

The Real and Financial Implications of the Global Saving Glut: A Three-Country Model

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Abstract: The model presented in this paper has two objectives. First, it models global imbalances in a simple way while conserving real and financial approaches. This double approach is necessary because Global Imbalances are due to the conjunction of financial and real phenomena: the increase in the price of commodities, the accumulation of foreign reserves by the Asian central banks, the limited absorption capacity of the OPEC countries, the insufficient development of the Asian financial system and the perception of better returns in the US. The second objective is to model the global saving glut hypothesis and to show its implications. In order to avoid the recession linked to the increase of their propensity to import, the United States increase their propensity to spend. This adjustment has a cost. The Global Imbalances grow quickly with an increase of current account imbalances and NFA in both the US and Asia. The euro area supports an appreciation of its exchange rate which put it in a long depression.

JEL Classification: F21 ; F32 ; F41 ; F47

Key words : International Macroeconomics, Global Imbalances, Balance of Payments, International Finance , Simulation and Forecast

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" The economist with but one model for the analysis of the balance of payments has handicapped him- or herself. [...] sometimes capital drives the current account, sometimes the other way round. "

Kindleberger (1987), p. 11

1 Introduction

During the last years, the Global Imbalances have been increasing. The weight of both current account imbalances and net foreign assets in the 2006 world economy is twice what it was in 1996. If we choose an approach by the real sector, the two big reasons for this growth of Global Imbalances are the increase of commodities prices and the under evaluation of the Renminbi. The three major players of the GI are the US, for deficits, and the OPEC and the Asian countries, for surpluses. The US suffered the brunt of rising price of oil and the under evaluation of Renminbi and, since the beginning of the millennium, their propensity to spend has been increasing. This paper presents the alternatives of the US to respond to this shock and the consequences of their reactions, first, on the countries with flexible exchange rates and, second, on the countries with fixed exchange rates.

The model presented in this paper has two objectives. First, it models global imbalances in a simple way while conserving real and financial approaches (the Three-Country model presented here is comprised of 50 equations). This double approach is necessary because Global Imbalances are due to the conjunction of financial and real phenomena: the increase in the price of commodities, the accumulation of foreign reserves by the Asian central banks, the limited absorption capacity of the OPEC countries, the insufficient development of the Asian financial system and the perception of better returns in the US. The second objective is to model the global saving glut hypothesis and to show its implications. We want to demonstrate that in the present context, the increase in the US propensity to spend would offset negative impact on their propensity to import, but with an increase in their net foreign debt. The United States can temporarily avoid a recession by accumulating debts on the rest of the world as long as fixed exchange rate countries accept to accumulate dollar assets. The second part briefly describes the evolution in the economic literature on global imbalances. The third part presents the model with three identical flexible exchange rate countries. We introduce the Global Saving Glut Hypothesis in the fourth part.

2 A brief review of the literature on Global Imbalances

The article by Dooley, Folkerts-Landau and Garber (2003) marks the return at the forefront of the issue of current imbalances in economic literature. They argue that the Bretton Woods system has returned so their work has been named Bretton Woods II. The authors consider that the global imbalances of the 2000s result from an export-led growth strategy of Asian countries that is similar to the one adopted by Europe and Japan after the Second World War. In both cases, the surplus countries accumulate reserves so that their exchange rate remains undervalued relative to the dollar. They can maintain their competitiveness and benefit from growth by exports. However, as Eichengreen (2004) pointed out, the resemblance to Bretton Woods is limited. The current international monetary system is a floating exchange rates one and the consistency between the Asian countries in the years 2000 is lower than that of Europe during the 1960s. In addition, the thesis of Bretton Woods II considers the global imbalances resulting from the real sector, i.e. the top of the balance of payments, and the financial sector - i.e. the bottom of the balance of payments - adjust to it. This vision of global imbalances from the top of the balance of payments is not adopted in the following papers. The Global Saving Glut Hypothesis, supported by Bernanke (2005), assumes that the global imbalances result from both the financial and real sectors. The current account surpluses of the emerging countries have two origins. On the one hand, following the financial crisis of 1997, the Asian emerging countries are accumulating reserves to cover against a possible sudden exit in foreign capital. At the same time, they maintain the under evaluation of their exchange rates, and the exports led their growth. On the other hand, the emergence of new great industrial countries weighs on oil prices. OPEC emits them as well as a surplus of savings that they want to invest abroad, since their absorption capacity is limited due to its small population. The saving surplus of the emerging countries leads to the United States, the economy that presents the best features. Bernanke lists the special features that make the U.S. financial sector the most attractive. This is the growth of productivity linked to the development of new technologies, the low political risk, the strong property rights protection or still favourable institutional environment. These inflows of investments lead an appreciation of the dollar, an increase in asset prices and, after 2000, lower interest rates and an increase in household wealth. The combination of these factors motivates households to reduce their savings and increase consumption. Thus, the global savings glut is absorbed by the increase in spending of U.S. households that avoids a recession due to an excess of supply.

The equilibrium model of Caballero, Fahri and Gourinchas (2006) explains growth of GI by the inability of financial systems of certain areas to

achieve sufficient investment to use all the savings available. The current pattern of GI and the low global interest rates result from the differences on the financial institutions development in the world and from the greatest potential growth of the United States compared to other financially developed areas. This thesis provides a new element to explain the accumulation of foreign assets by Asian countries beyond the level of reserves to provide assurance against a flight of foreign capital. Furthermore, Caballero et al (2006), all kinds of models have been developed to represent the evolution of global imbalances. In Obstfeld and Rogoff (2005) the adjustment occurs by changing the preferences between tradable and non tradable goods and between domestic and foreign goods. The model of Blanchard, Giavazzi and Sa (2005) stressed the role of the exchange rate in the allocation of international portfolio. These three models have a major disadvantage that should be overcome: they assume that the GDP are not affected by the adjustments of current imbalances. In the continuous time model with two countries Asada, Chiarella, Flaschel and Franke (2003) and Proaño (2008), the GDP reacts to the adjustment of current imbalances, but they only model the real sector. Finally, models of Lavoie and Zhao (2008), Godley and Lavoie (2007) and Zhao (2006) have the advantage of being stock-flow consistent and of representing both the top and the bottom of the balance of payments. However, they should be simplified (Lavoie, 2008): these three-country models comprise 91, 79 and 89 equations, respectively. In his review of the state of macroeconomics, Blanchard (2008) also argues for smaller models to capture a specific mechanism. He cites Solow including:

" My general preference is for small, transparent, tailored models, often partial equilibrium, usually aimed at understanding some little piece of the (macro-) economic mechanism. "

Solow (2008)

3 A model of three identical countries with flexible exchange rates

The model is composed of three identical countries. These economies exchange goods and services and hold foreign assets that provide incomes. We assume the three countries are at equilibrium before shocks: trade equilibrium, current account equilibrium, zero net foreign debt and stable exchange rates. The model is divided into two sectors. The real sector (3.1) describes the equations of national income, domestic demand, imports, exports and income balance. The financial sector (3.2) presents the evolution of supply and demand for foreign assets and allows determining the net external position and the exchange rate. Simulations (3.3) illustrate the effect of an increase in the propensity to spend and the impact of a competitiveness shock.

