	8	12	16	24
	A. Real Total Net Portfolio Return $r_{t,k}$							
nxa	**−.36**	**−.35**	**−.35**	**−.33**	**−.22**	**−.14**	**−.09**	**−.04**
	(.07)	(.05)	(.04)	(.04)	(.03)	(.03)	(.02)	(.02)
$\bar{R}^2(1)$	[.11]	[.18]	[.24]	[.26]	[.21]	[.13]	[.09]	[.02]
$\bar{R}^2(2)$	[.14]	[.25]	[.34]	[.38]	[.35]	[.24]	[.19]	[.16]
	B. Real Total Excess Equity Return $r^{ae}_{t,k} - r^{le}_{t,k}$							
nxa	**−.14**	**−.13**	**−.12**	**−.11**	**−.06**	**−.03**	−.02	.01
	(.03)	(.02)	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)
$\bar{R}^2(1)$	[.07]	[.13]	[.17]	[.18]	[.10]	[.03]	[.01]	[.00]
$\bar{R}^2(2)$	[.11]	[.20]	[.28]	[.31]	[.26]	[.15]	[.10]	[.17]
	C. Net Export Growth $\Delta nx_{t,k}$							
nxa	**−.08**	**−.08**	**−.07**	**−.07**	**−.07**	**−.06**	**−.06**	**−.04**
	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
$\bar{R}^2(1)$	[.05]	[.10]	[.13]	[.17]	[.31]	[.44]	[.53]	[.58]
$\bar{R}^2(2)$	[.04]	[.08]	[.12]	[.17]	[.38]	[.55]	[.66]	[.79]
	D. FDI-Weighted Effective Nominal Rate of Depreciation $\Delta e_{t,k}$							
nxa	**−.08**	**−.08**	**−.08**	**−.08**	**−.07**	**−.06**	**−.04**	**−.02**
	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
$\bar{R}^2(1)$	[.09]	[.16]	[.28]	[.31]	[.41]	[.41]	[.33]	[.12]
$\bar{R}^2(2)$	[.10]	[.21]	[.35]	[.40]	[.52]	[.55]	[.55]	[.38]

NOTE.—Regressions of the form $y_{t,k} = \alpha + \beta nxa_t + \epsilon_{t+k}$, where $y_{t,k}$ is the k-period real total net portfolio return ($r_{t,k}$), total excess equity return ($r^{ae}_{t,k} - r^{le}_{t,k}$), net export growth ($\Delta nx_{t,k}$), or the FDI-weighted depreciation rate ($\Delta e_{t,k}$). Newey-West robust standard errors are in parentheses with a $k-1$ Bartlett window. Adjusted R^2's are in brackets. $\bar{R}(1)$ reports the adjusted R^2 of the regression on nxa_t; $\bar{R}(2)$ reports the adjusted R^2 of the regression on ϵ^x_t, ϵ^m_t, ϵ^a_t, and ϵ^l_t. The sample is 1952:1–2004:1 (1973:1–2004:1 for the exchange rate). Boldface entries are significant at the 5 percent level.

short to medium horizons, between one quarter and two years. It then declines significantly and disappears in the long run. As shown in Section III.*B*, its overall contribution to external adjustment amounts to roughly 27 percent.

The picture is very different when we look at net export growth. We find that nxa_{t-1} predicts a substantial fraction of future net export growth in the long run: the $\bar{R}^2$ is 0.58 at 24 quarters (0.79 with three regressors!). This result is consistent with a long-run adjustment via the trade balance. A large positive external imbalance predicts low future net export growth, which restores equilibrium. The classic channel of trade adjustment is therefore also at work, especially at longer horizons (eight quarters and more).

Looking at exchange rates, we find a similarly strong long-run predictive power on the rate of depreciation of the dollar. The $\bar{R}^2$ increases up to 0.41 (0.55 with three regressors!) at 12 quarters. There is significant predictive power at short, medium, and long horizons.[36]

Taken together, these findings indicate that two dynamics are at play. At horizons smaller than two years, the dynamics of the portfolio returns seem to dominate, and exchange rate adjustments create valuation effects that have an immediate impact on cyclical external imbalances. At horizons longer than two years, there is little predictability of asset returns. But there is still substantial exchange rate predictability, which goes hand in hand with a corrective adjustment in future net exports.[37] 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 United States 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 one to 12 quarters ahead against its fitted values with *nxa* and independently with our three regressors. The improvement in fit is striking as the horizon increases. Our predicted variable does well at picking the general tendencies in future rates of depreciation as well as the turning points, even one to four quarters ahead.

