# The Great Moderation and the U.S. External Imbalance

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*The early 1980s marked the onset of two striking features of the current world macroeconomy: the fall in U.S. business cycle volatility (the "great moderation") and the large and persistent U.S. external imbalance. In this paper, we argue that an external imbalance is a natural consequence of the great moderation. If a country experiences a fall in volatility greater than that of its partners, its incentives to accumulate precautionary savings fall and this results in a permanent deterioration of its external balance. To assess how much of the current U.S. imbalance can be explained by this channel, we consider a standard two-country business cycle model in which households are subject to business cycle shocks they cannot perfectly insure against. The model suggests that a fall in business cycle volatility like that observed in the United States can account for about 20 percent of the actual U.S. external imbalance.*

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## I. Introduction

One of the most striking features of the U.S. economy over the last 20 years has been a large reduction in business cycle volatility. This phenomenon, also known as the "great moderation," has been the topic of a large and growing debate among economists and policymakers, which has focused mostly on explaining why it has occurred.[1] Most studies conclude that a significant part of the observed decline in macroeconomic volatility has been driven by a reduction in the volatility of the underlying macro shocks hitting the economy. This finding constitutes the starting point of our paper, which asks whether and to what extent the great moderation can explain another important phenomenon that has characterized the U.S. economy in the last two decades, namely, the large and persistent U.S. external imbalance. The support for our supposition that such a connection exists is both empirical and theoretical.

Empirically, many researchers date the onset of the great moderation to around 1983–84 (see, for example, Stock and Watson [2003]); interestingly, just around that time the current U.S. external balance began to deteriorate.

Theoretically, in a world in which country-specific shocks cannot be perfectly insured, the equilibrium external balance of a country is affected by, among many other factors, the strength of its precautionary saving motive relative to that of its partners. This, in turn, is affected by the relative volatility of the shocks faced by the country. As the relative volatility of the shocks falls, a country faces less risk vis-à-vis its partners and, as a consequence, its precautionary motive is weakened and the component of its external assets accumulated for self-insurance purposes falls. We develop this idea using a standard two-country business cycle model with investment, in which the only internationally traded asset is a single non-contingent bond. Moreover, each country faces a fixed limit on its international borrowing. In this framework, country-specific shocks cannot be perfectly insured; there is an explicit precautionary motive to save and we can numerically characterize the mapping between the relative volatility of the shocks hitting the two economies and the external balance of the two countries. We then use this mapping to quantitatively assess how much of the observed deterioration of the U.S. net foreign asset position can be explained by the reduction in the volatility of the U.S. shocks. We find that, with reasonable parameterizations of the model, the great moderation can generate an external imbalance which is about 4.5 percent of GDP 25 years after its onset and reaches 7 percent of GDP in the long run. Actual U.S. imbalances are much larger than these numbers; nevertheless, the imbalances explained by the great moderation are non-trivial and account for about 20 percent of the observed ones.

This paper contributes to the recent literature that attempts to assess the sustainability and the evolution of the current U.S. imbalances (see, for example, Backus *et al*. [2006], Edwards [2005], or Obstfeld and Rogoff [2005]). Our contribution to

1. A partial list of the relevant literature includes McConnell and Perez-Quiros (2000), Blanchard and Simon (2001), Ahmed, Levin, and Wilson (2002), Leduc and Sill (2003), Stock and Watson (2003), Bernanke (2004), and Arias, Hansen, and Ohanian (2006).

this literature is that at least a part of the U.S. imbalances is due to the efficient market response to an underlying structural change in the world economy and that, regarding that portion, we should not expect any sudden adjustment. Two recent papers also reach a similar conclusion. One is by Caballero, Fahri, and Gourinchas (2006), who argue that part of the recent U.S. imbalances can be explained by the different growth experiences of the United States, Japan, Europe, and emerging markets. Another is by Mendoza, Quadrini, and Ríos-Rull (2006), who argue that substantial imbalances can be explained by the fact that the United States experienced a faster process of internal financial liberalization than the rest of the world.

Our work is also related to research that studies the importance of precautionary saving in incomplete markets (see, for example, Aiyagari [1994]). These studies typically find that in a closed economy aggregate precautionary saving is quantitatively small because of general equilibrium effects. The higher the risk a country faces, the larger the precautionary balance it will want to hold. However, as these balances increase, returns to capital fall, curtailing the equilibrium amount of precautionary saving. Our study instead focuses on an open economy, so in a given country these general equilibrium effects are smaller and precautionary saving can become larger.

The paper is organized as follows. Section II provides some evidence relevant to our hypothesis. Section III presents the model. In Section IV, we describe the experiment, discuss parameter values, and present results. Section V concludes.

## II. Data

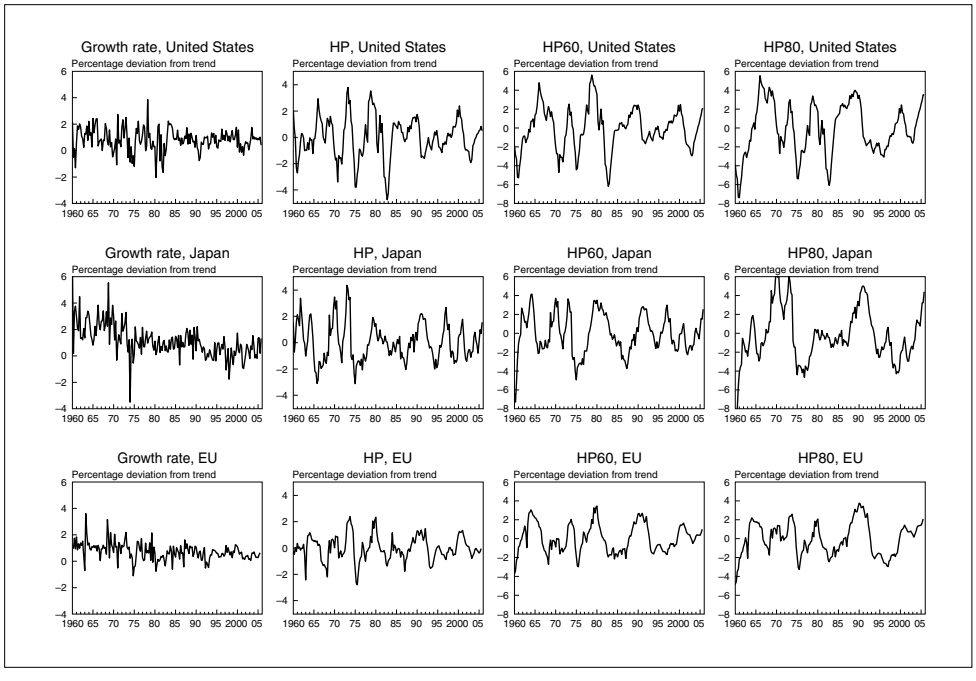
In this section, we document some facts that are central to the hypothesis of this paper. First, we show that among large developed economies (the United States, Japan, and the European Union [EU], henceforth the G-3) the United States has displayed the largest reduction in business cycle volatility; in other words, although the "moderation" has been a worldwide phenomenon, only the United States has experienced a "great" one. Second, we document that the onset of the great moderation in the United States has coincided with the beginning of the recent deterioration in the U.S. net foreign asset position.

### A. Business Cycle Volatility in the G-3 Economies

Figure 1 reports several commonly used measures of business cycle fluctuations for the G-3 economies for the period starting in 1960/I and ending in 2005/IV. All data are from the OECD's *Quarterly National Accounts*.

