

# Productivity Shocks, Global Financial Integration, and the U.S. Current Account

Suparna Chakraborty\*, Robert Dekle†

April 16, 2008

## Abstract

An influential explanation for the recent rise in the U.S. current account deficit is the boom in U.S. productivity. Using a two country general equilibrium model, this paper quantitatively shows that the gap in productivity growth between the U.S. and the "rest of the world" cannot explain the U.S. current account deficits, especially in the 1980s and the 2000s. This is because on a GDP-weighted basis, the "rest of the world" actually had higher productivity growth during these periods, and standard macroeconomic models would predict an outflow of funds from the U.S. to the rest of the world, and a consequent U.S. current account *surplus*. We show that changes in the degree of global financial integration can help explain this anomaly in U.S. current account behavior. We find, however, that our model overpredicts the growth in U.S. GDP in the 1990s and 2000s.

JEL Codes: F32, F34, F36

*Keywords:* Current account deficit, productivity, financial integration, general equilibrium

## 1 Introduction

In recent years, rising global current account imbalances have attracted much attention. The overall U.S. current account deficit rose from a modest \$120 billion in 1996 (1.6% of GDP) to \$666 billion in 2005 (6.06% of GDP) (**Figure 1-A**). There are four distinct periods of evolution: 1980 to 1986 when the U.S. current account deficit widened, followed by 1986 to 1991, when the deficit declined. The 1990s were a period of almost continuous widening of the US deficit (except for a brief period during 1994 to 1997), with the current account deficit rising especially rapidly since 2000. In **Figure 1-B**, we decompose the U.S.

---

\*Department. of Economics and Finance, Baruch College, CUNY

†Department of Economics, University of Southern California. The authors thank the participants in the 2007 Econometric Society Summer Meetings for helpful comments. Any opinions expressed are those of the authors and not necessarily those of the Federal Reserve System.

current account deficit into that with Europe, Japan, emerging Asia, and the Middle East. Although because of data limitations, the decomposition including emerging Asia can only be performed after 1999, it is evident from Figure 1-B that in the last few years, the deficit with emerging Asia is the most rapidly growing component of the U.S. current account deficit (by 2005, accounting for about 30 percent of the total U.S. deficit.)<sup>1</sup>

Perhaps the most influential explanation of this phenomenon of widening U.S. current account deficits is that of widening productivity gaps between the U.S. and the "rest of the world." Since the mid-1990s, the U.S. economy experienced a productivity surge—and a rise in real returns to capital—while productivity in Europe and Japan stagnated. IMF (2005), Hunt and Rebucci (2005), and Engle and Rogers (2006) attribute the widening U.S. current account deficits to funds from the Europe and Japan seeking higher returns in the U.S. A rise in U.S. productivity relative to the world will raise U.S. investment and consumption, and increase the U.S. current account deficit.

This "productivity gap" view, however, cannot explain the rising U.S. deficits since 2000. Table 3 depicts our calculations of Total Factor Productivity (TFP) growth for the "rest of the world," when that region includes: 1) only Europe and Japan; and 2) Europe, Japan, and emerging Asia for different subperiods since 1980. While it is true that U.S. productivity growth has outstripped the world's between 1991 and 2000; since 2000, U.S. productivity growth has lagged by a large margin, the productivity growth in the world, including that of emerging Asia. This is mainly because of very rapid TFP growth in emerging Asia (over 5 percent), particularly in China (Dekle and Vandenbroucke, 2006), and of the growing economic weight of emerging Asia in the world (**Figure 1-C**). If the differential productivity view is correct, then the U.S. should have been running current account surpluses (or, at the least, experience a decline in the deficit), and funds should have been flowing *out* from the U.S. in the 2000s, when in fact the opposite happened. The phenomenon of high U.S. current account deficits despite relatively low U.S. TFP growth is actually not unique to the last few years. Throughout the 1980s, U.S. productivity growth lagged those of Europe and Japan's, but the U.S. ran high current account deficits (**Figure 1-A, Table 3**)<sup>2</sup>.

In this paper, we provide an accounting of why the U.S. ran current account deficits, despite higher productivity growth in the "rest of the world," not only in the post-2000 period, but also in the past, the 1980s. Using an explicit, two-region dynamic stochastic general equilibrium model, we attribute U.S. current account deficits to changes in the "cost" of buying U.S. assets in the "rest of the world." We interpret this "cost" as relating to regulatory and other changes in the financial sector; and find that our model-derived measure correlates closely during our period of analysis (1980-2003) with other well-known measures of

---

<sup>1</sup> See Dekle, Eaton, and Kortum (2007) for the role of China and emerging Asia in explaining U.S. current account deficits; and how much exchange rates need to adjust to equilibrate the U.S. current account deficits.

<sup>2</sup> The US current account *deficit* as a share of GDP widened in the early eighties though there was some narrowing of the deficit since 1986.

global financial deregulation (Chinn and Ito, 2005); and with distinct, identifiable episodes of global financial shocks.

Our results are robust to raising the persistence of underlying productivity shocks to a random walk process in our benchmark model; and to introducing adjustment costs to physical capital in an extended version of the benchmark model. These two modifications will introduce persistence in output and investment, and combined with the usual persistence in consumption, introduce persistence in the current account. Despite these modifications, we find that our measure of financial liberalization still accounts for the bulk of the actual U.S. current account balance.

Our benchmark model is a standard two region business cycle model, where regions trade in final goods and international assets, but not in factors of production. In contrast to standard imperfect asset market models as in Baxter and Crucini (1995), we assume that international asset trading is costly. These costs can be interpreted as monitoring costs or administrative costs associated with international lending, and are dependent on a region's financial institutions. Introducing costs to asset trading helps capture the evolution of financial markets in a simple way. Specifically as a region's financial markets evolve, and there is a move towards increased financial integration, these trading costs decline. Regions are ex-ante symmetric, although ex-post they may differ in their productivity shocks and openness of financial markets. In our quantitative analysis, the two regions represent the United States and the "rest of the world."

Our benchmark model gives us two testable hypothesis: (1) a positive productivity gap between the U.S. and "rest of the world" results in a current account deficit in the U.S.; (2) financial liberalization in the "rest of the world," interpreted as a decline in the cost of international asset trading, leads to an influx of funds into the U.S. that magnifies the current account deficit. We test our first hypothesis by taking our model to the data, and feeding in the observed series of measured Total Factor Productivity shocks, and assuming that costs of asset trading do not change, see how well our model accounts for observed pattern of the current account deficit. This exercise tells us that TFP alone is not enough to account for the US current account deficit, and some other force is at work.

Our model, however, fails to explain why growth in U.S. per capita GDP is so low, despite the high inflow of capital into the U.S. One possible explanation that we quantitatively examine is that the capital was diverted to the government sector. In addition, the cost of adjusting capital is also a potentially important factor that keeps the U.S. from fully utilizing the benefits of increased capital inflows. We find that introducing these two modifications lowers predicted U.S. output as compared to our benchmark model. However, predicted U.S. output is still much higher than that what is observed in the data, which leaves us with a puzzle: why did not the inflow of funds into U.S. lead to a much higher growth of output?

The idea that changes in overseas—especially emerging Asian—financing behavior can be related to the expansion of the U.S. current account was first

floated by Dooley, Folkerts-Landau, and Garber (2004) and Chadha (2006) (the so-called "Deutsche Bank" view). Mendoza, Quadrini, and Rios-Rull (2006), and Caballero, Farhi, and Gourinchas (2006) have both formally modelled this idea.<sup>3</sup> These papers, however, are all theoretical; and do not perform the empirical exercise that we do here for the first time, depicting how a reasonable pattern of changes in global financial structure—amended to a standard two-country macroeconomic model—can quantitatively account for the evolution of the U.S. current account.

The rest of the paper is organized as follows. In Section 2, we present the theoretical model underlying our quantitative analysis. Section 3 summarizes the qualitative predictions of our model. In Section 4, we take our model to the data and present the results of our quantitative exercise. We also introduce modifications to our benchmark model to get a better match to the data. Finally, Section 5 concludes.

## 2 Benchmark model

Our model builds on the incomplete financial markets framework developed by Baxter and Crucini (1995). In the Baxter and Crucini (1995) model, instead of a full set of contingent financial contracts, there is only one internationally traded asset, a bond, which can be freely bought and sold. In our set up, we introduce costs to international lending or to the buying and selling of foreign bonds, which are intended to capture various frictions arising from the lack of liberalization in international financial transactions, such restrictions on foreign lending by domestic banks or taxes on the purchases of foreign bonds and assets.

Time is discrete, indexed by  $t = 0, 1, 2, \dots$  and the time horizon is infinite. The world is comprised of two countries, Home and Foreign, indexed by  $i \in (H, F)$ , each of which is populated by an unit measure of identical, infinitely-lived households<sup>4</sup>. In addition to households, each country is also populated by an infinite number of perfectly competitive firms that own the production technology. There is only one good in our model, produced by the firms in each country, using country-specific capital and labor. Once produced, the good is then traded between the two countries, and is used for consumption and investment.

The goal of the paper is to quantitatively study the impact of differential productivity growth on global imbalances in an environment of increasing asset market integration. To this end, we introduce costs to international lending, or to the purchase of foreign bonds, where costs reflect the relative difficulty of foreign financial market access. Costs evolve according to changes in domestic and international regulations, with a lowering of costs reflecting increasing ease of access to global financial markets.

---

<sup>3</sup>Other papers using dynamic optimizing frameworks to analyze the U.S. current account include Cavallo and Tille (2006), and Faruqee, Laxton, Muir and Pesenti (2005).

<sup>4</sup>The assumption of equal population size is for simplicity. Relaxing the assumption would modify the resource constraints. Our main findings would not change.

Uncertainty in our model arises from country-specific productivity shocks, and shocks to the costs of foreign lending. The countries are ex-ante perfectly symmetric.

## 2.1 Preferences and technologies

Households in country  $i$  maximize expected discounted utility over consumption  $c_{it}$ , and leisure  $1 - l_{it}$ :

$$E \sum_{t=0}^{\infty} \beta_i^t u(c_{it}, l_{it}) \quad (1)$$

The budget constraint is given by:

$$c_{it} + x_{it} + s_{it} + f(s_{it}, \phi_{it})s_{it} \leq w_{it}l_{it} + r_{it}^k k_{it-1} + R_t s_{it-1} \quad (2)$$

where  $w_{it}l_{it}$  denotes labor income, and the return to capital is given by  $r_{it}^k k_{it-1}$ . In addition, households earn returns on international lending where  $R_t$  represents the gross world interest rate at time  $t$ .

Income is used to finance consumption, physical capital investment,  $x_{it}$ , and for international net lending. International net lending, or the purchasing (or selling) foreign bonds involves a cost, where  $f(s_{it}, \phi_{it})$  denotes the cost of purchasing a foreign bond in terms of the final good. If buying or selling bonds is frictionless, as in the usual Baxter and Crucini (1995) model, then  $f(s_{it}, \phi_{it}) = 0$ .

We take  $f(s_{it}, \phi_{it})$  to encompass all the impediments and frictions that the home country may have in lending to the foreign country. These impediments and frictions may include constraints on international lending such as foreign exchange controls, or bank minimum capital requirements, which restrict foreign bank lending. They may also include frictions arising from asymmetric information that impair the ability of home lenders to costlessly acquire information about the behavior of foreign firms (the borrowers). In many models, these asymmetric information problems will lead to additional monitoring costs for the home lender, raising the costs of lending (Bernanke, Gertler, and Gilchrist, 1995).

The evolution of the capital stock is captured by:

$$k_{it} = (1 - \delta_i)k_{it-1} + x_{it} \quad (3)$$

For our purposes, we assume unit costs are constant with respect to the amount of foreign lending, or the purchase of foreign bonds,  $s_{it}$ , but vary over time:

$$f(s_{it}, \phi_{it}) = \phi_{it} \quad (4)$$

$\phi_{it}$  captures the impact of external factors that affect the cost of purchasing bonds or of lending internationally. Financial liberalization is captured by a

decline in  $\phi_{it}$  that allows households to lend more, or to purchase more foreign bonds, at lower costs.

