

# Liquidity Constraints and Global Imbalances

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## Abstract

International capital movements in the last 15 years have been characterized by large swings between advanced and emerging economies. This paper builds a two-country overlapping generations model with a short-term non-productive sovereign asset and a long-term productive asset to account for the reversal of the current account of the emerging countries in 1998 and the sharp reduction in global imbalances in 2008. We argue that the allocation of saving between liquid non-productive and long-term productive assets has a negative impact on income but a positive one the current account.

Keywords: balance of payments, capital market imperfections, exchange rate, global imbalances, growth, liquidity, overlapping generations  
JEL Classification numbers: E20, F21, F31, F43, O16, O41

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# 1 Introduction

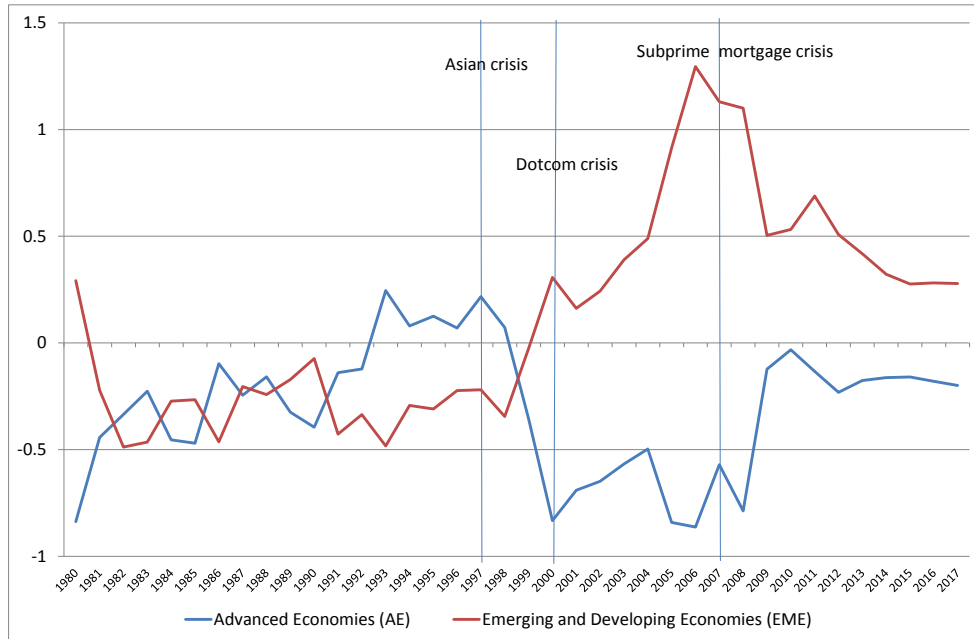
International capital movements have been characterized by many changes in the last 15 years. These changes can be summarized by four facts. 1) The current account of the emerging and developing countries (EME countries hereafter) has turned from a deficit to a hefty surplus after 1998 (see Figure 1). The increasing gap observed in the 2000s between the current account deficit of the advanced economies (AE countries hereafter) and the current account surplus of the EME countries has been called "global imbalances".<sup>1</sup> 2) The current account reversal in the EME countries occurred after many of these countries experienced balance of payment crises in the 1990s. 3) Global imbalances have reduced drastically since 2008 when the financial crisis erupted in the AE countries. 4) Both in 1998 and 2008, the saving rate in the EME countries changed more abruptly than the investment rate while the two rates followed closely the same path in the AE countries (see Figure 2).

The first fact has been studied extensively in the literature. The most influential explanation was proposed by Bernanke (2005) who argued that the emergence of global imbalances was mainly due to a sharp increase in the saving rate in the EME countries. This is the so-called "global saving glut" hypothesis, which contradicted the common view that the large U.S. current account deficit in the 2000s was caused by U.S. domestic policies. The question is why the rise in saving in the EME countries did not translate in as much domestic investment in these countries. One possible answer is the underdevelopment of their financial markets, which leads savers to search for diversified stores of value in the U.S or other western asset markets (Caballero, Farhi, and Gourinchas (2008) and Mendoza, Quadrini, and Ríos-Rull (2009)). Another possible answer is government intervention in international asset markets to accumulate foreign exchange reserves in order to stave off balance-of-payments crises (see, for instance, Alfaro, Kalemli-Ozcan, and Volosovych (2011), Gagnon (2012) or Artige and Cavenaile (2011)). These tentative explanations have focused on long-term determinants of global imbalances. However, the last three highlighted facts seem to pinpoint a link between financial crises and sudden changes in saving behavior in particular.

The objective of the present paper is to build a framework able to explain both the reversal in the current account balance experienced by the EME countries in 1998 and the strong reduction in global imbalances when the financial crisis hit the western economies at the end of the 2000s. We thus consider a two-country overlapping generations (OLG) model with exchange rates, in which firms may face liquidity constraints when households change the reallocation of their resources to short-term sovereign assets. Our paper is related to Jappelli and Pagano (1994) who consider an overlapping generations economy where households are credit constrained. Our model is also a deterministic framework but focuses on credit to firms and examine the effect of liquidity constraints to the firms

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<sup>1</sup>Blanchard and Milesi-Ferretti (2010) emphasize that the absolute value of the current accounts by country as a percentage of world GDP was relatively stable from 1970 to 1996 and started to increase sharply from then on.