3.1 The real sector

The real sector is represented synthetically in order to focus only on the adjustment mechanisms vis-à-vis the rest of the world. We use a model of absorption *à la* Alexander (1952). If the absorption is lower than national income, the country has a current account surplus and vice versa. In the propensity to spend c , it does not distinguish the propensity to spend of households ($1 - s$), enterprises (i) and state (g):

$$c = 1 - s + i + g$$

The subject of the paper is not to explain the government's way of intervening but to define the level of domestic spending that it should attempt to achieve through fiscal, monetary and exchange rate policies. The fiscal policy acts on the budget deficit g . The monetary policy changes saving and investment levels, in particular, playing on interest rates. Finally, changes in central bank reserves allow to compensate for current account imbalances without modifying the exchange rate. In the model with flexible exchange rates, the level of domestic D expenditure is determined like Samuelson (1939) and Hicks (1956), the propensity to spend of the country (c) and its GNP in the previous period Y . We assume that before the shock: $c1 = c2 = c3 = 1$.

$$D1_t = c1 \times Y1_{t-1} \quad (1)$$

$$D2_t = c2 \times Y2_{t-1} \quad (2)$$

$$D3_t = c3 \times Y3_{t-1} \quad (3)$$

Imports are defined as standard by levels of expenditure and relative prices, approached by the nominal exchange rate (that implies $P1 = P2 = P3 = 1$). The country 1's currency is the \$, that of country 2 is the £ and that of the country 3 is the & (with $1\$ = e \times \text{£}$; $1\$ = ex \times \&$; and $1\text{£} = \frac{ex}{e} \&$).

$$\log(IM12_t) = \log(m120) + m121 \times \log(D1_{t-1}) + m121 \times \log(e_{t-1}) \quad (4)$$

$$\log(IM21_t) = \log(m210) + m211 \times \log(D2_{t-1}) - m212 \times \log(e_{t-1}) \quad (5)$$

$$\log(IM13_t) = \log(m130) + m131 \times \log(D1_{t-1}) + m132 \times \log(ex_{t-1}) \quad (6)$$

$$\log(IM31_t) = \log(m310) + m311 \times \log(D3_{t-1}) - m312 \times \log(ex_{t-1}) \quad (7)$$

$$\log(IM23_t) = \log(m230) + m231 \times \log(D2_{t-1}) + m232 \times \log\left(\frac{ex_{t-1}}{e_{t-1}}\right) \quad (8)$$

$$\log(IM32_t) = \log(m320) + m321 \times \log(D3_{t-1}) - m322 \times \log\left(\frac{ex_{t-1}}{e_{t-1}}\right) \quad (9)$$

We determine the propensity to import by the ratio of imports on expenditures.

$$\mu12_t = \frac{IM12_t}{D1_t} \quad (10)$$

$$\mu21_t = \frac{IM21_t}{D2_t} \quad (11)$$

$$\mu13_t = \frac{IM13_t}{D1_t} \quad (12)$$

$$\mu31_t = \frac{IM31}{D3_t} \quad (13)$$

$$\mu32_t = \frac{IM32_t}{D3_t} \quad (14)$$

$$\mu23_t = \frac{IM23_t}{D2_t} \quad (15)$$

The balance of investment incomes is calculated as the difference between incomes received and incomes paid taking into account exchange rate variations:

$$\begin{aligned} INC13_t = & (\omega13_{t-1} \times W1_{t-1} \times r3_{t-1} \times \frac{ex_{t-1}}{ex_t}) \\ & - (\omega31_{t-1} \times \frac{W3_{t-1}}{ex_{t-1}} \times r1_{t-1}) \end{aligned} \quad (16)$$

$$\begin{aligned} INC31_t = & (\omega31_{t-1} \times W3_{t-1} \times \frac{ex_t}{ex_{t-1}} \times r1_{t-1}) \\ & - (\omega13_{t-1} \times W1_{t-1} \times r3_{t-1} \times ex_{t-1}) \end{aligned} \quad (17)$$

$$\begin{aligned} INC12_t = & (\omega12_{t-1} \times W1_{t-1} \times r2_{t-1} \times \frac{e_{t-1}}{e_t}) \\ & - (\omega21_{t-1} \times \frac{W2_{t-1}}{e_{t-1}} \times r1_{t-1}) \end{aligned} \quad (18)$$

$$\begin{aligned}
INC21_t &= (\omega 21_{t-1} \times W 2_{t-1} \times \frac{e_t}{e_{t-1}} \times r 1_{t-1}) \\
&\quad - (\omega 12_{t-1} \times W 1_{t-1} \times r 2_{t-1} \times e_{t-1})
\end{aligned} \tag{19}$$

$$\begin{aligned}
INC32_t &= (\omega 32_{t-1} \times W 3_{t-1} \times r 2_{t-1} \times \frac{e_{t-1}}{ex_{t-1}} \times \frac{ex_t}{e_t}) \\
&\quad - (\omega 23_{t-1} \times W 2_{t-1} \times \frac{ex_{t-1}}{e_{t-1}} \times r 3_{t-1})
\end{aligned} \tag{20}$$

$$\begin{aligned}
INC23_t &= (\omega 23_{t-1} \times W 2_{t-1} \times \frac{ex_{t-1}}{e_{t-1}} \times \frac{e_t}{ex_t} \times r 3_{t-1}) \\
&\quad - (\omega 32_{t-1} \times W 3_{t-1} \times r 2_{t-1} \times \frac{e_{t-1}}{ex_{t-1}})
\end{aligned} \tag{21}$$

Then, we determine the GNP by the sum of the absorption (or expenditure Overall residents) A , the trade balance (the difference between exports and imports) $X - IM$ and the income balance INC .

$$Y = A + (X - IM) + INC$$

$$\text{avec } D = A + IM$$

The GNP corresponds to domestic demand (the first member), plus exports (the second and third members), plus net income investment (fourth and fifth members).

$$\begin{aligned}
Y1_t &= (1 - \mu 12_t - \mu 13_t) \times D1_t + \frac{1}{e_t} \times \mu 21_t \times D2_t \\
&\quad + \frac{1}{ex_t} \mu 31 \times D3_t + INC12_t + INC13_t
\end{aligned} \tag{22}$$

$$\begin{aligned}
Y2_t &= (1 - \mu 21_t - \mu 23_t) \times D2_t + e_t \times \mu 12_t \times D1_t \\
&\quad + \frac{e_t}{ex_t} \times \mu 32_t \times D3_t + INC21_t + INC23_t
\end{aligned} \tag{23}$$

$$\begin{aligned}
Y3_t &= (1 - \mu 31_t - \mu 32_t) \times D3_t + ex_t \times \mu 13_t \times D1_t \\
&\quad + \frac{ex_t}{e_t} \times \mu 23_t \times D2_t + INC31_t + INC32_t
\end{aligned} \tag{24}$$

The real sector allows for determining the trade balance. The trade deficit is the difference between imports and exports expressed in domestic currency:

$$DC13_t = IM13_t - \frac{1}{ex_t} \times IM31_t \quad (25)$$

$$DC12_t = IM12_t - \frac{1}{e_t} \times IM21_t \quad (26)$$

$$DC32_t = IM32_t - \frac{ex_t}{e_t} \times IM23_t \quad (27)$$

$$DC21_t = -DC12_t \times e_t \quad (28)$$

$$DC31_t = -DC13_t \times ex_t \quad (29)$$

$$DC23_t = -DC32_t \times \frac{e_t}{ex_t} \quad (30)$$

3.2 The financial sector

A portfolio model *à la* Kouri (1981) which incorporates the mechanical model of Blanchard et al. (2005) represents the financial sector. It is used to determine exchange rates. The propensity to hold foreign assets is determined in accordance with the *horizontal constraint* of Godley (1996), i.e., for each equation, the sum of all rates of return coefficients is equal to zero.

$$\omega12_t = \lambda120 - \lambda121 \times r1_t + \lambda122 \times r2_t - \lambda123 \times r3_t \quad (31)$$

$$\omega13_t = \lambda130 - \lambda131 \times r1_t - \lambda132 \times r2_t + \lambda133 \times r3_t \quad (32)$$

$$\omega21_t = \lambda210 + \lambda211 \times r1_t - \lambda212 \times r2_t - \lambda213 \times r3_t \quad (33)$$

$$\omega23_t = \lambda230 - \lambda231 \times r1_t - \lambda232 \times r2_t + \lambda233 \times r3_t \quad (34)$$

$$\omega31_t = \lambda310 + \lambda311 \times r1_t - \lambda312 \times r2_t - \lambda313 \times r3_t \quad (35)$$

$$\omega32_t = \lambda320 - \lambda321 \times r1_t + \lambda322 \times r2_t - \lambda323 \times r3_t \quad (36)$$

Net foreign debt is equal to the value of assets held by foreign investors in the country, minus the value of assets held by domestic investors abroad, plus the trade deficit vis-à-vis the foreign country.

$$\begin{aligned}
 NFD12_t &= \omega 21_{t-1} \times \frac{W2_{t-1}}{e_{t-1}} \times (1 + r1_{t-1}) \\
 &\quad - \omega 12_{t-1} \times W1_{t-1} \times (1 + r2_{t-1}) \times \frac{e_{t-1}}{e_t} + DC12_t
 \end{aligned} \tag{37}$$

