Valuation Effects with Transitory and Trend Productivity Shocks

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Abstract

In the past two decades, cross-border portfolio holdings of a large variety of assets have risen sharply. This has created an important role for changes in asset prices of a country's external assets and liabilities (i.e. "valuation effects") in affecting the country's net foreign asset position. Valuation effects are commonly thought as stabilizing; they counteract current account movements and mitigate the impact of the current account on the country's net foreign asset position. This paper shows that whether valuation effects are stabilizing or not depends

critically on the nature of underlying productivity shocks. In response to transitory shocks, valuation effects are stabilizing; but in response to trend shocks, such effects amplify the impact of the current account on the net foreign asset position. These contrasting results arise because optimally smoothing consumers respond differently to a transitory shock than to a trend shock to income. The results are consistent with the pattern of external imbalances between the United States and other G.7 countries since the 1990s.

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1 Introduction

1.1 Contributions

In traditional balance of payments models, the evolution of a country's net foreign asset (NFA) position is fully determined by the current account. For example, countries that run a current account deficit experience a parallel reduction in their NFA position. These models are based on the assumption that countries trade only a single bond of constant real value. However, in the past two decades cross-country portfolio holdings of a large variety of assets have risen sharply. This has created a potentially important role for changes in asset prices, or "valuation effects", to play in a country's NFA position (Lane and Milesi-Ferretti 2007). Valuation effects are changes in the value of a country's gross external assets and liabilities due to asset price and exchange rate fluctuations. Positive valuation effects arise when the capital gains on foreign assets held by domestic agents are larger than those on domestic assets held by foreign agents. *Ceteris paribus*, positive valuation effects enhance a country's external financial wealth and improve its NFA position. Following this argument, Gourinchas and Rey (2007) point out that large, persistent current account deficits of a country such as the U.S. do not necessarily lead to a sharp deterioration in the NFA position if the country experiences positive valuation effects. In such a situation, current account deficits can be much more sustainable than was previously thought and valuation effects exert a stabilizing role - they offset part of the current account deficit and mitigate the decline in the country's NFA position.

This paper investigates theoretically if valuation effects do move to offset the current account and stabilize a country's NFA position. It shows that the impact of valuation effects depends critically on the nature of underlying shocks. In response to transitory shocks, valuation effects are stabilizing; they counteract current account movements and help to soften the impact of the current account on a country's NFA position. In response to trend shocks, valuation effects are amplifying; they move in the same direction as the current account, and reinforce, or "amplify", the impact of the current account on the NFA position. The theoretical predictions are illustrated by the evolution of the NFA position of the U.S. with other G.7 countries since the 1990s: valuation effects (from stocks and bonds) were negative and amplifying before 2002 and have been positive and stabilizing since 2002.

The mechanism of valuation effects works as follows: in response to a positive

productivity shock, domestic asset prices appreciate (relative to foreign asset prices) to reflect a better performance of the domestic economy. The appreciation of domestic asset prices creates a negative valuation effect, in response to both a positive transitory shock and a positive trend shock.

However, the role of the valuation effect in the two scenarios is very different. Following a positive transitory shock, agents smooth consumption and save. Investment also increases, but less than the increase in saving due to the presence of capital adjustment costs. As a result, the domestic country runs a current account surplus. The negative valuation effect hence moves in the opposite direction of the current account and offsets the current account surplus. Valuation effects are said to have a stabilizing property on NFA position as they counteract the fluctuations of the current account.

On the other hand, after a positive trend productivity shock, valuation effects are amplifying. A positive trend productivity shock implies that growth is sustained, *i.e.* higher output today will be followed by even higher output tomorrow. Put differently, the increase in current income is lower than the increase in permanent income. Consumption smoothing implies that consumption rises more than output and the domestic country runs a current account deficit. The negative valuation effect then moves in the same direction as the current account, and reinforces the current account deficit. As a result, the decrease in the NFA position is now more than the current account deficit, which means valuation effects are amplifying. Simulation results indicate sizable valuation effects, especially in response to trend shocks because asset price appreciations are more dramatic in this case.

Quantitatively, the model is calibrated and estimated to match second-order moments of U.S. output, consumption and investment series. The estimated model can account for most of the volatility of the U.S.'s trade and current account, about two-thirds of the U.S.'s changes in NFAs, and one-third of the U.S.'s valuation effects.

The empirical literature has sought to identify if the U.S.'s valuation effects are stabilizing. Gourinchas and Rey (2007) impute net foreign asset returns from 1952 to 2004, and interpret these as the “valuation channel” of changes in NFA position. They find that the valuation channel is stabilizing and accounts for 27% of the U.S.'s cyclical external adjustments. However, Curcuru, Dvorak, and Warnock (2008), after correcting for measurement errors, find that the average return differential of U.S. claims (in stocks and bonds) over U.S. liabilities is essentially zero during the period from 1994 to 2006. Bertaut and Tryon (2007) do not associate valuation effects to

asset returns, but to relative changes in asset prices¹. Their data indicates that between 1994-2006, the U.S.'s cumulative valuation effects are significant and positive. From my calculation using their data, total valuation effects from stocks and bonds during 1994-2006 period were \$1295 billion, offsetting about 22.8% of the size of the U.S.'s total current account deficits. My calculation is consistent with the finding of Curcuru, Dvorak, and Warnock (2008), because the U.S.'s external assets had a lower average return than its liabilities before 2002, but higher after 2002 (Figure 4², Appendix A). Since after 2002, the total holdings of foreign assets on which the U.S. experienced positive valuation effects are larger, the aggregate U.S.'s valuation effect in 1994-2006 is positive and stabilizing (Figure 5, Appendix A).