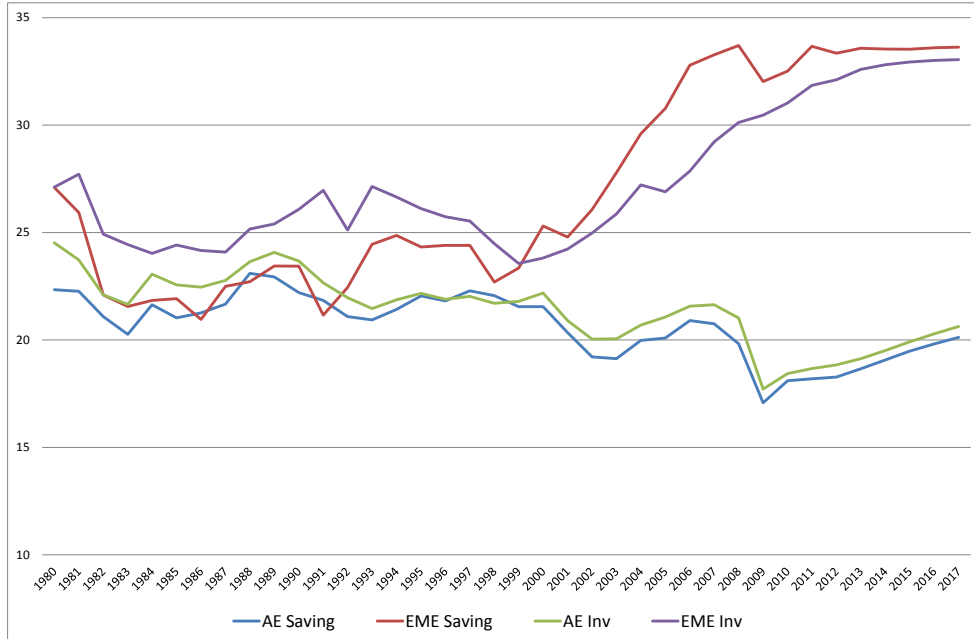


Source: IMF, World Economic Outlook, October 2012  
Country groups information: see IMF 2012 WEO database.  
IMF estimates for data after 2011.

Figure 1: Current account balance as a percentage of world output (1980-2017)

on current accounts. If households have the choice between a short-term non-productive sovereign asset and a long-term productive corporate asset, any change in this allocation between the two will affect liquidity supplied to the firms. In an open-economy framework, this reallocation has also an impact on the current account.

The paper is organized as follows. Section 2 defines the two-country overlapping generations model with exchange rates and presents the dynamic equilibrium in an open economy. Section 3 analyzes the steady-state current account balances when tastes and population growth rates differ across countries and when the exchange rate is manipulated. Section 4 examines global imbalances in the two-country model, and studies the existence of an intertemporal equilibrium with exchange rate and different time preferences. The effect on interest rates is discussed. Finally, section 5 concludes.



Source: IMF, World Economic Outlook, October 2012  
Country groups information: see IMF 2012 WEO database.  
IMF estimates for data after 2011.

Figure 2: Gross national saving and investment as a percentage of GDP (1980-2017)

## 2 A Two-Country Model

### 2.1 Setup

We consider a discrete-time deterministic model of an economy consisting of two countries, country  $A$  and country  $B$ , producing the same good under perfect competition from date  $t = 0$  to infinity. We assume that country  $A$  stands for a group of emerging economy and country  $B$  is the group of the most advanced countries. Like in Buiter (1981) we assume that there is no international trade in the consumption goods. The balance of payments is thus reduced to the financial balance only, which is the symmetric account of the current account. Each country is populated by overlapping generations living for three periods. We assume that the population grows at a constant rate  $n_A$  in country  $A$  and at a constant rate  $n_B$  in country  $B$ . When young, individuals supply inelastically one unit of labor to the firms, receive a wage and allocate this income between consumption, short-term saving

and long-term saving. They consume the return on their short-term non-productive asset when middle-aged and the return on their long-term productive asset when old. The labor market is perfectly competitive within the national borders while physical capital moves freely across countries when capital markets integrate. The representative firm in each country produces a single aggregate good using a Cobb-Douglas technology of the form

$$Y_{i,t} = A_i K_{i,t}^\alpha L_{i,t}^{1-\alpha}, \quad i = A, B, \quad (1)$$

where  $K_{i,t}$  is the stock of capital,  $L_{i,t}$  is the labor input, and  $A_i$  represents total factor productivity in country  $i$  at time  $t$ . We assume that physical capital fully depreciates after one period. At time  $t$ , the representative firm of country  $i$  has an installed stock of capital  $K_{i,t}$ , chooses the labor input paid at the competitive wage  $w_{i,t}$ , equal to the marginal product of labor, and maximizes its profits

$$\pi_{i,t} = \max_{L_{i,t}} A_i K_{i,t}^\alpha L_{i,t}^{1-\alpha} - w_{i,t} L_{i,t}, \quad (2)$$

where  $\pi_{i,t} = R_{i,t} K_{i,t}$  are the profits distributed to the owners of the capital stock and  $R_{i,t}$  the real interest factor, which is equal to the marginal product of capital. Since returns to scale are constant, the production function can be written in intensive form:

$$y_t = A_i k_{i,t}^\alpha, \quad (3)$$

where  $k_{i,t} \equiv K_{i,t}/L_{i,t}$  is the capital-labor ratio.