The quantity of the assets held by investors from country 2 in country 1 is equal to the share ($\omega 21$) of country 2's wealth ($W2_{t-1}$) held in country 1 during the previous period, times the exchange rate $\text{£}/\text{\$}$ ($1 \times \text{£} = \frac{1}{e} \times \text{\$}$), times the rate of return of country 1's assets in dollars ($1 + r1_{t-1}$). The value of assets held by investors from country 1 in country 2 is equal to the share of country 1's wealth of the previous period ($W1_{t-1}$), times the propensity to hold assets of country 2 ($\omega 12_{t-1}$), times the rate of return on assets of country 2 in dollars ($(1 + r2_{t-1}) \times \frac{e_{t-1}}{e_t}$). The net foreign debt of country 2 vis-à-vis country 1 is the opposite of the previous, times the exchange rate.

$$NFD21_t = -NFD12_t \times e_t \tag{38}$$

We obtain the other net foreign debts in the same way:

$$\begin{aligned}
 NFD13_t &= \omega 31_{t-1} \times \frac{W3_{t-1}}{ex_t} \times (1 + r1_{t-1}) \\
 &\quad - \omega 13_{t-1} \times W1_{t-1} \times (1 + r3_{t-1}) \times \frac{ex_{t-1}}{ex_t} + DC13_t
 \end{aligned} \tag{39}$$

$$NFD31_t = -NFD13_t \times ex_t \tag{40}$$

$$\begin{aligned}
 NFD32_t &= \omega 23_{t-1} \times \frac{W2_{t-1}}{e_{t-1} \times ex_t} \times (1 + r3_{t-1}) \\
 &\quad - \omega 32_{t-1} \times W3_{t-1} \times (1 + r2_{t-1}) \times \frac{e_{t-1}}{ex_{t-1}} \times \frac{ex_t}{e_t} + DC32_t
 \end{aligned} \tag{41}$$

$$NFD23_t = -NFD32_t \times \frac{e_t}{ex_t} \tag{42}$$

The supply of domestic assets BS is given by a ratio k of GNP Y :

$$BS1_t = k1 \times Y1_t \tag{43}$$

$$BS2_t = k2 \times Y2_t \tag{44}$$

$$BS3_t = k3 \times Y3_t \quad (45)$$

To simplify, we set: $k1 = k2 = k3 = 1$ (assuming that the supply of assets is the same size as GNP). The domestic wealth W is equal to the supply of domestic assets BS minus the net foreign debt NFD expressed in home currency.

$$W1_t = BS1_t - NFD12_t - NFD13_t \quad (46)$$

$$W2_t = BS2_t - NFD21_t - NFD23_t \quad (47)$$

$$W3_t = BS3_t - NFD31_t - NFD32_t \quad (48)$$

The exchange rate $\$/\pounds$ is defined so as to equalize the liabilities of country 1 and the assets of country 2:

$$(NFD12_t + \omega12_t \times W1_t) \times e_t = \omega21_t \times W2_t$$

We replace $W1$ and $W2$ by their expressions:

$$W1_t = BS1_t - NFD12_t - NFD13_t$$

$$W2_t = BS2_t + NFD12_t \times e_t - NFD23_t$$

We get the following expression:

$$e_t \times (NFD12_t + \omega12_t \times (BS1_t - NFD12_t - NFD13_t)) = \omega21_t \times (BS2_t + NFD12_t \times e_t - NFD23_t)$$

This equation determines the exchange rate $\$/\pounds$:

$$e_t = \frac{\omega21_t \times BS2_t - NFD23_t}{\omega12_t \times (BS1_t - NFD13_t) + (1 - \omega21_t - \omega12_t) \times NFD12_t} \quad (49)$$

We remark that as in the Blanchard et al. model, the higher the assets supply, the lower the exchange rate variation resulting from current account imbalances. Furthermore, as country 2's net foreign debt vis-à-vis country 3 increases, the $\$$ is weakened compared to \pounds , because the country 2's assets supply available in country 1 decreases. Similarly, when country 1's net foreign debt vis-à-vis country 3 increases, its exchange rate appraises because country 1's assets supply available in country 2 decreases. In the same way, the exchange rate $\$/\pounds$ is determined in order to equalize country 1's liabilities vis-à-vis country 3 and country 3's assets vis-à-vis country 1.

$$(NFD13_t + \omega13_t \times W1_t) \times ex_t = \omega31_t \times W3_t$$

We replace $W1$ and $W3$ by their expressions:

$$ex_t \times (NFD13_t + \omega13_t \times (BS1_t - NFD13_t - NFD12_t)) = \omega31_t \times (BS3_t + NFD13_t \times ex_t - NFD32_t)$$

This equation allows us to obtain the $\$/\&$ exchange rate:

$$ex_t = \frac{((BS3_t - NFD32_t) \times \omega31_t)}{(BS1_t - NFD12_t) \times \omega13_t + (1 - \omega13_t - \omega31_t) \times NFD13_t} \quad (50)$$

The preceding remarks are also valid for this equation.

3.3 The simulations

3.3.1 Scénario 1: a shock on country 1's propensity to spend

Country 1's propensity to spend increases from 1 to 1.005 (*graphique 3*). This rise provokes an increase of country 1's GNP and a growth of assets supply. As a result, country 1's currency is depreciated compared to two other countries currencies. The competitiveness of country 1 increases so it releases a trade surplus, a current account surplus and its net foreign position improves. Its trade surplus is shrinking gradually with the growth of its GDP but its current account surplus continues to increase because trade surplus reduction is offset by an elevation of the net income related to the depreciation of its currency.

3.3.2 Scenario 2: a shock on the propensity to import of countries 1 and 2

In countries 1 and 2, the propensity to import goods made in country 3 passes from 0.05 to 0.055 (*graphique 4*). The GNP of countries 1 and 2 decrease while that of country 3 increases. The currencies of countries 1 and 2 depreciate relative to the country 3 to return to current account equilibrium. As a first step, the country 3's trade balance surplus allows it to accumulate assets in the rest of the world. As a second step, the country 3 recorded a trade deficit which is offset by the receipt of net income. A new equilibrium is established in which the country 3 consumes more goods than it produces because the balance of investment incomes procures him a rent.

4 Modeling the global saving glut hypothesis

We start from the previous three-country model to describe the relationships between the three major areas that currently interact. The country 1 is the United States who hold the currency on which some countries are pegged. The country 2 is named the *euro area* and it comprises flexible exchange rates countries. The country 3 is named *Asia* and it includes fixed exchange rates countries. However, this model does not describe the current global imbalances since it ignores several key features of the global economy. First, some countries have fixed exchange rates so the Asian propensity to hold foreign securities must be determined to leave unchanged its exchange rate (4.1). Second, the limited absorption capacity of OPEC and Asia should be taken into account (4.2). Third, the Bernanke's global saving glut hypothesis is described by a model endogenizing the American propensity to spend to maintain the income of the United States unchanged (4.3). Simulations (4.4) allow observing the effects of expansionary politics, of under-evaluation of the Renminbi and of the absorption by the United States of the global saving glut.

4.1 Asia pegs its currency on the dollar

In this case, the adjustment is made by modifying the Asian home bias as long as it agrees to acquire securities issued to offset the current account imbalance. The home bias compatible with a fixed exchange rate allows equalizing supply and demand for U.S. assets without modifying exchange rates:

$$(NFD13_t + \omega13_t \times W1_t) \times ex_t = \omega31_t \times W3_t$$

We replace $W1$ and $W3$ by their expressions and we get the following expression:

$$(NFD13_t + \omega13_t \times (BS1_t - NFD13_t - NFD12_t)) \times ex_t = \omega31_t \times (BS3_t + NFD13_t \times ex_t - NFD32_t)$$

This equation gives the level of home bias that adjusts current account imbalances while maintaining the exchange rate unchanged:

$$\omega31_t = \frac{\omega13_t \times (BS1_t - NFD12_t) + (1 - \omega13_t) \times NFD13_t}{\frac{(BS3_t - NFD32_t)}{ex_t} + NFD13_t} \quad (51)$$

This equation replaces equation 35 of the previous model and the exchange rate equation 50 is removed. The country 3 is in fixed exchange rates vis-à-vis the United States.