On the theoretical front, Devereux and Sutherland (2009b) investigate valuation effects in a two-country dynamic stochastic general equilibrium model. They relate valuation effects to return differentials. My paper however associates valuation effects with changes in asset prices. Ghironi, Lee, and Rebucci (2007) also explicitly consider asset prices but they do not consider the impact of trend productivity shocks. Coeurdacier, Kollmann, and Martin (2009) also briefly discuss valuation effects with transitory shocks, although they focus on explaining equity home bias. One key contribution of my paper is that it identifies the contrasting role of valuation effects as stabilizing after transitory shocks, and amplifying after trend shocks. Unlike the conventional wisdom that valuation effects are generally stabilizing, as showcased in empirical findings of Gourinchas and Rey (2007), and as implied by the theoretical results of Ghironi, Lee, and Rebucci (2007), Coeurdacier, Kollmann, and Martin (2009), and Devereux and Sutherland (2009b), this paper shows that valuation effects can be amplifying too. This situation is illustrated by the evolution of NFA position between the U.S. and other G.7 countries during the 1990s, which I discuss in section 1.2.

My paper follows Aguiar and Gopinath (2007) in its approach to introduce trend shocks, and Tille and van Wincoop (2007) and Devereux and Sutherland (2007) in their method of solving for portfolio choice. They develop an approximation method to characterize time-varying equilibrium portfolios in a two-country dynamic general equilibrium model, in which financial markets are incomplete³. In my paper, market incom-

¹Bertaut and Tryon (2007) calculated valuation effects from stocks and bonds between the U.S. and every other country from 1994 to 2007.

²For sources of data used in all the figures and tables, see Appendix A.

³For different solution methods, see Evans and Hnatkovska (2007); Heathcote and Perri (2007); Pavlova and Rigobon (2009).

pleteness, along with home bias in portfolio holdings, is assumed⁴, by the presence of an exogenous cost of investing in foreign equities.

The paper is related to a large literature on global imbalances⁵. Also using expected higher growth of the U.S. than other industrialized countries, Engel and Rogers (2006) explain the U.S.'s current account deficit, but they do not examine valuation effects. Caballero, Farhi, and Gourinchas (2006) use the growth gap between the U.S. and Continental Europe in the 1990s to explain U.S.-Europe capital flows.

1.2 U.S.'s external imbalances with other G.7 countries

The paper's theoretical results have some important implications for the U.S.'s external imbalances with other G.7 countries. The U.S. experienced persistently higher economic and productivity growth than other countries in the 1990s, arguably due to the information and communication technology revolution that took place in the U.S. in this period (Figure 1). The average annual growth rate of U.S. PPP GDP during 1990-2000 was 1.94%, compared to 1.47% for other G.7 countries (henceforth referred to as G.6). At the same time, U.S.'s relative stock prices followed an upward trend (whether adjusted for changes in exchange rates or not), while the U.S.-G.6 current account balance has continued to worsen (Figures 2, 3).

Figure 1: U.S.-G.6 Normalized Total Factor Productivity ratios

⁴For papers that seek to explain home bias in portfolio holdings, see Kollman (2006); Engel and Matsumoto (2009); Heathcote and Perri (2007); Benigno (2007); Coeurdacier, Kollmann, and Martin (2009).

⁵See for example Obstfeld and Rogoff (2005); Caballero, Farhi, and Gourinchas (2006); Engel and Rogers (2006); Mendoza, Quadrini, and Rios-Rull (2009) among others.

Figure 2: Log of normalized stock price index ratios (Jan-1990=0), after incorporating changes in exchange rates, 1990-2008

Figure 3: U.S.-G.6 current account and non-FDI valuation effects, 1995-2007

The theoretical results imply that if the U.S. indeed had a positive trend productivity shock relative to other industrialized countries, the valuation effects between the U.S. and these countries would be negative and they would worsen the impact of the current account deficit on the U.S.'s NFA position. Figure 3 shows that from 1995 to 2001, U.S.-G6 valuation effects were generally negative (except in 1999⁶), and they exacerbated the impact of the current account deficit on the NFA position. After 2002, the U.S.'s valuation effects became positive, while the U.S.'s current account remains in deficit. These two phenomena are consistent with the view that the U.S. had (or at least was perceived to have had) a *negative transitory shock* at that time.

⁶In 1999 the dot com bubble in other countries was even more severe than that of in U.S., leading to a positive valuation effect.

2 The Model

2.1 The framework

The framework is a one-good, two-country DSGE model. Each country has a large number of identical households and firms. Output is produced with labor and capital. The technological progress is affected by a transitory and a trend shock, both of which are AR(1) processes. There are two assets: equities of Home country's firms and of Foreign country's firms. Households observe wages, output, dividend payments, equity prices and choose how much to work, how much to consume and how to allocate their wealth between the two assets in their portfolios. Firms choose labor inputs, investment, and dividend payments.

In the model, financial assets serve two purposes: for inter-temporal consumption smoothing and for risk-sharing. Households would like to insure themselves against the risks of undiversifiable labor income and domestic equity holdings. Ideally, in a frictionless asset market, agents would hold assets to completely insure themselves against any country-specific shocks (Lucas 1982). However, in reality, residents of most countries exhibit home bias in their portfolio holdings (Tesar and Werner 1995). A number of explanations for the home-bias puzzle have been presented. In this paper I assume that there is a small cost of investing abroad, as in Tille and van Wincoop (2007) and Heathcote and Perri (2004). These costs reflect a lack of market knowledge, market access and information, as well as cultural and language barriers. Such costs make investing abroad less attractive and create home bias in portfolio holdings.

Note that there is only one good in the model, thus, we cannot explicitly account for exchange rate movements. In practice, valuation effects consist of movements in both nominal asset prices and in foreign exchange rates. However, to the extent that exchange rate movements are equilibrium responses to fundamental shocks, the change in relative real asset prices in our model reflects both movements in nominal asset prices and exchange rates.

2.2 Technology and Firms

Denote the two countries Home (H) and Foreign (F). Both countries $i = H, F$ produce an identical perishable good. Production of country i employs both capital and labor in a standard Cobb-Douglas function. Capital stock can be adjusted with a cost, which

is typically introduced in the literature to match investment moments.

$$Y_t^i = z_t^i K_t^{i\alpha} (\Gamma_t^i L_t^i)^{1-\alpha} \quad (1)$$

where $0 < \alpha < 1$ is the capital share of output. z_t^i is the transitory shock that follows an AR(1) process

$$\log(z_t^i) = \rho_z \log(z_{t-1}^i) + \epsilon_t^{iz} \quad (2)$$

where $0 < \rho_z < 1$ and ϵ_t^{iz} represents an *iid* draw from a normal distribution with zero mean and standard deviation σ_z .