The representative agent of country ( $i$ ) maximizes a logarithmic additively separable utility function

$$U_i = \ln c_{i,t} + \beta \ln d_{i,t+1} + \phi_i \beta^2 \ln e_{i,t+2} \quad (4)$$

subject to the budget constraints

$$c_{i,t} = w_{i,t} - s_{i,t} - z_{i,t} \quad (5)$$

$$d_{i,t+1} = R_{i,t+1} z_{i,t} - v_{t+1} \quad (6)$$

$$e_{i,t+2} = R_{i,t+1} R_{i,t+2} s_{i,t} + R_{i,t+2} v_{t+1} \quad (7)$$

$$c_{A,t}, d_{A,t+1}, e_{A,t+2} > 0 \quad (8)$$

The intertemporal budget constraint is

$$c_{i,t} + \frac{d_{i,t+1}}{R_{i,t+1}} + \frac{e_{i,t+2}}{R_{i,t+1} R_{i,t+2}} \leq w_{i,t} \quad (9)$$

where  $c_{i,t}$ ,  $d_{i,t+1}$  and  $e_{i,t+2}$  are consumption levels when the individuals of country  $i$  are respectively young, middle-aged and old and  $\beta$  is the psychological discount factor. The individuals work when young and earn a wage equal to  $w_{i,t}$ . They earn the interest factor  $R_{i,t+1}$  on their short-term saving at time  $t+1$  and earn the interest factor  $R_{i,t+1}R_{i,t+2}$  on their long-term saving when old. We assume that the short-term saving is the purchase of a sovereign asset issued by the government to finance public expenditure while the long-term saving is the purchase of a corporate asset issued by the firms. The maturities of the sovereign and the corporate assets are, respectively, one and two periods. All assets are assumed to be held until maturity. Therefore, the sovereign asset is more liquid than the corporate asset. The parameter  $\phi_i \in ]0, 1]$  depicts the individuals's aversion to the less liquid assets. When  $\phi_i$  decreases, the preference for liquidity increases and so does the credit constraint on the firms.

### 3 The Autarkic Equilibrium

In this section, we assume that the national economies are closed economies. The maximization of (4) with respect to (9) yields the following first-order conditions:

$$d_{i,t+1} = \beta R_{i,t+1} c_{i,t} \quad (10)$$

$$e_{i,t+2} = \phi_i \beta R_{i,t+2} d_{i,t+1} \quad (11)$$

Therefore, the optimal levels of individual short-term and long-term saving are:

$$z_{i,t} = \frac{\beta}{1 + \beta + \phi_i \beta^2} w_{i,t} \quad (12)$$

$$s_{i,t} = \frac{\phi_i \beta^2}{1 + \beta + \phi_i \beta^2} w_{i,t}, \quad (13)$$

where  $s_{i,t} = \phi_i \beta z_{i,t}$ . When the preference for liquidity increases (lower  $\phi_i$ ), short-term saving  $z_{i,t}$  increases relative to long-term saving  $s_{i,t}$ .

The optimal levels of consumption at each period are:

$$c_{i,t} = \frac{1}{1 + \beta + \phi_i \beta^2} w_{i,t} \quad (14)$$

$$d_{i,t+1} = \frac{\beta}{1 + \beta + \phi_i \beta^2} R_{i,t+1} w_{i,t} \quad (15)$$

$$e_{i,t+2} = \frac{\phi_i \beta^2}{1 + \beta + \phi_i \beta^2} R_{i,t+1} R_{i,t+2} w_{i,t} \quad (16)$$

The capital market is composed of two markets: the market for non-productive sovereign assets and the market for productive corporate assets. The capital market equilibrium is characterized by:

$$I_{i,t} = L_{i,t} s_{i,t} \quad (17)$$

$$B_{i,t} = L_{i,t} z_{i,t} \quad (18)$$

where  $I_{i,t}$  is corporate investment and  $B_{i,t}$  is the total assets issued by the government at time  $t$ . Equation (17) describes the equilibrium in the corporate asset market and Equation (18) the equilibrium in the sovereign market. We assume that the capital stock fully depreciates after two periods. Therefore, these asset flows lead to the following stocks:

$$K_{i,t+2} = I_{i,t} \quad (19)$$

$$B_{i,t+1} = R_{i,t+1} B_{i,t} \quad (20)$$

In intensive form,

$$k_{i,t+2} = \frac{\phi_i \beta^2}{1 + \beta + \phi_i \beta^2} \frac{L_{i,t}}{L_{i,t+2}} w_{i,t} \quad (21)$$

$$b_{i,t+1} = R_{i,t+1} \left( \frac{L_{i,t}}{L_{i,t+1}} \right) \frac{\beta}{1 + \beta + \phi_i \beta^2} w_{i,t} \quad (22)$$

where  $k_{i,t} \equiv \frac{K_{i,t}}{L_{i,t}}$  is the capital-labor ratio and  $b_{i,t} \equiv \frac{B_{i,t}}{L_{i,t}}$  is the debt-labor ratio. The optimal factor prices at time  $t$  are

$$w_{i,t} = (1 - \alpha) A_i k_{i,t}^\alpha \quad (23)$$

$$R_{i,t-1} R_{i,t} = \alpha A_i k_{i,t}^{\alpha-1}, \quad (24)$$

where the rate of return on long-term saving is the compound interest over two periods. The rate of return on short-term saving at time  $t$  derives from  $R_{i,t} = \frac{B_{i,t}}{B_{i,t-1}}$ , which yields

$$R_{i,t} = \frac{k_{i,t}^\alpha}{k_{i,t-1}^\alpha} \quad (25)$$

It can easily verified that the return on two successive sovereign assets is equal to the return on the corporate asset. At time  $t$ , the condition is

$$\frac{k_{i,t-1}^\alpha}{k_{i,t-2}^\alpha} \frac{k_{i,t}^\alpha}{k_{i,t-1}^\alpha} = \alpha A_i k_{i,t}^{\alpha-1}, \quad (26)$$

