The Expectations-Driven U.S. Current Account*

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Abstract

Since 1991, survey expectations of long-run output growth for the U.S. relative to the rest of the world exhibit a pattern strikingly similar to that of the U.S. current account, and thus also to global imbalances. We show that this finding can to a large extent be rationalized in a two-region stochastic growth model simulated using expected trend growth filtered from observed productivity. In line with the intertemporal approach to the current account, a major part of the buildup of the U.S. current account deficit appears to be driven by the optimal response of households and firms to improved growth prospects.

JEL Codes: F32, E13, E32, D83, O40.

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1 Introduction

Since 1991, the U.S. current account has moved from almost balanced to a large deficit of six percent of GDP in 2005, and has fallen by half afterwards. This pattern is closely related to the evolution of survey expectations of long-run output growth for the U.S. relative to the rest of the world. Such a relationship should come as no surprise from the perspective of the intertemporal approach to the current account, which explains external imbalances as resulting from the consumption-smoothing motive of households.[1] According to this theory, rising relative income growth expectations would lead to increased borrowing from abroad, and thus a rising current account deficit would be the optimal response to changing perceptions about long-run economic fundamentals. By contrast, policy discussions in the aftermath of the crisis of 2008/2009 instead mainly focused on the possibility that current account balances represent undesirable "global imbalances", driven by factors such as government manipulation of the exchange rate, financial repression in emerging economies, or overly stimulative policies and distortions in deficit countries.[2] Seeing a close link between imbalances and the crisis, commentators even recommend limiting current account balances to a certain magnitude, and aim to find appropriate measures from historical experience.[3] One of the insights provided by the intertemporal approach is that expected growth trends should be of first-order importance when it comes to finding the level to which current account balances should converge.

In this paper, we assess the ability of the intertemporal approach to the current account to quantitatively explain the global imbalances of the last two decades. To this end, we set up and simulate a two-region stochastic growth model that allows for changing productivity trend growth rates. The productivity growth rate in either region is assumed to consist of two stochastic components with different persistence. However, in contrast to the perfect information assumption maintained in standard rational expectations models, we assume

[1] The textbook treatment of the approach is found in Obstfeld and Rogoff (1995).

[2] For example, the survey by Obstfeld and Rogoff (2010), on the link between global current account imbalances and the financial crisis, de-emphasizes the role of expectations of productivity growth and mentions them only when discussing Bernanke's (2005) idea of a "global savings glut."

[3] See, for example, Blanchard and Milesi-Ferretti (2012).

that observed productivity growth is only a noisy signal of the small but persistent trend component that determines long-run income expectations. After all, economic agents cannot know future trend growth with certainty. This signal-extraction problem is assumed to be solved by means of the Kalman filter applied to productivity data for the U.S. and for a proxy of the rest of the world.[4] To generate a model-implied current account, we feed the resulting series for the two perceived persistent growth rates and actual productivity into the calibrated model's equilibrium conditions.

The historical simulation of the model suggests that indeed a substantial part of U.S. current account dynamics from 1991 to 2010 can be explained by changes in trend growth expectations for the U.S. relative to those for the rest of the world. This is because the substantial widening of the current account deficit in the late 1990s coincides with improving perceived U.S. productivity growth prospects, while those for the rest of the world worsened after the Asian financial crisis. Likewise, when trend U.S. productivity growth slowed down since 2005, and growth in China and the rest of the world stayed high, global imbalances in the model and the data narrow until 2010. It is striking that the actual and model-implied contractions of the U.S. current account after 2005 are of the same order of magnitude, resulting from the inferred shift in relative growth expectations.[5]

Our findings indicate that global current account imbalances could be seen as an efficient response to changing perceptions of relative long-run growth prospects in the global economy. There are possible alternative, or at least complementary, explanations. Bernanke's (2005) idea of a 'savings glut' posits that the more rapidly growing Asian economies in particular were willing to finance the U.S. current account deficit at very low real rates. Indeed, high capital mobility in our model keeps interest rates low when U.S. growth prospects improve, allowing U.S. residents to borrow cheaply against their higher expected future income. This would be an explanation of the savings glut mainly driven by growth fundamentals. Others have interpreted Bernanke's savings glut as a response to evolving cross-country differences

[4] The rest of the world is proxied by the main trading partners of the U.S., which includes Japan, Germany, France, the U.K., Italy, Canada, China, Korea and Taiwan. The nine countries accounted in 2003 for about 2/3 of U.S. imports and slightly less of U.S. exports.

[5] The result is robust to plausible variations in most values of the structural parameters. The role of the high persistence of the permanent component of trend growth is discussed in detail below.

in financial development, and the relative quality and depth of U.S. financial markets (for example, Caballero, Fahri, and Gourinchas, 2008, and Mendoza, Quadrini, and Rios-Rull, 2009). By contrast, Obstfeld and Rogoff (2010) argue that the savings glut was mostly driven by inefficient, policy-induced distortions that unwound during the crisis. These arguments imply that relative growth prospects may at best be of minor importance.

To allow for alternative explanations in our simulation, we introduce stochastic variations in discount factors and in an international interest-rate 'risk premium.' They can be interpreted as representing financial factors. In principle, any behavior on the current account can be generated by appropriately sized shocks. Therefore we restrict the realized shocks to those that aid the model in explaining actually observed real interest rate movements, on top of what is already captured by relative trend growth expectations. A historical shock decomposition suggests, however, that such factors are likely to be of relatively lesser importance for the understanding of U.S. current account dynamics than movements in growth expectations. Thus, we agree with Obstfeld and Rogoff (2010) that the current account "imbalances" and the financial crisis may have had common causes. Our analysis places greater emphasis on the efficient responses to perceived changes in trend productivity growth rather than inefficient policies. Of course, these perceptions almost surely turn out wrong ex post, but they are the best possible information that agents can have.

The importance of imperfect information for our results is best understood from the perspective of the idea of expectation-driven business cycles, as stressed by Beaudry and Portier (2004) and others.[6] In that literature, 'news' on future levels of productivity are shown to potentially generate empirically plausible business cycle fluctuations and comovements. In our model, revisions of the trend growth rate actually amount to revisions of all future productivity levels, which, if correctly perceived, would have large immediate effects on perceived future income. Counterfactually large changes in consumption and the current account would be the consequence. But since agents in the model only slowly learn about innovations in the trend growth rate, the accumulation of knowledge about future productivity

[6] See, for example, Jaimovich and Rebelo (2009), Schmitt-Grohé and Uribe (2008), and Fujiwara, Hirose, and Shintani (2008).

is slow and thus the adjustment of the current account more gradual.[7]

The related literature so far has focused on emerging markets and thus small open economy models. Boz, Daude, and Durdu (2011) use a small open-economy model to show how slow learning affects the impulse responses to productivity growth shocks. By contrast, Aguiar and Gopinath (2008) maintain the assumption of perfect information and use consumption data to indirectly infer what long-run productivity growth was perceived to be. The resulting model-implied current account dynamics are quantitatively of a plausible magnitude, but do not to match the pattern of adjustment well. Cicco, Pancrazi, and Uribe (2010) report that the Aguiar and Gopinath approach has difficulties matching other empirical facts for emerging markets. In our view the reason is the assumed perfect information about trend growth rates. The innovation of our paper is to combine the imperfect information assumption with empirical measures of growth expectations to explain net capital flows between large open economies.[8]

In a study more closely related to ours, Engel and Rogers (2006) also build on the intertemporal approach but relate the current account to changes in the expected share of U.S. income relative to the rest of the world. There is an intimate connection between our analysis and theirs, since world income shares should ultimately depend on long-run productivity growth rates. A simulation of their model using growth projections to calculate measures of perceived income shares fails to explain the U.S. current account. The counterfactual, immediate jumps in consumption follow from the assumed full-information in their perfect-foresight model. However, in a reduced form exercise they use expected income shares calculated from published long-term growth forecasts from Consensus Economics and can better explain the U.S. current account until 2005.[9] We conduct a similar exercise in our structural model, using 6-to-10 year Consensus forecast data for our the U.S. and our

[7] News under slow learning about productivity growth are correlated, with implications for the empirical assessment of expectation-driven business cycles, as discussed by Leeper and Walker (2011).

[8] In our model, information is imperfect and public. Tille and van Wincoop (2011) show that dispersed private information helps in addition to explain the simultaneous capital inflows and outflows, or gross capital flows, which are about six times larger then net flows.