The perfectly competitive firms own a production technology that combines labor  $l_{it}$  and capital  $k_{it-1}$  to produce the traded good  $y_{it}$  :

$$y_{it} \leq F(A_{it}, k_{it-1}, l_{it}) \quad (5)$$

$A_{it}$  represents productivity that is exogenously determined. Ex-post, the home and the foreign countries differ with respect to country-specific productivity shocks. A country experiencing a negative productivity shock will increase saving and accumulate foreign bonds; the country experiencing a positive productivity shock will run a current account deficit.

Every period, the firm maximizes profits  $\pi_{it}$  subject to the production technology summarized in (5), where profits are given by:

$$\pi_{it} = y_{it} - w_{it}l_{it} - r_{it}^k k_{it-1} \quad (6)$$

The world goods market clearing condition requires that aggregate consumption and investment in the world be less than or equal to world production of the traded good:

$$\sum_{i=H}^F (c_{it} + x_{it}) \leq \sum_{i=H}^F y_{it} \quad (7)$$

Bond market clearing requires that the aggregate bond holdings in the world every period is zero:

$$\sum_{i=H}^F s_{it} = 0 \quad (8)$$

We are interested primarily in the dynamics of the current account in our model. The current account in country  $i$  is defined as the sum of the trade balance and net interest payments. Given our model, the current account is given by:

$$y_{it} - c_{it} - x_{it} - (R_t - 1) s_{it-1} \quad (9)$$

where  $y_{it} - c_{it} - x_{it}$  is the trade balance, and  $(R_t - 1) s_{it-1}$  is the net interest earnings on foreign lending (bonds).

Given the budget constraint summarized in (2) and the definition of the current account as summarized in (9), we can express the current account in country  $i$  as:

$$s_{it} + \phi_{it} * s_{it} - s_{it-1} \quad (10)$$

which is of course identical to the net change in international lending in the home country, or borrowing by the foreign country.

## 2.2 Equilibrium

An equilibrium in our model is given by a vector of allocations  $\{c_{it}, l_{it}, x_{it}, k_{it}, y_{it}, s_{it}\}_{t=0}^{\infty}$ ,  $i = H, F$  and a vector of prices  $\{w_{it}, r_{it}^k, R_t\}_{t=0}^{\infty}$ ,  $i = H, F$  such that given a state of the economy summarized by  $\{k_{it-1}, s_{it-1}\}_{t=0}^{\infty}$ ,  $i = H, F$ , and exogenous shocks to productivity and cost of lending  $\{A_{it}, \phi_{it}\}_{t=0}^{\infty}$ ,  $i = H, F$ , the allocations and the prices solve (1) the representative household's utility maximization problem (summarized in (1) to (4)) and (2) the firm's profit maximization problem (summarized in (5) and (6)), (3) the world resource constraint is satisfied (summarized in (7)), and (4) the bond market clearing condition is satisfied (summarized in (8)).

Note that balanced growth in our model assumes that the long run rate of technological progress, denoted in our model by  $\gamma$ , in the two countries are identical.

## 3 Model Predictions

Ex-ante we have two equally sized countries,  $H$  and  $F$  that are symmetric in every respect. Ex-post we allow them to vary with respect to productivity,  $A_{it}$  and bond trading cost  $\phi_{it}$ . Taking the U.S. as the foreign country, and the rest of the world as the home country, we make the reasonable assumption that the U.S. and the rest of the world are equally sized, since U.S. GDP is about 1/3 of world GDP.

### 3.1 Parameters

The utility function is assumed to be quasi-linear (often referred to as GHH after Greenwood, Hercowitz and Huffman (1988)) where:

$$u(c_{it}, l_{it}) = \frac{\left(c_{it} - \frac{\psi}{v} l_{it}^v (1 + \gamma)^t\right)^{1-\sigma}}{1 - \sigma} \quad (11)$$

The GHH preferences are widely used in the international macroeconomics literature (see Mendoza (2006)) as it better fits certain international business cycle facts as compared to Cobb-Douglas preferences.

The production function has a labor-augmenting Cobb-Douglas form:

$$F(A_{it}, k_{it-1}, l_{it}) = k_{it-1}^{\theta_i} (A_{it} l_{it} (1 + \gamma)^t)^{1-\theta_i} \quad (12)$$

The key parameters are summarized in **Table 1**. We choose the share of capital to be 33% of GDP in both countries yielding  $\theta_i = .33$ ,  $i \in \{H, F\}$ . Capital is assumed to depreciate at an annual rate of 10% so that  $\delta_i = 0.10$ ,  $i \in \{H, F\}$ . These parameters are taken from Backus, Kehoe and Kydland (1992). We assume  $\sigma = 2$ . The long term growth rate of technological progress or  $\gamma$  is taken as 2%, and the steady state rate of interest is taken as 6%. Further, assuming that in the steady state, households in both countries choose

to allocate 33% of their time to work (from Backus, Kehoe and Kydland (1992), and normalizing the steady state output to be 1, we calculate  $\psi = 3.95$ , given  $v = 1.6$  (from Mendoza (2006)).

$\phi_{it}$  embodies intangibles like information about domestic and international policies regarding a country's access to world financial markets. We back out the steady state value of  $\phi_{it}$  from the budget constraint, and the first order conditions of the model, shown below. To do this, we need steady state values of the capital output  $\frac{k_i}{y_i}$  ratio, and the net lending to output ratio  $\frac{\Delta s_i}{y_i}$ . The capital output ratio is taken as the average long run capital to output ratio of the U.S. economy. The net lending (or U.S. borrowing) to output ratio is estimated to match the average ratio of net current account balances of the U.S. to its output, over the period 1980 to 2003. This yields the net lending to output ratio of .012 or gross lending to output ratio  $\frac{s_i}{y_i}$  of .61. Given these parameters, the steady state  $\phi_i$  is calculated to be .0127. Given our steady state capital output ratio, we calculate  $\beta_i = .99$ .

## 3.2 Qualitative Results

### 3.2.1 Solution Algorithm

Given the functional specifications, the necessary first order conditions of our model for country  $i \in \{H, F\}$  are given by:

$$\left(c_{it} - \frac{\psi}{v} l_{it}^v\right)^{-\sigma} - \lambda_{it} = 0 \quad (13)$$

$$(1 - \theta)y_{it} - \psi l_{it}^v = 0 \quad (14)$$

$$\lambda_{it+1} \left(\theta \frac{y_{it+1}}{k_{it+1}} + 1 - \delta_i\right) - \frac{(1 + \gamma)^\sigma}{\beta_i} \lambda_{it} = 0 \quad (15)$$

$$\lambda_{it+1} R_{t+1} - \frac{(1 + \gamma)^\sigma}{\beta_i} \lambda_{it} (1 + \phi_{it}) = 0 \quad (16)$$

where  $\lambda_{it} \beta_i^t (1 + \gamma)^{t(1-\sigma)}$  is the shadow price of consumption; and the variables are detrended by their long term growth rates. Equation (13) and (14) are standard. Equation (13) equates the marginal utility of consumption to its shadow price, and Equation (14) equates the marginal rate of substitution between consumption and leisure to the marginal product of labor. Note that under quasi-linear (or GHH) preferences, the marginal rate of substitution between consumption and leisure is independent of consumption, making labor choice immune to wealth effects. Equation (15) and (16) are the intertemporal conditions for investment in capital, and for international net lending.

From (16), we can see that in equilibrium, the marginal disutility from diverting one unit of output from consumption to bond purchase is equated to the present discounted value of the future marginal utility gained from the international lending or of bond returns. Usually, this disutility would just be

the shadow price. However, in our setup, an extra unit of lending or bond purchases, increases the cost associated with bond trading, and this cost has to be taken into account when calculating the marginal disutility today.

We solve our model using the technique of log-linearization. To that end, we first need to specify the stochastic processes underlying our exogenous variables.

The stochastic processes are vector autoregressive processes of order one and are given by:

$$\begin{bmatrix} \tilde{A}_{Ht} \\ \tilde{A}_{Ft} \\ \tilde{\phi}_{Ht} \\ \tilde{\phi}_{Ft} \end{bmatrix} = P \begin{bmatrix} \tilde{A}_{Ht-1} \\ \tilde{A}_{Ft-1} \\ \tilde{\phi}_{Ht-1} \\ \tilde{\phi}_{Ft-1} \end{bmatrix} + \begin{bmatrix} \tilde{\epsilon}_{AHt} \\ \tilde{\epsilon}_{AFt} \\ \tilde{\epsilon}_{\phi Ht} \\ \tilde{\epsilon}_{\phi Ft} \end{bmatrix} \quad (17)$$

where  $\tilde{A}_{it}$ ,  $i \in \{H, F\}$  denotes the log deviation of productivity from its steady state, and  $\tilde{\phi}_{it}$ ,  $i \in \{H, F\}$  denotes the deviation of the cost of bond trading from its steady state. Epsilon or the error terms capture the shocks.  $P$  is a 4x4 matrix that summarizes the parameters underlying the stochastic process. The innovations  $\{\tilde{\epsilon}_{AHt}, \tilde{\epsilon}_{AFt}, \tilde{\epsilon}_{\phi Ht}, \tilde{\epsilon}_{\phi Ft}\}$  are serially independent, multivariate normal random variables. The variance-covariance matrix of the innovations is summarized by another 4x4 matrix that we call  $Q$ . We initially assume no contemporaneous correlation of the innovations in the two countries<sup>5</sup>.

For our analysis, we take the parameters determining the evolution of productivity from Kehoe and Perri (2002). While we have backed out the steady-state value of  $\phi_{it}$ , the cost of international lending, the stochastic process driving  $\phi_{it}$  over time is unknown. To this end, we make two assumptions regarding the evolution of  $\phi_{it}$ : (1)  $\phi_{it}$  is not correlated with  $A_{it}$ , and (2)  $\phi_{it}$  between countries are not correlated.

Given that  $\phi_i$  captures policy-related and other external effects on the cost of lending and the purchase of bonds, we believe that these assumptions are realistic. As for the persistence of the initial shock to  $\phi_{it}$ , we experiment with a very high (.91); as well as very low persistence (.5). In addition, we assume that the variance of  $\phi_i$  is low. The matrices  $P$  and  $Q$  are summarized in **Table 2-A**<sup>6</sup>.

In any period  $t$ , given the state of the economy summarized by the vector  $\{k_{it-1}, s_{it-1}\}_{i=H,F}$ , and the realization of the exogenous shocks summarized by the vector  $\{A_{it}, \phi_{it}\}_{i=H,F}$ , the numerical solution to our model expresses the endogenous control and state variables as functions of the state and the exogenous variables, where the coefficients of the functions depend on the parameters underlying the stochastic processes defined in (17).

<sup>5</sup>We could not detect any statistically significant correlation between our calculated "home" (European Union and Japan, and EU, Japan and emerging Asia respectively) and "foreign" (U.S.) TFPs. Despite this lack of correlation in the productivity shocks between the two regions, as a robustness check of our basic results presented in the paper, we performed impulse response analysis, imposing some spillover of shocks between the regions (contemporaneous correlation of shocks of 0.05). None of the impulse responses were affected.

<sup>6</sup>For sake of brevity, we report the results for the high persistence of  $\phi_i$ . Our qualitative results do not change for low persistence.

### 3.2.2 Impulse responses

Before carrying out the quantitative exercises, that is, apply our model to the actual data, we examine the qualitative properties of our model by performing impulse response exercises. As mentioned, our research is motivated by observed changes in the U.S. and the "rest of the world" current accounts between the 1980s and today.