which yields

$$k_{i,t} = \alpha A_i k_{i,t-2}^\alpha \quad (27)$$

The capital stock per worker at time  $t$  is indeed equal to the share in income per capita at  $t-2$ . Substituting for the optimal expressions of  $w_{i,t}$  and  $R_{i,t+1}$ , we can rewrite Equations (21) and (22) as

$$k_{i,t+2} = \frac{\phi_i \beta^2}{(1 + \beta + \phi_i \beta^2)(1 + n_i)^2} (1 - \alpha) A_i k_{i,t}^\alpha \quad (28)$$

$$b_{i,t+1} = \frac{\beta}{(1 + \beta + \phi_i \beta^2)(1 + n_i)} (1 - \alpha) A_i k_{i,t+1}^\alpha \quad (29)$$

where  $n_i = \frac{L_{i,t+1}}{L_{i,t}}$  is the constant population growth rate.

When the aversion to illiquidity increases (lower  $\phi_i$ ), long-term saving decreases and so does investment, all else equal. However, the purchase of short-term assets and present consumption increase.

The steady-state capital stock per worker is

$$\bar{k}_i = \left( \frac{\phi_i \beta^2 (1 - \alpha) A_i}{(1 + \beta + \phi_i \beta^2)(1 + n_i)^2} \right)^{\frac{1}{1-\alpha}} \quad (30)$$

The lower  $\phi_i$ , the tighter is the liquidity constraint on the corporate sector. Moreover, the lower  $\phi_i$ , the lower  $\bar{k}_i$ . Any increase in the liquidity constraint (lower  $\phi_i$ ) reduces capital accumulation. The steady-state sovereign asset per worker is

$$\bar{b}_i = \left( \frac{\beta(1 - \alpha) A_i}{(1 + \beta + \phi_i \beta^2)(1 + n_i)} \right)^{\frac{1}{1-\alpha}} \left( \frac{\phi_i \beta}{1 + n_i} \right)^{\frac{\alpha}{1-\alpha}} \quad (31)$$

The effect of a decrease in  $\phi_i$  on  $\bar{b}_i$  is ambiguous. We can show that the effect is positive if  $\alpha < \beta^2 \phi_i$  and negative otherwise. In fact, a decrease in  $\phi_i$  lowers  $\bar{k}_i$ , which affects negatively  $\bar{b}_i$  while it increases the propensity to save in the sovereign asset. The total effect depends on the magnitude of the capital share in income (which affects the part of the wage that is saved) and of  $\beta^2 \phi_i$  which affects the propensity to invest in physical capital. If we rule out unrealistic extreme cases (high values of  $\alpha$  and low values of  $\beta$  and  $\phi$ ), then we can conclude that the effect of a decrease in  $\phi_i$  on  $\bar{b}_i$  is positive.



## 4 The Open-Economy Equilibrium

We now assume that capital can freely move across countries. We also assume that the individuals in the world prefer the asset markets of country  $B$  (AE countries) to that of country  $A$  (EME countries). Therefore,

$$k_{B,t} = \lambda k_{A,t} \quad (32)$$

$$b_{B,t} = \lambda b_{A,t} \quad (33)$$

where  $\lambda > 1$ . If the sovereign debts were perfect substitutes,  $\lambda$  would equal to one and the individuals in both countries would be indifferent in purchasing assets in country  $A$  or country  $B$ . When  $\lambda > 1$ , there is a preference for the assets in country  $B$ .

The equilibrium in the world goods market at period  $t$  is given by the world income accounts identity:

$$\begin{aligned} Y_{A,t} + Y_{B,t} &= L_{A,t}c_{A,t} + L_{A,t-1}d_{A,t} + L_{A,t-2}e_{A,t} + I_{A,t} + L_{B,t}c_{B,t} + \\ &+ L_{B,t-1}d_{B,t} + L_{B,t-2}e_{B,t} + I_{B,t}, \end{aligned} \quad (34)$$

where the world output is equal to the aggregate consumption of the young, the middle-aged and the old generations and the aggregate investment in both countries. Full depreciation of the current capital stock in each country implies  $I_{A,t} = K_{A,t+2}$  and  $I_{B,t} = K_{B,t+2}$ . It is assumed that the owners of the capital stock at date  $t = 0$  and  $t = 1$  in both countries cannot move this stock from one country to the other. The integration of capital markets thus occurs at date  $t = 2$ . The equilibrium in the international capital market, once capital is mobile across countries, derives from (34) and yields:

$$I_{A,t} + I_{B,t} = L_{A,t}s_{A,t} + L_{B,t}s_{B,t} \quad (35)$$

$$B_{A,t} + B_{B,t} = L_{A,t}z_{A,t} + L_{B,t}z_{B,t} \quad (36)$$

Let us rewrite the equilibrium in the capital markets in terms of stocks:

$$K_{A,t+2} + K_{B,t+2} = I_{A,t} + I_{B,t} \quad (37)$$

$$B_{A,t+1} + B_{B,t+1} = R_{A,t+1}B_{A,t} + R_{B,t+1}B_{B,t} \quad (38)$$

Although there is perfect mobility in the international capital market, the assets in country  $A$  and country  $B$  are not perfect substitutes since there is a world preference for the assets

in country  $B$ . Moreover, the equilibrium in the capital market requires real interest parity. On the sovereign market, real interest parity implies

$$\frac{R_{B,t+1}}{R_{A,t+1}} = \frac{\epsilon_{t+1}}{\lambda\epsilon_t}, \quad (39)$$