[9] Other important papers studying the current account and its relation to growth take a long-run perspective over many decades, assuming perfect foresight and thus perfect information about future growth, include (2006), Ferrero (2010), and Chen, Imrohoroglu, and Imrohoroglu (2009).

rest-of-the-world aggregate. In general, the literature on the intertemporal approach (or the present value model) has had difficulty explaining the current account by including a number of relevant variables. However, most tests of the present value model assume a process in productivity that is trend stationary, rather than difference stationary as in this paper. From the perspective of our results, this is not surprising, since only changes in growth rates have sufficiently large effects on present values of income and therefore the current account.[10]

The paper proceeds from here as follows. In section 2, we set the stage for our analysis by establishing the close relationship between long-run growth expectations and the U.S. current account. In section 3, we develop the model – a two-country real open economy stochastic growth model – that incorporates changes in long-run trend growth, and then present the calibration and simulation strategy. In section 4, we simulate the model with the optimal forecasts of long-run growth extracted from actual productivity data with the Kalman-filter. We also allow for shocks that may be seen to proxy for financial market developments or policies. Then we discuss how 6-to-10 year output growth forecasts generated from the Kalman-filtered trend productivity growth rates move in comparison with actual survey data on long-run GDP growth from Consensus Forecasts. Finally, we provide an interpretation of the results from the perspective of the news literature. Section 5 concludes and points to directions for future research.

2 Growth expectations and the current account in the data

This section establishes the main empirical facts that motivate our analysis: growth expectations and the evolution of the U.S. current account. First, consider growth expectations, which we take from Consensus Economics, who collects private forecasters' expectations for real GDP growth and other macroeconomic variables in a large number of countries. Every six months this survey includes questions about participants' expectations of real GDP growth (and other variables) at a horizon up to ten years. Here, we focus on real GDP

[10]For a survey on the present value model of, or intertemporal approach to the current account, see Nason and Rogers (2006)

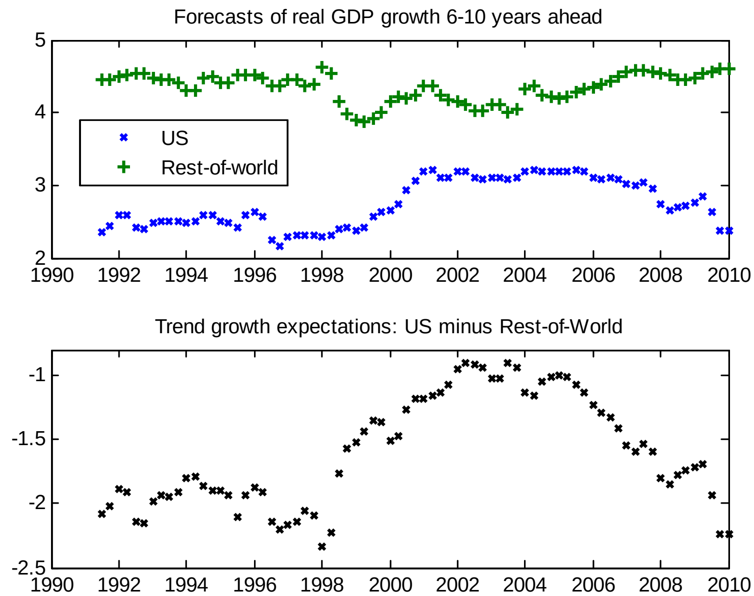

Figure 1: Consensus forecasts of real GDP growth 6-10 years ahead

growth expectations at the longest horizon (6 to 10 years ahead) for the U.S. and a set of nine countries, i.e., Japan, Germany, France, the U.K., Italy, Canada, China, Korea, and Taiwan, that in 2008 jointly accounted for about 2/3 of world GDP.[11] For the G-7 economies these long-horizon expectations start in 1989, whereas for the major economies of the Asia-Pacific region they start in 1995.

The top panel of Figure 1 shows growth expectations for the U.S. and the GDP-weighted average of the expectations for the other nine countries (henceforth referred to as the "rest of the world").[12] GDP growth expectations in the rest of world remained higher on average than in the U.S. and underwent a decline in the late 1990s after which they slowly returned to higher levels by 2010. By contrast, U.S. growth expectations were lower in the 1990s and increase by about a percentage point by 2001. By 2010 however, they have returned to the growth rates expected in the 1990s. The bottom panel shows the difference between these two series, that is, U.S. minus rest-of-the-world long-run growth expectations. Relative

[11]The shares in world GDP are taken from www.ers.usda.gov, the shares in U.S. imports and exports from Loretan (2005).

[12]The long-horizon forecasts are always published in April and October. In the figure, we show these data after interpolating to a quarterly frequency.

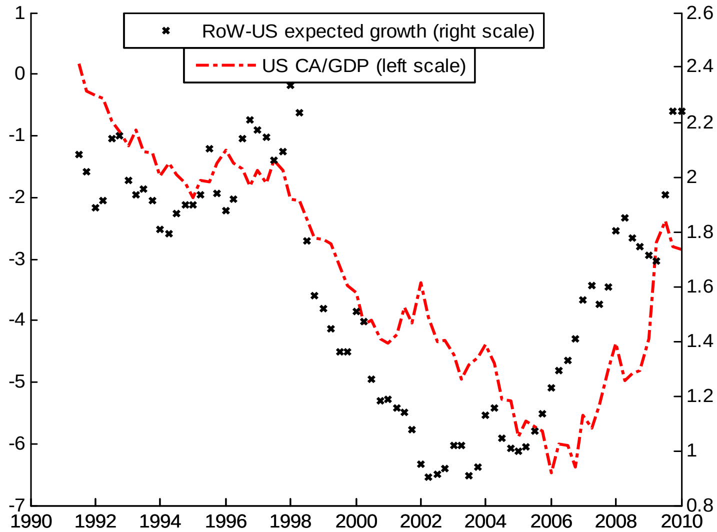

Figure 2: Consensus Forecast Growth Expectations and the Current Account

growth prospects for the U.S. rose by about 1.5 percentage points between 1998 and 2002, and remained high until 2005, when a steady decline set in. While the initial increase reflected in roughly equal measure an increase in perceived U.S. trend growth and a decline in trend growth elsewhere, the reversal in recent years is mostly due to lower U.S. trend growth expectations.

Figure 2 shows the relationship between the current account and growth expectations, which motivates our analysis. The points marked with $\times$ depict the gap between world and U.S. growth expectations from Consensus Forecasts, that is, the inverse of the series shown in the lower panel of Figure 1. The dash-dotted red line gives the U.S. current account as a percentage of GDP since 1991. With a small lead, the relative survey expectations of long-run output growth exhibit a pattern strikingly similar to that of the U.S. current account. At this point we conjecture that there is a causal relationship between growth expectations and the current account, as suggested by the intertemporal approach to the current account. It then appears that rising optimism about relative U.S. growth led U.S. households to borrow against future higher incomes, and foreigners to provide the desired funds.

Of course, Figure 2 does not allow us to infer that relative growth expectations explain the observed level of the current account. In principle, the persistently higher average growth expectations in the rest of the world ought to lead to outflows of capital from the U.S., that is, a U.S. current account surplus. But this is not necessarily the case. For example, persistent structural differences in the functioning of financial markets may lead to outflows of capital from emerging markets, even though they grow faster than a developed market like the U.S. The fact that the U.S. current account was essentially balanced in the early 1990s even though growth expectations differed by about 2 percentage points illustrates this point. Therefore, we focus here is on the effects of changes in relative growth expectations. Explaining which factors explain the absence of a current account surplus in spite of these large difference in growth trends we leave outside the scope of this paper.[13]

3 A two-country real business cycle model

Our model is a two-region real stochastic growth model with one non-standard element: productivity growth rates in both regions vary due to persistent and transitory shocks. In this section, we first present the model and its equilibrium conditions. Then we define the equilibrium of the model and describe the solution method. This is also the place where we introduce the formation of productivity growth expectations on the basis of observed productivity growth. Finally, we describe the data and calibration strategy.