4.2 The limited absorption capacity of fixed exchange rates countries

The absorption capacity of country 3 is limited for two reasons. On the one hand, we assume that Asia reach its maximum absorption capacity because its financial system is not able to use domestic saving. On the other hand, the absorption capacity of OPEC countries is limited due to their small population. We model this dual limit by assuming that the level of expenditure of the country 3 is fixed $\Delta D3 = 0$. Then the propensity to spend adjusts changes in income:

$$c3_t = \frac{D3}{Y3_{t-1}} \quad (52)$$

This equation replaces equation 3 of the previous model.

4.3 The U.S. propensity to spend is endogenized to maintain constant U.S. GNP

We determine the level of the U.S. propensity to spend that can avoid a recession in the United States resulting from country 3's current account surplus. The level of propensity to spend which can absorb the shock $c1^*$ is determined in Brender and Pisani (2007). We highlight the equilibrium values (pre-shock). As a first step, we equalize pre-shock income $\bar{Y}1$ with post-shock income $Y1$:

$$Y1 = \bar{Y}1$$

Avec $D3 = \bar{D}3$, $D1 = c1 \times Y1_{t-1}$ et $c1 = 1$, on a donc :

$$(1 - \mu12_t - \mu13_t) \times c1^* \times Y1_{t-1} + \frac{1}{e_t} \times \mu21_t \times D2_t + \frac{1}{ex_t} \times \mu31_t \times D3 + INC12_t + INC13_t = (1 - \bar{\mu}12 - \bar{\mu}13) \times Y1_{t-1} + \frac{1}{\bar{e}} \times \bar{\mu}21 \times \bar{D}2 + \frac{1}{\bar{ex}} \times \bar{\mu}31 \times D3 + \bar{INC}12 + \bar{INC}13$$

Then we determine the level of $c1^*$ which maintain the American GNP constant after a competitiveness shock:

$$c1^* = \frac{\bar{\mu}21 \times \frac{1}{\bar{e}} \times \bar{D}2 - \mu21_t \times \frac{1}{e_t} \times D2_t + D3 \times (\bar{\mu}31 \times \frac{1}{\bar{ex}} - \mu31_t \times \frac{1}{ex_t} - INC12_t - INC13_t)}{(1 - \mu12_t - \mu13_t) \times Y1_{t-1}} + \frac{1 - \bar{\mu}12 - \bar{\mu}13}{1 - \mu12_t - \mu13_t} \quad (53)$$

To avoid a global recession, the U.S. must increase their propensity to spend $c1$ in order to compensate for the reduction in Asia $c3$.

4.4 The simulations

4.4.1 Scenario 1: a shock on the U.S. propensity to spend without global saving glut hypothesis

The U.S. propensity to spend rises from 1 to 1.005. The supply of U.S. securities and the American GNP increase (*figure 5*). The result is a depreciation of the dollar vis-à-vis the euro and an increase in Asian reserves to avoid an appreciation of € . The increase in the GNP generates a trade deficit vis-à-vis Asia that is partly offset by a surplus vis-à-vis Europe. The euro area has a trade deficit with the United States and Asia as the euro appreciates against currencies of both countries. The net external debt of the United States and Europe increase and their net income is negative. Finally, Asia has a current account surplus and the United States and Europe a deficit. The European GNP decreases and that of Asia expands.

4.4.2 Scenario 2: a shock on the propensity to import of countries 1 and 2 without global saving glut hypothesis

The propensity to import Asian products to the United States and Europe increased from 0.05 to 0.055 (*figure 6*). The trade balances of both economies decline while Asia has a surplus. The trade balances tend to return to equilibrium with the depreciation of the euro vis-à-vis both Asian and American currencies and with the decline of European and U.S. GNP. Asia accumulates U.S. assets in order to avoid an appreciation of its currency. This accumulation leads to an increase of Asian net incomes. The U.S. GNP diminishes gradually to adjust the shock. The European GNP is reduced and then stabilized after the euro has depreciated. Finally, the increase of U.S. and European propensity to import causes a global recession and growing global imbalances.

4.4.3 Scenario 3: a shock on the propensity to import from countries 1 and 2 with global saving glut hypothesis

In this case, the propensity to spend of the United States adjusts itself in order to maintain their GNP unchanged following the increase in their propensity to import Asian products (*figure 7*). The dollar depreciates against the euro since the effect of the propensity to spend is stronger than the one of the propensity to import. Asia accumulates U.S. assets to maintain the level of its exchange rate with the dollar. The trade and current account imbalances persist. Thus, global imbalances grow rapidly: the current account deficit and the net foreign debt of the United States continue to rise as the current account surplus and the net foreign assets of Asia. External imbalances in the Euro area are less important. The adjustment takes place through the

gradual reduction of European GNP that is linked to the deteriorating competitiveness.

5 Conclusion

The model presented a real and financial approach of global imbalances. It includes only 50 equations in the three-country model – or about twice less than models of Zhao (2006), Godley and Lavoie (2007) and Lavoie and Zhao (2008) – although, unlike the models of Obstfeld and Rogoff (2005), Blanchard et al (2005) and Caballero et al (2006), it does not involve a constant GDP. A first series of simulations is conducted in a model with flexible exchange rates. The increase in the propensity to import country 3's products in countries 1 and 2 causes a reduction of the GNP of both countries and provokes small external imbalances that stabilize after the depreciation of exchange rates. Then, we model the global saving glut hypothesis. We take into account three new elements. First, some countries are pegged on the dollar. Country 3 is renamed *Asia* and its propensity to hold U.S. assets allows maintaining unchanged the parity with the dollar. Second, we assume a limited absorption capacity in fixed exchange rates countries tied to the small population in the OPEC countries and to the limited financial development in Asia. To model this constraint, we set the level of domestic spending in Asia is limited. Third, under the Bernanke's global saving glut hypothesis, it is assumed that the United States raise their propensity to spend in order to maintain their GNP stable following an increase in their propensity to import. When we repeat the previous experience taking into account the first two elements, the Asian GNP stagnated and there is a strong recession in the United States and Europe. By adding the third element, it appears that the recession can be avoided in the United States if they increase their propensity to spend. However, the consequences for the global economy are disastrous: global imbalances grow very fast (the current account and external positions of the United States and Asia) and the Euro zone experience a deep recession.

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6 Appendix

A Parameters

We remark that:

- in the flexible exchange rates model there are 50 endogenous equations for 50 equations,
- the model with a fixed exchange rate between the U.S. and Asia has 49 equations for 49 endogenous variables,
- when we introduce the *global saving glut hypothesis*, there are 50 equations for 50 unknowns.