The panels in the first column (growth rates) report the series for the quarterly log real GDP detrended using first differences, which emphasize very short-term fluctuations. The panels in the second column (HP) report log real GDP detrended using a Hodrick-Prescott filter with a smoothing parameter of 1,600; this detrending method isolates cycles shorter than 32 quarters. The third and fourth columns report the same variable detrended using high-pass filters that exclude cycles longer than 60 (HP60) and 80 quarters (HP80), respectively. These high-pass filters include the

**Figure 1 Business Cycles in the G-3 Economies**




so-called "medium-run cycles" that contain a significant fraction of GDP cyclical variation (see, for example, Comin and Gertler [2006]) and thus of country-specific risk. The panels clearly show the onset of the U.S. great moderation around 1984 and show that the decline in U.S. business cycle volatility appears at several different frequencies. From Figure 1, it also emerges that, as noted, for example, by Stock and Watson (2005), a decline in business cycle volatility occurred in Japan and the EU too, although its magnitude is not as large or as uniform across frequencies as in the United States.

To get a better sense of the magnitude of the reduction in volatility, Table 1 reports the percentage standard deviations of the series in Figure 1 for the pre-(1960/I–1983/IV) and post-moderation (1984/I–2005/IV) period, along with the change in volatility across periods.[2] The key message of Table 1 is that the United States, regardless of the frequency, is the country which has experienced the largest reduction in volatility. Note for example how, in the EU, high and medium-run business cycle volatility, as captured by the HP80 filter, has actually increased slightly.

2. In the table, we use the same sample split for all three economies. Results are very similar when we experiment with different sample splits.

**Table 1 Changes in Volatility of Real GDP Cycles in the G-3 Economies**

| Filter | Country | Percentage standard deviation | | |
|---|---|---|---|---|
| | | 1960/I–1983/IV | 1984/I–2005/IV | Change |
| Growth rate | United States | 1.08 | 0.51 | –0.57 |
| | Japan | 1.25 | 0.78 | –0.47 |
| | EU | 0.77 | 0.42 | –0.35 |
| HP | United States | 1.90 | 0.96 | –0.94 |
| | Japan | 1.68 | 1.12 | –0.56 |
| | EU | 1.08 | 0.73 | –0.35 |
| HP60 | United States | 2.84 | 1.32 | –1.52 |
| | Japan | 2.42 | 1.56 | –0.86 |
| | EU | 1.61 | 1.31 | –0.30 |
| HP80 | United States | 3.15 | 2.05 | –1.10 |
| | Japan | 3.13 | 2.35 | –0.88 |
| | EU | 1.58 | 1.84 | +0.26 |

## B. The Great Moderation and U.S. External Imbalances

Figure 2 provides some evidence on the timing of the great moderation and the onset of U.S. external imbalances.

The top panel reports estimates of the instantaneous conditional U.S. business cycle volatility obtained fitting a simple generalized autoregressive conditional heteroskedasticity (GARCH) model on the time series for U.S. real GDP. Consistently with the previous literature, the panel shows a sharp fall of volatility estimates around 1983–84.[3] The bottom panel shows how the U.S. external imbalance started to appear just around that time (data on the U.S. net foreign asset position are from Lane and Milesi-Ferretti [2006]). Obviously, this might be purely a coincidence and these facts might be completely unrelated; or it might be the case that some fundamental change in the United States or the world economy is responsible for both these phenomena. In this paper, we will not explore these possibilities but will take the decline in volatility as exogenously given and ask how much of the growing external imbalances it can explain. We will do so in the next section with the help of a standard general equilibrium model.

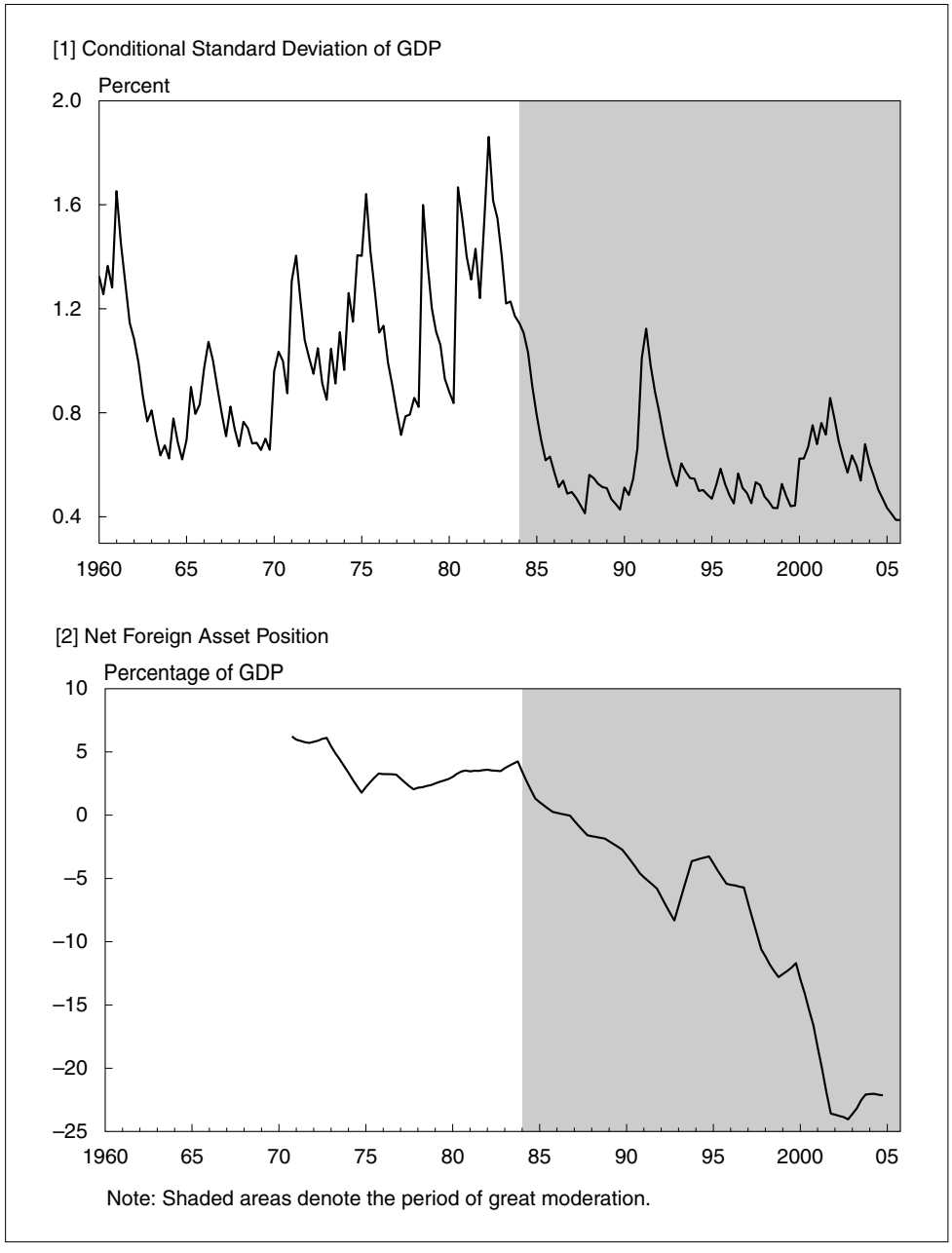
3. We specify the GARCH model as

$$y_t = \beta_0 + \beta_1 y_{t-1} + \epsilon_t,$$

$$\sigma^2_{\epsilon_t} = \beta_2 + \beta_3 \epsilon^2_{t-1} + \beta_4 \sigma^2_{\epsilon_{t-1}},$$

where $y_t$ is the log of U.S. real GDP, $\epsilon_t$ is a normal random variable with time-varying variance $\sigma^2_{\epsilon_t}$ and $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$ are parameters to be estimated. Figure 2 reports the estimated path for $\sigma_{\epsilon_t}$.