3.1 Setup

The model consists of two countries, home (U.S.) and foreign (the rest of the world), which is denoted by an asterisk $*$. We normalize the population size of the home economy to 1 and the relative population size of the foreign economy, i.e., rest of the world, to $\mathcal{P}^*$, so that $1/(1+\mathcal{P}^*)$ is the fraction of home population in the world. Each country is inhabited by a large number of infinitely-lived households and is endowed with a constant returns to scale production technology utilized by competitive firms. Firms produce a single good which can be used for consumption and investment in both countries. Financial capital markets

[13] The difficulty of explaining the counter-intuitive capital flows to developed countries is explored in detail by Gourinchas and Jeanne (2011), who call this “the allocation puzzle.”

are incomplete in that only a risk-free bond is traded. The home and foreign countries are identical in terms of preferences and technology, so we focus on the home economy.

Households in the home economy maximize the present value of their instantaneous utility, discounted with a stochastic discount factor β_t. Thus a representative household maximizes

$$E_0 \sum_{t=0}^{\infty} \beta_t \frac{C_t^{1-\sigma} - 1}{1-\sigma},$$

Because of our focus on intertemporal consumption smoothing, we abstract from labor supply decisions by assuming that households supply labour inelastically to domestic firms. The stochastic discount factor evolves according to $\beta_t = \beta^{1-\rho_\beta} \beta_{t-1}^{\rho_\beta} \exp(\epsilon_t^\beta)$, with ϵ_t^β is i.i.d. distributed as $\epsilon_t^\beta \sim N\left(0, \sigma_{\nu^\beta}^2\right)$. Note that the expectations operator denotes here the expectation conditional on information available in the current period. Below we describe agents' information set regarding the technology process.

The household faces two constraints, for the budget and for capital accumulation. The former is given by

$$W_t L + r_t^k K_{t-1} + r_{t-1} B_{t-1} = C_t + I_t + B_t - B_{t-1}.$$

Income consists of real labor income $W_t L$, as well as the return on capital determined in the previous period, $r_t^k K_{t-1}$, and the net return on non-contingent real bonds, $r_{t-1} B_{t-1}$, respectively. The income is used to finance consumption C_t, investment I_t, and to accumulate net foreign assets, B_t. When agents borrow from the rest of the world it follows that $B_t < 0$. The capital accumulation constraint equals

$$K_t = (1-\delta) K_{t-1} + I_t \left[1 - \varphi\left(\frac{I_t}{I_{t-1}}\right)\right].$$

An investment rate different from the steady-state growth rate is subject to quadratic adjustment costs, $\varphi(I_t/I_{t-1}) = \phi/2 \left(I_t/I_{t-1} - e^g\right)^2$, with $\varphi(e^g) = \varphi'(e^g) = 0$, and $\varphi''(e^g) > 0$ at the stationary steady state and g the long-run net growth rate.

A competitive representative firm in the home economy produces a single good according to the technology

$$Y_t = K_{t-1}^\alpha \left(Z_t L\right)^{1-\alpha},$$

where $0 < \alpha < 1$. The capital stock used by firms has to equal the capital K_{t-1} supplied by households in period t. The production factor labor L is in fixed supply.[14] Aggregate technology evolves according to

$$\ln(Z_t/Z_{t-1}) = g_t + \omega_t, \tag{1}$$

with

$$g_t = \left(1 - \rho_g\right) g + \rho_g g_{t-1} + \nu_t. \tag{2}$$

Both ω_t and ν_t are i.i.d. distributed as $\nu_t \sim N\left(0, \sigma_\nu^2\right)$ and $\omega_t \sim N\left(0, \sigma_\omega^2\right)$. The growth in technology thus has two components. An innovation ω_t leads to a permanent shift in the *level* of technology Z_t, but has no persistent effects on the *growth rate* of technology, $\ln\left(Z_t/Z_{t-1}\right)$. An innovation ν_t, by contrast, leads to a sequence of changes in Z_t in the same direction because it raises its growth rate temporarily above its steady-state growth rate.[15]

The information structure is as follows. Agents observe the actual change in technology, $dz_t \equiv Z_t/Z_{t-1} = \exp(g_t + \omega_t)$, but not the individual components, g_t and ω_t. Thus, in an information theoretic sense, dz_t is a signal that contains information about g_t, about which beliefs have to be formed, and ω_t is a noise term. For later purposes, we introduce a second signal, which also contains information about g_t, but where the noise is unrelated to current technology. Call this signal

$$s_t = g_t + \mu_t, \tag{3}$$

where the noise term is i.i.d. according to $\mu_t \sim N\left(0, \sigma_\mu^2\right)$.

The foreign economy has the exact same physical and information structures. Furthermore, note that the signals on technology are observed by agents in both regions, and that the problem of inferring g_t and g_t^* is solved in the same manner. Thus, agents in both regions share the same beliefs about either region's trend growth components. The goods produced can be consumed in both regions and a bond market clearing condition must hold, taking account of the relative size of the rest of the world, $\mathcal{P}^*$:

$$B_t^* \mathcal{P}^* + B_t = 0, \tag{4}$$

[14] This assumption is immaterial for our results relating to the current account.

[15] An alternative formulation of the technology process involving regime switching has been explored in Kahn and Rich (2007).

since bonds are in zero net supply in the world economy.

3.2 Stationary equilibrium conditions

Optimization of agents and aggregate constraints result in optimality conditions for all relevant variables, depending on the expectations about future growth which are formed on the basis of beliefs about the permanent components of productivity growth, g_t and g_t^*.

The economy of the model is growing at a stochastic growth rate. Therefore, to find the solution for the equilibrium dynamics, the system must be made stationary for standard solution methods to be applicable. Thus we divide all variables that grow in steady state with the same growth rate as technology by Z_t, denoting the rescaled variables by lower case letters: $k_{t-1} = K_{t-1}/Z_{t-1}$, $c_t = C_t/Z_t$, $\lambda_t = \Lambda_t Z_t^{\sigma}$, $dz_t = Z_t/Z_{t-1}$, and similarly for the other non stationary variables. After the rational expectations solution has been found, the levels of the variables can be found by appropriate rescaling.

The households' optimal choice of consumption is given by the equality of the marginal utilities of wealth and of consumption, and by the Euler equation. In stationary form, the first condition is

$$\lambda_t = c_t^{-\sigma}. \tag{5}$$

The marginal utility of wealth is given by the Lagrange multiplier on the budget constraint. It equals the marginal utility of consumption. The intertemporal Euler equation derived from the holdings of real bonds is

$$\lambda_t = \beta_t \left(1 + r_t\right) E_t \lambda_{t+1} \left(dz_{t+1}\right)^{-\sigma}, \tag{6}$$

which balances current and future marginal utilities. The only difference with a standard Euler equation is the presence of the scale factor resulting from the presence of time varying growth rates in the stationary condition.

Factor supply is determined by intertemporal conditions for investment and capital. Capital is chosen such that the marginal value of a unit of installed capital is equal to its discounted expected value, which is the sum of the marginal product of capital and the expected value of capital, net of depreciation. Thus capital adjusts to meet the Euler equation

$$q_t = E_t \beta_t \left(dz_{t+1}\right)^{-\sigma} \frac{\lambda_{t+1}}{\lambda_t} \left[r_{t+1}^k + q_{t+1}\left(1-\delta\right)\right], \tag{7}$$

where r_t^k is the rental rate of capital and q_t the marginal value of a unit of installed capital. In the presence of adjustment costs investment follows

$$\begin{aligned} 1 &= q_t \left(1 - \frac{\phi}{2}\left(\frac{i_t}{i_{t-1}/dz_t} - e^g\right)^2 - \frac{i_t}{i_{t-1}/dz_t}\phi\left(\frac{i_t}{i_{t-1}/dz_t} - e^g\right)\right) \\ &\quad + \phi E_t \beta_t \left(dz_{t+1}\right)^{-\sigma} \frac{\lambda_{t+1}}{\lambda_t} q_{t+1} \left(\frac{i_{t+1}}{i_t/dz_{t+1}} - e^g\right)\left(\frac{i_{t+1}}{i_t/dz_{t+1}}\right)^2, \end{aligned} \tag{8}$$

and the stationary capital stock evolves according to

$$k_t = \left(1-\delta\right)\frac{k_{t-1}}{dz_t} + i_t\left[1 - \frac{\phi}{2}\left(\frac{i_t}{i_{t-1}}dz_t - e^g\right)^2\right]. \tag{9}$$

Aggregate output of firms in the domestic economy equals

$$y_t = \left(\frac{k_{t-1}}{dz_t}\right)^{\alpha} L^{1-\alpha}. \tag{10}$$

The optimal choice of k_{t-1} and L is governed by the equalities of the marginal products to factor prices:

$$r_t^k = \alpha\left(\frac{k_{t-1}}{dz_t}\right)^{-(1-\alpha)} L^{1-\alpha}, \tag{11}$$

$$w_t = \left(1-\alpha\right)\left(\frac{k_{t-1}}{dz_t}\right)^{\alpha} L^{-\alpha} \tag{12}$$

Finally, from the budget constraint it follows that output equals spending plus net foreign asset accumulation:

$$y_t = c_t + i_t + b_t - b_{t-1} + \frac{dz_t - \left(1 + r_{t-1}\right)}{dz_t} b_{t-1}. \tag{13}$$

Since the model is expressed in per capita terms, the global goods market clearing condition takes account of the relative sizes and productivities of the two regions:

$$y_t + y_t^* \mathcal{P}^* \frac{Z_t^*}{Z_t} = c_t + i_t + \left[c_t^* \mathcal{P}^* + i_t^* \mathcal{P}^*\right] \frac{Z_t^*}{Z_t} \tag{14}$$

the scale factor Z_t^*/Z_t reflects the fact that growth rates vary around the long-run growth rates, so that productivity levels will change over time, depending on the history of shocks.