United States				Euro area				Asia			
Notations	Description	Status	Initial value	Notations	Description	Status	Initial value	Notations	Description	Status	Initial value
c1	Propensity to spend	exogenous/ endogenous*	1	c2	Propensity to spend	exogenous	1	c3	Propensity to spend	exogenous/ endogenous*	1
k1	supply of domestic assets/GDP ratio	exogenous	1	k2	supply of domestic assets/GDP ratio	exogenous	1	k3	supply of domestic assets/GDP ratio	exogenous	1
ex	exchange rate (1 \$ = ex £)	endogenous/ exogenous*	1	ex/£	exchange rate (1 £ = ex/£ \$)	implicit	1	1/ex	exchange rate (1 £ = 1/ex \$)	implicit	1
m120	constant in the equation of imports of European products	exogenous	0.05	m210	constant in the equation of imports of American products	exogenous	0.05	m310	constant in the equation of imports of American products	exogenous	0.05
m121	income elasticity in the equation of imports of European products	exogenous	1	m211	income elasticity in the equation of imports of American products	exogenous	1	m311	income elasticity in the equation of imports of American products	exogenous	1
m122	price elasticity in the equation of imports of European products	exogenous	1	m212	price elasticity in the equation of imports of American products	exogenous	1	m312	price elasticity in the equation of imports of American products	exogenous	1
m130	constant in the equation of imports of Asian products	exogenous	0.05	m230	constant in the equation of imports of Asian products	exogenous	0.05	m320	constant in the equation of imports of European products	exogenous	0.05
m131	income elasticity in the equation of imports of Asian products	exogenous	1	m231	income elasticity in the equation of imports of Asian products	exogenous	1	m321	income elasticity in the equation of imports of European products	exogenous	1
m132	price elasticity in the equation of imports of Asian products	exogenous	1	m232	price elasticity in the equation of imports of Asian products	exogenous	1	m322	price elasticity in the equation of imports of European products	exogenous	1
r1	interest rate	exogenous	0.04	r2	interest rate	exogenous	0.04	r3	interest rate	exogenous	0.04
λ120	constant in the propensity to hold European assets equation	exogenous	0.1	λ210	constant in the propensity to hold American assets equation	exogenous	0.1	λ310	constant in the propensity to hold American assets equation	exogenous	0.1
λ121	coefficient on r1 in propensity to hold European assets equation	exogenous	0.2	λ211	coefficient on r1 in propensity to hold American assets equation	exogenous	0.4	λ311	coefficient on r1 in propensity to hold American assets equation	exogenous	0.4
λ122	coefficient on r2 in propensity to hold European assets equation	exogenous	0.4	λ212	coefficient on r2 in propensity to hold American assets equation	exogenous	0.2	λ312	coefficient on r2 in propensity to hold American assets equation	exogenous	0.2
λ123	coefficient on r3 in propensity to hold European assets equation	exogenous	0.2	λ213	coefficient on r3 in propensity to hold American assets equation	exogenous	0.2	λ313	coefficient on r3 in propensity to hold American assets equation	exogenous	0.2
λ130	constant in the propensity to hold Asian assets equation	exogenous	0.1	λ230	constant in the propensity to hold Asian assets equation	exogenous	0.1	λ320	constant in the propensity to hold European assets equation	exogenous	0.1
λ131	coefficient on r1 in propensity to hold Asian assets equation	exogenous	0.2	λ231	coefficient on r1 in propensity to hold Asian assets equation	exogenous	0.2	λ321	coefficient on r1 in propensity to hold European assets equation	exogenous	0.2
λ132	coefficient on r2 in propensity to hold Asian assets equation	exogenous	0.2	λ232	coefficient on r2 in propensity to hold Asian assets equation	exogenous	0.2	λ322	coefficient on r2 in propensity to hold European assets equation	exogenous	0.4
λ133	coefficient on r3 in propensity to hold Asian assets equation	exogenous	0.4	λ233	coefficient on r3 in propensity to hold Asian assets equation	exogenous	0.4	λ323	coefficient on r3 in propensity to hold European assets equation	exogenous	0.2
ω12	propensity to hold European assets	endogenous	0.2	ω21	propensity to hold American assets	endogenous	0.2	ω31	propensity to hold American assets	endogenous*	0.2
ω13	propensity to hold Asian assets	endogenous	0.2	ω23	propensity to hold Asian assets	endogenous	0.2	ω33	propensity to hold European assets	endogenous	0.2
D1	domestic demand	endogenous	100	D2	domestic demand	endogenous	100	D3	domestic demand	endogenous/ exogenous	100
IM12	imports of European products	endogenous	5	IM21	imports of American products	endogenous	5	IM31	imports of American products	endogenous	5
IM13	imports of Asian products	endogenous	5	IM23	imports of Asian products	endogenous	5	IM32	imports of European products	endogenous	5
μ12	propensity to import European products	endogenous	0.05	μ21	propensity to import American products	endogenous	0.05	μ31	propensity to import American products	endogenous	0.05
μ13	propensity to import Asian products	endogenous	0.05	μ23	propensity to import Asian products	endogenous	0.05	μ32	propensity to import European products	endogenous	0.05
Y1	GNP	endogenous	100	Y2	GNP	endogenous	100	Y3	GNP	endogenous	100
DC12	commercial deficit vis-à-vis the euro area	endogenous	0	DC21	commercial deficit vis-à-vis the United States	endogenous	0	DC31	commercial deficit vis-à-vis the United States	endogenous	0
DC13	commercial deficit vis-à-vis Asia	endogenous	0	DC23	commercial deficit vis-à-vis Asia	endogenous	0	DC32	commercial deficit vis-à-vis the euro area	endogenous	0
NFD12	net foreign debt vis-à-vis the euro area	endogenous	0	NFD21	net foreign debt vis-à-vis the United States	endogenous	0	NFD31	net foreign debt vis-à-vis the United States	endogenous	0
NFD13	net foreign debt vis-à-vis Asia	endogenous	0	NFD23	net foreign debt vis-à-vis Asia	endogenous	0	NFD32	net foreign debt vis-à-vis the euro area	endogenous	0
BS1	supply of domestic assets	endogenous	100	BS2	supply of domestic assets	endogenous	100	BS3	supply of domestic assets	endogenous	100
W1	national wealth	endogenous	100	W2	national wealth	endogenous	100	W3	national wealth	endogenous	100
INC12	Net income transfers between U.S. and European	endogenous	0	INC21	Net income transfers between U.S. and European	endogenous	0	INC31	Net income transfers between U.S. and Asian	endogenous	0
INC13	Net income transfers between U.S. and Asian	endogenous	0	INC23	Net income transfers between European and Asian	endogenous	0	INC32	Net income transfers between European and Asian	endogenous	0
e	exchange rate (1 \$ = e £)	endogenous	1	1/£	exchange rate (1 £ = 1/£ \$)	implicit	1	e/ex	exchange rate (1 £ = e/ex \$)	implicit	1

* the first term indicates the status of the variable in the first model in flexible exchange rates, the second term indicates the status of the variable when the country is in 3 fixed exchange and the assumption of surplus global savings is made.