**Figure 2 U.S. Business Cycle Volatility and External Imbalances**




Note: Shaded areas denote the period of great moderation.

## III. The Model

We consider a version of the standard one-good, two-country business cycle model of Backus, Kehoe, and Kydland (1992). One additional assumption we make, relative to the standard model, is that we restrict international asset trade to a single non-contingent bond, as in Baxter and Crucini (1995), and we impose limits on borrowing. In the model, agents face country-specific shocks and use international borrowing and lending both for smoothing consumption and for allocating investment efficiently. The presence of borrowing limits, together with the persistence of business cycle shocks, makes it hard to perfectly insure country-specific shocks and this lack of insurance generates a precautionary saving motive, which is essential for understanding the relation between external imbalances and country-specific shock volatilities.

The world economy consists of two countries, $i = 1, 2$, each inhabited by a large number of infinitely lived consumers and endowed with a constant-returns-to-scale production technology operated by competitive firms. Time is discrete, and each period is a quarter. Throughout the rest of the paper, we will refer to the United States as country 1. The countries produce a single good, and their preferences and technology have the same structure and parameter values. Although the technologies have the same form, they differ in two important respects: in each country, the labor input consists only of domestic labor, and production is subject to country-specific technology shocks.

In each period $t$, the economy experiences one of finitely many events $s_t$. We denote by $s^t = (s_0, \ldots, s_t)$ the history of events up through and including period $t$. The probability, as of period zero, of any particular history $s^t$ is $\pi(s^t)$. We assume that idiosyncratic risk within each country is perfectly insured among residents so that we can consider a representative consumer in each country who has preferences of the form

$$\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\pi(s^t)U(c_i(s^t)), \tag{1}$$

where $c_i(s^t)$ denotes consumption of the representative consumer in country $i$ after history $s^t$, $U(c) = (c^{1-\gamma})/(1-\gamma)$, $\gamma > 0$ is a positive parameter determining risk aversion and intertemporal elasticity of substitution of representative consumers in both countries, and $\beta > 0$ is a positive parameter capturing their rate of time preference. The representative agents in the two countries are endowed with one unit of labor that they supply inelastically to domestic firms,[4] own domestic capital that they rent to domestic firms, trade internationally a non-contingent default-free bond, and choose consumption and investment in each state of the world to maximize their expected lifetime utilities, given in (1) subject to the following budget constraints:

$$c_i(s^t) + x_i(s^t) + b_i(s^t) \le w_i(s^t) + r_i(s^t)k_i(s^{t-1}) + b_i(s^{t-1})R_i(s^{t-1}),$$

and capital accumulation constraints:

4. The assumption of inelastic labor supply is not essential for our purposes.

$$k_i(s^t) = (1-\delta)k_i(s^{t-1}) + x_i(s^t) - \phi k_i(s^{t-1})\left[\frac{x_i(s^t)}{k_i(s^{t-1})} - \delta\right]^2,$$

for every $s^{t-1}$ and $s^t$. Here $w_i(s^t)$ and $r_i(s^t)$ are the wage and rental rate on capital in country $i$, $\delta$ is the depreciation rate of capital, $x_i(s^t)$ is investment in country $i$, $\phi$ is a parameter that determines the magnitude of capital adjustment costs, $R(s^{t-1})$ is the gross interest rate on the non-contingent borrowing and lending between period $t-1$ and period $t$, and $b_i(s^t)$ denotes the quantity of the non-contingent bonds purchased at $t$ by a consumer in country $i$. An important assumption of the model is that countries face fixed limits to their international borrowing. Without these limits, the single bond traded in this economy would allow agents to insure very well against country-specific shocks (as noted by Baxter and Crucini [1995]) and so the precautionary saving motive, which is crucial for generating the persistence of the external imbalance, would disappear. We assume that constraints on international borrowing have the form $b_i(s^t)/y_i(s^t) \geq -\bar{b}$, where $\bar{b}$ is some positive number and $y_i(s^t)$ is aggregate output in country $i$.

Finally, competitive firms hire capital and labor to operate a Cobb-Douglas technology and solve the standard static profit maximization problem

$$\max_{l_i(s^t),k_i(s^{t-1})} A_i(s^t) l_i^{1-\alpha}(s^t) k_i^{\alpha}(s^{t-1}) - w(s^t) l_i(s^t) - r_i(s^t) k_i(s^{t-1}),$$

where $\alpha$ is a constant parameter and $A_i(s^t)$ is a country-specific total factor productivity (TFP) shock that follows an exogenous process. Note that aggregate output in country $i$ at $s^t$, denoted by $y_i(s^t)$, can be written as a function of domestic labor supply $l_i(s^t)$ and capital stock installed in country $i$ in the previous period $k_i(s^{t-1})$. Since labor is inelastically supplied and equal to one, we can write GDP in each country as

$$y_i(s^t) = A_i(s^t) k_i^{\alpha}(s^{t-1}).$$

An equilibrium for this economy is defined as a collection of mappings for prices $w_i(s^t)$, $r_i(s^t)$, $R(s^t)$, exogenous processes $A_i(s^t)$, and quantities $c_i(s^t)$, $x_i(s^t)$, $k_i(s^t)$, $b_i(s^t)$ such that, when consumers and firms take prices and exogenous processes as given, the quantities solve their optimization problems and such that the markets for consumption/investment goods, capital, labor, and bonds clear in each country, in each date $t$ and in each state $s^t$.

## IV. The Experiment

We will now use the model just described as a measuring tool to quantify the size and the persistence of the imbalances generated by a country-specific reduction in business cycle volatility, such as the one experienced by the United States and documented in Section II. To do so, we first compute equilibria in a completely symmetric world, in

which both countries face the same constant volatility of shocks. We then assume that at a given point in time along this equilibrium path, the volatility of U.S. shocks falls to a new constant level and that agents in both countries learn about this change instantaneously. We finally evaluate the expected responses of selected macro variables to this change. Summarizing, we will be computing impulse responses to a change in second moments, as opposed to traditional impulse responses to changes in first moments. To perform this experiment, we will first choose parameter values and then characterize the numerical solution of the model.

**A. Parameters and Computation**

We need to set values for the preference parameters $\beta$ and $\gamma$, for the technology parameters $\alpha$, $\delta$, and $\phi$, and for the borrowing constraint $\bar{b}$. We also need to specify an exogenous process for the TFP shocks $A_i(s^t)$. The discount factor $\beta$, the capital depreciation rate $\delta$, the share of capital in production $\alpha$, and the capital adjustment costs $\phi$ are set so that a symmetric equilibrium in the model (i.e., an equilibrium in which both countries face equally volatile shocks) displays an average return on capital of 4 percent, a yearly average capital to GDP ratio of 2.5, an average capital share of GDP equal to 36 percent, and an investment series that is three times as volatile as the GDP series.[5] These values are typical for the United States and other major world economies, and the structure of the model allows us to easily and precisely identify the parameters. The risk aversion $\gamma$ and the borrowing constraint parameter $\bar{b}$ are important for our analysis, but there are no obvious data that allow us to precisely identify them. In our benchmark parameterization, we set the risk aversion to five, which is in between the value typically used in macro studies (which use numbers around two) and finance studies (which usually set it to values of 10 or higher). We also limit international borrowing to less than 100 percent of GDP. In the sensitivity analysis subsection below, we experiment with different values both for the risk aversion and for limits to international borrowing. The last important input of the model is the stochastic process for TFP shocks. In this class of models, it is common to specify it as a bi-variate autoregressive process of the form

$$\begin{bmatrix} \log(A_1(s^t)) \\ \log(A_2(s^t)) \end{bmatrix} = \begin{bmatrix} \rho & \psi \\ \psi & \rho \end{bmatrix} \begin{bmatrix} \log(A_1(s^{t-1})) \\ \log(A_2(s^{t-1})) \end{bmatrix} + \begin{bmatrix} M(t)\,\epsilon_1(s^t) \\ \epsilon_2(s^t) \end{bmatrix}, \tag{2}$$

where $\rho$ and $\psi$ are fixed parameters and $\epsilon_i(s^t)$ are jointly normal shocks with zero mean, variance $\sigma_\epsilon^2$, and correlation coefficient $\eta$, and the term $M(t)$ is a declining function of time that captures the reduction in business cycle volatility. Note that we model the great moderation as a reduction in volatility in U.S. (country 1) business cycles only and that we keep business cycle volatility in the other country (the rest of the world) constant. In reality, volatility fell also in other countries, but our assumption captures in a simple way the fact, documented in Table 1, that in