where  $\epsilon_t$  is the real exchange rate between country  $A$  and country  $B$  at time  $t$ . We assume that  $0 < \frac{\epsilon_{t+1}}{\epsilon_t} < \infty$  to eliminate uninteresting degenerate capital market equilibria. If the foreign exchange market is perfect and without country intervention, the ratio  $\frac{\epsilon_{t+1}}{\epsilon_t}$  equals 1. Let us define that an increase in  $\epsilon_t$  corresponds to a real appreciation of the currency of country  $A$  and a real depreciation of the currency of country  $B$ . The equilibrium condition in the sovereign debt market is therefore:

$$\frac{k_{A,t+1}}{k_{B,t+1}} = \left( \frac{\epsilon_{t+1} A_A}{\lambda\epsilon_t A_B} \right)^{\frac{1}{\alpha}}. \quad (40)$$

Real interest parity in the corporate asset market implies

$$\frac{R_{B,t+1}R_{B,t+2}}{R_{A,t+1}R_{A,t+2}} = \frac{\epsilon_{t+2}}{\lambda\epsilon_t}, \quad (41)$$

which leads to the following equilibrium condition

$$\frac{k_{A,t+2}}{k_{B,t+2}} = \left( \frac{\epsilon_{t+2} A_A}{\lambda\epsilon_t A_B} \right)^{\frac{1}{1-\alpha}}. \quad (42)$$

If the law of one price applies for all periods the equilibrium condition in the capital market is the same as in the nonmonetary economy. If the real exchange rate,  $\epsilon_t$ , decreases over time (i.e. if country  $A$ 's currency depreciates in real terms) then the real return on capital in country  $B$  gets higher. Interest parity is reestablished either if capital moves from country  $A$  to country  $B$ , which raises the interest rate in country  $A$  and reduces it in country  $B$ , or if there is an adjustment of the nominal exchange rate (i.e. a nominal depreciation of country  $A$ 's currency), or a combination of the two.

By using Equations (13), (37) and (40), we can compute the intertemporal equilibrium with perfect foresight in each country at time  $t = 2$  when capital markets become integrated:

$$k_{A,2} = \frac{(1-\alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,0} k_{A,0}^\alpha}{1+\beta+\phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,0} k_{B,0}^\alpha}{1+\beta+\phi_B \beta^2} \right)}{L_{A,2} + L_{B,2} \left( \frac{\lambda\epsilon_0 A_B}{\epsilon_2 A_A} \right)^{\frac{1}{1-\alpha}}} \quad (43)$$

$$k_{B,2} = \frac{(1-\alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,0} k_{A,0}^\alpha}{1+\beta+\phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,0} k_{B,0}^\alpha}{1+\beta+\phi_B \beta^2} \right)}{L_{A,2} \left( \frac{\epsilon_2 A_A}{\lambda\epsilon_0 A_B} \right)^{\frac{1}{1-\alpha}} + L_{B,2}}, \quad (44)$$

where  $\epsilon_0$  is assumed to be equal to 1. An increase in  $\epsilon_2$  (i.e. an appreciation of the currency of country  $A$  at time  $t = 2$ ) yields an increase in  $k_{A,2}$  and a decrease in  $k_{B,2}$ . When capital markets integrate, the country that will experience an appreciation of its currency in the future attracts foreign saving, which leads to an increase in its capital stock (or a decrease in its marginal productivity). If the preference for liquidity increases in any of the two countries (lower  $\phi_i$ ), the effect is always negative on  $k_{A,2}$  and  $k_{B,2}$ . The sovereign bonds in both countries when capital markets are integrated are:

$$b_{A,2} = \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,1}}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,1} \left( \frac{\lambda \epsilon_1 A_B}{\epsilon_2 A_A} \right)}{1 + \beta + \phi_B \beta^2} \right) k_{A,2}^\alpha}{L_{A,2} + \lambda L_{B,2}} \quad (45)$$

$$b_{B,2} = \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,1} \left( \frac{\epsilon_2 A_A}{\lambda \epsilon_1 A_B} \right)}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,1}}{1 + \beta + \phi_B \beta^2} \right) k_{B,2}^\alpha}{L_{B,2} + \frac{1}{\lambda} L_{A,2}}, \quad (46)$$

We can observe that an increase in the preference for liquidity (lower  $\phi_i$ ) in any country yields higher  $b_{A,2}$  and  $b_{B,2}$ . The effect of a currency appreciation is also clear: the demand for the sovereign bond increases in the country where the currency appreciate. Moreover, when the world preference for country  $B$ 's asset market increases (an increase in  $\lambda$ ), the demand for sovereign assets issued by country  $B$  increases, all else equal, and the demand for sovereign assets issued by country  $A$  decreases. After the capital market integration ( $t \geq 2$ ), the intertemporal equilibrium with perfect foresight for a generation born at time  $t$  in each country is characterized by

$$k_{A,t+2} = \frac{(1 - \alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,t}}{1 + \beta + \phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,t} \left( \frac{\lambda \epsilon_{t-2} A_B}{\epsilon_t A_A} \right)^{\frac{1}{1-\alpha}}}{1 + \beta + \phi_B \beta^2} \right) k_{A,t}^\alpha}{L_{A,t+2} + L_{B,t+2} \left( \frac{\lambda \epsilon_t A_B}{\epsilon_{t+2} A_A} \right)^{\frac{1}{1-\alpha}}} \quad (47)$$