Table 1: Values of model parameters

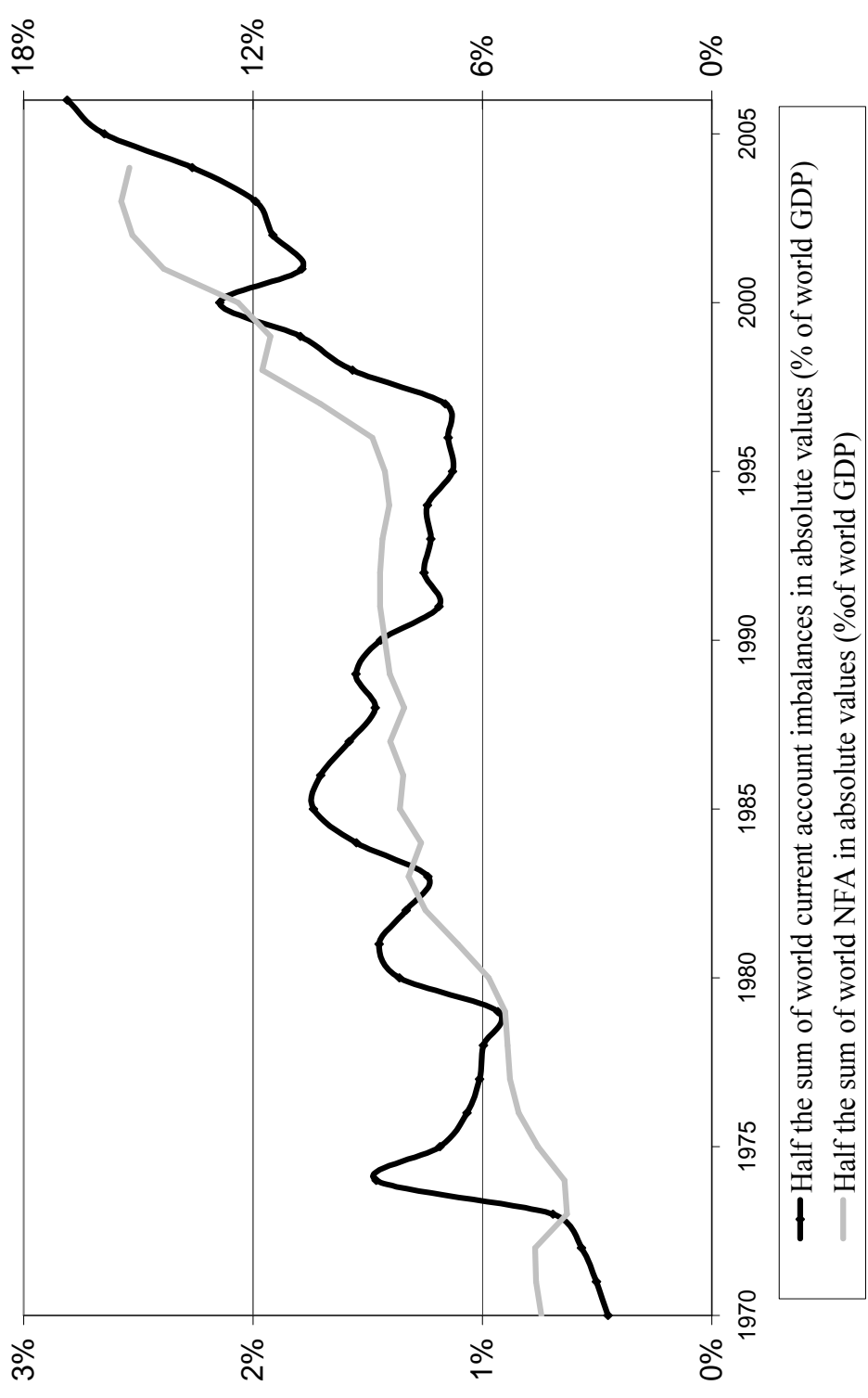


Figure 1: Evolution of global imbalances in flows and stocks

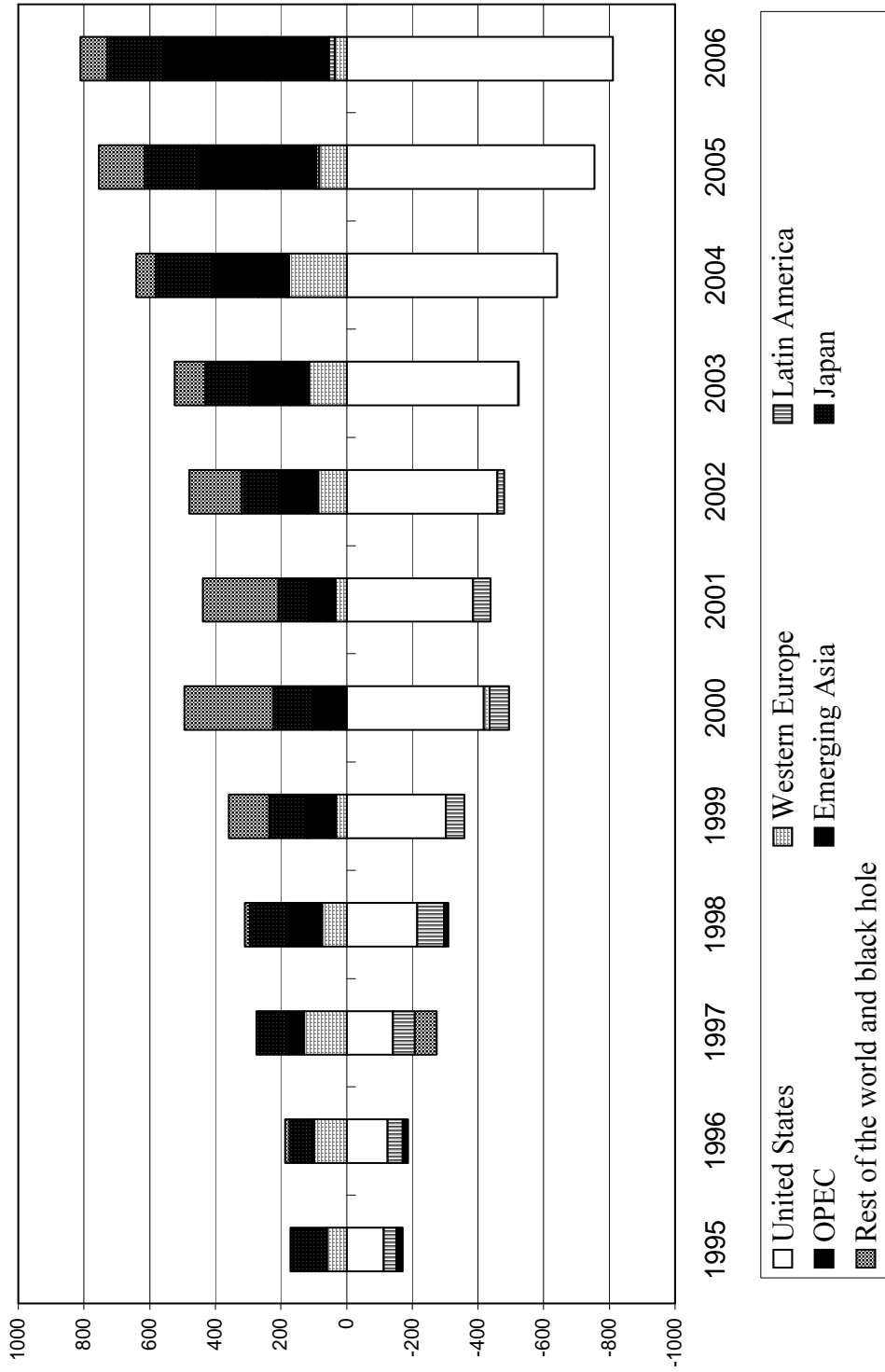


Figure 2: Evolution of current account imbalances (in billions of dollars)

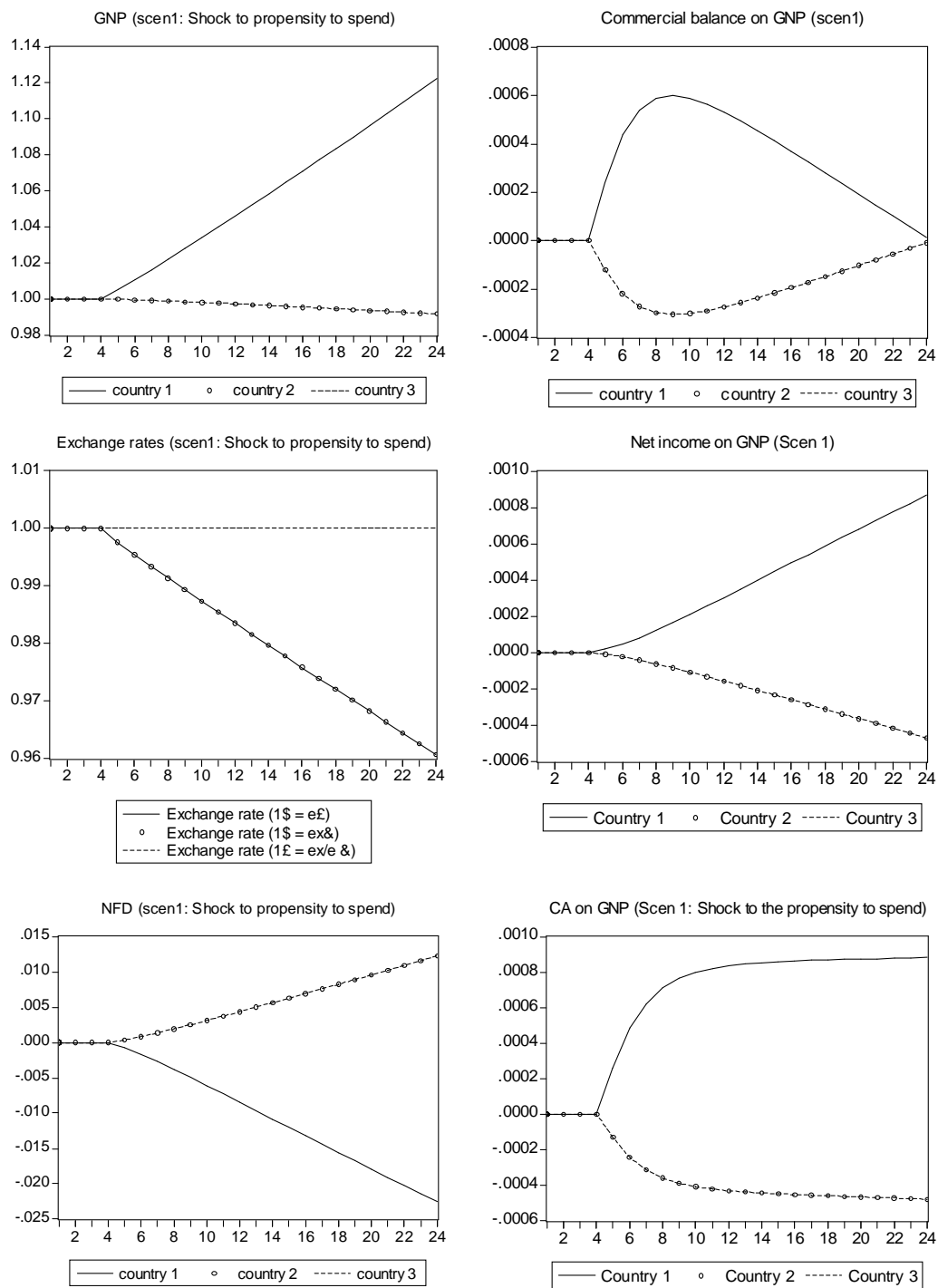


Figure 3: Country 1's propensity to spend increases from 1 to 1.005, in flexible exchange rates