5. Note that due to the precautionary saving motive in this economy, the long-run averages of variables are in general different from the value of the variables in the deterministic steady state. For example, for our benchmark parameterization, long-run average capital is about 1.7 percent higher than capital in the deterministic steady state.

the United States the reduction in business cycle volatility has been larger than in other countries.

In the model, these shocks are the drivers of business cycle fluctuations including the medium-run ones, so we pick the parameters of the process to match statistics for log GDP filtered with a high-pass filter (the series labeled HP80 in Table 1). First we specify $M(t)$ as follows:

$$M(t) = \begin{cases} 1 & \text{if } t < 1984 \\ 1-\lambda & \text{if } t \geq 1984 \end{cases},$$

where $0 < 1 - \lambda < 1$; then choose $\sigma$ and $\rho$ to match the persistence and the volatility of HP80 log GDP in the United States in the pre-moderation period. Note that the degree of persistence of the shocks is a key parameter, as it determines the strength of the precautionary saving motive, so in the sensitivity analysis subsection below we will experiment with different values for $\rho$. The parameter $\lambda$ affects the decline of the ratio of U.S. volatility to foreign volatility. Table 1 reveals that, for HP80 GDP, the ratio fell by about 15 percent for the United States versus Japan and by 79 percent for the United States relative to the EU. As a conservative estimate, we set $\lambda$ to match a decline of 33 percent, but we experiment with different values.[6] Our results are not very sensitive to the parameters $\psi$ and $\eta$ that determine the structure of business cycle co-movement between countries. We simply set $\psi = 0$ and $\eta = 0.4$ so that the model reproduces the co-movement of HP80 GDP between the United States, EU, and Japan in the 1960–2005 period.[7]

For computational reasons, we transform the process (2) into a nine-state Markov chain; the parameters of the states and transition probability matrix of the Markov chain are estimated on simulated data from (2), by a combination of maximum likelihood and method of moments.[8] Table 2 summarizes our benchmark choices of parameter values.

Note finally that, since we are interested in capturing the effect of changes in volatilities, we cannot numerically compute equilibria of this model using linearization-based methods, as, in such methods, individuals' and firms' decision rules are independent from second moments of the shocks. We instead compute decision rules using a global solution method that is designed to generate close approximations to true equilibrium allocations across a large portion of the state space; in particular, we solve the model by approximating policy functions for consumption $c_i(s^t)$, investment $x_i(s^t)$, bond purchases $b_i(s^t)$, and price functions $w_i(s^t)$, $r_i(s^t)$, and $R(s^t)$ as piecewise bilinear functions defined over a state space that consists of productivities $A_i(s^t)$, installed capital $k_i(s^{t-1})$, and bond holdings $b_i(s^{t-1})$.

6. The parameter $\lambda$ also affects the post-1984 population mean of productivity shocks in the United States. To abstract from this effect in all our experiments we rescale the post-1984 U.S. productivity shocks so that their population mean is equal to the pre-1984 mean.
7. Although there is some evidence that cross-country business cycle correlation has also actually declined through time (see Heathcote and Perri [2004]), in this experiment we keep it fixed to focus on the effects of the decline in volatility.
8. Details of the estimation procedure together with the states and the transition probabilities of the Markov chain are available upon request.

**Table 2 Benchmark Parameter Values**

[1] Preferences and Technology

| Name | Symbol | Value |
|---|---|---|
| Discount factor | $\beta$ | 0.9895 |
| Risk aversion | $\gamma$ | 5 |
| Capital share | $\alpha$ | 0.36 |
| Depreciation rate | $\delta$ | 0.0255 |
| Capital adjustment cost | $\phi$ | 0.2 |
| Borrowing limit | $\bar{b}$ | 100 percent |

[2] TFP Shocks

| Name | Symbol | Value |
|---|---|---|
| Persistence | $\rho$ | 0.98 |
| Spillover | $\psi$ | 0.0 |
| Standard deviation | $\sigma_\epsilon$ | 0.0075 |
| Standard deviation ratio decline | $\lambda$ | 0.33 |
| Correlation | $\eta$ | 0.4 |