The parameter Γ_t^i represents a combination of a cumulative product of the growth shocks of country i (as in Aguiar and Gopinath (2007)) and a convergence process. In particular:

$$\Gamma_t^i = g_t^i \Gamma_{t-1}^i \left(\frac{\Gamma_{t-1}^{-i}}{\Gamma_{t-1}^i} \right)^\lambda \quad (3)$$

$$\log(g_t^i) = (1 - \rho_g) \log(\bar{g}) + \rho_g \log(g_{t-1}^i) + \epsilon_t^{ig} \quad (4)$$

Γ_t^i can also be thought of as the “permanent” component of country i ’ technology. ρ_g and λ are between 0 and 1. ϵ_t^{ig} is *iid* normal with zero mean and standard deviation σ_g . $\bar{g} > 1$ is the common long run growth rate. Γ_{t-1}^{-i} is the permanent component of the other country’s technology. $\left(\frac{\Gamma_{t-1}^{-i}}{\Gamma_{t-1}^i} \right)^\lambda$ represents a convergence process: the two countries’ technology and output levels are assumed to converge in the long run. Convergence is assumed so that a local solution method can be applied. This assumption is not unrealistic, however, particularly among countries and regions with similar institutions (for example, see Barro and Sala-i Martin (2003) for different states of the U.S., and Dowrick and Nguyen (1989) or Madsen (2007) for OECD countries). Having said that, it is important to note that the main results of the paper do not depend on this assumption. In this paper, λ is set close to zero (implying a long convergence).

Every period, firms in country i , after paying labor costs, decide how much to reinvest (subject to an adjustment cost), and how much to distribute back to shareholders in dividends.

$$D_t^i = Y_t^i - W_t^i L_t^i - (K_{t+1}^i - (1 - \delta) K_t^i) - \frac{\varphi}{2} \left(\frac{K_{t+1}^i}{K_t^i} - \bar{g} \right)^2 K_t^i \quad (5)$$

where D_t^i, W_t^i, L_t^i denote dividend payments, wages and labor inputs of country i ’s firms. We assume that capital depreciates at rate δ , and the adjustment cost to capital stock is quadratic, where φ is the adjustment cost parameter.

2.3 Assets

There are two assets: equities of the Home firms and those of the Foreign firms. The price at time t of firm i 's equity carried into the next period is denoted Q_{t+1}^i , measured in terms of the consumption good. The holder of this claim gets a dividend in period t and can sell the claim for price Q_{t+1}^i . The overall return to country i 's equity, in terms of the consumption good is:

$$R_t^i = \frac{Q_{t+1}^i}{Q_t^i} + \frac{D_t^i}{Q_t^i} \quad (6)$$

The above equation states that the return to investment in domestic equity comprises a dividend yield and an appreciation of the equity.

I assume a credit market friction. In particular, agents investing abroad receive the gross return times a “local expert” cost $e^{-\tau}$, as in Tille and van Wincoop (2007). The cost captures expenses paid to local experts for local market access and information, as well as expenses spent to overcome cultural and language barriers. This friction generates a home-bias in portfolio holdings and market incompleteness. The “local expert” cost is paid in the host country; for instance, the cost could represent payments to experts in the local economy.

2.4 Households

An infinitely-lived representative household maximizes its expected discounted utility:

$$U_i = E_0 \sum_{t=0}^{\infty} e^{\left[\sum_{\tau=0}^{t-1} \log \left(\frac{C_{\tau}^i}{\chi Y_{\tau}^i} \right)^{-\phi} \right]} \beta^t \frac{(C_t^{i\gamma} (1 - L_t^i)^{1-\gamma})^{1-\sigma}}{1 - \sigma} \quad (7)$$

I assume an endogenous discount factor, as in Schmitt-Grohe and Uribe (2003) and Devereux and Sutherland (2009a). This is a simple technical device to induce uniqueness of the deterministic steady state and stationary responses to temporary shocks. Specifically, the endogenous discount factor decreases with the aggregate consumption-output ratio, which the representative household takes as given. χ will be set equal to the long run consumption-output ratio so that the long run discount factor equals β . In addition, ϕ is set arbitrarily small so that in the short run, the deviations of the endogenous discount factor from the standard discount factor β are negligible.

Denote θ_t^i the fraction of country i 's wealth invested in that country's equity carried from the last period to the current period. Country i 's wealth in terms of the

consumption good evolves according to the following law of motion:

$$A_{t+1}^i = \theta_t^i A_t^i R_t^i + (1 - \theta_t^i) A_t^i R_t^{-i} e^{-\tau} + W_t^i L_t^i - C_t^i + (1 - \theta_{-i,t}^i) A_t^{-i} R_t^i (1 - e^{-\tau}) \quad (8)$$

where A_{t+1}^i is the wealth of country i 's households carried to the next period. $\theta_t^i A_t^i R_t^i + (1 - \theta_t^i) A_t^i R_t^{-i} e^{-\tau}$ is country i 's income from equities (R_t^{-i} is the return of the other country's equity), and $(1 - \theta_{-i,t}^i) A_t^{-i} R_t^i (1 - e^{-\tau})$ is the local expert cost that country i collects from the other country's investors. Following Tille and van Wincoop (2007), I assume that τ is second order (*i.e.* proportional to the variances of the shocks) so that the portfolio holding is well-behaved.

The timing of the agent's problem is as follows: A representative agent enters the period knowing his wealth, his domestic and foreign equity holdings, and the domestic and foreign equity prices. Output is then observed. The agent then chooses consumption and portfolio holdings for the next period, taking the returns as given. However in equilibrium, the returns are affected by the agent's portfolio choice.

2.5 Households' and firms' decisions, and market-clearing

Taking wages as given, country i 's households choose labor supply, consumption, and a portfolio to hold to maximize their discounted utility (7) subject to their budget constraint (8). The first-order conditions of the problem are in Appendix B.