When agents take net positions in international bond markets, an interest rate, or risk, premium must be paid, which relates the domestic interest rate r_t and the rest of the world's real interest rate r_t^* by the following equation:

$$r_t = r_t^* - \varphi \left[\exp\left(\frac{b_t}{y_t} - \frac{b}{y} \right) - 1 \right] + \exp(\varepsilon_t^p) - 1, \tag{15}$$

where b/y reflects the steady-state ratio of the country's net foreign assets to GDP.[16] Thus, both the actual net foreign asset position relative to GDP, b_t/y_t, and movements of the real interest rate r_t^* in the rest of the world will affect the borrowing conditions of the domestic economy. The variable ε_t^p reflects the possibility of an international risk premium shock in financial markets and equals $\varepsilon_t^p = \rho_{\varepsilon^p} \varepsilon_{t-1}^p + \epsilon_t^p$, with $\epsilon_t^p \sim N\left(0, \sigma_{\nu^p}^2\right)$.

3.3 Equilibrium, beliefs about growth, and solution method

Under full information on the productivity components g_t and ω_t, these stationary conditions and their foreign counterparts (as well as the corresponding transversality conditions) determine the rational expectations equilibrium of the model economy. The signal s_t, and hence μ_t, would be irrelevant, because they do not contain any additional information. That is, for any sequence of shocks $\{\omega_t,\ \nu_t,\ \omega_t^*,\ \nu_t^*,\ \epsilon_t^p,\ \epsilon_t^\beta,\ \epsilon_t^{*\beta}\}_{t=0}^{\infty}$ there is a unique sequence of endogenous variables $\{c_t,\ c_t^*,\ y_t,\ y_t^*,\ i_t,\ i_t^*,\ \lambda_t,\ \lambda_t^*,\ q_t,\ q_t^*\ b_t,\ k_t,\ k_t^*,\ r_t,\ r_t^*,\ r_t^k,\ r_t^{k^*},\ w_t,\ w_t^*,\ dz_t,$ $dz_t^*,\ g_t,\ g_t^*, \varepsilon_t^p\}_{t=0}^{\infty}$. This is because, under rational expectations, there is a direct mapping between shocks and variables under the implied identity between the objective and subjective distribution. The model can be solved by log-linearizing the equilibrium conditions around the stationary steady state, and applying familiar methods for the solution of linear rational expectations models (e.g., Sims, 2002).

Under the assumed imperfect information about the individual shocks, the above stationary equilibrium conditions alone do not imply a mapping between shocks and variables. Nonetheless, the equilibrium conditions characterize the joint equilibrium dynamics between

[16] The financial intermediation premium ensures that the net foreign asset position becomes stationary in the linearized version of the model (see Schmitt-Grohe and Uribe, 2003).

the endogenous variables, for any given evolution of beliefs about the permanent component of productivity growth g_t.

We assume that agents solve the problem of forming beliefs $g_{t|t}$ about the trend component of growth from the signals $\ln dz_t$ and possibly s_t by means of the Kalman filter. In general, given processes for g_t, ω_t and μ_t, the solution to the filtering problem is the recursion

$$g_{t|t} = (1-\kappa)\rho_g g_{t-1|t-1} + \kappa\left[\theta \ln dz_t + (1-\theta)s_t\right], \tag{16}$$

and the Kalman gain κ is given by

$$\kappa = \frac{\eta - \left(1-\rho_g^2\right) + \eta\sqrt{\left(\left(1-\rho_g^2\right)/\eta\right)^2 + 1 + 2(1+\rho_g^2)/\eta}}{\eta + \left(1+\rho_g^2\right) + \eta\sqrt{\left(\left(1-\rho_g^2\right)/\eta\right)^2 + 1 + 2(1+\rho_g^2)/\eta}}.$$

The signal-to-noise ratio $\eta \equiv \sigma_\nu^2/(\sigma_\omega^2\theta)$ measures the importance of innovations to trend growth relative to permanent one-off changes to the level of technology. The relative volatility of the level shifts in technology ω_t to the noise μ_t determines a parameter

$$\theta = \frac{\sigma_\mu^2}{\sigma_\omega^2 + \sigma_\mu^2},$$

which weighs the signals in the Kalman filter. For the foreign country, a similar filter applies. In the empirical analysis, we assume that $\theta = 1$,which can mean that the signal is completely uninformative ($\sigma_\mu^2 \to \infty$) or that the noise terms are identical, $s_t = \omega_t$.

Given a belief $g_{t|t}$, agents use the assumed process for g_t, (equation 2), to extrapolate the current growth rate of the permanent component of productivity growth into future periods, $t+i$, $i > 0$, so that $g_{t+i|t} = g + \rho_g^i \left(g_{t|t} - g\right)$, since ν_t is i.i.d. Thus, the change in productivity is expected to be $E_t \ln dz_{t+1} = g_{t+1|t}$ one period hence . The same applies to $g^*_{t|t}$, the belief about the foreign country's persistent component of productivity growth.

In technical terms, we use the state-space representation of the rational expectations solution of the log-linearized model, and replace the rows in the matrices that determine the response of the economy to the current states of g_t and ω_t with the corresponding beliefs $g_{t|t}$ and $\omega_{t|t}$. The belief $g_{t|t}$ is crucial for the response of current choices and thus endogenous variables, since it determines the expected evolution of technology. Given the linearity of the first-order approximated economic system, certainty equivalence holds. Therefore, we can ignore the fact that agents in principle would take into account the fact that they may revise their beliefs again in the future, after new information arrives. An alternative justification of separating optimization and inference about productivity growth would be to allude to the concept of anticipated utility, following Kreps (1998). In this view, agents' decisions are based on their current beliefs about productivity only, ignoring that beliefs may change in the future.[17]

3.4 Calibration and data

For the calibration, we assign values to the deep parameters, taking guidance from the literature and by a priori reasoning. The values are displayed in Table 1. International capital mobility is assumed high, in that we set the international risk premium parameter to a value of $\varphi = 0.0002$, since we consider a period where financial market appear highly integrated. For the model to possess a well-defined steady state, the growth rates in the two regions are assumed to be the same in the long-run, that is $dz = dz^*$. This implies for the steady-state Euler equations that

$$dz = (\beta (1 + r))^{\frac{1}{\sigma}} = (\beta^* (1 + r^*))^{\frac{1}{\sigma}} = dz^*,$$

so that, for equal long-run discount factors, the interest rates are also the same. Given this symmetry, we set the steady state U.S. current account relative to GDP to zero, which is also close to the initial value in our sample, which begins in 1991. The size of the domestic economy in the world economy is assumed to be 25% so that $\mathcal{P}^*$ equals 3. Household preferences are calibrated based on values from Schmitt-Grohe and Uribe (2008). In their estimation, they find a value for the coefficient of relative risk aversion close to $\sigma = 2$.

The share of labor in the production function is set at $\alpha = 1/3$ and capital depreciates at quarterly rate $\delta = 0.025$. All these parameter values determine the steady state of the stationary version of the model. The investment adjustment costs $\phi = 7$, which is in line with values in the literature (e.g., Smets and Wouters, 2003). When not otherwise indicated, the foreign country has identical preferences and technologies. Also the persistency parameters

[17] See Cogley and Sargent (2008) for a recent discussion of anticipated utility, and a comparison with solutions that take account the non-linearity of the model.