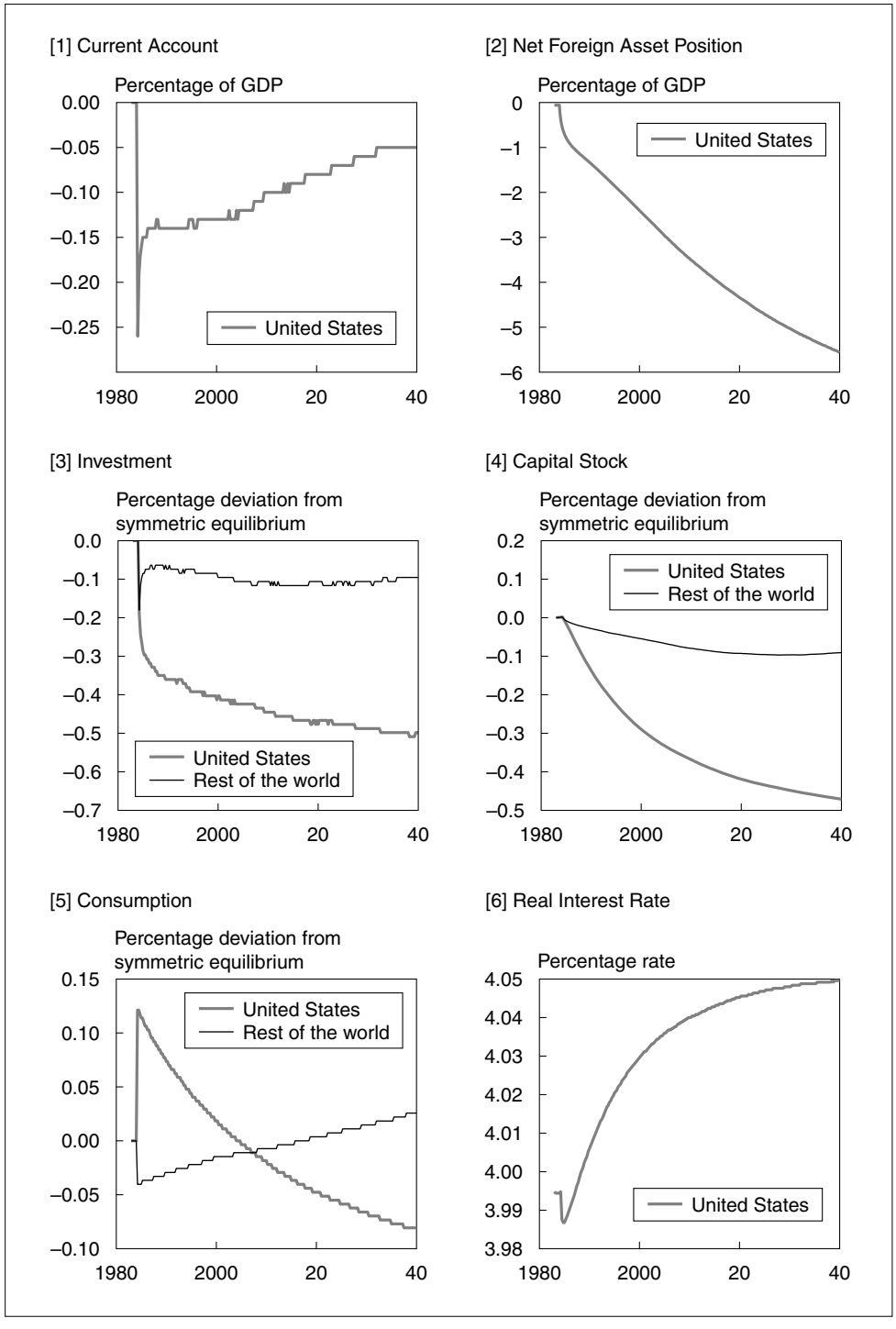
## B. Main Results

Figure 3 shows the expected responses of key variables over 60 years to a reduction in U.S. volatility. As we discussed above, we assume that in 1984/I the standard deviation of the innovations of U.S. productivity shocks unexpectedly falls by 33 percent and then stays constant at the new lower level forever.[9] Panels 1 and 2 contain our key results and show that, in response to a reduction in the shocks' volatility, the United States expects (averaging across possible shock realizations) a persistent negative net foreign asset position, which reaches, 25 years after the volatility reduction, about 4.5 percent of GDP. Panel 2 in Figure 2 suggests that the current U.S. expected imbalances are about 24 percent of GDP, so our proposed channel could explain about 20 percent of the current total U.S. external debt. Keep in mind, however, that the net foreign asset position in Figure 2 includes also the position with developing countries (such as China) and oil exporting countries that are not explicitly modeled here. If one focuses only on the U.S. external debt with Japan and the EU, our estimate of the imbalance in 2004 is about 12 percent of GDP, suggesting that our story could explain around one-third of the external imbalances of the United States with other developed economies.[10] Note finally that the external imbalance increases

9. The responses displayed in Figure 3 are averages over a large number of model simulations. In each simulation, we start with both countries with identical shocks and with identical capital stock equal to the deterministic steady state. We then simulate both economies for 300 periods with shocks having equal variance (so the average capital stock reaches its long-run value) and in period 300 (which in panels 1 through 6 corresponds to 1984/I) we reduce the variance of the U.S. shocks.

10. To compute the foreign asset position of the United States with Japan and the EU only, one needs data on bilateral net foreign asset positions that are not readily available in standard data sources for all types of assets. We estimated that position to be 12 percent by first computing the U.S. net foreign asset position vis-à-vis the EU and Japan for securities only (including debt and equity) derived using data from the Treasury International Capital (TIC) reporting system. We then assumed that the ratio of the U.S. net foreign asset position vis-à-vis the rest of the world to the U.S. foreign asset position vis-à-vis the EU and Japan is the same when calculated for all assets and for securities only.

**Figure 3 Impulse Responses to a Reduction in U.S. Volatility**



rapidly initially, but then stabilizes. By the year 2100 (not shown in the graph) the imbalance is constant at a level of 7 percent of GDP.

To understand the dynamics leading to the imbalance, in panels 3 through 6 we report the expected paths of investment, capital stock, consumption, and the real interest rate. Since U.S. consumers hold all claims to U.S. GDP, a fall in U.S. GDP volatility diminishes their risk and their precautionary saving motive. This effect makes them more "impatient," as they prefer current over future consumption. This preference is reflected in the declining path of U.S. consumption (see panel 5). How do U.S. consumers obtain higher current consumption in exchange for future consumption?

There are two ways they can do it: one is by reducing capital stock, the other is by borrowing in international markets. Because of the presence of adjustment costs, the reduction of the capital stock is implemented only gradually, so initially U.S. consumers will borrow heavily in international markets (see panels 1 and 2, which show that, for the first 20 years after the shocks, the current account balance remains low and the net foreign asset position declines rapidly). This drives up the international interest rate $R(s^t)$, and this increase makes investment and capital stock fall in the foreign country as well.[11] In other words, foreigners substitute domestic capital with international bonds as international bonds now pay a higher interest rate. Over time, the fall in U.S. capital stock and U.S. foreign assets increases the exposure of U.S. consumers to risk and thus reduces their "impatience"; as a consequence, their demand for current consumption falls, they are able to finance their consumption path simply from the reduction in investment, and they no longer need to use international markets. In panel 1, observe that around the year 2020 the current account deficit is negligible. This also stops the upward pressure on the interest rates and the decline in investment abroad.

To understand the final effects of the change, it is helpful to observe panel 5, which reports the consumption patterns. The panel shows that both countries achieve higher levels of consumption relative to the pre-moderation period. Notice, however, that the countries enjoy the additional consumption at different times and for different reasons. U.S. residents face lower income risk in the process, become effectively more impatient, and so find it optimal to enjoy the extra consumption early in time by borrowing in international markets and slowly running down their capital stock. The foreign country instead does not face a reduction in its volatility but faces an increase in the international interest rates, so it will find it optimal to increase saving and enjoy higher consumption later. This intertemporal redistribution of consumption requires transfers of resources from the rest of the world to the United States in the early periods and reverse transfers in the later periods; in equilibrium the early transfers from the rest of the world to the United States show up as U.S. current account deficits, while the late transfers from the United States to the rest of the world show up as interest payments on the accumulated U.S. foreign debt.

11. There is no growth in the model. If there were, there would not be a reduction in the capital stock but growth would slow.

Intuition about the final outcome can also be gained by thinking of this issue as a portfolio problem. Residents of both countries are forced to hold their own risky capital but can trade a risk-free asset in zero net supply. It is immediate to show that when the risky assets have the same characteristics and agents have the same preferences, the only possible long-run equilibrium portfolio is the one in which residents of both countries hold a zero amount of the bond, that is, an equilibrium in which there are no long-run imbalances. But when the U.S. domestic assets become less risky (without changing their expected return) then U.S. residents seek to rebalance their portfolio in favor of the risky asset. One way they can do so is by going short in the bond; foreign agents, on the other hand, will be happy to hold additional bonds if they pay a higher return. So an equilibrium long-run portfolio after the United States faces a reduction in volatility would involve the United States being short in bonds, the rest of the world being long on bonds and a real interest rate being higher relative to the one in the symmetric equilibrium. This is exactly what the impulse responses suggest is going to happen to country portfolios in the long run.

One final consideration should be devoted to the effects that the fall in volatility has on the long-run allocation of capital. Panels 3 and 4 of Figure 3 show that in the long run capital falls in both economies but in the United States it falls more than in the rest of the world, so that the U.S. share of world capital falls. This last aspect might seem puzzling if one assumes that after the great moderation U.S. capital has the same expected return as that in the rest of the world but is less risky, so that one would expect the U.S. share of world capital to rise. What prevents this from happening is the lack of diversification, that is, the fact that all claims on U.S. income are held by U.S. residents. Since they are the only ones who face the reduction in risk, their desired stock of buffer assets falls and this is reflected in the fall in the U.S. capital stock. We conjecture that in a model in which agents can also choose between holding domestic and foreign capital a country-specific reduction in volatility might lead to a surge in investment in that country and consequently to a larger imbalance.