F. Out-of-Sample Forecast

Since the classic paper of Meese and Rogoff (1983), the random walk has been considered the appropriate benchmark to gauge the forecasting ability of exchange rate models. These authors showed that none of the existing exchange rate models could outperform the random walk at short to medium horizons in out-of-sample forecasts, even when the realized values of the fundamental variables were used in the predictions. More than 20 years later, this very strong result still stands.[38]

[36] Again, the persistence of *nxa* in the predictive regressions is not an issue. Performing the pretest of Campbell and Yogo (2006), 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's test, however, we can reject the hypothesis of no predictability at the 5 percent level. Once again, this implies that our predictability regressions are robust.

[37] 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 eight quarters. We do not include these determinants in our analysis.

[38] See Cheung, Chinn, and Garcia (2005). At very short horizons, however (between one and 20 trading days), Evans and Lyons (2005) show that a model of exchange rates based on disaggregated order flow outperforms the random walk.

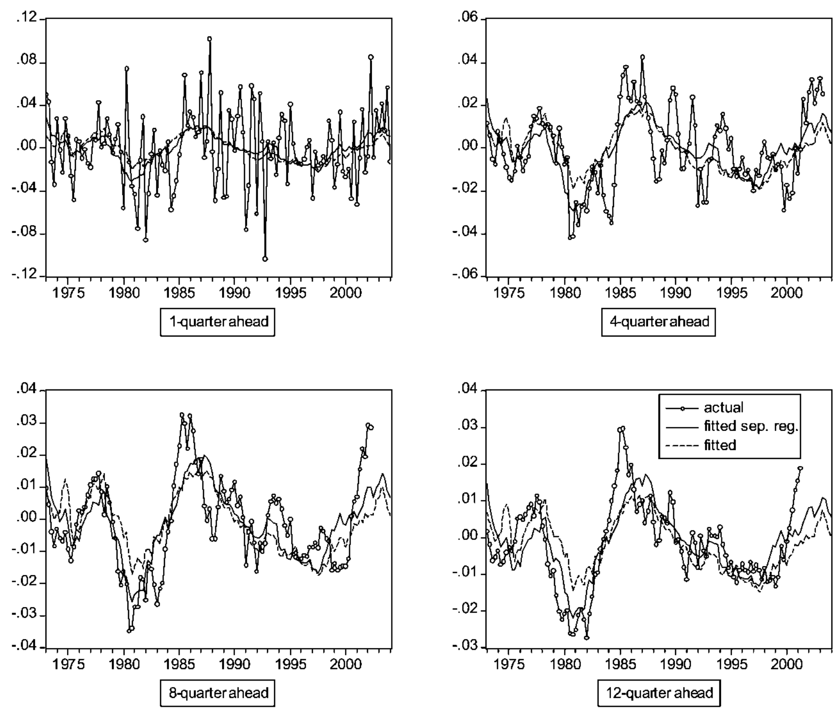

FIG. 6.—Predicted one- to 12-quarter-ahead depreciation rates. Each graph reports (*a*) the realized depreciation rate at the one- to 12-quarter horizon; (*b*) the fitted depreciation rate using *nxa* (fitted); and (*c*) the fitted depreciation rate using ϵ^x, ϵ^m, ϵ^a, and ϵ^l as separate regressors.

We perform out-of-sample forecasts by estimating our model using rolling regressions and comparing its performance to the random walk. We start by splitting our sample in two. We refer to the first half, from 1952:1 to 1978:1, as the "in sample." We then construct out-of-sample forecasts in three steps. First, we reestimate our variable *nxa* following the methodology of Section II over the in sample.[39] This guarantees that our constructed *nxa* does not incorporate *any* future information. Second, still over the in sample, we estimate the forecasting relationship between future returns and lagged *nxa*. Finally, we use this estimated relation to form a forecast of the first nonoverlapping 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

[39] In particular, we use a one-sided filter to compute the trends. We also construct the sample weights μ^z using data from the in sample only and the restriction that the discount factor be constant and equal to its steady-state value, as in subsection *A*. We use our benchmark value of $\rho = 0.95$ in those calculations.

up to 104 out-of-sample observations.[40] We emphasize that, since we are estimating the trend components and the weights using only data available at the time of prediction, we cannot fall victim to any look-ahead bias.[41] This exercise is very stringent: given the reduced size of the sample, *nxa* cannot be as precisely estimated as if we used the whole sample each time.