Table 1: Parameters of the model

Parameters		Values
φ	International risk premium	0.0002
σ	Coefficient of relative risk aversion	2
β	Steady state discount factor U.S.	0.988
β^*	Steady state discount factor RoW	0.988
α	Capital share	0.3
δ	Depreciation rate	0.025
ϕ	Investment adjustment costs	7
ρ_β	Persistence of the time preference shocks	0.5 (0.85)
ρ_{ε^P}	Persistence of the risk premium shock	0.5 (0.85)
ρ_g	Persistence of the growth rate shock	0.95
$\mathcal{P}^*$	Size of the foreign economy	3

are the same for the home and foreign country.

The persistence of the growth rate shock is $\rho_g = 0.95$. This is a value frequently found in the literature (e.g. Erceg, Guerrieri and Gust , 2006; Gilchrist and Saito, 2008). The choice of ρ_g is not important for the correlation between the simulated and actual current accounts. It does matter however for the magnitude of the simulated current account movements, which we explore in more detail. In applications in the literature, the Kalman gain varies between 0.025 as in Edge, Laubach, Williams (2007) up to 0.1 in Erceg et al. (2005). As in Gilchrist and Saito (2008) we take the standard deviation of the transitory component to be $\sigma_\omega = 0.01$ while the persistent component is $\sigma_\nu = 0.001$. Blanchard, L'Huillier and Lorenzoni (2011) show that the standard deviation of the disturbance μ is about 1.4 times larger than the disturbance to ω, so that we set $\sigma_\omega = 0.0139$. This then implies a Kalman gain κ of 0.0816 with θ equal to 0.6573.

Kollmann (2002) provides values of the persistence of the risk premium shock ρ_{ε^P} between 0.5 and up to around 0.9. In the baseline simulation the persistence of the risk premium shock is set to $\rho_{\varepsilon^P} = 0.5$. We also allow for a value at the higher end of $\rho_{\varepsilon^P} = 0.85$. The values for the persistence of the time preference shock found in the literature vary between 0.85 and 0.28, which are based on the estimation of medium-scale DSGE models.[18] The baseline value is set to $\rho_\beta = 0.5$, but we also allow for $\rho_\beta = 0.85$, at the upper end of the

[18] See Gali, Smets and Wouters (2011), Smets and Wouters (2007), and Schaumburg, Tambalotti and Primiceri (2008).

available estimates. We impose equal standard deviations for the discount factor shocks, i.e., $\sigma_\beta = \sigma_{\beta^*} = 0.07$, and set the standard deviation of the international premium shock to $\sigma_{\varepsilon^P} = 0.007$. For the historical shock decomposition, the precise values of the standard deviations are not essential. What matters are the relative volatilities, which are of the same order of magnitude as the estimates of García-Cicco, Pancrazi, and Uribe (2010).

We use the following data sources: labour productivity for the U.S. is taken from Bureau of Labour Statistics. For the rest of the world, which includes Japan, Germany, France, the U.K., Italy, Canada, China, Korea and Taiwan, productivity data are taken from the ECB's AMECO data base as well as the IMF's World Economic Outlook (WEO). The Penn World Tables provide the income shares for the weighted aggregate world measures. Real interest rates are calculated by utilizing WEO data for inflation and for 10-year government bond yields. In the historical simulation, we rescale the simulated endogenous variables back to either levels or growth rates, in order to be comparable with the actual data.

4 The U.S. current account and growth expectations

In this section, we simulate the U.S. current account using proxies of long-run growth expectations. The following subsection presents the core of our analysis, where we begin by feeding into the model the actual path of productivity and the estimated path of the trend component of productivity growth, and show the model-implied and actual U.S. current accounts. Then we check the robustness of the simulation to differences in the persistence of the growth process and allow for stochastic variation in other factors that in the model may also be drivers of current account movements. Section 4.2 complements the analysis by exploring the link between the Kalman-filtered estimate of long-run growth expectations and the direct survey evidence on expectations from Consensus Forecasts presented in section 2. Finally, we discuss how imperfect information affects the response of the current account to changes in trend growth and provide an interpretation of the results from the perspective of the news literature.

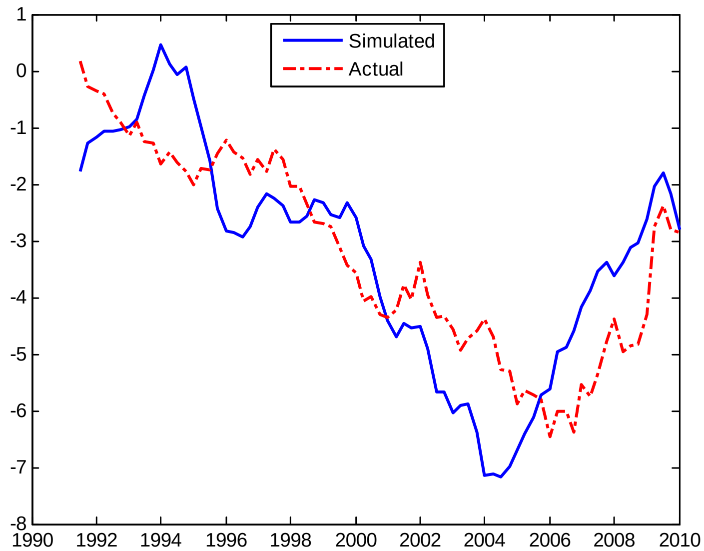

Figure 3: Actual and simulated evolution of the U.S. current account (growth expecations only)

4.1 Historical simulations

To obtain the model's prediction for the current account, we first apply the Kalman filter to the U.S. and Rest-of-the-World productivity data for the change in productivities dz_t and dz_t^* described above. The processes are given by equations (1) and (2). The result are two series of beliefs $g_{t|t}$ and $g_{t|t}^*$ about the long-run, persistent component of the productivity growth rate. We then fed the beliefs and actual productivity growth, $\ln dz_t$ and $\ln dz_t^*$, into the state-space representation of the model's equilibrium conditions, and trace out the implied time series for the current account.[19] For this part of the analysis, we assume that agents extract the long-run component of growth from actual productivity movements only. That is, in equation (16), we set $\theta = 1$, so that the signal-to-noise ratio collapses to $\eta \equiv \sigma_\nu^2/\sigma_\omega^2$. Given η, the implied Kalman gain is then 0.0614. The quantitative exercise covers the years 1991 to 2010.

Figure 3 shows the actual and the simulated U.S. current account. Both in direction and

[19] The transitory component of productivity growth are given by $\omega_{t|t} = \ln dz_t - g_{t|t}$, and $\omega_{t|t}^* = \ln dz_t^* - g_{t|t}^*$.

magnitude, the two series move closely.[20] From about 2000, the current account is predicted to fall to its lowest level by 2004, and soon rapidly improves by half until 2010. From 2001, the model-implied current account leads the data, predicting an earlier and sharper rise in the current account deficit, and also an earlier fall after 2004. It is remarkable that the simulated current account contracts long before the onset of the economic crisis in 2008, which suggests that the underlying growth expectations did not simply fall because of lower growth during crisis. This corresponds to the pattern established in Figure 2, which related the current account to survey output expectations, rather than to the filtered productivity growth trend.

From the perspective of the model, the driver of the increase in the current account deficit are the improving growth expectations in the U.S. relative to slightly worsening outlook in the rest of the world. Particularly since the late 1990s, U.S. households have reacted to these favorable prospects by increasing their borrowing and consumption, financed by foreign households who remained relatively pessimistic. The improvement of growth abroad and the decline in U.S. growth expectations since about 2005 leads to a reversal of this trend and borrowing in the U.S. declines again relative to the Rest-of-the-World. All these developments would be efficient given that they reflect the rational responses of economic agents to their optimal forecasts based on observed productivity data.

Even though productivity growth expectations appear sufficient to explain the broad pattern of actual current account imbalances, it is not obvious whether the data could not also be explained by other factors, as we stressed in the introduction. For example, authors such as Caballero, Fahri, and Gourinchas (2008) as well as Mendoza, Quadrini, and Rios-Rull (2009) highlight the trends in the relative degrees of financial development or the relative quality of U.S. assets, which can cause current account movements between countries with different levels of development. These financial factors can be best captured in our model by shocks to the discount factor and to the international risk premium condition, which affect the intertemporal trade-offs faced by households in a different manner. The discount factor shock changes intertemporal preferences, that is, the incentives to borrow or lend, given the

[20] The model implied data have been normalized so as to have the same mean as the actual current account.

prevailing interest rates, while the risk premium shock changes the interest rates faced by households in the two regions.