**C. Sensitivity Analysis**

In this subsection, we check how sensitive our findings are to changes in parameter values. The goal is to identify the important elements that determine the quantitative importance of our channel. In particular, we examine how the response of external imbalances to reduction in volatility changes when we change the risk aversion, the limits to international borrowing, the persistence of international shocks, and the extent of the great moderation.

As our main interest is the size of the external imbalance induced by the great moderation, for every alternative parameterization we report in Table 3 the size of the net foreign asset position in 2010, that is, 25 years after the onset of the great moderation.

The first row of the table examines the effect of the risk aversion. Note how at a lower level of risk aversion the external imbalance generated by our mechanism is substantially smaller. When U.S. agents are less risk averse, they reduce their precautionary saving less in response to the reduction of risk; as a consequence, their

**Table 3 Sensitivity of U.S. Imbalances**

As a percentage of GDP

| Sensitivity to risk aversion, $\sigma$ | | | | | |
|---|---|---|---|---|---|
| | $\sigma = 2$ | | $\sigma = 5$ | | $\sigma = 8$ |
| Imbalance | 1.8 | | 4.5 | | 5.0 |
| Sensitivity to limits to international borrowing (percentage of GDP) $\bar{b}$ | | | | | |
| | $\bar{b} = 0$ | $\bar{b} = 0.7$ | $\bar{b} = 1$ | $\bar{b} = 1.3$ | $\bar{b} = \infty$ |
| Imbalance | 0 | 3.6 | 4.5 | 5.4 | –0.2 |
| Sensitivity to persistence of productivity shocks, $\rho$ | | | | | |
| | $\rho = 0.96$ | | $\rho = 0.98$ | | $\rho = 0.993$ |
| Imbalance | 2.4 | | 4.5 | | 9.0 |
| Sensitivity to fall in U.S. volatility, $\lambda$ | | | | | |
| | $\lambda = 0.25$ | | $\lambda = 0.33$ | | $\lambda = 0.50$ |
| Imbalance | 3.9 | | 4.5 | | 7.0 |

desire to consume early is reduced and so are their external imbalances. The second row highlights the effect of the tightness of the borrowing constraint. The effect of reduction in volatility on the external imbalance is nonlinear in the borrowing constraints. Obviously, when the constraints are set to zero, no borrowing is allowed and the response of U.S. imbalances to changes in volatility is zero. When constraints are initially relaxed, some borrowing is possible. As the constraints relax, U.S. consumers can reduce their precautionary balance more in response to a fall in volatility, and so the fall in volatility generates an imbalance that is larger the looser the constraint is. But as the constraints get very loose so that they no longer bind in equilibrium, the economy gets arbitrarily close to full risk sharing (see, for example, Baxter and Crucini [1995]). In a full risk-sharing equilibrium, agents no longer have a precautionary saving motive and so the reduction in the buffer stock of saving and the corresponding long-run imbalances do not emerge in response to a change in volatility.

The next row shows that the persistence of the shocks plays an important role. When shocks are very persistent, the precautionary saving motive is strong (as these shocks are hard to self-insure) and thus a reduction in shock volatility causes a large fall in the precautionary saving motive and a large imbalance. Notice that when $\rho$ is set to 0.993 the imbalance reaches about 9 percent of GDP.[12] When shocks are less persistent they are easier to insure, so agents hold less of a precautionary buffer and as a consequence the reduction in shock volatility generates a much smaller imbalance.

Finally, the last row shows that, not surprisingly, the larger the reduction in volatility, the larger the imbalance. When U.S. volatility falls by 50 percent (instead of 33 percent as in the benchmark case) the imbalance reaches 7 percent of GDP. If instead the reduction in volatility is only 25 percent, the imbalance falls to 3.9 percent.

12. The value of 0.993 is the highest value we can set in our numerical procedure.

## V. Conclusions

We have presented a simple framework to evaluate how much of the current U.S. imbalance can be explained by the great moderation, that is, the reduction in business cycle volatility that started in the mid-1980s and that has affected the United States more than its partners. We find that, *ceteris paribus*, the great moderation could be responsible for about 20 percent of the current U.S. external imbalance. Our study suggests that this part of the external imbalance deriving from the great moderation is not pathological and does not require any correction, but rather the opposite; it arises so that in a world with limited insurance possibilities agents can share the benefits of a unilateral reduction in volatility. We want to stress that our conclusion applies only to a fraction of the current U.S. external imbalances. Understanding the causes and consequences of the remaining (and large) part of those imbalances remains a hotly debated and important research question.

Finally, our empirical analysis is only limited to the United States and our theoretical framework is exceedingly simple, as we assume that the only internationally traded asset is a non-contingent bond. In ongoing work (Fogli and Perri [2006]), we extend this study in both directions, by examining the link between macroeconomic volatility and external imbalances in a large cross-section of countries (in emerging countries where macroeconomic volatility is greater, the effects we described might be quantitatively more important) and by considering a richer asset market structure where we allow for international diversification through stocks.

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# Comment*

**HANS GENBERG**

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It is a pleasure to discuss the paper by Alessandra Fogli and Fabrizio Perri. It is very interesting and stimulating, as it presents a new perspective on a topic that has been discussed extensively in the recent past. The new methodology emphasizes the importance of second moments of macroeconomic variables for the determination and savings and investment, and hence the current account. The results are intriguing, because they suggest that the current account deficit in the United States and the corresponding surplus elsewhere is not something that one needs to worry about: they simply represent efficient responses to underlying shocks.

The objective of the paper is to find a unified explanation of the so-called great moderation in the United States and what one can perhaps call the great imbalance. The "great moderation" refers to the reduction in the volatility of U.S. business cycles since approximately 1984. The great imbalance is the deterioration of the net international investment position of the United States. Other researchers tend to emphasize the recent evolution of the current account deficit instead and, depending on which of the two one looks at, the timing of the onset of the imbalance can be debated. If one looks at the current account as a percentage of GDP, the beginning

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of the great imbalance can be dated either in the mid-1970s, in 1984, or indeed in 1998, when there was a sharp increase in the deficit. If on the other hand one associates the external imbalance with the net international investment position, then the start can indeed be fixed as sometime close to the start of the great moderation in 1984. I suspect that the differences in the evolution of the two measures of the external imbalance are due to valuation effects of external claims and liabilities and the sharp decline in the U.S. dollar during this period. If this is correct, it would be useful to explain, within the context of the type of model used in the paper, how one should treat exchange rate-induced changes in the investment position. They should presumably be incorporated in both the portfolio decisions of agents and in their savings/consumption choices.

Be that as it may, the basic idea of the paper is that lower business cycle volatility in the United States relative to the rest of the world has reduced precautionary savings in the United States. Part of that has been financed by borrowing abroad. To induce foreign residents to lend, the interest rates on the debt must increase. That reduces investment abroad, and hence there is consistency with the increased current account deficit in the United States. Expressed as simply and intuitively as possible, this then is the basic message of the paper. But of course much more is involved once one moves beyond impact effects and studies the dynamics of the economies over time. Here it becomes a bit harder to provide intuitive explanations for the results, as we shall see in a moment.

The model proposed in the paper is a real business cycle model with two countries and one good. I like the simplification of using a one-good framework, because it means that one does not have to worry about the exchange rate, and it therefore shifts the emphasis of the analysis away from exchange rate adjustments to the evolution of savings and investment. I think that is a useful first approximation.

The emphasis on second moments of shocks means that it is not possible to analyze a linearized version of the model, and therefore to find analytical solutions. Instead, the properties of the model are explained by means of simulated impulse responses to changes in variances of shocks.