We compare the mean-squared errors (MSE) of a model featuring only *nxa* and a constant to the MSE of a driftless random walk. We construct the forecasts involving *nxa* as described above, using only data available up to the date of the forecast.[42] To assess the statistical significance of our results, we use the MSE-adjusted statistic described in Clark and West (2006). 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 upward in small samples (MSE_u-adjusted). The difference between the two MSEs is asymptotically normally distributed. We use a Newey-West estimator for the variance of the difference in MSE in order to take into account the serial correlation induced by overlapping observations when the forecast horizon exceeds one quarter.

Table 4 presents the results. A positive ΔMSE-adjusted statistic indicates that our model outperforms the random walk in predicting exchange rate depreciations. For the FDI-weighted exchange rate, our model outperforms significantly the random walk, including one quarter ahead. The p-values are always very small except at 16 quarters. Results for the trade-weighted exchange rate are very similar. The table also reports the ratio of the (unadjusted) MSEs. 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.[43]

[40] See app. C of Gourinchas and Rey (2005) for details. Changes in the cutoff point do not seem to make any difference for our results, provided that the number of observations used to perform the estimation is sufficient.

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

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

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

TABLE 4
OUT-OF-SAMPLE TESTS FOR EXCHANGE RATE DEPRECIATION AGAINST THE MARTINGALE HYPOTHESIS

	HORIZON (Quarters)						
	1	2	3	4	8	12	16
	A. FDI-Weighted Depreciation Rate						
MSE_u/MSE_r	.960	.920	.858	.841	.804	.818	.903
ΔMSE-adjusted	1.48	1.53	1.61	1.51	1.20	.74	.35
	(.68)	(.60)	(.57)	(.53)	(.37)	(.24)	(.23)
p-value	[.01]	[.01]	[<.01]	[<.01]	[<.01]	[<.01]	[.06]
	B. Trade-Weighted Depreciation Rate						
MSE_u/MSE_r	.949	.900	.830	.788	.733	.929	.961
ΔMSE-adjusted	2.76	3.03	2.94	2.78	1.91	.67	.29
	(1.03)	(1.03)	(1.02)	(.98)	(.69)	(.38)	(.24)
p-value	[<.01]	[<.01]	[<.01]	[<.01]	[<.01]	[.03]	[.11]

NOTE.—ΔMSE-adjusted = $MSE_r - MSE_u$-adjusted is the Clark-West (2006) 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 Δe_{t+1} against nxa_t. Rolling regressions are used with a sample size of 105. *t*-statistics are in parentheses. The *p*-value of the one-sided test using critical values from a standard normal distribution is in brackets. Under the null, the random walk encompasses the unrestricted model. The sample is 1952:1–2004:1. The cutoff is 1978:1.

IV. Conclusion

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

Historically, we find that a substantial part of cyclical external imbalances (27 percent) are eliminated via predictable changes in asset returns. These valuation effects occur at short to medium horizons, whereas 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 United States relative to the liabilities, hence contributing to the process of international adjustment via the "valuation channel." In the longer run, a depreciated dollar favors trade surpluses, hence contributing to the adjustment via the "trade channel." The counterpart of the effect of exchange rate movements as an adjustment tool is that today's external imbalance contains significant information on future exchange rate changes. We are able to predict in sample 9 percent of the variance of the exchange rate one quarter ahead, 31 percent a year ahead, and 41 percent three years ahead. Our model also has significant out-of-sample forecasting power, so that we are able to beat the random walk at all horizons between one and 16 quarters.

Our approach implies a very different channel through which exchange rates affect the dynamic process of external adjustment. In traditional frameworks, fiscal and monetary policies are seen as affecting relative prices on the goods markets (competitive devaluations are an example) or as affecting saving and investment decisions. But fiscal and monetary policies should also be thought of as mechanisms affecting the relative price of assets and liabilities, in particular through interest rate and exchange rate changes. This means that monetary and fiscal policies may affect the economy differently than in the standard new open economy macro models à la Obstfeld and Rogoff.[44]

We used accounting identities and a minimal set of assumptions to derive our results. Any intertemporal general equilibrium model can therefore be nested in our framework. More specific theoretical mechanisms can be introduced and tested as restrictions within our setup. They will have to be compatible with our empirical findings regarding the quantitative importance of the two adjustment mechanisms and the horizons at which they operate. Thus our results provide useful information to guide more specific theories. The challenge consists in constructing models with fully fledged optimizing behavior compatible with the patterns we have uncovered in the data. A natural question arises as to why the rest of the world would finance the U.S. current account deficit and hold U.S. assets, knowing that those assets will underperform. In the absence of such a 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 in which home bias in asset holdings is prevalent, shocks may have very asymmetric impacts on asset demands, leading to large relative price adjustments on asset markets. Suppose, for example, that the world demand for U.S. goods falls, thereby increasing the current account deficit of the United States. The wealth of the United States goes down relative