In principle, any desired behavior of the current account can be generated by an appropriately chosen evolution of the three financial shocks. To restrict these shocks to reasonable magnitudes, we therefore include two additional series for which they have first-order implications, namely U.S. and Rest-of-the-World real interest rates. We use a historical shock decomposition to find the combination of shocks that aid the model in explaining the gap, or residual, between the model-implied and the actual evolution of interest rates. Our previous results would not be robust if filling the gap required financial shocks that would induce large changes in the model-implied current account shown above.

The solid lines in the two panels in Figure 4 are the differences between the real interest rates in the data and those implied by the model for filtered growth expectations. The difference for the U.S. in the upper panel is mostly positive during the 1990s and mostly negative for the second half of the sample. This is part of a well-known trend in real interest rates, and it is not induced in the model by the evolution of growth expectations. The same trend is seen for the real interest rate in the Rest-of-the-World.

Figure 4 also shows the structural shocks that are required to explain these differences, for the baseline calibration of the model.[21] Interestingly, the shock decomposition assigns mostly foreign intertemporal preference disturbances, shown by the red (dark) bars, as well as international risk premium shocks, shown by the yellow (light) bar, as the shocks that drive domestic and foreign residual interest rate movements. For example, towards the end of the 1990s, in the wake of the Asian financial crisis of 1998, the risk premium shock raises the interest rate earned by foreigners in the U.S., which could work towards increasing capital flows into the U.S. This could be capturing the notion that international investors regarded U.S. financial assets as safer investments. Conversely, with the onset of the economic crisis in 2008, part of the actual decline in real interest rates is explained in the model by a risk premium shock that reduces the return on U.S. assets relative to investments in the rest of the world.

[21] Given the linearity of the system, the historical decomposition can in fact be conducted directly on the gap between the model-implied and actual interest rate movements.

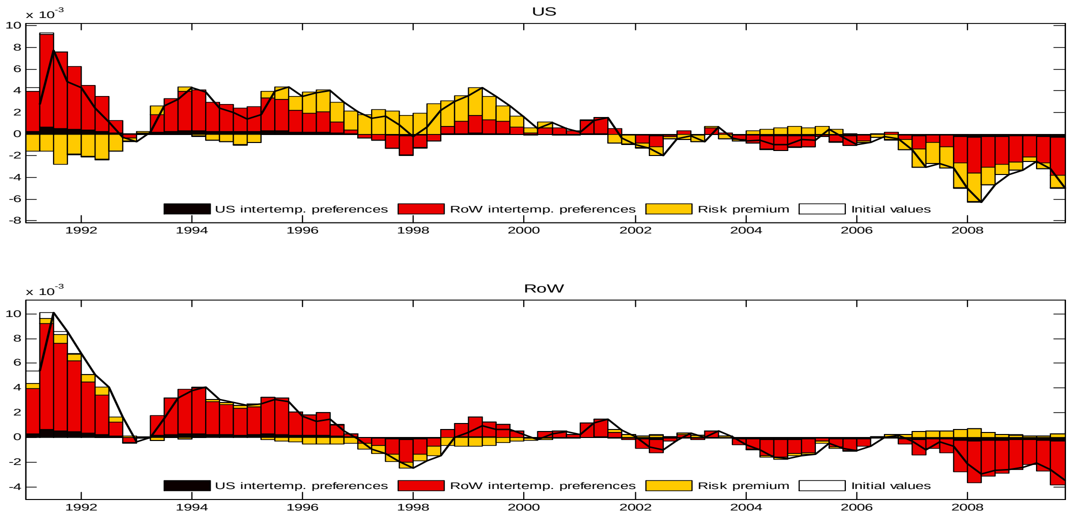

Figure 4: Decomposition of the real interest rates

The dashed line in Figure 5 shows the evolution of the current account after feeding the shocks identified above into the model, in addition to the Kalman-filtered trend growth rates. For the baseline persistence of the shocks, $\rho_\beta = \rho_{\varepsilon^P} = 0.5$, used up to this point, the line is essentially identical to the simulated current account in Figure 3. Higher persistencies are likely to affect this result, as they will lead to different discounted present value calculations, and therefore change consumption choices and the current account. The dotted line in Figure 5 shows the implied evolution of the U.S. current account for higher values $\rho_\beta = \rho_{\varepsilon^P} = 0.85$. For the second half of the 1990s, the current account deficit would be somewhat larger, and the contraction after the crisis more pronounced, but the effects are small. Interestingly, the two periods where the international interest rate premium shock appears to matter most in the historical shock decomposition coincides with the periods where the two simulated current accounts show the largest difference.

In a recent study García-Cicco, Pancrazi, and Uribe (2010) assess growth rate shocks in emerging countries. They use long-run time series evidence and estimate for Argentina that the persistence of the trend growth rate is 0.35 on an annual basis, or 0.77 on a quarterly basis. This value however seems low compared to other studies focusing on developed economies,

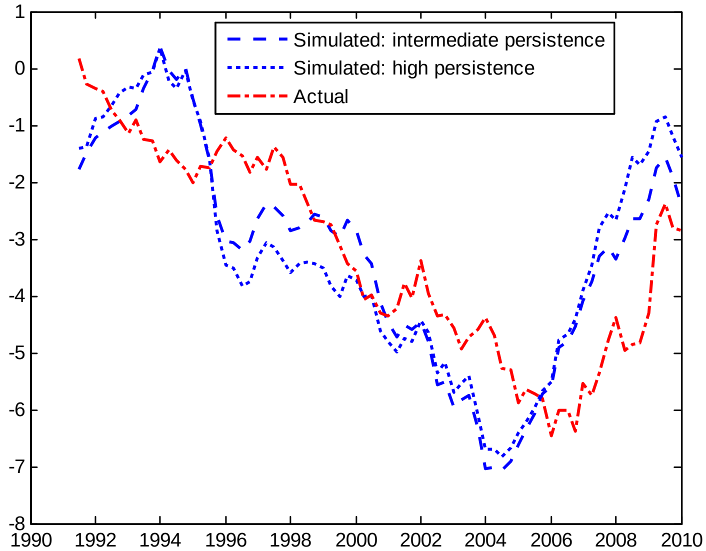

Figure 5: Actual and simulated evolution of the U.S. current account (growth expecations togehter with intermediate or highly persistent intertemporal preference and risk premium shocks)

so we take it as a lower bound for our robustness check.[22] In the following, we present simulation results for $\rho_g = 0.77$, along with the corresponding variations in the discount factor and international interest rate premium shocks. This is necessary, because with a lower persistence of trend growth shocks, also the model-implied real interest rates change, and thus the history of the other shocks necessary to explain the gap to interest rates in the data. We also vary the persistencies of those shocks, which turns out to play a larger role.

Figure 6 shows three simulation exercises and the actual U.S. current account. First, consider the solid line, which shows the simulated current account for the persistence of $\rho_g = 0.77$ for trend growth variations. Still, even at this low value, the model generates significant current account movements, with an implied increase of the deficit from about 2 percent in the mid 1990s to almost 5 percent in 2005. The overall range of the predicted deficits is lower, but the correlation with the data remains. Note that this simulation does not yet include the shocks that we use to proxy financial and other factors.

[22]It is worth noting that our results outlined below would still hold for values of ρ_g somewhat lower lower than the range of available estimates considered here.