Consider a reduction in the variance of total factor productivity (TFP) shocks in the United States that will lead to a reduction in the variance of output as required to explain the great moderation after 1984; as already noted, precautionary saving falls and consumption increases. In addition, capital in the United States is now a safer asset and there will be an increasing demand to hold that asset. Therefore, investment should increase. The current account deteriorates because consumption and investment increase, and output is unchanged initially. Turning to the effects in the rest of the world, as consumption and investment in the United States are financed by borrowing abroad, the interest rate on debt will have to increase. The risk-adjusted relative return on capital abroad therefore declines, because there is no change in volatility and the return on debt has increased. Hence investment falls abroad. So we get consistency between the savings-investment balance in the United States on the one hand, and that in the rest of the world on the other.

Do we find these patterns in the data? If one looks at the current account, it deteriorates significantly at about the same time as the great moderation started in

1984, and savings declined. These facts represent a fairly clear consistency between the model's predictions and actual outcomes in the United States. Turning to the dynamics of investment over time, the correspondence between model simulations and facts is more complicated. The model predicts that there should have been an initial investment boom in the United States, but this does not seem to have happened.

So, does the model explain the facts? Yes and no. The current account and savings do go in the right direction initially, but one of the problems is that the current account keeps getting worse in the data, especially after 1997 and 1998, whereas the model predicts a return to balance in the absence of further shocks. So, as Perri emphasized in his oral presentation, the authors do not claim to have a complete explanation of the evolution of the external accounts of the United States. Rather, they make a case that the reduction in volatility of TFP shocks in the U.S. economy is one of the factors responsible for the external imbalance of the past 20-odd years.

Let me now turn to three conundrums concerning the response of the model to a reduction in the volatility of TFP shocks in the United States.[13] The first relates to the long-run response of the capital stock in the two economies. My intuition would be that as capital in the United States has become a relatively safer asset, capital market equilibrium would entail a lower return on this asset. This in turn would imply a higher capital stock in the steady state.[14] In the rest of the world, the real return on debt has increased in the long run. My intuition suggests that this would lead investors to require a higher return on capital as well, leading to a lower capital stock. In both cases, the impulse response functions show exactly the opposite results from what my intuition tells me. It would be useful if the authors could discuss why the model produces these results which are, at least to me, counterintuitive. A related point is that investment in the rest of the world is negative throughout, yet the capital stock appears to return to the initial level at the end of the simulation period. This requires some explanation.

The second conundrum relates to the behavior of consumption. On impact consumption in both countries increases even though capital, and therefore output, falls (at least in the United States). So output falls, yet consumption increases. That is interesting, and could come about if the initial equilibrium was one where the capital/labor ratio was greater than that associated with the Golden Rule. Apparently, this is a property of the model and the parameters used in the simulations. It would be interesting to find out if other parameter values would result in a substantially different initial equilibrium and therefore different dynamics after the shock.

The third conundrum again relates to the behavior of investments during the initial few years of adjustment. First, there are sharp upward and downward adjustments in investment in both countries during the initial periods. I would have thought that in models were there are costs of adjustment of capital such spikes would be smoothed out. Furthermore, in the United States it appears that the capital stock first increases and then decreases. It is a bit surprising that when there are costs

13. According to an online dictionary, there are three precise meanings of "conundrum": (1) a riddle whose answer is or involves a pun; (2) a question or problem having only a conjectural answer; and (3) an intricate and difficult problem. It is the third meaning of the word that I am referring to here.

14. Since the economic environment is stochastic, it is not possible to find a steady state where the capital stock is exactly constant. However, the impulse response functions do seem to settle down to approximately constant values after a long-enough period of adjustment. It is in this sense that I use the notion of a steady state here.

of installing capital investors do not simply allow a smooth decline of the stock of capital through depreciation instead of incurring the adjustment costs implied by the initially increasing capital stock. Presumably, the answer must be imbedded in the exact nature of the adjustment costs function. It would be interesting if the authors could show results for other specifications than that which lies behind the impulse responses shown in the paper.

After raising these points where the intuitive explanation of the results is not quite clear, I would like to offer some suggestions that could help in rendering the paper more accessible and allow it to address additional aspects of the external imbalance of the United States. First, it would help the reader if it were possible to compute and discuss the nature of steady-state equilibria before one gets into the dynamics. If the authors could explain where the economies in the model would be once the impulse response functions have become approximately flat, then it is likely that it would be easier to account for the dynamics of adjustment.

My second suggestion relates to the sharp increase in the current account deficit after 1997–98. In the spirit of the model, and also reflecting perceptions in East Asia (a major counterpart to the U.S. current account deficit), perhaps this is due to increased (actual or perceived) risk in East Asia. It is frequently mentioned in discussions of the buildup of foreign exchange reserves of central banks in this region that this buildup represents self-insurance against possible shocks. The potential size of such shocks was revised upward in response to the events in 1997–98. If the private sector in East Asia thinks of these shocks in the same way, the authors' model would predict that there would be a reduction in investment in the region. If one looks at the data, this is exactly what happened after 1997–98, apart from mainland China. As saving rates stayed more or less constant, countries in the region developed sizable current account surpluses. So, in the spirit of the model, this event could explain the sharp deterioration of the U.S. current account in the past six to seven years, something that the focus only on the initial TFP shock in the United States could not account for.

My final suggestion would be to combine the model in the paper with that presented by Maurice Obstfeld in his keynote speech at this conference.[15] In that paper, the change in the current account is introduced exogenously, and the implication for changes in relative prices is derived. The paper by Fogli and Perri presents a theory of where the changes in the current account may come from. Put the two papers together, and you have an explanation both of the change in the current account itself and the associated real exchange rate adjustments. It would be very interesting to find out if such a combined model could generate the relationships between current account imbalances and real exchange rates that are often referred to in policy discussions of current account adjustments. If it could, we would have an explanation of a relationship between these two variables that is entirely driven by a third factor, technology shocks, and which is therefore void of any policy implication, contrary to what is often suggested in the recent debate.

In summary, this is an interesting paper, which I enjoyed reading. The results are intriguing, as they suggest that there is no need to worry about current account

15. See Obstfeld (2006).

imbalances. I believe that providing some more intuitive explanations of the specific results would be helpful, as it would make the paper more accessible. Extensions to include more than one good and therefore the response of relative prices in the model would also be useful, as it would shed light on the relationship between current account adjustments and real exchange rate changes that is a major focus of much of the recent policy debate.

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# Comment*

**AVIRAM LEVY**
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First of all, I would like to thank the organizers for inviting me to discuss this paper, which I enjoyed reading. The paper makes an effort, which should be praised, to apply international real business cycle models to the explanation of current account imbalances, which is a popular topic for central banks these days. As we have just heard, the paper's conclusions are reassuring, and they subscribe to the so-called "benign" view of the U.S. current account deficit. Let me say from the beginning that I find the model very original and well focused. But like other real business cycle models, its weakness seems to be represented by the difficulty it has in fitting the actual evolution of the macroeconomic variables that it considers. In my presentation, I will comment on the plausibility and the realism of the assumptions and of the numerical solutions of the model, and I will say a few words on the extent to which they are consistent with the observed macroeconomic trends. In doing so, I will deliberately play the role of the "contrarian," focusing only on the weaknesses of the model and ignoring its points of strength.

A first issue is represented by the role of technology shocks in explaining lower macroeconomic volatility. The model assumes that the decline of output volatility was driven by a reduction in the volatility of underlying technology shocks. This is, of course, a simplification. We know that there is a large body of literature—with many contributions coming from staff of the Federal Reserve System—highlighting other

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factors which played a role in reducing output volatility: among them, improvements in inventory management, financial innovation, and the conduct of monetary policy.