There are two important trends: (1) during the 1980s, productivity growth in the "rest of the world", particularly in the European countries, and in Japan exceeded productivity growth in the U.S., but the trend has reversed since the 1990s; and (2) the 1980s and the 1990s were also periods of gradual financial liberalization in the European countries, in Japan, and particularly in East Asia. In our model, we assume that country  $H$  is the "rest of the world", and country  $F$  is the U.S.

While tracing the impulse responses, we are interested in the impact of three events: (1) a 1% negative shock to the productivity of the home country ( $A_H$ ); (2) a 1% positive shock to the productivity of the foreign country ( $A_F$ ) and (3) a 1% reduction in the cost international lending, or of international bond purchases, measured by a 1% decrease in  $\phi_H$ .

We are primarily interested in the impact of these three shocks on the current account of the U.S. that is, of the foreign country  $F$ . Note that according to Equation (10), the amount of borrowing in any period determines the current account, with an increase in bond purchases by country  $H$  increasing the current account deficit of country  $F$ .

We examine the impact of each of the three shocks, separately, on real macroeconomic aggregates like output and consumption, and on the international borrowing of the foreign country (U.S.). In addition to concerns about ballooning current account deficits in the U.S., researchers have tried to reconcile the high U.S. current account deficits with the low levels of the global real interest rate. Typically, we would expect that the excess of investment over saving (the current account deficit) in the U.S. would lead to higher global real interest rates. However, in reality, U.S. real interest rates have fallen from about 4.5 percent in 2000 to about 1.8 percent in 2005.

We plot the transition dynamics of our model in **Figures (2-A) to (2-C)**. In **Figure (2-D)** we plot the magnitude of current account, as a share of output under our three alternative shocks. Output in the foreign country increases under all three shocks. A rise in foreign productivity (U.S.) raises foreign country's output. A fall in home country (rest of the world) productivity lowers home country investment, leading to capital flows to the foreign country (U.S.), and an increase in investment and output in the U.S.

A fall in the home cost of lending,  $\phi_{it}$ , sharply raises foreign (U.S.) output. A decline in the cost of lending in the home country raises capital outflows, and increases foreign country (U.S.) investment, raising the marginal product of labor, labor supply, and output in the U.S. As expected, under all three shocks, borrowing by the U.S. rises, and the U.S. current account deficit expands.

As for the interest rate implications, a 1% decline in  $\phi_{it}$ , the cost of lending,

generates a *decline* in global interest rates, along with an increase in the flow of funds to the foreign country (U.S.). This helps reconcile why global real rates have fallen, despite an increase in U.S. international borrowing. Increased financial liberalization in the rest of the world raised the supply of funds, and despite higher productivity growth in the U.S., lowered global interest rates.

The increased inflow of funds to the US results in a deterioration of the current account. The current account as a share of output in the U.S. (country  $F$ ) deteriorates from its steady state value of  $-2\%$  immediately upon the shock (**Figure 2-D**). The effects are not very persistent as the shocks are not permanent. Nonetheless, a negative productivity shock in the home country, or a positive productivity shock in the foreign country, results in a sharp deterioration of the (foreign country) U.S. current account.

Holding constant the productivity shocks in both home and foreign countries, a 1% reduction in the cost of lending,  $\phi_{it}$  in the home country sharply deteriorates the current account of the foreign country (U.S.). Comparing the magnitude of changes brought about by the shocks in our three experiments, the initial response of the current account is largest when there is a reduction in the cost of lending in the home country (or in  $\phi_H$ ). Thus, the fall in international financial barriers to investing in the U.S. may explain why U.S. current accounts have risen so sharply.

Below, we perform a quantitative exercise to see if given the paths of home and foreign total factor productivity (TFP) shocks, we can explain the path of the U.S. current account. We show that TFP shocks alone cannot explain the U.S. current account deficits. Another factor, say changes in the ease of investing in U.S. assets, is necessary to explain the evolution of U.S. current account imbalances.

## 4 Quantitative Application to United States and Rest of the World

In bringing our stylized two-country model to the data, we need to define what the "rest of the world" stands for. In our two country model, country  $F$  or foreign represents the U.S. For country  $H$  or the home country representing the rest of the world, we consider two alternatives: (1) rest of the world comprises of EU15 and Japan, and (2) the rest of the world comprises of E15, Japan and emerging Asia, particularly China. Especially since the late 1990s, Asia (except Japan) has emerged as a major global player in world financial markets, not only because of rapid growth, but also because of the relaxation of capital outflow controls, and the purchase of U.S. bonds as foreign exchange reserves in emerging Asia, especially in China.

Using the two country model developed above, we try to match the current accounts and the GDPs per capita of the foreign country (U.S.) from 1980 to 2003, under the following scenarios. First, we combine the data from the European Union (EU-15) and Japan to see if the evolution of the U.S. current

accounts and GDPs per capita from 1980 to 2003<sup>7</sup>, can be explained by differences in the TFP shocks in the home (EU-15 and Japan) and foreign (U.S.) countries. We show that while difference in TFP shocks do a good job in explaining the U.S. current account deficits in the late 1980s and early 1990s, they do a poor job in explaining the U.S. current account later on particularly in the late nineties and since the beginning of the twenty first century.

Second, we add the data of emerging Asia (China, Hong Kong, Korea, Taiwan, and the ASEAN countries) to the data of the EU-15 and Japan. We show that although there is some improvement in the explanatory power of the model until 1999, the model does worse after 2000.

What is required for our model to explain the U.S. current account is for the financial frictions to behave in a non-monotonic fashion. That is, roughly speaking, the ease of investing in the U.S. has to start declining from about 1985 to about 1996, and then *rise* from 1997 to 2000, and then sharply decline. The decline in financial frictions starting in 1985 corresponds to the financial liberalization in Europe and Japan, including the "Big Bang" reforms at the start of Japan's "bubble economy." As domestic stock and land prices rose, Japan used the rising domestic asset prices to borrow, and invest in the U.S. In other words, the rise in domestic asset prices mitigated the financing constraints of Japanese firms, enabling them to lend to the U.S. The tightening of financing constraints from 1997 to 2000 is related to the Asian financial and Japanese banking crisis, limiting the ability of emerging Asian countries and Japan to lend to the U.S. We show that except for the Asian financial crisis years from 1997 to 2000, the decline in financing frictions ( $\phi_H$ ) from 1985 to 2003 is close to monotonic.

Although with non-monotonic financing frictions, we are able to describe the changes in the U.S. current account, we are still unable to account for the slow growth in U.S. per capita GDP. That is, given the rapid inflow of capital into the U.S., U.S. per capita GDP should be growing much faster than what is observed, between 1985 and 1991, and between 2001 and 2003.

We thus modify our basic model in two directions. First, while our basic model allowed for the adjustment of capital to be instantaneous, in our extended model, we allow for capital adjustment costs. Second, in our extended model, we allow for government spending that subtracts from capital accumulation. The late 1980s and between 2001 and 2003 were periods of large expansions in the government budget, which may have constrained U.S. investment and economic growth. With our extended model, we continue to explain the evolution of the U.S. current account quite well. While the extended model explains the slower growth in U.S. per capita GDP better than the basic model, the growth in per capita GDP simulated by our extended model, still considerably overshoots the actual growth in GDP per capita in the U.S.

---

<sup>7</sup>The choice of our time period is guided by data availability considerations, particularly data on capital output ratio.

## 4.1 The Data

The data are described in detail in the Data Appendix, We assume that the two regions, home and foreign, are equal sized in the steady-state, which we take to be 1980, but the two regions can subsequently diverge in size. As mentioned, for the home country representing the "rest of the world," we take two sets of countries, 1) Japan and the EU-15, and 2) Japan, the EU-15, and emerging Asia. In our analysis, TFP is measured as a Solow residual where:

$$A_{it} = \frac{y_{it}}{k_{it-1}^{\theta_i} (l_{it}(1 + \gamma)^t)^{1-\theta_i}} \quad (18)$$

To calculate TFP, we first must calculate  $y_{it}$ ,  $l_{it}$ , and  $k_{it-1}$  for our two sets of countries that we take as the "rest of the world." As described in the Data Appendix, we construct the aggregate variables for the "rest of the world" by taking a weighted sum of each corresponding variable. For example, as for the GDP of the home country, we take the weighted sum of the GDPs of each of the EU-15 countries and Japan, where the weight for country  $i$  is the share of country  $i$ 's per capita GDP in the sum of the EU-15+Japan's per capita GDPs. Since the inclusion of emerging Asia changes the set of countries and the associated weights, the estimated TFPs are different for the two sets of countries in our two experiments.

Thus calculated, we interpret changes in  $A_{it}$  as the deviation of TFP from its steady state, where in the steady state, global TFP is assumed to grow at 2%. **Figure (3-A)** depicts our estimated  $A'_{it}$ s. The average TFP growth rates during our four subperiods are summarized in **Table (3)**. The first subperiod (1980 to 1986) shows productivity growth in the EU-15 and Japan growing at .84% above trend on average, while that in the U.S. grows at .14% below trend. Similarly, during the next subperiod (1986 to 1991), productivity grows at .79% below trend in the U.S., and .87% above trend in EU-15 and Japan. This pattern changes during the third subperiod (1991 to 2000), when productivity in the EU-15 and Japan grows 1.35% below trend, while U.S. productivity growth .02% above trend. Productivity performance in the home country slightly improves in the last period (2000 to 2003), with TFP still growing slightly below trend at ( -.56%). In the foreign country (U.S.), productivity growth sharply picks up with TFP growing at .62% above trend during 2000-2003.

These TFP growth patterns change when we include emerging Asia in our set of countries in the "rest of the world," especially during early 1980s, and during the 2000-2003 period. In contrast to the previous case with only the EU-15 and Japan are in the home country, adding emerging Asia results in TFP growing at .24% below trend during 1980 to 1986. Since the mid-1980s, home country TFP growth including emerging Asia follows a cyclical pattern, growing above trend during the late 1980s, before declining below trend during the 1990s. It is remarkable that between 2000 and 2003, when emerging Asia is included in the home country, TFP growth is 3.9 percent, far above trend.

These patterns in the "rest of the world" and U.S. TFP growth suggest that if current accounts were affected by TFP growth alone, then in the 1980s

and since 2000, U.S. investors should be lending to the "rest of the world." We therefore should see a decline in the U.S. current account deficit since 2000, when in fact the U.S. current account deficit has increased. Thus, some other factor than differences in the home and foreign country TFPs must be affecting the U.S. current account. We attribute this factor to changes in the ease of buying U.S. financial assets, or financial liberalization in the home country.

## 4.2 Quantitative experiments

We first conduct our experiments when the "rest of the world" includes the EU-15 and Japan. We feed in the calculated annual changes in TFP in the home (EU-15 and Japan), and in the foreign (the U.S.) countries, assuming no change in financial liberalization. The results for the U.S. current account are shown in **Figure (3-B** with the legend "EXP1").

On the whole, the current account of the U.S. has been in deficit and the deficit increases from 1.36% of GDP during the 1980s to 4.35% of GDP between 2000 to 2003. Except for the 1980s, when our model predicts a U.S. current account surplus, the predictions from our model match up well with the data. In the 1980s, our model predicts a current account surplus, because TFP growth in the EU-15 and in Japan are high, while in the U.S. it is low, which should result in a flow of funds from the U.S. to the "rest of the world", when in fact, the opposite happened.

As mentioned, we also try to capture the patterns in U.S. output per capita. In general, our model underpredicts the growth in U.S. per capita output. This is because as shown above, our model predicts smaller U.S. current account deficits than in the data, which means that capital inflows into the U.S. are smaller. With smaller capital inflows, investment is lower, with lower growth in U.S. output per capita (**Figure 3-C** with the legend "EXP1").