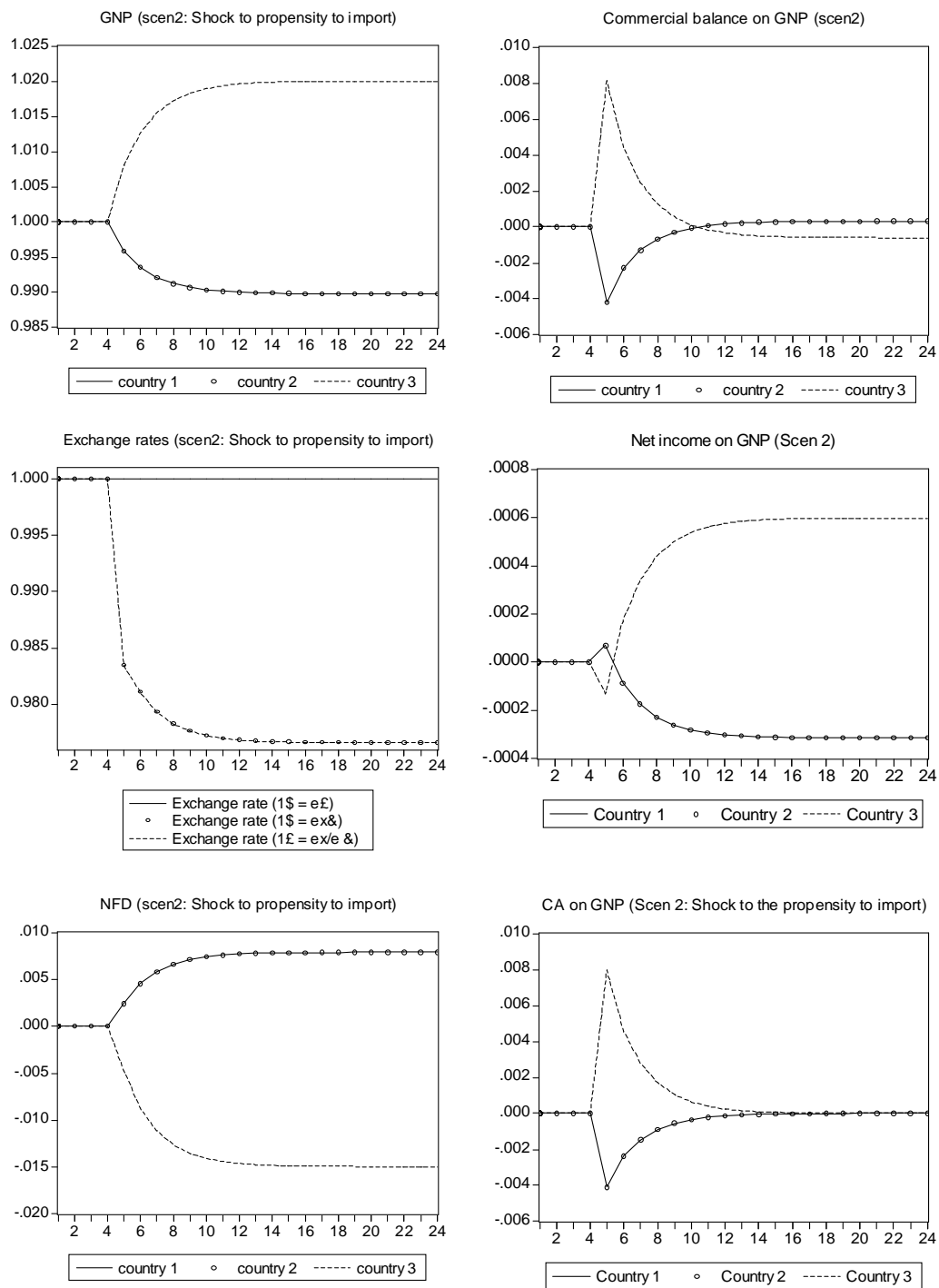


Figure 4: The propensities to import goods made in country 3 passe from 0.05 to 0.055, in flexible exchange rates

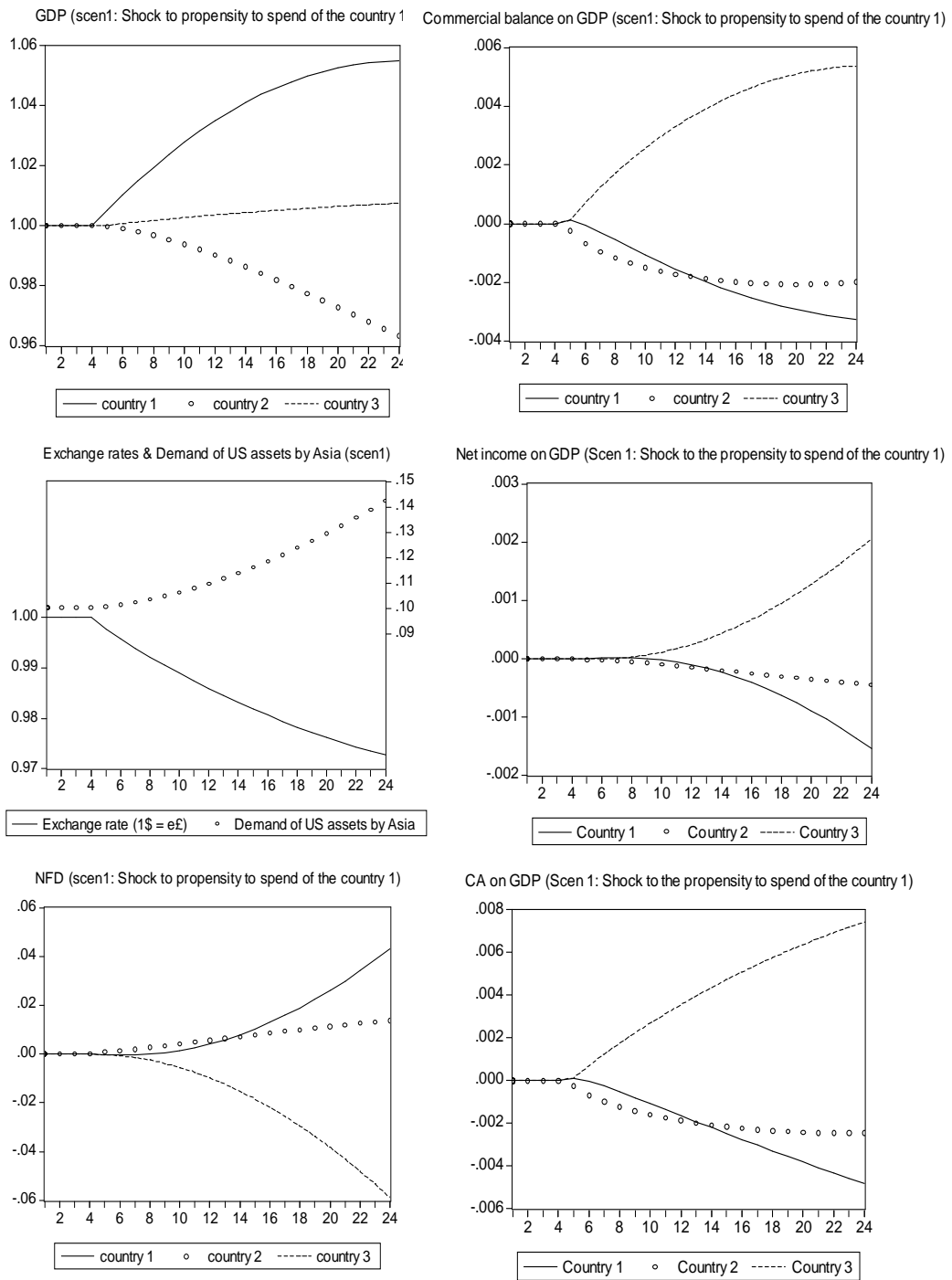


Figure 5: Country 1's propensity to spend increases from 1 to 1.005, in fixed exchange rates