Let me turn now to the supposed effects of the "great moderation" on investment and savings in the United States. The model suggests that, over the last 20 years, on the one hand the great moderation raised equilibrium investment, and on the other hand it reduced precautionary saving, thus bringing an increase in the current account deficit. But this claim is not easy to reconcile with the empirical evidence. The first problem is with household saving: it is true that it has declined sharply in the last 20 years, as already mentioned by my co-discussant. However, household saving may have declined for other reasons than reduced uncertainty. There are a number of studies that use micro-data on consumer incomes and consumer finances—see, for instance, Hurst *et al*. (2006)—and show that in the United States the precautionary motive for saving has been traditionally negligible, at least since the early 1990s, which is the earliest period for which panel data on consumer incomes are available. The other claim of the paper that does not fit reality perfectly has to do with capital accumulation in the United States. If we look at the past evolution of investment as a ratio of GDP, it is not evident at all that over the last 20 years this ratio was higher than in the previous 20 years. There was indeed a sharp increase in the investment to GDP ratio in the second half of the 1990s, which was a reflection of the stock market rally. But in the last five years, part of this was reversed and the cyclical rebound of investment was very weak and disappointing, especially in comparison with the very good performance of corporate profits.

A related weakness of the model has to do with the effects of the great moderation on external balances in countries other than the United States: if macroeconomic volatility has driven the current account in the United States, one would expect the same to have taken place, to some extent, also in the European Union (EU) and in Japan. But that was not the case if we look at the actual data. In the case of the EU, Table 1 of the authors' paper shows that medium-run macroeconomic volatility, as captured by the low-pass filter that excludes cycles longer than 80 quarters (LP80), has increased, and as expected, precautionary saving has increased. But this has not translated into a current account surplus, rather the opposite: after many years of external accounts being close to balance, in 2005 there was a slight current account deficit. Something similar can be said about Japan: the paper shows that there was a large decline of macro volatility in the last 20 years, but this did not translate into a current account deficit.

Let me turn now to some problems of "timing" that can be found in the results of the paper. The first issue is the timing of the great moderation and the U.S. external deficit: as already mentioned by my co-discussant, the paper assumes that the worsening of the U.S. external balance started in the mid-1980s, coinciding with the great moderation. But if we consider flows rather than stocks, one can argue that the discontinuity of the U.S. external account was in the mid-1990s rather than in the mid-1980s. In fact, according to many commentators the worsening of the external accounts in the 1990s was a temporary reflection of President Ronald Reagan's economic policies and of the associated U.S. dollar appreciation, but most of that worsening was reversed in the following years until, in the early 1990s, the current account returned to balance. Since we are talking about flows and stocks, a related

problem of the paper is represented by valuation effects. The paper claims that it can explain one-third of the U.S. net investment position, but we all know that without valuation effects the net investment position in the United States would be much larger today. As a consequence, the paper's claim that it explains one-third of the U.S. external imbalance may be an overstatement.

The other issue related to timing is represented by the impulse responses of the model, whose time profile and size are not plausible. First, the effects of the great moderation on the current account are very front-loaded. This has already been noted by my co-discussant: most of the adjustment takes place over the first four to five years after the shock; after 15 years, the current account is back to zero. One obvious implication of this result is that the current account deficits of the last few years have not reflected anymore the decline of volatility but, most likely, other factors.

In conclusion, my comments on the paper can be summarized as follows. First of all, the links between the great moderation, savings, investment, and the current account as implied by the model do not fit reality very well. The model indeed explains part of the U.S. external deficit, but it does so far away in the past. As a consequence, it fails to explain the worsening that has taken place over the last 10 years. Even adjusting the results for the excessive front-loading of the model, which may reflect the assumption that volatility of productivity shocks falls instantaneously, the explained portion of the current account deficit is still small: this portion is 0.8 percent of GDP at impact and around 0.3 percent in the following years. In summary, the model proposed by the authors is very original and well focused, but the paper's policy conclusions are somewhat optimistic as regards the portion of the U.S. external imbalance that is explained by the model.

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## General Discussion

Responding to the comments by the discussants, Fabrizio Perri stressed that the paper should not be interpreted as reflecting optimistic views about the state of U.S. external imbalances. As for the discrepancies between the actual and predicted movements in the U.S. current account and investment, he stated that the model abstracted from factors that had been found important in describing these variables in the previous literature. He agreed with the suggestion by Hans Genberg that incorporating additional countries with increased business cycle volatility in the late 1990s would improve the model's fit for the U.S. current account during that period. Regarding the measure of external imbalances, Perri claimed that the net foreign asset position rather than the

current account should be used, because the former takes into account valuation effects. He agreed with Aviram Levy's point that the size of precautionary savings was small at the micro level, but stated that it could be slightly larger at the aggregate level.

In the general discussion, several participants made comments on the fit of the model to the data. Anthony Richards (Reserve Bank of Australia) suggested testing the predictions of the model using the data from many countries other than the United States. Maurice Obstfeld (University of California at Berkeley) suggested comparing the movements of Tobin's Q predicted by the model to the evolution of stock prices in the United States, anticipating that the model accounts for the stock market boom in the mid-1980s but not that in the 1990s. Hung Tran (International Monetary Fund) pointed out that the model's prediction of a rise in the real interest rate around 2000 was not consistent with the global decline in the interest rates observed around that period. Perri replied that the global decline in the interest rates could be explained by other factors than that proposed in the paper. Observing that the beginning of the U.S. current account deterioration could be dated to 1981 instead of 1984, Junggun Oh (The Bank of Korea) wondered how one explains the U.S. current account deterioration during the period when the business cycle volatility was high in the United States.

Several participants commented on the assumptions of the model and the calibration of the parameters. Lucrezia Reichlin (European Central Bank) referred to the fact that the business cycle persistence was lower in the United States than in Europe, and argued that the model overstated the size of external imbalances since it assumed the same persistence for both the United States and the rest of the world. Perri agreed and added that the sensitivity of the predictions of the model to the modification suggested by Reichlin depended on the calibration of other parameters such as the degree of risk aversion. David Longworth (Bank of Canada) pointed out that different countries experienced great moderation at different times, and argued that assuming the same timing for all the countries made the model overestimate the size of external imbalances. Perri replied that more flexibility is desirable in terms of the assumed timings of the great moderation across countries. Longworth also questioned the assumption that the great moderation was recognized immediately when it occurred in 1984, referring to the fact that even economists took a long time to recognize it. Regarding the assumption that agents were perfectly insured against their idiosyncratic shocks within a country, Kenneth N. Kuttner (Oberlin College) asked whether there was any evidence that the volatility of the idiosyncratic shocks had decreased in the United States or that the ability of individuals to insure against their idiosyncratic shocks had improved. Perri responded that the volatility of the idiosyncratic shocks had increased in the United States, while the ability of individuals to insure against their idiosyncratic shocks may have improved because the credit markets had developed.

Several participants suggested possible extensions of the model. Richards and Obstfeld suggested incorporating a richer portfolio structure by allowing agents to hold foreign equities. Perri thought that the modification would affect the predictions of the model through two channels: first, it leads to a greater diversification of risks and the precautionary saving motive becomes weaker, and second, it increases the global demand for U.S. assets when the U.S. capital becomes less risky. Hiroshi Fujiki (Bank of Japan) suggested considering the role of financial globalization that

occurred concurrently with the great moderation in the United States, noting that financial globalization may have contributed to a decrease in the size of the shocks to the economy or an increase in the degree of international spillover of the shocks. Sylvain Leduc (Board of Governors of the Federal Reserve System) suggested incorporating endogenous labor supply decisions into the model, as this would help the model to explain a larger fraction of the U.S. current account deficits following the great moderation.