Country i 's firms choose labor demand, dividend payments and capital next period to maximize the discounted stream of dividend payments subject to the firms' constraint. Note that following Heathcote and Perri (2007), I assume the firms also use the same discount factors as the households. Thus, the firms' problem is to solve:

$$\max_{L_t^i, D_t^i} E_0 \sum_{t=0}^{\infty} e^{\left[\sum_{\tau=0}^{t-1} \log \left(\frac{C_{\tau}^i}{x Y_{\tau}^i} \right)^{-\phi} \right]} \beta^t D_t^i \quad (9)$$

The first-order conditions of the firms' problem are also in Appendix B.

Clearing of the good and asset markets entails :

$$\begin{aligned} Y_t^H + Y_t^F &= C_t^H + C_t^F + (K_{t+1}^H - (1 - \delta) K_t^H) + (K_{t+1}^F - (1 - \delta) K_t^F) \\ &+ \frac{\varphi}{2} \left(\frac{K_{t+1}^H}{K_t^H} - \bar{g} \right)^2 K_t^H + \frac{\varphi}{2} \left(\frac{K_{t+1}^F}{K_t^F} - \bar{g} \right)^2 K_t^F \end{aligned} \quad (10)$$

$$Q_{t+1}^H = \theta_{t+1}^H A_{t+1}^H + (1 - \theta_{t+1}^H) A_{t+1}^F \quad (11)$$

$$Q_{t+1}^F = \theta_{t+1}^F A_{t+1}^F + (1 - \theta_{t+1}^F) A_{t+1}^H \quad (12)$$

2.6 Valuation effects

In standard inter-temporal models, the change in the net foreign asset position equals the current account. In this model, however, this equation needs not hold, because the model explicitly considers capital gains or losses arising from changes in domestic and foreign asset prices, that is, the “valuation effects”. In the model, the valuation effects for the Home country are:

$$VE_t^H = (1 - \theta_t^H)A_t^H \left(\frac{Q_{t+1}^F}{Q_t^F} e^{-\tau} - 1 \right) - (1 - \theta_t^F)A_t^F \left(\frac{Q_{t+1}^H}{Q_t^H} e^{-\tau} - 1 \right) \quad (13)$$

where $(1 - \theta_t^H)A_t^H \left(\frac{Q_{t+1}^F}{Q_t^F} e^{-\tau} - 1 \right)$ is the home country’s capital gain from Foreign equity holdings, after adjusting for the “local expert” costs, and $(1 - \theta_t^F)A_t^F \left(\frac{Q_{t+1}^H}{Q_t^H} e^{-\tau} - 1 \right)$ is the foreign investors’ capital gain from holding domestic equity.

The current account consists of the trade balance and net factor income:

$$CA_t^H = Y_t^H - C_t^H - (K_{t+1}^H - (1 - \delta)K_t^H) - \frac{\varphi}{2} \left(\frac{K_{t+1}^H}{K_t^H} - \bar{g} \right)^2 K_t^H + (1 - \theta_t)A_t^H \frac{D_t^F}{Q_t^F} e^{-\tau} - (1 - \theta_t^F)A_t^F \frac{D_t^H}{Q_t^H} e^{-\tau} \quad (14)$$

The change in NFA position equals:

$$\Delta NFA_t^H = [(1 - \theta_{t+1}^H)A_{t+1}^H - (1 - \theta_{t+1}^F)A_{t+1}^F] - [(1 - \theta_t^H)A_t^H - (1 - \theta_t^F)A_t^F] \quad (15)$$

This equals the current account plus the valuation effects:

$$\Delta NFA_t^H = CA_t^H + VE_t^H \quad (16)$$

To see this, substitute (14) and (15) into (16), and use equation (6) for equities’ returns, and equation (8) for the households’ budget constraints.

3 Solution of the model

3.1 De-trending the system

Given that a realization of g permanently affects Γ , output is non-stationary with a stochastic trend. For a home variable X^H following Aguiar and Gopinath (2007), I introduce a lower-case x^H to denote its detrended counterpart.

$$x_t^H = \frac{X_t^H}{\Gamma_{t-1}^H}$$

For any foreign variable X^F , I also use introduce x^F :

$$x_t^F = \frac{X_t^F}{\Gamma_{t-1}^H}$$

The variables that do not need to be detrended are R_t^i, L_t^i and θ_t^i ,

Appendix C presents the system in terms of detrended variables. Note that there is now a new variable, $\pi_t = \frac{\Gamma_{t-1}^F}{\Gamma_{t-1}^H}$, which is the ratio of the two permanent technology components. π_t is a state variable and converges to one in the steady state.

It is well-known that up to a first-order approximation, the values of the portfolio choice θ_{t+1}^H and θ_{t+1}^F are indeterminate, because at this level of approximation, the two assets are perfect substitutes. Previous literature usually relies on perfect market structures that make portfolio choice irrelevant. Following the approach of Tille and van Wincoop (2007) and Devereux and Sutherland (2007), I solve for the first-order accurate solution of the detrended system above (including the long run portfolio choice decisions). First I take the first-order approximation of the system, and solve for the first-order accurate solution of the non-portfolio choice variables *conditional* on the long run steady state portfolio choice. Subsequently, the conditional solution is substituted into the second-order approximations of the portfolio choice equations to pin down the values of the long run portfolio choice. I will show that the current account, changes in NFA position and valuation effects can also be approximated to first order. After solving for the detrended variables, level variables are recovered.