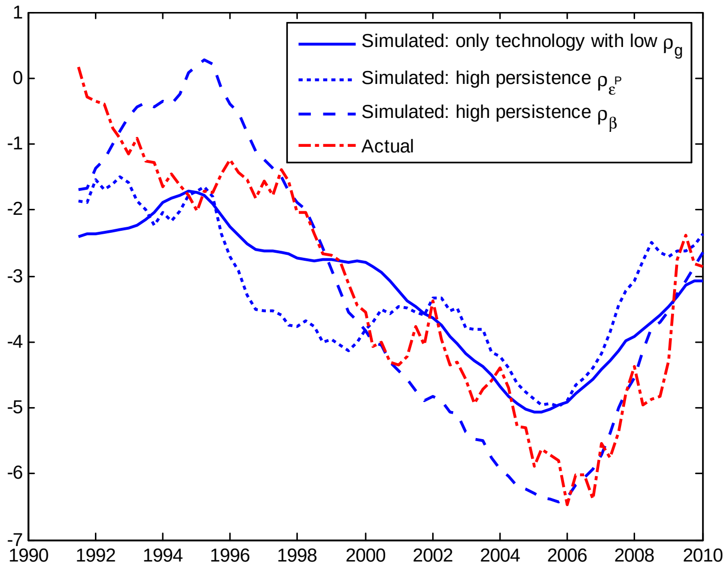

Figure 6: Actual and simulated evolution of the U.S. current account (growth expecations only as well as togehter with intertemporal preference and risk premium shocks)

In the two remaining simulations, we increase in turn the persistencies of the discount factor and interest rate premium shocks. That is, starting with $\rho_g = 0.77$, we show the results for $\rho_\beta = 0.85$ and $\rho_{\varepsilon^P} = 0.5$ and for the converse case. In the first case, it turns out that domestic discount factor shocks are as important as foreign shocks.[23] The dashed line in Figure 6 shows the corresponding evolution of the current account. In fact, it shows a pattern much closer to the actual current account and also to the baseline simulation. Still, even here, changing growth expectations explain about half the range of the current account variation in the data. Finally, for a high persistence of the interest rate premium shock, i.e., $\rho_{\varepsilon^P} = 0.85$ and $\rho_\beta = 0.5$, the simulated current account shown by the dotted line exhibits a pattern that covers the same range of deficits as the simulation for $\rho_g = 0.77$, but is less correlated with the actual current account.

Our historical simulations of the model suggest that changing growth expectations between the U.S. and the rest of the world are important to understand the U.S. current account. This result is robust in the sense that even for a low persistence of changes in

[23]The shock decompositions for these cases are not shown here.

growth trends, and thus smaller effects of trend changes on households' expected incomes, changing relative growth expectations at least drive about half the observed changes in the current account.

4.2 Long-run growth expectations: surveys and model-implied data

In the preceding sections, we mimicked part of the inference process that economic agents must be pursuing by using the Kalman filter to extract the trend growth component of observed productivity growth. The resulting sequences of beliefs $g_{t|t}$ for the U.S. and $g^*_{t|t}$ for the rest of the world and productivity data we fed into the model. Naturally, the simulation allows to explicitly calculate these long-run growth expectations, which we now exploit and link to the relative long-run output growth expectations from Consensus Forecasts, that we highlighted in section 2.

Figure 7 shows both the model-implied 6-to-10 year relative output growth expectations, along with the corresponding output growth expectations from Consensus Economics and the U.S. current account, as shown in Figure 2. Overall, the model-implied growth expectations differential shows an evolution similar to that of the Consensus Forecast differential, except around 1996. From 1998, the model's growth rates follow even closer the actual current account, until about 2005. From then on, however, the declining perceived productivity growth rate differential also mandates declining output growth rate differences, that leads to a divergence of the model-implied and Consensus forecast growth rates. By 2010, both the simulated long-run forecast, the Consensus forecasts shown in Figure 2, and the current account have halved in magnitude.

Even though survey-based expectations and model-based expectations are broadly following the same pattern, differences remain. They will almost certainly stem from factors other than productivity growth, such as population growth differentials, and ongoing capital deepening, partly triggered by anticipated structural changes, such as the transition in China and other countries. Other factor driving survey forecasts further away from these fundamentals however may be departures from rationality, or bubbles, which disconnect forecasts

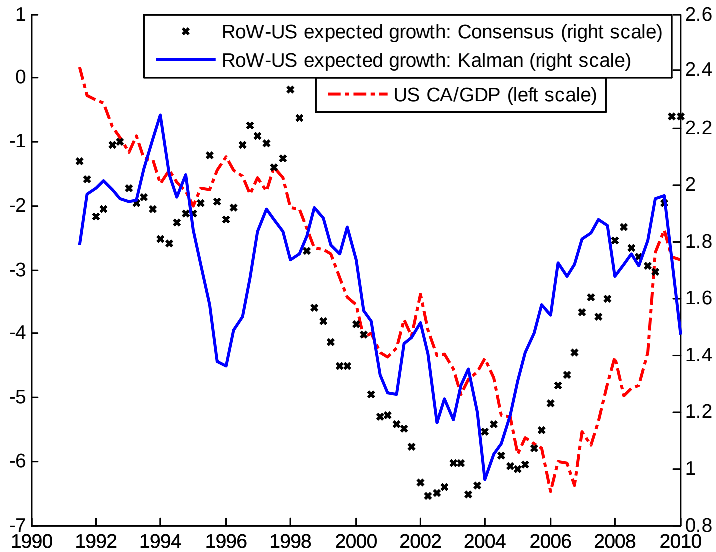

Figure 7: 6-to-10 year output growth forecasts from Consensus and Kalman-filtered productivity data

from what is fundamentally justified. The noise signals introduced in section 3, and further discussed in the following section could be used to capture these deviations.

A final step that suggests itself is to directly use Consensus Forecast growth expectations for the simulation of the model. We take the assumed process for trend growth, equation (2), to back out from the reported output growth rate expectations the beliefs $g_{t|t}$ and $g^*_{t|t}$ for the trend growth component. However, when doing so we have to account for the fact that Consensus' long-run output forecasts are not only based on productivity growth, as those mentioned above. We do not attempt to tackle this issue in a systematic fashion but account for such factors by scaling down the resulting variations of beliefs for trend productivity growth.[24] Therefore the main focus should be on the shape and the turning points of the implied current account movements, rather than its level. Figure 8 shows that our structural model can translate survey-based output forecasts into plausible current

[24]Output growth is the sum of productivity growth, capital deepening and the growth of the labour force, so that $g^y_{6-10} = (1-\alpha)\, g_{6-10|t} + \alpha g^k_{6-10} + (1-\alpha)\, g^L_{6-10}$. For example Jorgenson, Ho and Stiroh (2008) argue for the U.S. that over the last decades around two-third of output growth are driven by productivty and the remaining part by other factors such as capital deepening or labour. When extracting $g_{t|t}$ (and $g^*_{t|t}$) from the 5-10 year ahead output forecasts, this has to be taken into account.

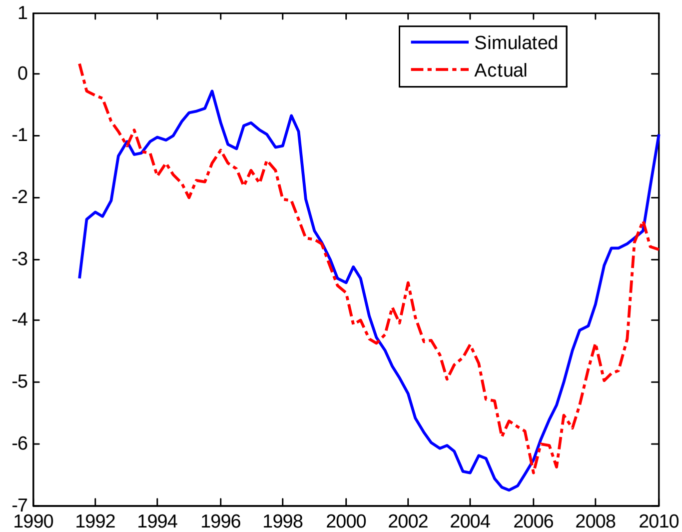

Figure 8: Actual and simulated evolution of the U.S. current account (growth expecations based on consensus forecast)

account dynamics. This gives support to the deterministic exercise conducted by Engel and Rogers (2006) in a simpler model. They use expected world income shares calculated from Consensus Forecasts to predict the U.S. current account.

4.3 News, noise, and the current account

In the interpretation of the model, the bulk of low-frequency movements in the U.S. current account since the early 1990s can be explained by perceived changes in the permanent component of a specific productivity growth process. As we mentioned, there are other potential sources of long-run income growth, such as population growth, or other changes in the structure of an economy that initiate long-lasting adjustment processes to a new steady state. All these changes can be seen as driven by fundamental factors. By contrast, we now discuss a notion of perceptions of long-run growth driven by non-fundamental shocks, drawing on the distinction between news and noise introduced earlier in section 3. Part of the signals that agents receive about productivity growth may be extraneous noise, leaving them to arrive at perceptions of trend growth that are not triggered by underlying changes in fundamentals.