$$k_{B,t+2} = \frac{(1 - \alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,t} \left( \frac{\epsilon_t A_A}{\lambda \epsilon_{t-2} A_B} \right)^{\frac{1}{1-\alpha}}}{1 + \beta + \phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,t}}{1 + \beta + \phi_B \beta^2} \right) k_{B,t}^\alpha}{L_{A,t+2} \left( \frac{\epsilon_{t+2} A_A}{\lambda \epsilon_t A_B} \right)^{\frac{1}{1-\alpha}} + L_{B,t+2}} \quad (48)$$

$$b_{A,t+1} = \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,t}}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,t} \left( \frac{\lambda \epsilon_t A_B}{\epsilon_{t+1} A_A} \right)}{1 + \beta + \phi_B \beta^2} \right) k_{A,t+1}^\alpha}{L_{A,t+1} + \lambda L_{B,t+1}} \quad (49)$$

$$b_{B,t+1} = \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,t} \left( \frac{\epsilon_{t+1} A_A}{\lambda \epsilon_t A_B} \right)}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,t}}{1 + \beta + \phi_B \beta^2} \right) k_{B,t+1}^\alpha}{L_{B,t+1} + \frac{1}{\lambda} L_{A,t+1}} \quad (50)$$

When capital markets are integrated, an appreciation of the currency in country  $A$  has a negative effect on  $b_{A,t+1}$ . It is a consequence of the positive effect of this appreciation on  $k_{A,t+1}$ , which lowers the return on capital. The dynamics of the capital stock per worker and of the sovereign asset per worker leads to a steady state if the condition in the following proposition is met:

**Proposition 1** *In a two-country model with overlapping generations living for three periods with integrated capital markets, the intertemporal equilibrium admits a unique globally stable interior steady state provided that the dynamics of the real interest rate over time is linear.*

**Proof:**  $\bar{k}_i$  is stationary if and only if  $\frac{\epsilon_{t+1}}{\epsilon_t}$  is a constant for any  $t$ . Let us say that this constant is  $\theta$ .

The steady state is characterized by:

$$\bar{k}_A = \left[ \frac{(1 - \alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,t}}{1 + \beta + \phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,t} \left( \frac{1}{\theta^2} \frac{A_B}{A_A} \right)^{\frac{1-\alpha}{\alpha}}}{1 + \beta + \phi_B \beta^2} \right)}{L_{A,t+2} + L_{B,t+2} \left( \frac{1}{\theta^2} \frac{A_B}{A_A} \right)^{\frac{1}{1-\alpha}}} \right]^{\frac{1}{1-\alpha}} \quad (51)$$

$$\bar{k}_B = \left[ \frac{(1 - \alpha) \left( \frac{\phi_A \beta^2 A_A L_{A,t} \left( \theta^2 \frac{A_A}{A_B} \right)^{\frac{1-\alpha}{\alpha}}}{1 + \beta + \phi_A \beta^2} + \frac{\phi_B \beta^2 A_B L_{B,t}}{1 + \beta + \phi_B \beta^2} \right)}{L_{A,t+2} \left( \theta^2 \frac{A_A}{A_B} \right)^{\frac{1}{1-\alpha}} + L_{B,t+2}} \right]^{\frac{1}{1-\alpha}} \quad (52)$$

When purchasing power parity is satisfied,  $\theta = 1$  and the steady state does not depend on exchange rates. The steady-state of the sovereign asset per worker in country  $i$  is:

$$\bar{b}_A = \left[ \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,t}}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,t} \left( \frac{1}{\theta} \frac{A_B}{A_A} \right)}{1 + \beta + \phi_B \beta^2} \right)}{L_{A,t+1} + \lambda L_{B,t+1}} \right] \bar{k}_A^\alpha \quad (53)$$

$$\bar{b}_B = \left[ \frac{(1 - \alpha) \left( \frac{\beta A_A L_{A,t} \left( \theta \frac{A_A}{A_B} \right)}{1 + \beta + \phi_A \beta^2} + \frac{\beta A_B L_{B,t}}{1 + \beta + \phi_B \beta^2} \right)}{L_{B,t+1} + \frac{1}{\lambda} L_{A,t+1}} \right] \bar{k}_B^\alpha \quad (54)$$

The level of the sovereign asset at the steady state and away from the steady state depends on  $\phi_i$  and  $\lambda$  the preference for the advanced country's sovereign market.

## 5 The Balance of Payments

In an open two-country world, a country can finance domestic investment by foreign saving. The difference between domestic investment and domestic saving is equal to the current account balance. In other words, a country can spend more or less than it produces. The national income accounts identity of country  $i$  in this two-country economy is

$$Y_{i,t} + R_{i,t-1}R_{i,t}(L_{i,t-2}s_{i,t-2} - K_{i,t}) + R_{i,t}(L_{i,t-1}z_{i,t-1} - B_{i,t-1}) = L_{i,t}c_{i,t} + L_{i,t-1}d_{i,t} + L_{i,t-2}e_{i,t} + G_{i,t} + K_{i,t+2} + G_{i,t}, \quad (55)$$

where  $Y_{i,t}$  and  $[R_{i,t-1}R_{i,t}(L_{i,t-2}s_{i,t-2} - K_{i,t}) + R_{i,t}(L_{i,t-1}z_{i,t-1} - B_{i,t-1})]$  are the Gross Domestic Product (GDP) and the net factor income from abroad respectively, and the sum of the two is the Gross National Income (GNI) of country  $i$  at time  $t$ . On the right hand side of the identity,  $G_{i,t}$  is the difference between domestic spending on foreign capital and foreign spending on domestic capital. In this model of one single good in each country, where there is no trade in consumption goods and there are no unilateral transfers,  $G_{i,t}$  is the current account balance of country  $i$  at time  $t$ . This is simply the difference between the factor income from abroad and the factor income payments to the foreign country. In intensive form, taking into account the fact that  $y_{i,t} = w_{i,t} + R_{i,t}k_{i,t}$ , the current account balance is equal to