Consider the first-order approximation of the system in appendix C. The portfolio choice decisions that enter the first-order system are the steady-state portfolio $\theta^H (= \theta^F)$ and the term $(\hat{\theta}_{t+1}^H - \hat{\theta}_{t+1}^F)$. They enter the system *only through* the first-order approximations of the budget constraint equation (C16) and the asset market clearing condition (C7):

$$\bar{g}a(\hat{a}_{t+1}^H + \hat{g}_t^H + \lambda\hat{\pi}_t) + c\hat{c}_t^H - aL(\hat{a}_t^H + \hat{L}_t^H) = \theta aR\hat{R}_t^H + (1 - \theta)aR\hat{R}_t^F + aR\hat{a}_t^H \quad (17)$$

$$q\hat{q}_{t+1}^H - \theta a\hat{a}_{t+1}^H - (1 - \theta)a\hat{a}_{t+1}^F = a(\hat{\theta}_{t+1}^H - \hat{\theta}_{t+1}^F) \quad (18)$$

$\hat{\theta}_{t+1}^H - \hat{\theta}_{t+1}^F$ enters the system as a choice variable and will be useful to approximate the current account, valuation effects and the changes in net foreign asset position. Here note that I drop the superscripts H, F for the steady-state values, because for any pair of variables x_t^H and x_t^F , their steady-state values equal: $x^H = x^F = x$.

The system (conditional on long run portfolio choice θ) can be solved by any standard solution method for linear rational expectations models. I use the package of Schmitt-Grohe and Uribe (2004).

Next, I will substitute the solution (condition on θ) into the second-order approximations of the two portfolio choice Euler equations (C13) for the two countries:

$$\begin{aligned}
& E_t[(\gamma(1-\sigma)-1)\hat{c}_{t+1}^H \hat{R}_{t+1}^H - (1-\gamma)(1-\sigma)(1-L)^{(1-\gamma)(1-\sigma)} \frac{L}{1-L} \hat{L}_{t+1}^H \hat{R}_{t+1}^H] = \\
& E_t[(\gamma(1-\sigma)-1)\hat{c}_{t+1}^H \hat{R}_{t+1}^F - (1-\gamma)(1-\sigma)(1-L)^{(1-\gamma)(1-\sigma)} \frac{L}{1-L} \hat{L}_{t+1}^H \hat{R}_{t+1}^F - \tau] \quad (19) \\
& E_t[(\gamma(1-\sigma)-1)\hat{c}_{t+1}^F \hat{R}_{t+1}^H - (1-\gamma)(1-\sigma)(1-L)^{(1-\gamma)(1-\sigma)} \frac{L}{1-L} \hat{L}_{t+1}^F \hat{R}_{t+1}^H - \tau] = \\
& E_t[(\gamma(1-\sigma)-1)\hat{c}_{t+1}^F \hat{R}_{t+1}^F - (1-\gamma)(1-\sigma)(1-L)^{(1-\gamma)(1-\sigma)} \frac{L}{1-L} \hat{L}_{t+1}^F \hat{R}_{t+1}^F] \quad (20)
\end{aligned}$$

Subtracting one equation from the other, I obtain:

$$\begin{aligned}
& E_t \left[(\hat{R}_{t+1}^H - \hat{R}_{t+1}^F)(\gamma(1-\sigma)-1)(\hat{c}_{t+1}^H - \hat{c}_{t+1}^F) \right] \\
& - E_t \left[(\hat{R}_{t+1}^H - \hat{R}_{t+1}^F)((1-\gamma)(1-\sigma)(1-L)^{(1-\gamma)(1-\sigma)} \frac{L}{1-L} (\hat{L}_{t+1}^H - \hat{L}_{t+1}^F)) \right] = -\tau \quad (21)
\end{aligned}$$

Note that since the local expert cost τ is of second order, it does not appear in the system of first-order approximation, but does appear here. Equation (21) can be interpreted as follows: the covariance between the excess return and the difference in marginal utilities equals the local expert cost (note that up to second order, the covariance is time-invariant). If the cost τ is zero, the covariance is zero because domestic and foreign agents will have the same level of marginal utility regardless of the interest rate difference. In other words, both domestic and foreign investors are completely insured against country-specific risks (*i.e.* the market is effectively complete). A positive τ makes foreign investment less attractive, thereby creating home-biased portfolios and thus market incompleteness. As a result, the difference in marginal utilities is negatively correlated with the realized excess return because a country whose equity yields a higher return can afford to consume more, and has lower marginal utility.

I solve for θ by substituting the conditional result of the system into (21).

Denote the normalized current account, NFA position and valuation effects as $ca_t \equiv \frac{CA_t}{\Gamma_{t-1}}$, $nfa_t \equiv \frac{NFA_t}{\Gamma_{t-1}}$, and $vet_t \equiv \frac{VE_t}{\Gamma_{t-1}}$. The first-order approximations of all the economic

variables of interest can be expressed in first-order terms.

$$\begin{aligned} \hat{v}e_t^H = & (1 - \theta)a\bar{g} \left((\hat{a}_t^H + \hat{q}_{t+1}^F - \hat{q}_t^F) - (\hat{a}^F + \hat{q}_{t+1}^H - \hat{q}_t^H) \right) \\ & - (1 - \theta)a(\hat{a}_t^H - \hat{a}^F) - (\hat{\theta}_t^H - \hat{\theta}_t^F)a(\bar{g} - 1) \end{aligned} \quad (22)$$

$$\begin{aligned} n\hat{f}a_t^H = & (1 - \theta)a(\hat{a}_t^H - \hat{a}_t^F) - a(\hat{\theta}_t^H - \hat{\theta}_t^F) \\ \hat{c}a_t^H = & \Delta n\hat{f}a_t^H - \hat{v}e_t^H \end{aligned} \quad (23)$$

Note that $(\hat{\theta}_t^H - \hat{\theta}_t^F)$ is a first order term and was solved in the first-order system.

4 Quantitative Analysis

This section explains the calibration and estimation procedure of the parameters, documents empirical and theoretical business cycle moments, and plots impulse responses to both the transitory and trend productivity shocks.

4.1 Calibrations

I use a combination of calibrated and estimated parameters. The coefficients of risk aversion (σ), consumption exponent (γ) discount factor (β), depreciation rate (δ) and capital share (α) are set as standards. I set both the convergence parameter (λ) and the endogenous discount factor parameter (ϕ) to 0.001. I set $\bar{g}$ to the average growth rate of quarterly output from the data which is 1.0055 (*i.e.* 0.55% per quarter). The investment cost τ is calibrated so that the home asset holding θ is 0.9 (about the level of home bias of U.S. investors in 1990-2000). I estimate the remaining structural parameters $\rho_z, \sigma_z, \rho_g, \sigma_g$ and φ , using GMM estimation⁷.