The difference between model-implied growth forecasts and the Consensus survey forecasts may then be attributed to additional noisy signals. While in the Kalman-filter application in Section 4 we assumed that agents form long-run growth expectations using only observations about productivity, in reality these expectations may be based on many more variables, some of which may induce noise to the estimates.

For illustration, Figure 9 depicts the dynamic response of long-run growth expectations, that is, the beliefs $g_{t|t}$ about the permanent component of growth, g_t, to the three different types of shocks introduced in section 2. The first two shocks are those employed in the simulation above, namely the shock ν_t affecting the growth rate, and the shock ω_t, affecting the level of technology. The third shock is the noise shock μ_t that generates the signal s_t introduced earlier. The blue solid line in panel (a.) shows the evolution of the actual growth rate of technology following a shock of size 0.1 and with persistence $\rho_g = 0.95$. Under imperfect information, with a Kalman gain of $\kappa = 0.0816$, agents assign only about 5.4 percent of an unexpected productivity increase to the trend growth component and the remainder to the level shock ω_t. Thus the immediate impact on future growth perceptions $g_{t|t}$ is small, but they are continuously updated, as long as higher growth rates are observed.[25]

In panel (b.) of Figure 9, the corresponding evolution of the growth rate of productivity is shown after a one-time shock to the level of size 0.1. Again, the Kalman filter assigns roughly 5.4 percent of the change to the growth rate shock, and the remainder to the transitory shock. However, even though there are no further changes to technology, the long-term growth expectations continue to be above steady state, as they are only slowly revised downwards. Finally, panel (c.) shows the evolution of growth expectations after a one time shock of size 0.1 to the noise shock μ_t. Since the noise is unrelated to current technology, the growth rate of technology remains at its steady state. However, agents initially attribute 2.8 percent of this innovation to a change of the trend growth rate of technology. Growth expectations continue to be above steady state, even though there are no further changes to the signal.

Figure 10 dissects how under imperfect information these drivers of growth expectations affect the current account, the present value of income, and consumption. The top panel

[25] Compare this with the related discussion of news and noise shocks in Blanchard, L'Hullier, and Lorenzoni (2011).

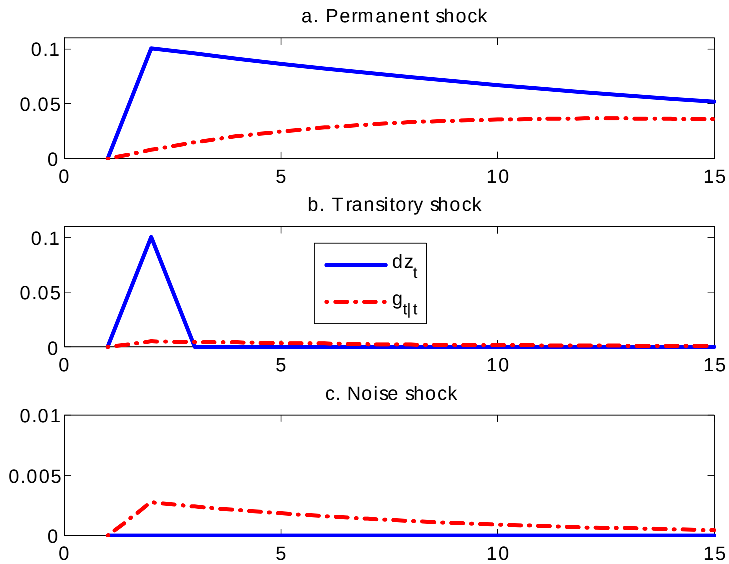

Figure 9: Growth expectations relative to fundamentals

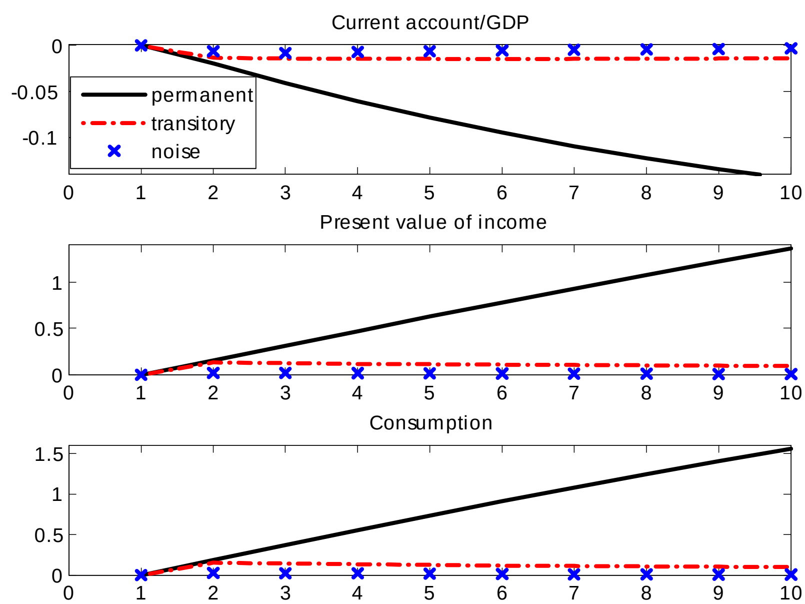

Figure 10: The effect of growth expectations on the current account, present value and consumption (all variables expressed as deviations from trend)

of the figure shows how under the different shocks in one region the current account moves into deficit. Only the permanent growth rate shock leads to a large and persistent decline. The second panel shows the present value of income, calculated via the recursion $PV_t = Y_t + E_t\beta\frac{\lambda_{t+1}}{\lambda_t}PV_{t+1}$.The present value also responds most pronounced to the growth rate shock but not to the other two shocks. The bottom panel of Figure 10 illustrates that the revisions to growth expectations result in a slowly building up response of consumption, a pattern that would not obtain under full information. Under full information, as in standard rational expectations business cycle models, shocks to the trend growth rate lead to counterfactual jumps in present values of income, consumption, and thus the current account.[26]

There are several conclusions that can be drawn from the above impulse responses. First of all, shocks to the *level* of technology have only small effects on the current account. Studies that focused on this type of shock are unlikely to yield much support for the intertemporal approach. Changes in technology must have information on future changes of technology, in other words, they must contain '*news*' about long-run trend growth, so as to be able to explain persistent movements of a country's current account. In hindsight, the resulting perceptions of future technology are almost never correct, since information of changing growth trends arrives with noise. Our simulation results suggest that that the buildup of the U.S. current account may have been the optimal response to the information available to agents at the time. More generally, it cannot be ascertained ex-ante whether the beliefs of agents regarding growth trends are fundamentally justified, or driven by non-fundamental factors, as could be in the case of a sequence of noise shocks that are misinterpreted as news. Any assessment of the extent to which current-account balances are consistent with intertemporal consumption smoothing must therefore rely importantly on one's best estimate of relative growth trends at home and abroad, besides other factors.

[26]Aguiar and Gopinath (2005) in fact assume full information, and use consumption data to infer what agents perception of the trend growth rate must have been.

5 Conclusions

In this paper we have shown that U.S. current account movements since 1991 are closely related to survey expectations of long-run output growth for the U.S. relative to the rest of the world. We have argued that this pattern is consistent with the prediction of the standard macroeconomic theory for the determination of a country's current account balance, the intertemporal approach. We therefore simulate a standard two-country, general equilibrium model with stochastic trend growth rates and imperfect information. We extract trend growth compononents from international productivity data using the Kalman-filter to obtain a measure of long-run growth expectations that we feed into the model. The model-implied and actual U.S. current account dynamics closely match, suggesting that the observed U.S. current account may to a large extent be driven by changing relative growth expectations between the U.S. and the rest of the world.

Our findings seem particularly relevant in the current situation, in which the economic policy debate is focused on regulatory reform so as to prevent a repeat of "global imbalances" of the dimension just seen. In the context of this debate, limits to current account balances have been proposed as an essential element. Our analysis on the contrary has shown that large current account deficits can be the optimal ex ante response to relatively small changes in trend growth rates. That said, for as long as agents need to take decisions under imperfect knowledge of trend growth rates at home and abroad, it is inevitable that current account movements will at times turn out to have been excessive, with all the concomitant painful adjustment this entails.

Despite our emphasis on a frictionless framework, in the aftermath of the greatest financial crisis at least since the Great Depression a natural next step would be to expand our model by integrating a role for financial intermediation within and between countries to better understand how changes in trend growth perceptions might interact with financial structure. We leave this for future work.

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