We next conduct our experiments when the "rest of the world" includes the EU-15, Japan, and emerging Asia (**Figures 3-B** and **3-C** with the legend "EXP2"). When we include emerging Asia, the fit of our model improves somewhat between 1995 and 1999, as the fall in TFP growth below trend in the "rest of the world" is higher. This narrowing of the negative TFP growth differential with the U.S. means that the model-simulated U.S. current account deficit increases between 1991 and 1999, corresponding more closely with the data. However, between 2000 and 2003, the fit of the model deteriorates, as the positive gap in the TFP growth differential between the "rest of the world" and the U.S. widens. Now given the very rapid TFP growth above trend in the home country (mainly China), the model predicts a current account *surplus* in the U.S., when we actually have a U.S. current account deficit. Our quantitative results are robust to different levels of persistence in the productivity shocks. We raised the persistence from our benchmark (0.95) to a random walk (1.0), and also lowered it to a serially uncorrelated process, but the simulated U.S. current account changed very little<sup>8</sup>.

---

<sup>8</sup>For the sake of brevity, we do not present the results of assuming a random walk process

In **Tables 4-A** and **4-B**, we show how well our model captures the trend and the fluctuations in the data. *Exp1* refers to the experiment when the rest of the world includes just the EU-15 and Japan; *Exp2* is when emerging Asia is included. From **Table 4-A**, we see that from 1980 to 2000, the model fits the data for the current account better when emerging Asia is included. From 2000, however, the model with emerging Asia predicts a current account surplus for the U.S. This is because productivity growth in the home country is higher than in the U.S., implying an outflow of capital from the U.S. to the home country. In terms of capturing the growth and fluctuations of per capita GDP, the model including emerging Asia does better (**Table 4-B**).

#### 4.2.1 The pattern in $\phi_H$

As noted above, with or without emerging Asia in the "rest of the world", our model misses much of the action in the evolution of the U.S. current account when we assume no change in global financial integration. We thus conduct the following counterfactual experiment: What would be the pattern in the financial liberalization in the "rest of the world",  $\phi_H$ , if we are to match the evolution of the U.S. current account? Does this derived pattern accord with the actual financial liberalization that has taken place?<sup>9</sup>

As mentioned,  $\phi_H$  or the cost of trading international assets, is intended to capture frictions in financial markets that include, but is not restricted to regulations, and the financial openness of country  $H$ . Thus, by its very nature, it is a normative concept for which we do not have a numerical equivalent in the data.

**Is the pattern in  $\phi_H$  plausible?** First, note that  $\phi_H$  starts to fall sharply from 1985 until 1991, and then stabilizes until about 1996. The decline in  $\phi_H$  starting in 1985 corresponds to the financial liberalization that took place in Japan and in the United Kingdom in the mid-1980s. In both countries, entry into the commercial banking, insurance, and securities businesses were liberalized. Banks, insurance companies, and securities firms were allowed to lend to more sectors, including to foreigners. Starting in 1996,  $\phi_H$  increases until 2000, corresponding to the Asian financial crisis, where collateral values of governments and financial institutions in emerging Asia were damaged, leading to a deterioration of lending to the U.S. Also, during this time, Japan was in the midst of its banking crisis, and Japanese bank lending to the U.S. deteriorated. The sharp decline in  $\phi_H$  starting in 2000 corresponds to the purchases of U.S. assets, particularly U.S. government bonds, by the Japanese and emerging market governments, to prevent their local currencies from appreciating, and accumulate U.S. reserves. This change in Asian reserve behavior, particularly by emerging market governments is captured by the sharp decline in  $\phi_H$  from 2000. In our model, any change that makes it easier for the rest of the world to

---

here. If interested, please contact the authors.

<sup>9</sup>Devereux and Lahiri (2006) apply a similar methodology to evaluate the role played by the G-6 countries in the deterioration of the U.S. current account.

buy U.S. assets is represented by a fall in  $\phi_H$  even if this change in buying U.S. assets is facilitated entirely by the home government.

**Figures 4-A** and **4-B** compare our derived measure of the cost of international lending (**4-A**) with an index of financial openness using the raw data provided by Chinn and Ito (2005) (**4-B**). Chinn and Ito's measure does not correspond directly to ours, since their measure also captures the liberalization of inward investment, as well as outward investment. For example, for Thailand, the Chinn and Ito measure captures how easy it is for foreigners to invest in Thailand; as well as how easy it is for Thai residents to invest abroad. Our derived measure of the decline in the cost of international lending only captures the ease of investing in the foreign (U.S.) country. In addition, while the Chinn and Ito measure is calculated from a careful reading of changes in regulations that made it easier for the "rest of the world" to invest in the U.S., that is, a *de jure* measure, ours is a *de facto* measure that captures the actual net capital flows from the "rest of the world" to the U.S., exclusive of the productivity shocks in the two countries.

Despite these differences, the pattern in our measure corresponds with Chinn and Ito's, especially between 1985 and 1994, when  $\phi_H$  or cost of bond trading in our model is falling (or it is becoming more easy to invest in foreign financial markets) and the Chinn and Ito measure is rising (indicating increased financial openness). The Chinn and Ito financial openness measure declines from 1996 to 2000, which corresponds to a rise in our  $\phi_H$ , owing to the Asian financial crisis. However, from 2000 to 2003, the two measure drift apart; while  $\phi_H$  falls sharply, the Chinn-Ito index shows less openness. The Chinn and Ito index may be capturing the capital controls instituted by many emerging markets after the Asian currency crisis, while our  $\phi_H$ , which focuses on capital outflows, cannot capture such capital inflow controls. For the entire period 1980 to 2003, the correlation coefficient between  $\phi_H$  and the Chinn-Ito measure is  $-0.41$ ; the two series are found to be cointegrated by the Johansen test (with a trend and intercept term).

### 4.3 Modifications to the benchmark model

Our benchmark model overpredicts the growth in U.S. output per capita because our model shows that capital in the U.S. grows too rapidly, and that there is no wasteful government spending. We modify our model to include capital adjustment costs, and U.S. government spending that is wasteful (ie., diverts resources from capital accumulation).

The model extensions affect the budget constraint of the consumer:

$$c_{it} + x_{it} + m(k_{it}, k_{it-1}) + s_{it} + f(s_{it}, \phi_{it})s_{it} \leq w_{it}l_{it} + r_{it}^k k_{it-1} + R_t s_{it-1} - T_t \quad (19)$$

where  $T_t$  denotes lumpsum taxes and  $m(k_{it}, k_{it-1})$  denotes adjustment costs associated with investment in the physical capital stock.

For our quantitative analysis, we use a quadratic specification for adjustment costs in capital such that:

$$m(k_{it}, k_{it-1}) = \frac{\chi}{2} \left( \frac{k_{it} - k_{it-1}}{k_{it-1}} \right)^2 k_{it-1} \quad (20)$$

Apart from representative consumers and firms, we include the government in our extended model that balances its budget every period such that<sup>10</sup>:

$$g_t = T_t \quad (21)$$

Including adjustment costs for investment affects the intertemporal condition determining investment in physical capital. Equation 15 reduces to:

$$\lambda_{it+1} \left( \theta \frac{y_{it+1}}{k_{it+1}} + 1 - \delta_i + \frac{\chi}{2} (1 + \gamma)^2 \left( \frac{k_{it+1}}{k_{it}} \right)^2 - \frac{\chi}{2} \right) - \frac{(1+\gamma)^\sigma}{\beta_i} \lambda_{it} \left( \chi (1 + \gamma) \frac{k_{it}}{k_{it-1}} - \chi \right) = 0 \quad (22)$$

In addition to the first order condition, the inclusion of adjustment costs and the government in our extended model affects the resource constraint (Equation 7) :

$$\sum_{i=H}^F (c_{it} + x_{it} + m(k_{it}, k_{it-1}) + g_{it}) \leq \sum_{i=H}^F y_{it} \quad (23)$$

#### 4.4 Results

For our analysis, we assume that government expenditure is exogenous. The steady state share of government expenditure in output is taken as 20% (the average for the period 1980 to 2003).

The stochastic process driving the exogenous shocks of our extended model are given by:

$$\begin{bmatrix} \tilde{A}_{Ht} \\ \tilde{A}_{Ft} \\ \tilde{\phi}_{Ht} \\ \tilde{\phi}_{Ft} \\ \tilde{g}_{Ht} \\ \tilde{g}_{Ft} \end{bmatrix} = P \begin{bmatrix} \tilde{A}_{Ht-1} \\ \tilde{A}_{Ft-1} \\ \tilde{\phi}_{Ht-1} \\ \tilde{\phi}_{Ft-1} \\ \tilde{g}_{Ht-1} \\ \tilde{g}_{Ft-1} \end{bmatrix} + \begin{bmatrix} \tilde{\epsilon}_{AHt} \\ \tilde{\epsilon}_{AFt} \\ \tilde{\epsilon}_{\phi Ht} \\ \tilde{\epsilon}_{\phi Ft} \\ \tilde{\epsilon}_{gHt} \\ \tilde{\epsilon}_{gFt} \end{bmatrix} \quad (24)$$

where  $\tilde{g}_{it}$  denotes the log deviation of government expenditures in country  $i$ ,  $i \in \{H, F\}$ . For our numerical analysis, we assume that government expenditures are uncorrelated across the two countries, and with other variables. We

<sup>10</sup>We assume a balanced budget for the government. An alternative way to do our exercise would be to allow for budget deficits, and also allow government to trade in bonds along with households.

estimate the parameters driving government expenditures from our data on U.S. government spending, and report the parameters in **Table 2-B**.

We measure  $\chi$  to be .01. We compare our extended model with the benchmark model and plot the results in **Figure 5-A** and **5-B** (the corresponding legend reads "Extension"). Model properties are summarized in **Table 5**.

Before explaining our answers, we would like the readers to note that the measurement of  $\phi_H$  using BCA analysis is designed to match the data on current account *levels*. In our tables and figures, we plot the current account as a share of output. While by construction, our model with TFP and time varying  $\phi_H$  matches up the data on current account levels exactly, it is not designed to match up output and to the extent that our model generated measure of output deviates from data, we get a discrepancy between model generated current account *as a share* of output and the data, despite the model fitting current account *levels* exactly. Our results show that introducing government expenditures and capital adjustment costs help reduce the fluctuations in U.S. output per capita to a large extent. We get a better match than in our basic model both in per capita output; and in the current account. However, even after introducing investment frictions, and crowding out of private investment by the government, our model predicts a positive growth rate of output of 4.36% above trend, as opposed to the data, where output grows  $-.84\%$  below trend between 2000 and 2003<sup>11</sup>. Thus, the low growth in output per capita that we observe in the U.S. data remains a puzzle. The large inflow of capital into the U.S. should have resulted in much higher growth of U.S. output per capita than what the U.S. actually experienced.

## 5 Conclusion

We show that a standard, equilibrium macroeconomic model, augmented to capture changes in financial liberalization in the "rest of the world," empirically explains well, the evolution of the U.S. current account from 1980 to 2003. Our results are robust to the introduction of permanent (random-walk) shocks, and to the inclusion of capital adjustment costs, both of which should raise the persistence of the current account, subject to only productivity shocks. Using our procedure, we derive a series for the cost of trading in international assets and compare it with other measures of financial liberalization in literature. Our series matches up well with existing measures, as well as with distinct, identifiable episodes in international financial liberalization.