Calibrated parameters are in table 1 below:

I have the following parameters to estimate: $\rho_z, \sigma_z, \rho_g, \sigma_g$ and φ . I also assume $\sigma_z^H \neq \sigma_z^F$ so that the model can account for the difference in U.S. and of G.6's output moments. The six parameters are estimated by the GMM method, where the following theoretical moments $\text{std}\left(\frac{y_t^H}{y_{t-1}^H}\right), \text{std}\left(\frac{y_t^F}{y_{t-1}^F}\right), \text{std}\left(\frac{c_t^H}{c_{t-1}^H}\right), \text{corr}\left(\frac{c_t^H}{y_t^H}, \frac{y_t^H}{y_t^F}\right), \text{corr}\left(\frac{y_t^H}{y_t^H}, \frac{y_t^H}{y_t^F}\right), \text{std}\left(\frac{c_t^H}{y_t^H}\right)$ are matched with the corresponding empirical moments. The estimated parameters are in table 2.

Historical quarterly data of U.S.'s GDP, consumption and investment are from the Bureau of Economic Analysis. Historical G.7's PPP(Purchasing Power Parity) GDP

⁷See Burnside (1991) for a description and applications of the GMM methodology.

σ	Risk aversion	2
γ	Consumption component (utility)	.36
β	Discount factor	0.98
α	Capital share	0.34
δ	Depreciation rate	0.04
λ	Convergence rate	0.001
ϕ	Elasticity of the discount factor	0.001
τ	Foreign investment cost	1.397×10^{-4}
$\bar{g}$	Long run growth rate	1.0055

Table 1: Calibrated parameters

data are from the OECD's statistics. G.6's average PPP GDP is calculated by taking the total G.6's PPP GDP divided by total G.6's population. The output ratio is the ratio of G.6's average PPP GDP and the U.S.'s PPP GDP obtained also from the OCED database. Data is quarterly from 1970,QI -2000,QI⁸.

		Estimated values	Standard errors
ρ_z	Persistence of transitory shocks	0.8404	(0.0002)
ρ_g	Persistence of growth shocks	0.5598	(0.0001)
σ_z^H	Standard deviation of Home transitory shocks	0.0070	(0.0000)
σ_z^F	Standard deviation of Foreign transitory shocks	0.0040	(0.0000)
σ_g	Standard deviation of growth shocks	0.0042	(0.0000)
φ	Adjustment cost	1.5086	(0.0005)

Table 2: Estimated parameters

4.2 Impulse Responses and Business Cycle Moments

To gain insights into how valuation effects influence the NFA position, I study the impulse responses to the two kinds of productivity shocks. Figure 6 in Appendix D contrasts the impulse responses of consumption, investment, current account, valuation effects and changes in net foreign assets to a 1% (i.e. $\varepsilon_z = 0.01$) positive *transitory* productivity shock and a 0.1% (i.e. $\varepsilon_g = 0.001$) *trend*(growth) productivity shocks.

The ratio of current account to income has a positive response (of about 0.5%) to

⁸I restrict the data until 2000 because after 2000, a significant part of U.S.'s consumption results from trading with China.

a 1% transitory productivity shock. Investment increases, but not enough to offset saving. Valuation effect response is negative because the domestic asset price appreciates. The size of the valuation effect response is relatively small compared to that of the current account because the domestic asset price appreciates only modestly, as investors know the positive shock to the home country is temporary. In contrast, in the case of the trend shock, valuation effects are much larger because the domestic asset price appreciates more, as investors know the domestic country will outperform the foreign country for a longer time. Valuation effects are negative and reinforce the movement of the current account.

	Data	Both shocks	Only Transitory	Only Trend
$std\left(\frac{Y_{t+1}^H}{Y_t^H}\right)$	0.0105 (U.S.)	0.0103 (0.0008)	0.0100 (0.0007)	0.0028 (0.0003)
$std\left(\frac{Y_{t+1}^F}{Y_t^F}\right)$	0.0067 (G.6.)	0.0067 (0.0005)	0.0061 (0.0004)	0.0028 (0.0003)
$std\left(\frac{C_{t+1}^H}{C_t^H}\right)$	0.0071	0.0067 (0.0005)	0.042 (0.0003)	0.0052 (0.0004)
$corr\left(\frac{C_t^H}{Y_t^H}, \frac{Y_t^H}{Y_t^F}\right)$	-0.5731	-0.5641 (0.2350)	-0.9577 (0.0243)	-0.2687 (0.2592)
$std\left(\frac{C_t^H}{Y_t^H}\right)$	0.0104	0.0104 (0.0019)	0.0085 0.0022	0.0009 (0.0003)
$corr\left(\frac{I_t^H}{Y_t^H}, \frac{Y_t^H}{Y_t^F}\right)$	0.122	0.1011 (0.2979)	0.3857 (0.2080)	-0.1146 (0.3150)
$std\left(\frac{NX_t^H}{Y_t^H}\right)$	0.011	0.0098 (0.0019)	0.0078 (0.0016)	0.0056 0.0012
$std\left(\frac{CA_t^H}{Y_t^H}\right)$	0.013	0.0091 (0.0016)	0.0071 (0.0012)	0.0054 (0.001)
$std\left(\frac{VE_t^H}{Y_t^H}\right)$	0.0148	0.0052 (0.0004)	0.0010 (0.0002)	0.0051 (0.0004)
$std\left(\frac{\Delta NFA_t^H}{Y_t^H}\right)$	0.0156	0.0121 (0.0016)	0.007 (0.0012)	0.096 (0.0011)

Table 3: Volatility of trade, current account, valuation effects and changes in NFA position

I run a simulation exercise to investigate the quantitative importance of valuation effects. In the simulation I generate 200 histories, each of 120 periods. Each period

corresponds to one quarter. I run three separate simulations. First I have both shocks, then I shut off the trend shocks, and finally I shut off the temporary shocks.