[44] 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.

to that of 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 (see Henderson and Rogoff 1982; Kouri 1983; Blanchard, Giavazzi, and Sa 2005). This depreciation increases the return of the net foreign asset portfolio of the United States and thereby contributes to closing the gap due to the shortfall in net exports.[45] Another interesting avenue to explore is models generating time-varying risk premia such as Campbell and Cochrane (1999).

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

Appendix A

Proofs

Proof of Lemma 1

The normalized law of asset accumulation is given by

$$\Gamma_{t+1}(\hat{A}_{t+1} - \hat{L}_{t+1}) = R_{t+1}(\hat{A}_t - \hat{L}_t + \hat{X}_t - \hat{M}_t). \tag{A1}$$

Under assumption 1, write the following first-order approximations:

$$\hat{Z}_t \approx \bar{Z}_t(1 + \epsilon_t^z),$$

$$\Gamma_{t+1} \approx \bar{\Gamma}_{t+1}(1 + \epsilon_{t+1}^{\Delta w}),$$

$$R_{t+1} \approx \bar{R}_{t+1}(1 + \hat{r}_{t+1}).$$

Substitute into the external budget constraint (A1). The left-hand side of the constraint becomes approximately (and up to a constant)

$$(\bar{A}_{t+1} - \bar{L}_{t+1})\bar{\Gamma}_{t+1}\left(1 + \frac{\bar{A}_{t+1}\epsilon_{t+1}^a - \bar{L}_{t+1}\epsilon_{t+1}^l}{\bar{A}_{t+1} - \bar{L}_{t+1}} + \epsilon_{t+1}^{\Delta w}\right). \tag{A2}$$

The term on the right-hand side becomes approximately (and up to a constant)

$$\bar{R}_{t+1}(1 + \hat{r}_{t+1})(\bar{A}_t - \bar{L}_t + \bar{X}_t - \bar{M}_t)\left(1 + \frac{\bar{A}_t\epsilon_t^a - \bar{L}_t\epsilon_t^l + \bar{X}_t\epsilon_t^x - \bar{M}_t\epsilon_t^m}{\bar{A}_t - \bar{L}_t + \bar{X}_t - \bar{M}_t}\right). \tag{A3}$$

Now reconstruct (A1) putting together (A2) and (A3) and using equation (3) (the trend budget constraint):

$$\frac{\bar{A}_{t+1}\epsilon_{t+1}^a - \bar{L}_{t+1}\epsilon_{t+1}^l}{\bar{A}_{t+1} - \bar{L}_{t+1}} + \epsilon_{t+1}^{\Delta w} = \hat{r}_{t+1} + \frac{\bar{A}_t\epsilon_t^a - \bar{L}_t\epsilon_t^l + \bar{X}_t\epsilon_t^x - \bar{M}_t\epsilon_t^m}{\bar{A}_t - \bar{L}_t + \bar{X}_t - \bar{M}_t}.$$

Finally, define, as in the text, $na_t = \mu_t^a\epsilon_t^a - \mu_t^l\epsilon_t^l$ and $nx_t = \mu_t^x\epsilon_t^x - \mu_t^m\epsilon_t^m$, where μ_t^z

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

and ρ_t are defined in lemma 1, and rewrite the budget constraint (up to a constant) as

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

which is equation (4) of the text. QED

Proof of Lemma 2

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

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

which is equation (5) of the text. QED

Proof of Proposition 1

Iterate forward equation (5) and impose assumption 4 to get equation (8) of the text. QED

Appendix B

U.S. Net Foreign Assets, Net Exports, and Exchange Rates

We apply our theoretical framework to the external adjustment problem of the United States. Our methodology requires constructing net and gross foreign asset positions at market value over relatively long time series and computing capital gains and returns on global country portfolios. In this appendix, we describe briefly the construction of our data set. A complete description of the data is presented in Gourinchas and Rey (2007).