In further work, we hope to allow more realistically for the borrowing constraint to depend on the collateral or the capital stock. We can take greater "financial integration" to mean that foreigners will be able to liquidate a larger proportion of the collateral. Foreigners may have trouble liquidating the entire amount of the collateral in the U.S. for the following reasons. Foreign lenders may poorly understand U.S. insolvency practices. Therefore, to recover collateral, they may have to resort to expensive local expertise, say by hiring pricey

---

<sup>11</sup> Findings do not change noticeably even when we assume a random walk process for TFP.

lawyers (Hermalin and Rose, 1999). The limited ability of foreign lenders to liquidate capital can also happen at the redeployment stage. Foreigners may have limited ability to identify users of second-hand capital, especially if the capital is heterogeneous; such ability is usually a by-product of credit relationships, which take time to accumulate (Dell'Araccia, et. al., 1999). As foreign financial markets are liberalized, foreigners participate more in U.S. financial markets, establishing connections with U.S. firms, banks, accountants, and lawyers, thereby increasing the ability of foreigners to seize more of the U.S. collateral. The ability of foreigners to seize U.S. collateral can also decline, if foreign participation in U.S. markets decreases. For example, during their domestic financial problems in the 1990s, Japanese financial institutions greatly lowered their participation in U.S. lending and other financial markets. One can expect that the ability of Japanese lenders to assess U.S. borrowers and to seize collateral has atrophied, given the limited experience in recent years of Japanese lenders in U.S. financial markets. This would show up as a decline in "financial integration."

## References

- [1] Baxter, Marianne and Crucini, Mario J, 1995. "Business Cycles and the Asset Structure of Foreign Trade," *International Economic Review*, vol. 36(4), pages 821-54, November
- [2] Bernanke, Benjamin, Gertler, Mark, and Gilchrist, Simon, 1995, "The Financial Accelerator and the Flight to Quality," *Review of Economics and Statistics*, June.
- [3] Backus, David K, Kehoe, Patrick J and Kydland, Finn E, 1992. "International Real Business Cycles," *Journal of Political Economy*, vol. 100(4), pages 745-75, August.
- [4] Caballero, Ricardo, Farhi, Emmanuel and Gourinchas, Pierre-Olivier, 2006, "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates," NBER Working Paper 11996, January 2006.
- [5] Cavallo, Michele and Tille, Cédric, 2006, "Could Capital Gains Smooth a Current Account Rebalancing?," Federal Reserve Bank of San Francisco Working Paper 2006-03, January 2006
- [6] Chadha, Bankim, 2006, "Feast or Famine," Deutsche Bank Research, May.
- [7] Chari V.V., Kehoe, Patrick J. and McGrattan Ellen R., 2007. "Business Cycle Accounting," *Econometrica*, Econometric Society, vol. 75(3), pages 781-836, 05.
- [8] Chinn, Menzie and Ito, Hiro, 2005, "Current Account Balances, Financial Development and Institutions: Assaying the World Savings Glut," October 2005

- [9] Cole, Harold L., and Lee Ohanian, 2002, "The U.S. and U.K. Great Depressions through the Lens of Neoclassical Growth Theory," *American Economic Review* 92 (2), 28-32.
- [10] Cole, Harold L., and Lee Ohanian, 2004, "New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis," *Journal of Political Economy* 112 (4), 779-816.
- [11] Dekle Robert and Vandenbroucke, Guillaume, 2006, "A Quantitative Analysis of China's Structural Transformation," IEPR Working Papers 06.51, Institute of Economic Policy Research (IEPR).
- [12] Dekle, Robert, Eaton, Jonathan, and Kortum, Samuel, 2006, "Unbalanced Trade," *American Economic Review*, May.
- [13] Dell'Ariccia, G., Friedman, E., and Marquez, R., 1999, "Adverse Selection as a Barrier to Entry in the Banking Industry," *Rand Journal of Economics*.
- [14] Devereux, Michael and Lahiri, Amartya, 2006, "Global Current Account Adjustment: a Decomposition," *Proceedings, Federal Reserve Bank of San Francisco*, June.
- [15] Dooley, M., Folkerts-Landau, D. and P. Garber, 2004, "The Revived Bretton Woods System: The Effect of Periphery Information and Reserve Management on Interest Rates and Exchange Rates in Center Countries," NBER Working Paper, 10332.
- [16] Engle, C. and J. Rogers, 2006, "The U.S. Current Account Deficit and the Expected Share of World Output," *Journal of Monetary Economics*, 53, 1065-95.
- [17] Faruquee, Hamid, Laxton, Douglas, Muir, Dirk and Pesenti, Paolo, 2005, "Smooth Landing or Crash? Model-based scenarios of global current account rebalancing," paper presented at the NBER conference on G-7 Current Account Imbalances: Sustainability and Adjustment, Newport, June 1-2, 2005
- [18] Greenwood, Jeremy, Hercowitz, Zvi, and Huffman, Gregory W., 1988. "Investment, Capacity Utilization and the Real Business Cycle" *American Economic Review*, June.
- [19] Hermalin, B. and Rose, Andrew, 1999, "Risks to Lenders and Borrowers in International Capital Markets," In: Feldsteirn, M. (Ed.), *International Capital Flows*. University of Chicago Press.
- [20] Hunt, Benjamin and Rebucci, Alessandro, 2005, "The U.S. Dollar and the Trade Deficit: What Accounts for the Late 1990s?," *International Finance*, vol. 8(3), pages 299-434.
- [21] IMF, 2005, *World Economic Outlook*.

- [22] Kehoe, Patrick J. and Perri, Fabrizio, 2002, "International Business Cycles with Endogenous Incomplete Markets," *Econometrica*, Econometric Society, vol. 70(3), pages 907-928, May.
- [23] Mendoza, Enrique G, 2006, 'Sudden Stops' in an Equilibrium Business Cycle Model with Credit Constraints: A Fisherian Deflation of Tobin's  $q$ ." Manuscript, University of Maryland.
- [24] Mendoza, Enrique G , Quadrini, Vincenzo and Ríos-Rull, José-Víctor, 2007. "Financial Integration, Financial Deepness and Global Imbalances," CEPR Discussion Papers 6149, C.E.P.R. Discussion Papers
- [25] Mulligan, Casey B., 2002, "A Dual Method of Empirically Evaluating Dynamic Competitive Equilibrium Models with Market Distortions, Applied to the Great Depression and World War II." NBER Working Paper 8775.

## DATA APPENDIX

The world in our model is made up of two regions: United States (referred to as "*foreign*") and EU15 and Japan (Experiment 1) or EU15, Japan and Emerging Asia (Experiment 2) referred to as "*home*". The Emerging Asian region comprises of China, HongKong, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand.

For our calculations, we need data on national income, employment, hours worked, population, capital stock, and the current accounts. The national income accounts data along with the data on population, employment and hours worked is calculated from the "Total Economy Database" and the "Industry Growth Accounting Database" that is maintained by the University of Groningen at the Growth and Development Center. The data on the capital stock is not available from the above dataset; and we collect it from the Kiel Institute database on capital stocks in the OECD countries. The data on the capital stock for China is from Dekle and Vandenbroucke (2006) and for Korea, capital stock data for some of the latter years are available from the Korea Statistical Yearbooks. We use annualized data for the period 1980 to 2003. Given below is a description of the variables used and how they are constructed from our annualized data.

*weights* : To get the weights of the countries that comprise our "rest-of-the-world" group, we take the GDP figures of individual countries from the Groningen data center which is expressed in millions of 1990 US\$ (converted at Geary Khamis PPPs). The Geary-Khamis conversion method is popular in current international comparative studies as it has some desirable properties. The weights are then constructed by dividing the total GDP of each constituent country by the aggregate GDP of the group where the group comprises of EU-15 and Japan; and EU-15 and Japan along with emerging Asia.

$y_{it}$  : The per capita output in U.S. is calculated as aggregate GDP divided by the population. For the home country per capita output, we consider the weighted aggregate output of the EU-15 and Japan; and EU-15, Japan and emerging Asia; where the weights are calculated as the share of a country's GDP in the aggregate GDP of "the-rest-of-the-world" (ROW). The population of the home country is similarly calculated as the weighted average of the population of countries constituting our ROW, where the weights are calculated as the population of the constituent country divided by the aggregate population of the ROW. The output data is expressed in our dataset in millions of 1990 US dollars.

$\frac{k_{it-1}}{y_{it}}$  : The capital-output ratio for the home country is calculated as the share of the weighted capital stock to weighted output, where the weights are measured as before as the share of the variable of the constituent country to the aggregate of the ROW

$l_{it}$  : Labor is calculated as:

$$l_{it} = \frac{E_{it}}{N_{it}} * \frac{H_{it}}{(50 * 100)}$$

where:

$\frac{E_{it}}{N_{it}}$  : Total employment to the total population for the U.S.; and weighted employment to the weighted population ratio for the "rest-of-the-world."

$\frac{H_{it}}{(50*100)}$  : Weighted average of annual hours worked to total hours, where total hours is assumed to be 50 hours per week and there are 100 work-weeks. For the U.S., instead of weighted hours we just take the annualized hours worked.

$g_{it}$  : Per capita government expenditure. For our analysis, we need the time series of government expenditure from the U.S. that we collect from the U.S. Bureau of Economic Analysis. We arrive at the per capita figures by dividing aggregate government expenditures by the population.

*current account share* : Along with output, we try to match the current account share in output in the U.S.; where the data comes from Bureau of Economic Analysis. The current account balance is collected from the Bureau of Economic Analysis (BEA) that is in millions of dollars. To get the share of the current account balance in output, we divide the current account balance by GDP. The current account balance data of the U.S. with individual countries is limited, in particular data for emerging Asia including China is not available before 1999.

*index of financial openness* : The index of financial openness was created by Chinn and Ito (2005)<sup>12</sup> as a proxy for international financial market liberalization. They compiled an index of the degree of capital account openness for 163 countries from 1970 to 2004. The index is calculated on the bases of dummy variables that codify the restrictions on cross-border financial transactions reported in the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) from the IMF. The dummy variables reflect the four major categories on the restrictions on external accounts: presence of multiple exchange rates; restrictions on current account transactions; restrictions on capital account transactions; and requirements for firms to surrender a fraction of export proceeds. The index is the first standardized principal component of these four variables and it takes higher values for countries that are more open to cross-border capital transactions. For example, the U.S. that is calculated to be the most open economy in terms of financial openness has an index value of 2.602508 in Chinn and Ito (2005) estimates.

For our measure of financial openness (Figure 4-B), we take the index from Chinn and Ito (2005) for the group of countries that form our rest of the world, namely, EU15, Japan, China and the rest of emerging Asia. We then calculate the weighted average of the index where the weights are given by the share of an individual country's GDP, in the aggregate GDP of the group.

---

<sup>12</sup>The data is downloadable from [http://www.ssc.wisc.edu/~mchinn/kaopen\\_2005.xls](http://www.ssc.wisc.edu/~mchinn/kaopen_2005.xls).

TABLE 1: PARAMETER SPECIFICATIONS

Parameter description	Parameter symbols	Parameter Values
<i>GROWTH RATE</i> Technology	$\gamma$	2%
<i>PREFERENCES</i> Coefficient of risk aversion	$\sigma$	2
Discount factor	$\beta$	.99
Leisure weight	$\psi$	3.95
<i>DEPRECIATION RATE</i> Physical capital	$\delta$	.1
<i>INCOME SHARES</i> Capital	$\theta$	.33
Labor	$1 - \theta$	.67
<i>ADJUSTMENT COST</i> (Extended Model) Capital	$\chi$	.01

Note: The parameters are calibrated from the necessary first order conditions and the steady state values of the variables. We assume that both countries are ex-ante symmetric so we take the parameter values to be the same in both countries.

**TABLE 2-A: STOCHASTIC PROCESS OF EXOGENOUS SHOCKS:  
BENCHMARK MODEL**

$$\mathbf{P} = \begin{pmatrix} .95 & 0 & 0 & 0 \\ 0 & .95 & 0 & 0 \\ 0 & 0 & .91 & 0 \\ 0 & 0 & 0 & .91 \end{pmatrix}$$

$$\mathbf{Q} = \begin{pmatrix} .007^2 & 0 & 0 & 0 \\ 0 & .007^2 & 0 & 0 \\ 0 & 0 & .002^2 & 0 \\ 0 & 0 & 0 & .002^2 \end{pmatrix}$$

Note: We plot the parameters for the stochastic process of evolution of TFP shocks and shocks to cost of lending in our benchmark model. We assume a VAR process of order one for the TFP shocks and assume them to be uncorrelated across the two countries. Similarly, the shocks to cost of international lending are also assumed to be uncorrelated across the two countries as well as uncorrelated with productivity shocks.