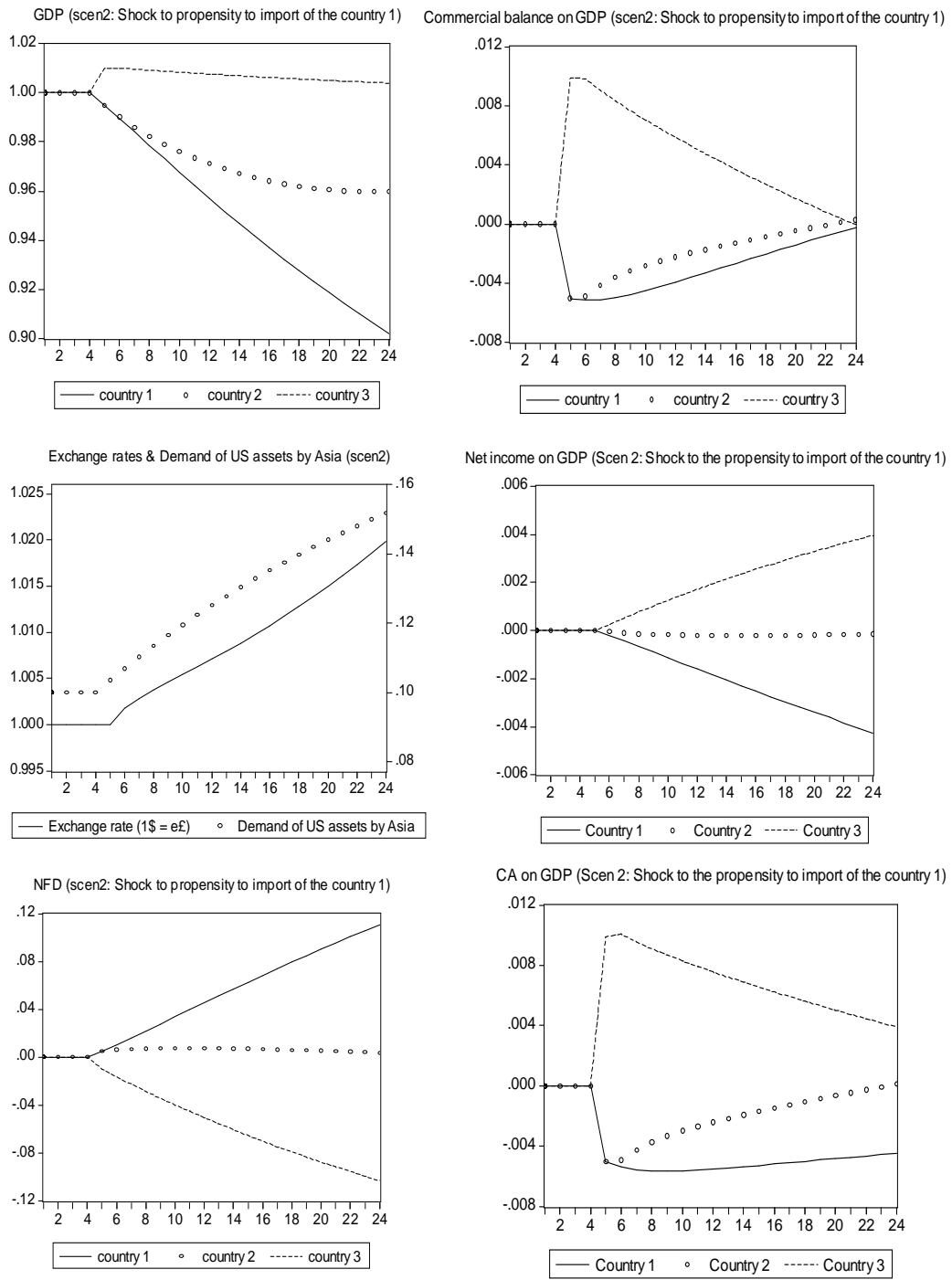


Figure 6: The propensities to import goods made in country 3 passe from 0.05 to 0.055, in fixed exchange rates

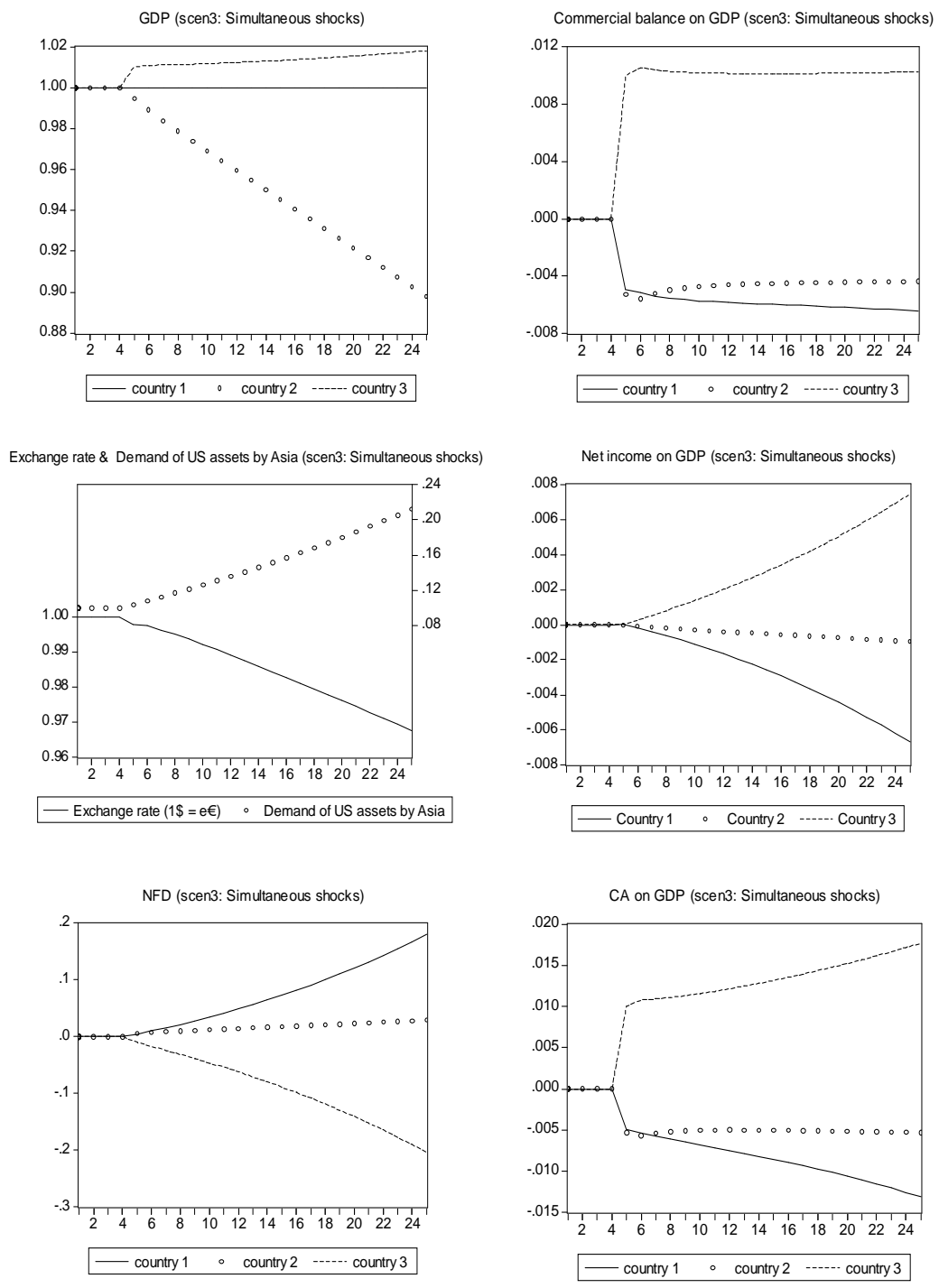


Figure 7: Global saving glut hypothesis