A. *Positions*

Data on the net and gross foreign asset positions of the United States are available from two sources: the U.S. Bureau of Economic Analysis and the Federal Reserve Flows of Funds Accounts (FFA) for the rest of the world.[46] Following official

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

classifications, we split the U.S. net foreign portfolio into four categories: debt (corporate and government bonds), equity, foreign direct investment, and other. The "other" category includes mostly bank loans and trade credits. It also contains gold reserves.[47] Our strategy consists in reconstructing market value estimates of the gross external assets and liabilities of the United States 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 subcategory of the financial account.

B. *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.[48]

We construct total returns for each class of financial assets as follows. For equity and FDI, we use quarterly total returns on the broadest stock market indices available in each country. The total return on debt is a weighted average of the total quarterly return on 10-year government bonds and the three-month interest rate on government bills, with weights reflecting the maturity structure of debt assets and liabilities. The total return on other assets and liabilities is computed using three-month interest rates. All returns are adjusted for U.S. 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 (2007) 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.

We construct total returns on the net foreign asset portfolio as follows. First, we use the definition of $r_t = |\mu^a| r_t^a - |\mu^l| r_t^l$. Second, by analogy, r_t^a and r_t^l are weighted averages of the returns on the four different subcategories of the

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

[48] Because of data availability, we assume away any spread between corporate and government debt.

financial account: equity, FDI, debt, and other. For instance, we write the total return on gross assets r_t^a as

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

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

It is difficult to construct precise estimates of the financially weighted nominal effective exchange rate, needed in particular to compute net portfolio returns in equation (10). There is little available evidence on the currency and country composition of total foreign assets. In practice, the Treasury Survey (U.S. Treasury 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.[49] We also make the realistic assumption that most foreign asset positions are not hedged for currency risk (see Hau and Rey 2006). For the period 1982–2004, our estimates are very close to the BEA international investment position at market value (see Gourinchas and Rey 2007).

References

Bergin, Paul R., and Steven M. Sheffrin. 2000. "Interest Rates, Exchange Rates and Present Value Models of the Current Account." *Econ. J.* 110 (April): 535–58.

Blanchard, Olivier, Francesco Giavazzi, and Filipa Sa. 2005. "International Investors, the U.S. Current Account, and the Dollar." *Brookings Papers Econ. Activity* (1): 1–49.

Campbell, John Y., and John H. Cochrane. 1999. "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior." *J.P.E.* 107 (April): 205–51.

Campbell, John Y., and Robert Shiller. 1988. "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors." *Rev. Financial Studies* 1 (Fall): 195–228.

Campbell, John Y., and Motohiro Yogo. 2006. "Efficient Tests of Stock Return Predictability." *J. Financial Econ.* 81 (July): 27–60.

Cheung, Yin-Wong, Menzie Chinn, and Antonio Garcia Pascual. 2005. "Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive?" *J. Internat. Money and Finance* 24 (November): 1150–75.

Christiano, Lawrence J., and Terry J. Fitzgerald. 2003. "The Band Pass Filter." *Internat. Econ. Rev.* 44 (May): 435–65.

Clark, Todd E., and Kenneth D. West. 2006. "Using Out-of-Sample Mean Squared

[49] 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.

Prediction Errors to Test the Martingale Difference Hypothesis." *J. Econometrics* 135 (November–December): 155–86.

Cochrane, John H. 1992. "Explaining the Variance of Price-Dividend Ratios." *Rev. Financial Studies* 5 (2): 243–80.

Cooley, Thomas F., and Edward C. Prescott. 1995. "Economic Growth and Business Cycles." In *Frontiers of Business Cycle Research*, edited by Thomas F. Cooley. Princeton, NJ: Princeton Univ. Press.

Evans, Martin D., and Richard K. Lyons. 2005. "Meese-Rogoff Redux: Micro-Based Exchange-Rate Forecasting." *A.E.R. Papers and Proc.* 95 (May): 405–14.

Gourinchas, Pierre-Olivier, and Jonathan A. Parker. 2002. "Consumption over the Life Cycle." *Econometrica* 70 (January): 47–89.

Gourinchas, Pierre-Olivier, and Hélène Rey. 2005. "International Financial Adjustment." Working Paper no. 11155 (February), NBER, Cambridge, MA.

———. 2007. "From World Banker to World Venture Capitalist: U.S. External Adjustment and the Exorbitant Privilege." In *G7 Current Account Imbalances: Sustainability and Adjustment*, edited by Richard H. Clarida. Chicago: Univ. Chicago Press (for NBER).

Hau, Harald, and Hélène Rey. 2006. "Exchange Rates, Equity Prices, and Capital Flows." *Rev. Financial Studies* 19 (Spring): 273–317.