**TABLE 2-B: STOCHASTIC PROCESS OF EXOGENOUS SHOCKS:  
EXTENDED MODEL**

$$\mathbf{P} = \begin{pmatrix} .95 & 0 & 0 & 0 & 0 & 0 \\ 0 & .95 & 0 & 0 & 0 & 0 \\ 0 & 0 & .91 & 0 & 0 & 0 \\ 0 & 0 & 0 & .91 & 0 & 0 \\ 0 & 0 & 0 & 0 & .98 & 0 \\ 0 & 0 & 0 & 0 & 0 & .98 \end{pmatrix}$$

$$\mathbf{Q} = \begin{pmatrix} .007^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & .007^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & .002^2 & 0 & 0 & 0 \\ 0 & 0 & 0 & .002^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & .02 & 0 \\ 0 & 0 & 0 & 0 & 0 & .02 \end{pmatrix}$$

Note: In our extended model, in addition to the exogenous shocks to productivity and cost of international lending, we also have exogenously given government expenditure. In Table 2-B, we thus extend the matrices outlining the parameters defining the stochastic process of TFP shocks and cost of bond lending to include the parameters defining the stochastic process underlying government expenditure. We assume the shocks to be uncorrelated across countries and with each other.

**TABLE 3: GROWTH RATE OF PRODUCTIVITY**

	<b>Home</b> <i>(EU15+Japan)</i>	<b>Home</b> <i>(EU15+Japan+Asia)</i>	<b>Foreign</b> <i>(US)</i>
1980 : 1986	.84% (1.21)	-.24% (3.06)	-.14% (2.53)
1986 : 1991	.87% (1.64)	.15% (1.57)	-.79% (.88)
1991 : 2000	-1.35% (1.41)	-1.18% (1.88)	.02% (1.41)
2000 : 2003	-.56% (.23)	3.88% (3.67)	.62% (1.5)

Note: Change in TFP measured as  $\frac{\Delta A_{it}}{A_{it}}$  where  $A_{it}$  is measured as a Solow Residual. "Home" includes EU15 and Japan or EU15, Japan along with emerging Asia while "Foreign" represents US. For each subperiod, we provide the average growth rate of  $A_{it}$  and the standard deviations are in brackets.

**TABLE 4-A: CURRENT ACCOUNT AS  
A SHARE OF OUTPUT (DATA AND BENCHMARK MODEL)**

	<b>Data</b>	<b>Exp1</b>	<b>Exp2</b>
1980 : 1986	-1.36% (1.46)	.25% (.95)	-.14% (1.43)
1986 : 1991	-2.03% (1.3)	.27% (.31)	.16% (.51)
1991 : 2000	-1.85% (1.21)	-.52% (.61)	-.71% (1)
2000 : 2003	-4.35% (.41)	-.89% (.97)	1.07% (2.21)

**TABLE 4-B: GROWTH RATE OF PER  
CAPITA OUTPUT (DATA AND BENCHMARK MODEL)**

	<b>Data</b>	<b>Exp1</b>	<b>Exp2</b>
1980 : 1986	.29% (2.93)	-.82% (3.34)	-.5% (2.5)
1986 : 1991	-.34% (1.76)	-1.8% (1.54)	-1.64% (.87)
1991 : 2000	.05% (1.41)	.55% (2.41)	.48% (2.15)
2000 : 2003	-.84% (1.16)	1.24% (2.23)	-.56% (2.53)

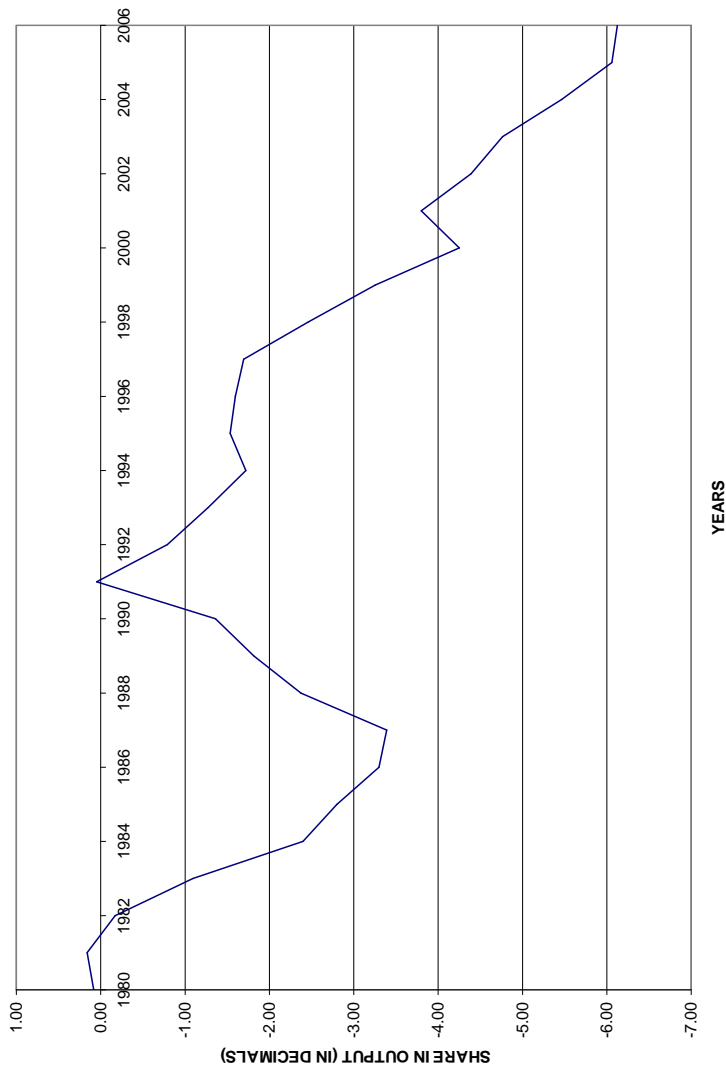
Note: We summarize the mean and standard deviations (in brackets) of current account share in output and output growth rate (in the US) of the data and model predictions in Tables 4-A and 4-B. We measure the growth rate of per capita output in the US with respect to the long term trend (2%). In Experiment 1 we just include EU15 and Japan in our rest of the world or home and in Experiment 2 emerging Asia is included along with EU15 and Japan in constructing rest of the world.

TABLE 5: CURRENT ACCOUNT AND OUTPUT GROWTH (DATA, BENCHMARK AND EXTENDED MODEL)

	Current account share			Output growth		
	<i>Data</i>	<i>Benchmark</i>	<i>Model Extension</i>	<i>Data</i>	<i>Benchmark</i>	<i>Model Extension</i>
1980 : 1986	-1.36% (1.46)	-.97% (2.25)	-.9% (2.05)	.29% (2.93)	4.6% (27.94)	2.1% (14.56)
1986 : 1991	-2.03% (1.3)	-1.85% (1.37)	-2.07% (1.41)	-.34% (1.76)	16.33% (21.05)	7.95% (11.18)
1991 : 2000	-1.85% (1.21)	-1.35% (1.01)	-1.82% (1.28)	.05% (1.41)	-1.09% (7.33)	-1.02% (3.53)
2000 : 2003	-4.35% (.41)	-3.16% (.24)	-4.17% (.18)	-.84% (1.16)	7.13% (11.69)	4.36% (5.41)

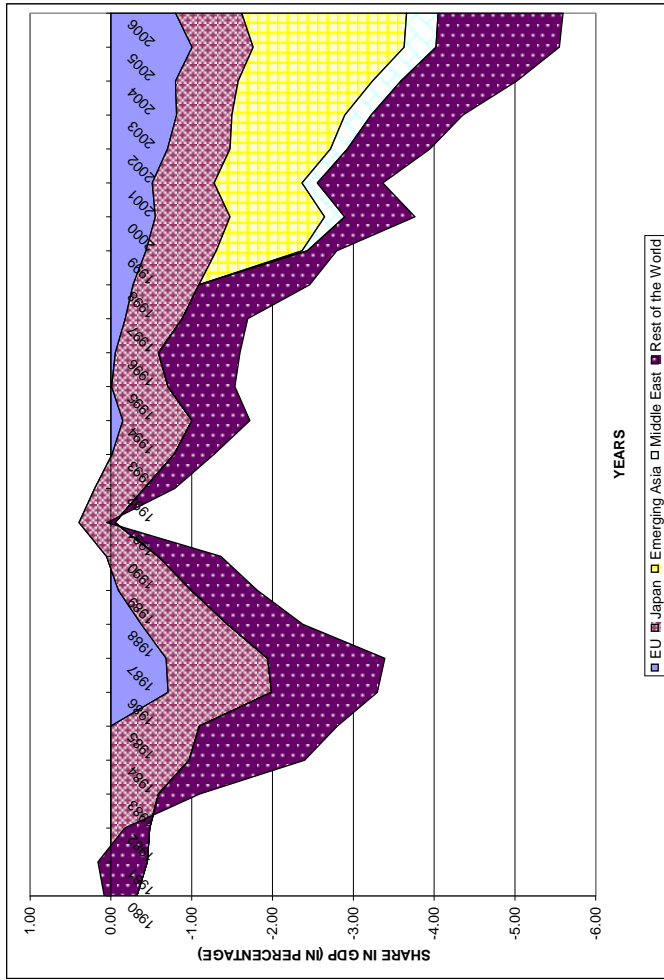
Note: Model predictions when  $\phi_H$  is constructed so that model predictions of current account *level* match data. In the table we plot the current account *as a share* of output. To the extent that our model does not match output exactly, we have a discrepancy between data and model generated current account share. We provide the results for the benchmark model and the extended model, where the extended model includes adjustment costs of capital and the government sector.

**FIGURE 1-A: US CURRENT ACCOUNT AS A SHARE OF GDP**



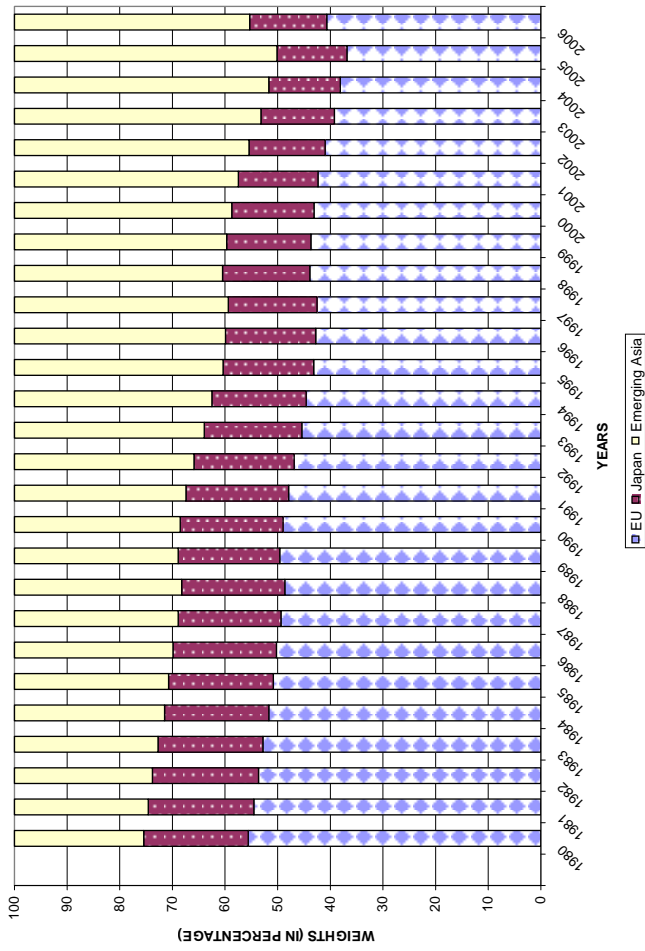
Note: The figure above depicts the current account of United States as a share of GDP during the period 1980 to 2006. Note that for our empirical analysis, we will concentrate on the period 1980 to 2003 for certain data availability limitations discussed in the text. The data for the figure above is collected from BEA.