$$g_{i,t} = w_{i,t} + \frac{L_{i,t-2}}{L_{i,t}}R_{i,t-1}R_{i,t}s_{i,t-2} + \frac{L_{i,t-1}}{L_{i,t}}R_{i,t}z_{i,t-1} - R_{i,t}b_{i,t-1} - c_{i,t} - \frac{L_{i,t-1}}{L_{i,t}}d_{i,t} - \frac{L_{i,t-2}}{L_{i,t}}e_{i,t} - \frac{L_{i,t+2}}{L_{i,t}}k_{i,t+2}, \quad (56)$$

or, equivalently, since  $d_{i,t} = R_{i,t}z_{i,t-1}$  and  $e_{i,t} = R_{i,t-1}R_{i,t}s_{i,t-2}$ ,

$$g_{i,t} = s_{i,t} - (1 + n_i)^2k_{i,t+2} + z_{i,t} - b_{i,t} \quad (57)$$

The current account per worker  $g_{i,t}$  is equal to the difference between domestic short-term and long-term saving, on the one hand, and the sale of domestic corporate and sovereign assets to the world on the other hand. Short-term saving thus crowds out corporate investment. The higher the short-term saving, the tighter the constraint is on credit to firms. However, for an emerging or a developing country concerned about avoiding a balance of payments crisis, an external deficit in the corporate sector can be offset by an external surplus in the sovereign sector. In other words, for EME countries, there may be a tradeoff between income growth and external financial stability. As for the effect of demographics, higher population dynamics has a negative effect on the current account, all else equal. At the steady state, the current account per worker becomes

$$g_{i,t} = \bar{s}_i - (1 + n_i)^2 \bar{k}_i + \bar{z}_i - \bar{b}_i, \quad (58)$$

where Equation (58) depends on the following parameters: the ratio of technological levels ( $A_A/A_B$ ), the real exchange rate, the population growth rate, the liquidity preference parameter  $\phi_i$  and  $\lambda$ , the preference for the advanced country's sovereign market. The existence of a steady-state for the current account also depends on the existence of the steady-state  $\bar{k}_i$ , i.e. if the dynamics of the real interest rate is constant.

## 6 Capital market integration and current account

Assume that country  $A$  and country  $B$  are identical in all respects except for the level of initial development:  $k_{A,0} < k_{B,0}$  and  $k_{A,1} < k_{B,1}$ . All other parameters, including the preference for liquidity  $\phi_i$ , are the same across countries. We also assume that the population sizes are identical for any  $t$  and  $\lambda = 1$  (perfect substitution in assets across countries). The world economy starts at time  $t = 0$  when capital markets are not integrated yet. Capital markets integrate at  $t = 2$ . Without loss of generality, we will focus on the current account of country  $A$ , the less developed country.

### 6.1 Flexible exchange rate

In this section, we will assume that exchange rates are flexible and, hence, purchasing power parity is verified at all periods. In the model, this implies that  $\theta = 1$ .

**Proposition 2** *In a two-country model with overlapping generations living for three periods and with two types of assets, in which both countries are identical except for the initial level of development, the less developed country  $A$  experiences a current account deficit when capital markets integrate and a balanced current account at the steady state.*

**Proof:** Under autarky at times  $t = 0$  and  $t = 1$ , short-term saving is equal to the supply of sovereign assets and long-term saving is equal to investment in physical capital. Since  $k_{A,t} < k_{B,t}$  the return on short-term and long-term saving is higher in country  $A$  than in country  $B$ . Therefore, when capital markets integrate at time  $t = 2$ , country  $A$  attracts foreign saving in the sovereign and corporate asset markets. A current account deficit thus ensues for this country. At the steady state, the economy of country  $A$  converges to that of country  $b$  and the current accounts are balanced.

Let us modify two assumptions: the population growth rate now is higher in country  $A$  and there is a preference for country  $B$ 's asset markets,  $\lambda > 1$ . The result is that the current account deficit of country  $A$  is reduced at time  $t = 2$  is reduced when capital markets integrate. Higher demographic dynamics implies a lower capital stock per worker

at time  $t = 2$  and its difference with saving per worker is smaller and the current account deficit diminishes. If  $\lambda > 1$ , country  $A$  is less attractive for foreign saving when capital markets integrate and, hence, its current account deficit is lower. At the steady state, the current accounts are no longer balanced. If population grows faster in country  $A$ , its current account will be in deficit. If  $\lambda > 1$ , saving from country  $A$  is used to purchase assets in country  $B$ . The current account of country  $A$  is therefore in surplus.

## 6.2 Fixed exchange rate

We now assume that country  $A$  pegs its currency to country  $B$ 's currency in order to control the real exchange rate dynamics. We thus consider the situation when  $\theta < 1$  for all  $t$ , which implies that country  $A$ 's currency depreciates in real terms over time.

**Proposition 3** *In a two-country model with overlapping generations living for three periods and with two types of assets, in which both countries are identical except for the initial level of development, the less developed country  $A$  experiences a current account deficit when its currency depreciates over time both at the time of capital markets integration and at the steady state.*

**Proof:** Equations (43) and (44) make clear that the impact of the depreciation of country  $A$ 's currency on the level of capital stock per worker is negative in country  $A$  and positive in country  $B$  when capital markets integrate. Its effects are the same on the sovereign assets (see Equations (45) and (46)). Therefore, a currency depreciation allows the less developed country to diminish its current account deficit when capital markets integrate. This result holds true at the steady state. As a result, there is a tradeoff between income per capita and current account management.