Table 3 reports averaged simulated standard deviations of output growth, consumption growth, the trade balance, the current account, valuation effects and changes in NFA position. Numbers in brackets are the standard deviations of the statistics. In the first six rows, it is not surprising that the model can match the data, because I use output, consumption and investment data to estimate the model's parameters. When it comes to trade, current account and valuation effects, the model can account for most of the volatility in the trade and current account of the U.S. economy, but only about one-third of the volatility of the U.S.'s valuation effects.

When only transitory shocks are present, the change in the NFA position is slightly less volatile than the current account because valuation effects offset some of the current account's movements. However, when only trend shocks are present, the change in the NFA position is much more volatile than the current account because valuation effects here are strongly reinforcing.

5 Conclusion

In light of the U.S.'s persistent current account deficits, both empirical and theoretical literature has pointed to "valuation effects" as a channel that could offset the deficits and mitigate the decline of the NFA position, that is, valuation effects are stabilizing. This paper shows that whether valuation effects are stabilizing or not depends on the nature of the underlying productivity shocks. In response to transitory shocks, valuation effects are stabilizing; but in response to trend shocks, valuation effects amplify the impact of the current account on NFA position. This situation is clearly illustrated by the external imbalances between the U.S. and other G.7 countries during the late 1990s when the U.S. experienced both current account deficits and negative valuation effects. Quantitatively, the model can explain for most of the volatility of the U.S.'s trade and current account, but it only accounts for about one-third of the U.S.'s valuation effects. This quantitative result is obtained in a framework where agents are fully rational, financial frictions are limited to only "local expert" costs, and information about transitory and trend productivity shocks is perfect. Relaxing these restrictions is worth exploring in future research.

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A Appendix A

In this appendix I provide the details about the data and methodology used to construct aggregates for all of the figures and tables used in this paper.

In Figures 1, total factor productivity (TFP) series of the G.7 countries from 1995-2006 are from OECD statistics. In Figure 2, the historical data of S & P 500 index are obtained Professor Robert Shiller’s website <http://www.econ.yale.edu/shiller/data.htm>. The historical data of the Nikkei and FTSE are from Wren Research at the address <http://www.wrenresearch.com.au/downloads/index.htm>. The historical data of DAX and the exchange rate are from the German Bundesbank.

In Figures 3 and 5, the series of the U.S.-G.6 current account are from the Bureau of Economics Analysis (International Transactions). Data on bilateral valuation effects are taken from Bertaut and Tryon (2007). Valuation effects are defined as the adjusted valuation changes of stocks and bonds that the U.S. holds in other G.7 countries (U.S.’s claims) minus the adjusted valuation changes of stocks and bonds other G.7 countries hold in the U.S. (U.S.’s liabilities).

Data used in Figure 4 is from Curcuru, Dvorak, and Warnock (2008), kindly provided by Stephanie E. Curcuru.

In table 3, data for output levels, investment, consumption are the same as those used in the GMM estimation. U.S.’s GDP, consumption and investment historical quarterly data are from the Bureau of Economic Analysis. Historical G.7.’s PPP(Purchasing Power Parity) GDP data are from the OECD. G6’s average PPP GDP is calculated by taking the total G6’s PPP GDP divided by total G6’s population. I restrict the data until 2000 because after 2000, a significant part of U.S.’s consumption results from trading with China. For trade and current account, since bilateral quarterly data on trade and current account between the U.S. and G.6. countries are not available, I use trade and

current account between the U.S. and the rest of the world in the period of 1970,QI-2000,QI. Data on valuation effects and changes in net foreign assets are quarterly U.S.-G.6. data from 1994 QII-2000 QIV, obtained from Bertaut and Tryon (2007). If we use quarterly U.S.-G.6. data from 1994,QII-2007,QIV, the standard deviations of $\frac{VE_t^H}{Y_t^H}$ and of $\frac{\Delta NFA_t^H}{Y_t^H}$ are 0.020 and 0.0187 respectively.

Figure 4: U.S.'s return differentials in stocks

Figure 5: U.S.'s valuation effects and the current account

B Appendix B

FOCs of the household's problem:

$$\frac{C_t^i}{\gamma} = \frac{W_t^i(1 - L_t)^i}{1 - \gamma} \quad (\text{B1})$$

$$\frac{(C_t^{i\gamma}(1 - L_t^i)^{1-\gamma})^{1-\sigma}}{C_t^i} = \beta \left(\frac{C_t^i}{\chi Y_t^i} \right)^{-\phi} E_t \left[\frac{(C_{t+1}^{i\gamma}(1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{C_{t+1}^i} R_{t+1}^i \right] \quad (\text{B2})$$

$$E_t \left[\frac{(C_{t+1}^{i\gamma}(1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{C_{t+1}^i} R_{t+1}^i \right] = E_t \left[\frac{(C_{t+1}^{i\gamma}(1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{C_{t+1}^i} R_{t+1}^{-i} e^{-\tau} \right] \quad (\text{B3})$$

FOCs of the firm's problem:

$$W_t^i = \frac{(1 - \alpha) z_t K_t^{i\alpha} (\Gamma_t L_t^i)^{1-\alpha}}{L_t^i} \quad (\text{B4})$$

$$\begin{aligned} & \frac{(C_t^{i\gamma}(1 - L_t^i)^{1-\gamma})^{1-\sigma}}{C_t^i} \left(1 + \varphi \left(\frac{K_{t+1}^i}{K_t^i} - \bar{g} \right) \right) = \\ & \beta \left(\frac{C_t^i}{\chi Y_t^i} \right)^{-\phi} E_t \left(\frac{(C_{t+1}^{i\gamma}(1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{C_{t+1}^i} \left[z_{t+1} \alpha \left(\frac{\Gamma_{t+1}^i L_{t+1}^i}{K_{t+1}^i} \right)^{1-\alpha} + 1 - \delta \right] \right) \end{aligned} \quad (\text{B5})$$