**FIGURE 1-B: CURRENT ACCOUNT AS A SHARE OF GDP: US TOTAL AND US BALANCE WITH INDIVIDUAL COUNTRIES**



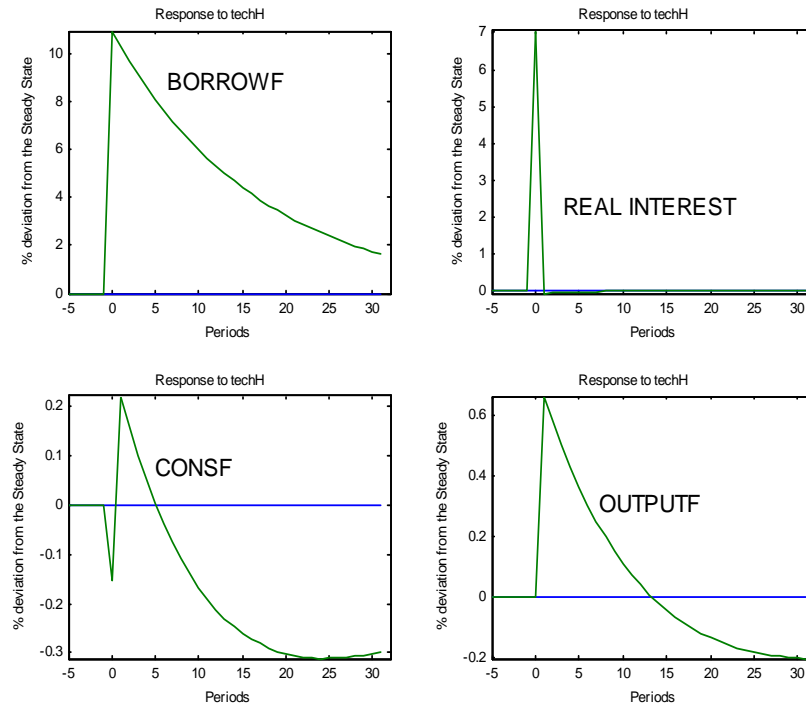
Note: In the above figure, we plot the share of US current account in GDP with its partners including a set of individual countries or group of countries and the rest of the world. The data is collected from BEA. One limitation of the data is that we don't have US current account balance data with emerging Asia, including China before 1999. Nevertheless, we do note that the US current account deficit with emerging Asia, particularly China as a share of US output increases between 1999 and 2005, while that with Japan, the major source of US funds in the 80s and early 90s reduces.

**FIGURE 1-C: SHARE OF A COUNTRY'S (EXCEPT USA) GDP IN THE AGGREGATE GDP OF REST OF THE WORLD**



Note: In this graph we plot the changing weights of the countries in the rest of the world except USA. We measure the weights as the ratio of GDP of an individual country to the aggregate GDP of the rest of the world where ROW comprises EU15, Japan and emerging Asia in our sample. Note that over the last two decades, and particularly since 2000, emerging Asia's (including China) share has increased. Japan was a major force upto 1991 however the weight has since then diminished.

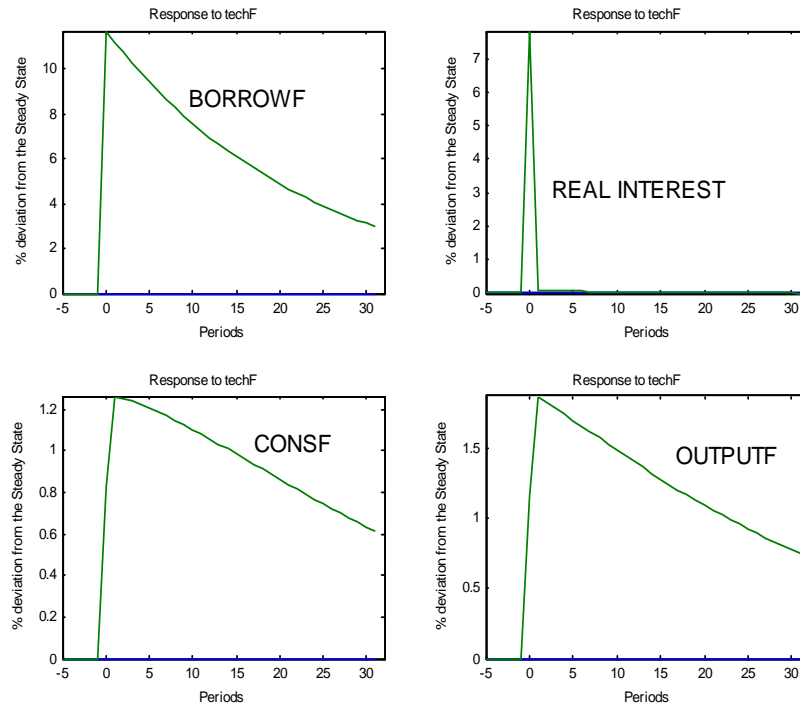
**FIGURE 2-A: IMPULSE RESPONSES TO A 1% NEGATIVE SHOCK TO HOME PRODUCTIVITY,  $A_H$**



Note: VARIABLE DESCRIPTION

The variables of interest are borrowings by the foreign country, BORROWF (or equivalently lending by the home country); the real interest rate on international lending, REAL INTEREST; consumption of the representative agents of the foreign country that is the recipient of international funds, CONSF; and the output of the foreign country or OUTPUTF.

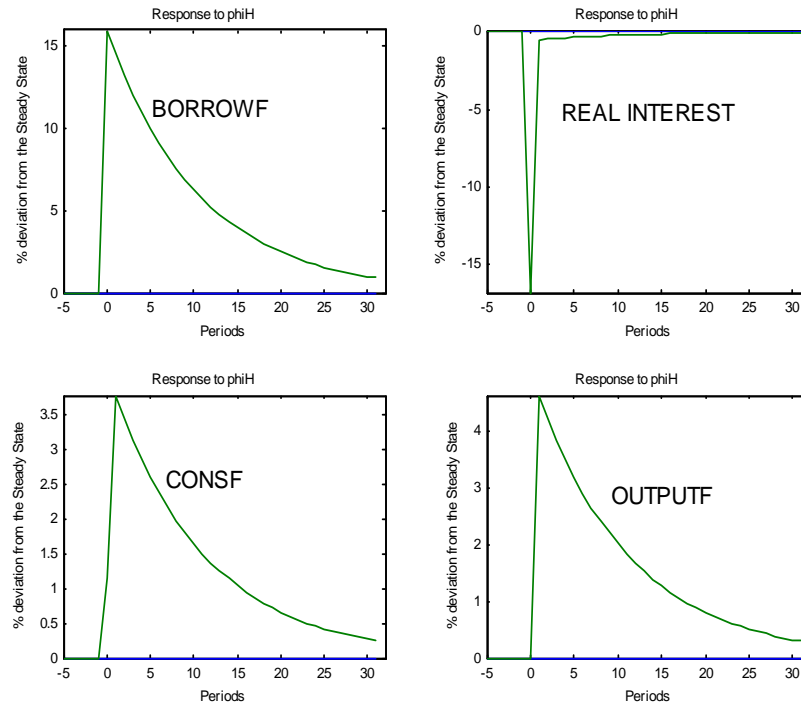
**FIGURE 2-B: IMPULSE RESPONSES TO A 1% POSITIVE SHOCK TO FOREIGN PRODUCTIVITY,  $A_F$**



Note: VARIABLE DESCRIPTION

The variables of interest are borrowings by the foreign country, BORROWF (or equivalently lending by the home country); the real interest rate on international lending, REAL INTEREST; consumption of the representative agents of the foreign country that is the recipient of international funds, CONSF; and the output of the foreign country or OUTPUTF.

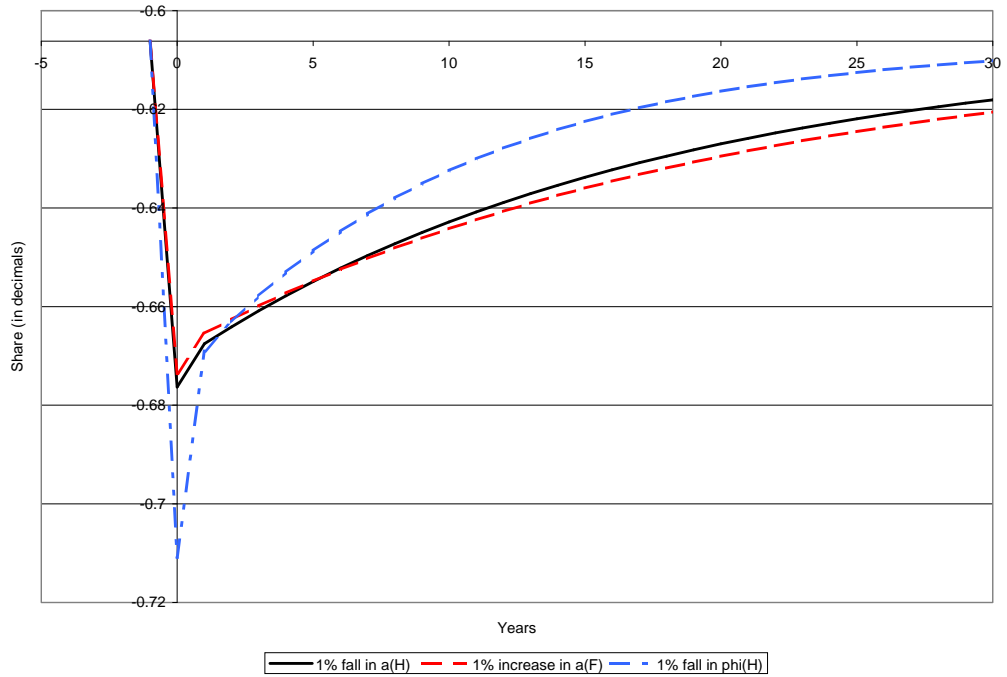
**FIGURE 2-C: IMPULSE RESPONSES TO A 1% NEGATIVE SHOCK TO COST OF INTERNATIONAL LENDING,  $\phi_H$**



Note: VARIABLE DESCRIPTION

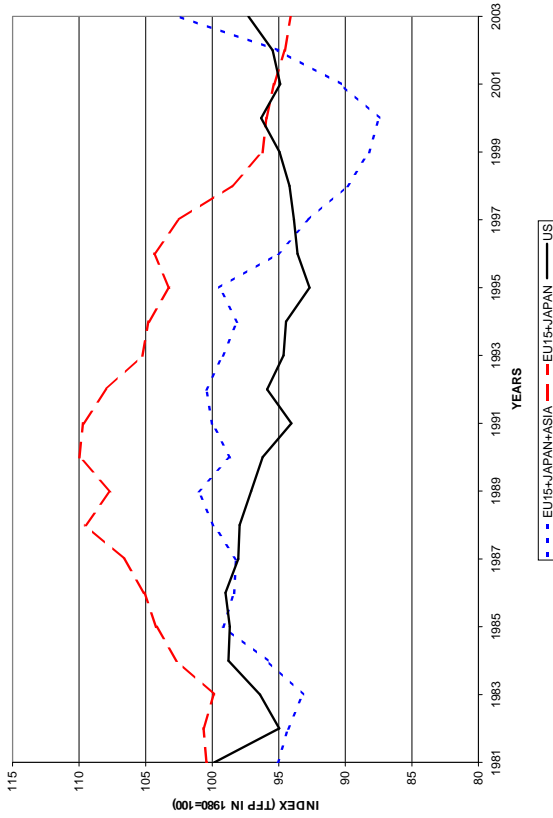
The variables of interest are borrowings by the foreign country, BORROWF (or equivalently lending by the home country); the real interest rate on international lending, REAL INTEREST; consumption of the representative agents of the foreign country that is the recipient of international funds, CONSF; and the output of the foreign country or OUTPUTF.