## 7 Tighter liquidity constraint in EME economies

Households allocate saving between the short-term non-productive sovereign assets and the long-term productive assets. We now assume that the preference for liquidity in country  $A$  is higher than in country  $B$ . Therefore, we have  $\phi_A < \phi_B$ . An increase in the preference for liquidity means a tighter liquidity constraint on the firms. This has a negative impact on capital accumulation. However, the effect on the current account is positive.

### 7.1 Flexible exchange rate

**Proposition 4** *In a two-country model with overlapping generations living for three periods and with two types of assets, in which countries differ in the initial level of development*

and the preference for liquidity, a reallocation of saving towards the short-term sovereign assets in the less developed country has a positive effect on its current account both at the time of capital markets integration and at the steady state.

**Proof:** It can be shown that  $\frac{dg_{A,t}}{d\phi_A} < 0$  both at the time of capital markets integration and at the steady state. This means that a decrease in  $\phi_A$  has a positive impact on country  $A$ 's current account and a negative impact on country  $B$ 's current account.

Before 1998, the emerging and developing countries as a group recorded current account deficits (see Figure 1). After many balance-of-payments crises in the 1990s, this group of countries, although less developed than the advanced countries, started to record current account surpluses, in contradiction with the predictions of the neoclassical growth theory. The turning point occurred in 1998. If we consider that the balance-of-payments crises triggered a reallocation of saving towards short-term assets, our framework shows that if these short-term assets finance non-productive assets, capital accumulation slows down but the current account improves. Our framework does not explain the increase in the saving rate observed in many EME countries after 1998 but account for the allocation of saving away from productive assets, the so-called "saving glut". Moreover, if we further consider that the balance-of-payments crises increased the preference for the western asset markets (increase in  $\lambda$ ), the reallocation of saving towards the western asset markets and towards the non-productive assets in emerging countries represented a key change in the current account dynamics in these countries. The advanced countries benefitted from this change as their interest rates declined at record lows.

## 7.2 Fixed exchange rate

Adding a fixed exchange rate system in the previous framework allows to add another element in the reversal in the current accounts of the EME countries after 1998.

**Proposition 5** *In a two-country model with overlapping generations living for three periods and with two types of assets, in which countries differ in the initial level of development and the preference for liquidity, a currency depreciation in the less developed country reinforces the positive effect on its current account of a reallocation of saving towards the short-term sovereign assets both at the time of capital markets integration and at the steady state.*

**Proof:** It can be shown that  $\frac{dg_{A,t}}{d\theta} < 0$  both at the time of capital markets integration and at the steady state.

Currency depreciations in emerging countries after 1998 also contributed to the improvement of the current accounts.



## 8 Tighter liquidity constraints in advanced economies

The financial crisis of 2007 and 2008 breaks out in the United States and rapidly spreads over Europe. This crisis triggered a reallocation of saving towards short-term assets in the western economies. In our framework, we assume a decrease in  $\phi_B$  but also a increase in  $\lambda$ , the preference for the asset markets of the advanced countries. Therefore, the effects of a financial crisis in the advanced countries and the emerging economies are not symmetric. The current financial crisis illustrates the strong asymmetry between the advanced economies and the emerging economies. When a financial crisis hits the advanced economies, the world still trust their sovereign debt markets and even reinforces its preference for them.

### 8.1 Flexible exchange rate

**Proposition 6** *In a two-country model with overlapping generations living for three periods and with two types of assets, in which countries differ in the initial level of development and the preference for liquidity, a reallocation of saving towards the short-term sovereign assets in the advanced country has a positive effect on its current account both at the time of capital markets integration and at the steady state. However, a simultaneous increase in the preference for the advanced asset markets has a negative impact on the advanced country's current account.*

**Proof:** It is straightforward to show that  $\frac{dg_{B,t}}{d\phi_B} < 0$  and  $\frac{dg_{B,t}}{d\lambda} < 0$  both at the time of capital markets integration and at the steady state.

After the financial crisis of 2007 and 2008, the large current account deficits of the advanced countries have reduced sharply but have not turned into surpluses. Therefore, the pattern of current accounts did not return to pre-1998 situation despite the magnitude of the crisis in the western economies. We argue that two effects are at work on the current accounts. One is reducing the current account deficit by reallocating saving away from productive assets and one is increasing it by maintaining the preference for western markets over the emerging ones.

### 8.2 Fixed exchange rate

Finally, we can add the effect of the fixed exchange rate to the current account of the advanced country. At a time of very low nominal interest rates in western countries, it is very unlikely that the pegged currencies of the emerging countries can further depreciate. Some have actually appreciated contributing to the reduction in the current accounts of the western economies

## 9 Conclusion

The objective of this paper is to build a framework to account for the salient facts of the international monetary system: the reversal of the current accounts in the emerging and developing countries in 1998, global imbalances in the 2000s and its sharp reduction when the financial crisis erupted in the western economies in 2007 and 2008. Our framework includes two types of assets: a short-term non-productive sovereign asset and a long-term productive corporate asset. We argue that a reallocation of saving towards the short-term asset triggered by a period of financial strain can cause both a slowdown of physical capital accumulation and an improvement in the current account. Moreover, we show that currency pegs are not only an instrument to promote growth through exports but also an instrument to stave off external financial crises.

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