Henderson, Dale W., and Kenneth Rogoff. 1982. "Negative Net Foreign Asset Positions and Stability in a World Portfolio Balance Model." *J. Internat. Econ.* 13 (August): 85–104.

Hooker, Sarah A., and John F. Wilson. 1989. "A Reconciliation of Flow of Funds and Commerce Department Statistics on U.S. International Transactions and Foreign Investment Position." Manuscript (July), Bd. Governors, Fed. Reserve System, Washington, DC.

Kehoe, Patrick J., and Fabrizio Perri. 2002. "International Business Cycles with Endogenous Incomplete Markets." *Econometrica* 70 (May): 907–28.

King, Robert G., and Sergio T. Rebelo. 1993. "Low Frequency Filtering and Real Business Cycles." *J. Econ. Dynamics and Control* 17 (January–March): 207–31.

Kouri, Pentti. 1983. "Balance of Payment and the Foreign Exchange Market: A Dynamic Partial Equilibrium Model." In *Economic Interdependence and Flexible Exchange Rates*, edited by Jagdeep S. Bhandari and Bluford H. Putnam. Cambridge, MA: MIT Press.

Kraay, Aart, and Jaume Ventura. 2000. "Current Accounts in Debtor and Creditor Countries." *Q.J.E.* 115 (November): 1137–66.

Kwiatkowski, Denis, Peter C. B. Phillips, Peter Schmidt, and Yongcheol Shin. 1992. "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root: How Sure Are We That Economic Time Series Have a Unit Root?" *J. Econometrics* 54 (October–December): 159–78.

Lane, Philip R., and Gian Maria Milesi-Ferretti. 2002. "External Wealth, the Trade Balance and the Real Exchange Rate." *European Econ. Rev.* 46 (June): 1049–71.

———. 2004. "Financial Globalization and Exchange Rates." Manuscript, Internat. Monetary Fund, Washington, DC.

Lettau, Martin, and Sydney Ludvigson. 2001. "Consumption, Aggregate Wealth, and Expected Stock Returns." *J. Finance* 56 (June): 815–49.

Mark, Nelson C. 1995. "Exchange Rates and Fundamentals: Evidence on Long-Horizon Predictability." *A.E.R.* 85 (March): 201–18.

Meese, Richard A., and Kenneth Rogoff. 1983. "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *J. Internat. Econ.* 14 (February): 3–24.

Mercereau, Benoit. 2003. "The Role of Stock Markets in Current Account Dynamics: A Time Series Approach." *Topics Macroeconomics* 3 (1): art. 6. http://www.bepress.com/bejm/topics/.

Mundell, Robert A. 1968. *International Economics.* New York: Macmillan.

Obstfeld, Maurice. 2001. "Mundell-Fleming Lecture: International Macroeconomics: Beyond the Mundell-Fleming Model." *IMF Staff Papers* 47 (special issue): 1–39.

———. 2004. "External Adjustment." *Rev. World Econ.* 140 (4): 541–68.

Obstfeld, Maurice, and Kenneth Rogoff. 1995. "The Intertemporal Approach to the Current Account." In *Handbook of International Economics*, vol. 3, edited by Gene M. Grossman and Kenneth Rogoff. Amsterdam: North-Holland.

———. 2007. "The Unsustainable U.S. Current Account Position Revisited." In *G7 Current Account Imbalances: Sustainability and Adjustment*, edited by Richard H. Clarida. Chicago: Univ. Chicago Press (for NBER).

Obstfeld, Maurice, and Alan M. Taylor. 2004. *Global Capital Markets: Integration, Crisis, and Growth.* Cambridge: Cambridge Univ. Press.

Sachs, Jeffrey. 1982. "The Current Account in the Macroeconomic Adjustment Process." *Scandinavian J. Econ.* 84 (2): 147–59.

Stock, James H., and Mark W. Watson. 1999. "Forecasting Inflation." *J. Monetary Econ.* 44 (October): 293–335.

Tille, Cedric. 2003. "The Impact of Exchange Rate Movements on U.S. Foreign Debt." *Current Issues Econ. and Finance* 9 (January): 1–7.

———. 2004. "Financial Integration and the Wealth Effect of Exchange Rate Fluctuations." Manuscript, Fed. Reserve Bank New York.

U.S. Treasury. 2000. "U.S. Holdings of Foreign Long-Term Securities." Dept. Treasury, Div. Internat. Finance, Bd. Governors, Fed. Reserve System. http://www.ustreas.gov/fpis/.