**FIGURE 2-D: THE IMPULSE RESPONSE OF THE U.S. CURRENT ACCOUNT SHARE TO PRODUCTIVITY AND LENDING COST SHOCKS**



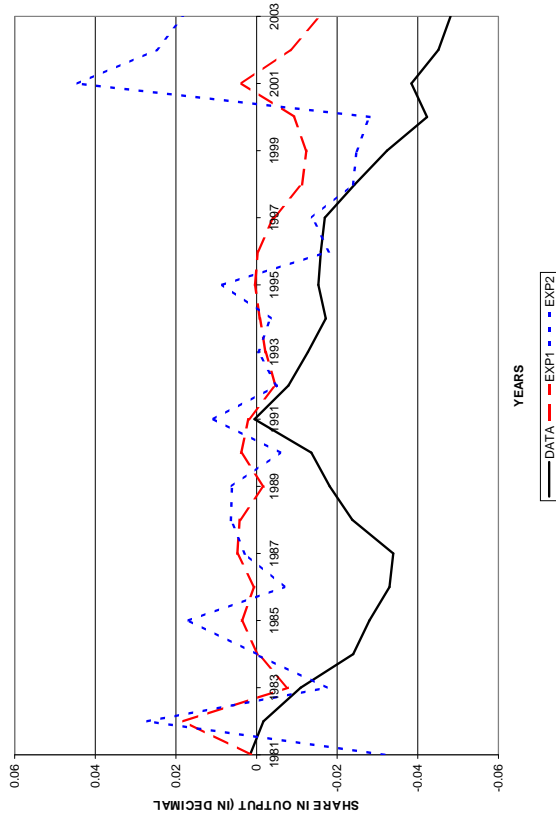
Note: We plot the transition dynamics of current account of United States as a share of output. The steady state value is taken as -2% (mean during 1980 to 2003). A negative sign denotes a current account deficit.

**FIGURE 3-A: TOTAL FACTOR PRODUCTIVITY AT HOME (REST OF THE WORLD) AND IN THE FOREIGN COUNTRY (U.S.)**



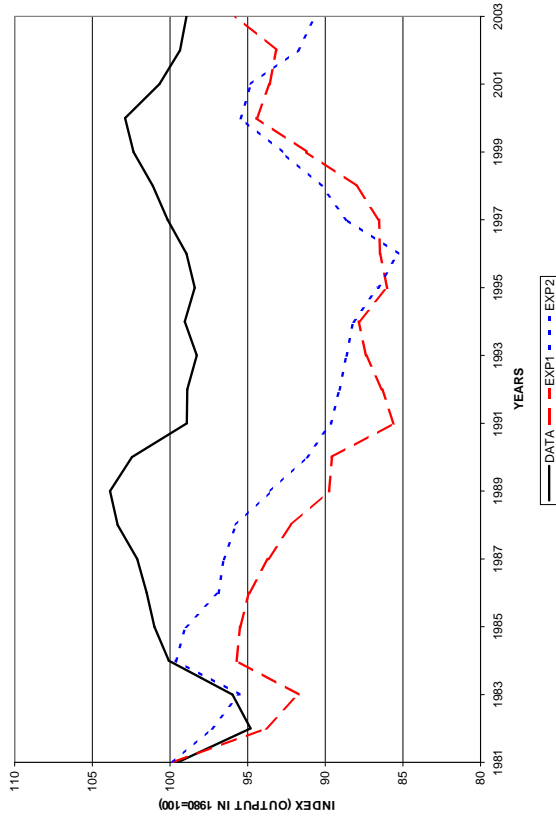
Note: We depict here the fluctuations of TFP around its steady state, where TFP in 1980 is normalized to 100. The TFP is calculated as the Solow Residual given the data on output, capital and labor. We plot the TFP fluctuations in United States and in rest of the world where rest of the world comprises of EU and Japan only (Experiment 1 in our model analysis) and EU, Japan along with emerging Asia (Experiment 2).

FIGURE 3-B: CURRENT ACCOUNT SHARE (DATA AND MODEL)



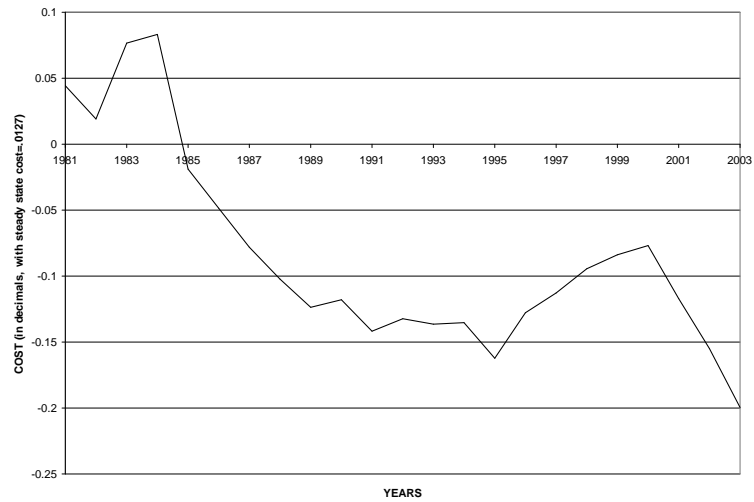
Note: In Figure 3-B we depict the data and model predictions of current account as a share of output by feeding in TFP shocks at home and foreign assuming no change in cost of bond trading. *Home* consists of EU15 and Japan in Experiment 1 and EU and Japan along with emerging Asia in Experiment 2.

**FIGURE 3-C: OUTPUT INDEX (DATA AND MODEL)**

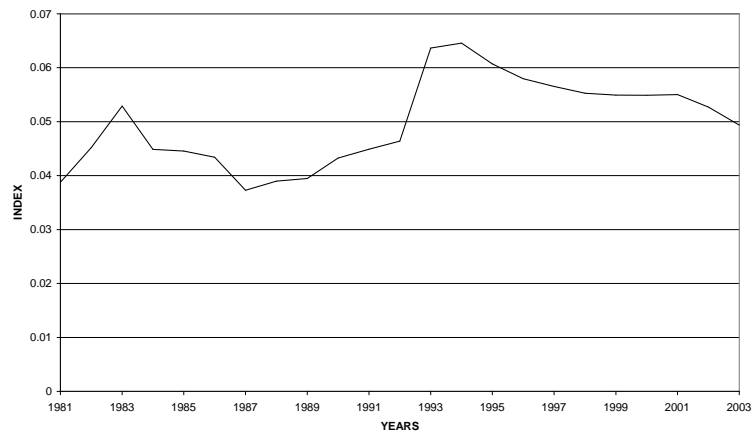


Note: In Figure 3-C we depict the data and model predictions of the index of output (where output in 1980 is normalized to 100) by feeding in TFP shocks at home and foreign assuming no change in cost of bond trading. *Home* consists of EU15 and Japan in Experiment 1 and EU and Japan along with emerging Asia in Experiment 2. In absence of any frictions, we assume per capita output would grow at 2% (the long run growth rate). Here we detrend the per capita output with respect to 2% to capture the fluctuations.

**FIGURE 4-A: COST OF INTERNATIONAL LENDING,  $\phi_H$**

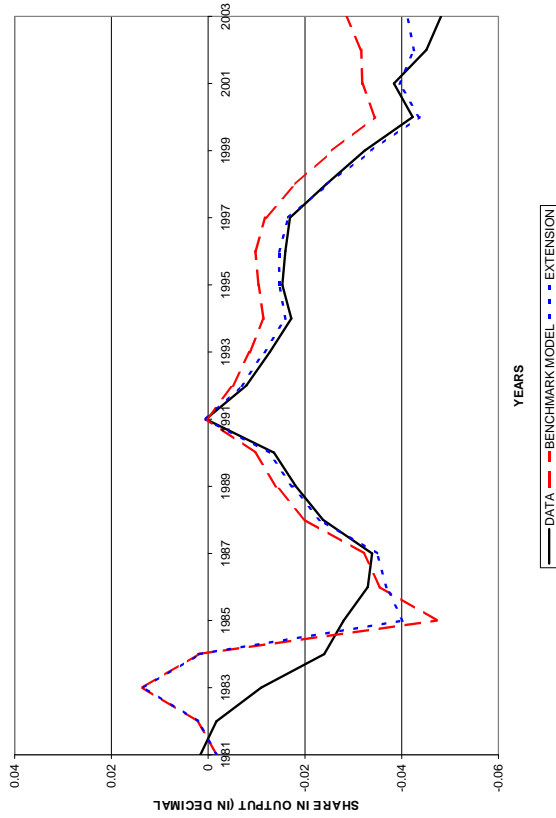


**FIGURE 4-B: INDEX OF FINANCIAL OPENNESS**



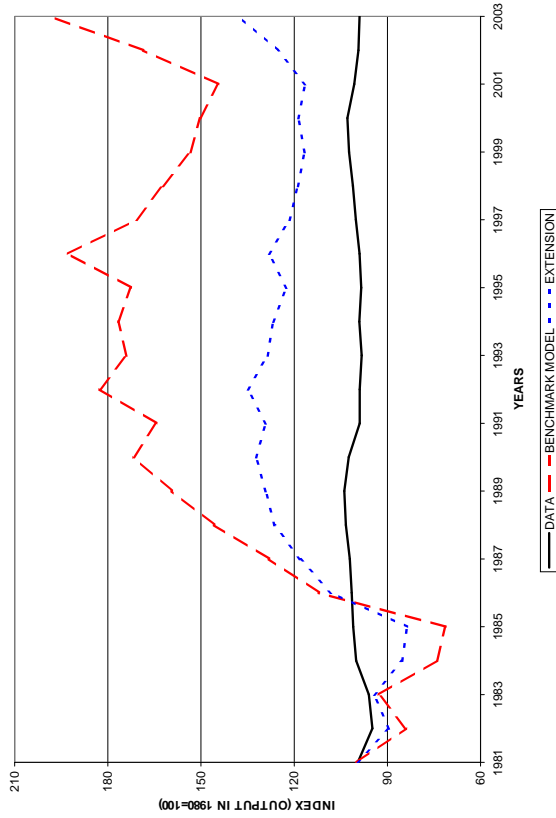
Note: In Figures 4-A and 4-B, we plot the time series of  $\phi_H$  (constructed to match the current account level) and the Index of Financial Openness. The index is originally due to Chinn and Ito (2005) who created an index of the degree of capital account openness of 163 countries during the period 1970 to 2004. We modify it to include the weighted index of financial openness in EU15, Japan and Emerging Asia where the weights are the share of each constituent country's GDP in the aggregate GDP of the group. Reduction in cost of bond trading is synonymous with increased openness.

**FIGURE 5-A: CURRENT ACCOUNT SHARE (DATA AND MODEL, BENCHMARK AND EXTENDED)**



Note: Figure 5-A plots the current account share feeding in TFP in unison with declines in cost of bond trading (as constructed in Figure 4-A). The results are plotted for the benchmark model and the extended model where the extended model incorporates exogenous government expenditure and capital adjustment costs in addition to cost of bond trading, while the benchmark model ignores government sector and capital adjustment costs.

FIGURE 5-B: INDEX OF OUTPUT (DATA AND MODEL, BENCHMARK AND EXTENDED)



Note: Figures 5-B plots the per capita output feeding in TFP in unison with declines in cost of bond trading (as constructed in Figure 4-A). The results are plotted for the benchmark model and the extended model where the extended model incorporates exogenous government expenditure and capital adjustment costs in addition to cost of bond trading, while the benchmark model ignores government sector and capital adjustment costs.