C Appendix C

Production:

$$y_t^H = z_t^H k_t^{H\alpha} L_t^{H1-\alpha} (g_t^H \pi_t^\lambda)^{1-\alpha} \quad (\text{C1})$$

$$y_t^F = z_t^F k_t^{F\alpha} L_t^{F1-\alpha} (g_t^F \pi_t^{1-\lambda})^{1-\alpha}$$

$$\log(z_t^i) = \rho_z \log(z_{t-1}^i) + \epsilon_t^{iz} \quad (\text{C2})$$

$$\Gamma_t^i = g_t^i \Gamma_{t-1}^{i1-\lambda} \Gamma_{t-1}^{-i\lambda} \quad (\text{C3})$$

$$\log(g_t^i) = \rho_g \log(g_{t-1}^i) + (1 - \rho_g) \log(\bar{g}) + \epsilon_t^{ig} \quad (\text{C4})$$

where $\pi_t = \frac{\Gamma_{t-1}^F}{\Gamma_{t-1}^H}$

Convergence:

$$\pi_{t+1} = \frac{g_t^F}{g_t^H} \pi_t^{1-2\lambda} \quad (\text{C5})$$

Market clearings:

$$a_t^H + a_t^F = q_t^H + q_t^F \quad (C6)$$

$$q_{t+1}^i = \theta_{t+1}^i a_{t+1}^i + (1 - \theta_{t+1}^{-i}) a_{t+1}^{-i} \quad (C7)$$

$$R_t^i = \frac{q_{t+1}^i}{q_t^i} g_t^i \pi_t^\lambda + \frac{d_t^i}{q_t^i} \quad (C8)$$

$$d_t^i = y_t^i - w_t^i L_t^i - (k_{t+1}^i g_t^i \pi_t^\lambda - (1 - \delta) k_t^i) - \frac{\varphi}{2} \left(\frac{k_{t+1}^i}{k_t^i} g_t^i \pi_t^\lambda - \bar{g} \right)^2 k_t^i \quad (C9)$$

$$\begin{aligned} y_t^H + y_t^F &= c_t^H + c_t^F + (k_{t+1}^H g_t^H \pi_t^\lambda - (1 - \delta) k_t^H) + (k_{t+1}^F g_t^F \pi_t^\lambda - (1 - \delta) k_t^F) \\ &\quad + \frac{\varphi}{2} \left(\frac{k_{t+1}^H}{k_t^H} g_t^H \pi_t^\lambda - \bar{g} \right)^2 k_t^H + \frac{\varphi}{2} \left(\frac{k_{t+1}^F}{k_t^F} g_t^F \pi_t^\lambda - \bar{g} \right)^2 k_t^F \end{aligned} \quad (C10)$$

First-order conditions of the consumer's problem:

$$\frac{c_t^i}{\gamma} = \frac{w_t^i (1 - L_t^i)}{1 - \gamma} \quad (C11)$$

$$\frac{(c_t^{i\gamma} (1 - L_t^i)^{1-\gamma})^{1-\sigma}}{c_t^i} = \beta \left(\frac{c_t^i}{\chi y_t^i} \right)^{-\phi} E_t \left[\frac{(c_{t+1}^{i\gamma} (1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{c_{t+1}^i} R_{t+1}^i (g_t^i \pi_t^\lambda)^{\gamma(1-\sigma)-1} \right] \quad (C12)$$

$$E_t \left[\frac{(c_{t+1}^{i\gamma} (1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{c_{t+1}^i} R_{t+1}^i \right] = E_t \left[\frac{(c_{t+1}^{i\gamma} (1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{c_{t+1}^i} R_{t+1}^{-i} e^{-\tau} \right] \quad (C13)$$

First-order conditions of the producer's problem:

$$w_t^i = (1 - \alpha) z_t^i k_t^{i\alpha} L_t^{i-\alpha} (g_t^i \pi_t^\lambda)^{1-\alpha} \quad (C14)$$

$$\begin{aligned} &\frac{(c_t^{i\gamma} (1 - L_t^i)^{1-\gamma})^{1-\sigma}}{c_t^i} \left[1 + \varphi \left(\frac{k_{t+1}^i}{k_t^i} g_t^i \pi_t^\lambda - \bar{g} \right) \right] = \\ &E_t \beta \left(\frac{c_t^i}{\chi y_t^i} \right)^{-\phi} \left[\frac{(c_{t+1}^{i\gamma} (1 - L_{t+1}^i)^{1-\gamma})^{1-\sigma}}{c_{t+1}^i} (g_t^i \pi_t^\lambda)^{\gamma(1-\sigma)-1} \right] \left[z_{t+1}^i \alpha \left(\frac{L_{t+1}^i}{k_{t+1}^i} \right)^{1-\alpha} (g_{t+1}^i \pi_{t+1}^\lambda)^{1-\alpha} + 1 - \delta \right] \end{aligned} \quad (C15)$$

Budget constraint:

$$a_{t+1}^i g_t^i \pi_t^\lambda = \theta_t^i a_t^i R_t^i + (1 - \theta_t^i) a_t^i R_t^{-i} e^{-\tau} - c_t^i + w_t^i L_t^i + (1 - \theta_t^{-i}) a_t^{-i} R_t (1 - e^{-\tau}) \quad (C16)$$

Changes in NFA position, Valuation Effects and the Current Account:

$$\Delta n f a_t^i = [(1 - \theta_{t+1}^i) a_{t+1}^i g_t^i \pi_t^\lambda - (1 - \theta_{t+1}^{-i}) a_{t+1}^{-i} g_t^i \pi_t^\lambda] - [(1 - \theta_t^i) a_t^i - (1 - \theta_t^{-i}) a_t^{-i}] \quad (C17)$$

$$v e_t^i = (1 - \theta_t^i) a_t^i \left(\frac{q_{t+1}^{-i}}{q_t^{-i}} e^{-\tau} g_t^i \pi_t^\lambda - 1 \right) - (1 - \theta_t^{-i}) a_t^{-i} \left(\frac{q_{t+1}^i}{q_t^i} e^{-\tau} g_t^i \pi_t^\lambda - 1 \right) \quad (C18)$$

$$c a_t^i = \Delta n f a_t^i - v e_t^i \quad (C19)$$

D Appendix D: Impulse responses

1% positive transitory shock

0.1% positive trend(growth) shock

Figure 6: Impulse Responses to 1% transitory shock and 0.1% in trend shock