International monetary regimes and SFC modeling

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1. Introduction

Transformation of the international monetary regimes has been a key issue in the settlement of new growth regimes. The Bretton Woods system, based on the dollar as a key currency convertible in gold in theory, with fixed but adjustable exchange rates and capital control, was a pilar of the fordist regime during the 1950s-1960s. After its crisis in 1971-1973 it was replaced by a flexible exchange rates regime with a progressive liberalization of the capital controls where the dollar was always playing a dominant role. This system was hybrid combining pure floating for some currencies and anchorage on the dollar or on currencies basket for others. The system was more instable but allowed to manage increasing international imbalances and was able to integrate some rare cooperative experiences like in 1985-1987.

At the regional level, where a high degree of integration makes the exchange rates instability more difficult to manage, efforts have been made to build more consistent monetary system. The European one is the more achieved since it evolved from a rather loose European monetary system at the end of the 1970s to a full monetary union in 1999.

At the international level, after the financial crisis of 2008, the problems raised by exchange rate instability and the utility to build a new international monetary regime, more stable and more able to sustain development, have led to broad proposals by the IMF itself or the Chinese authorities. Keynesian economists have proposed more radical reform based on the creation of an International Clearing Union using the bancor as in Keynes' original project.

These issues have been largely debated in the regulation literature on international growth regime (Aglietta, Boyer, Mistral) but without analyzing in a modeling approach how these institutional changes transform the regulation mechanisms and can make them more efficient or inefficient. The purpose of the paper is to show how these issues can be rather precisely studied using SFC models inspired by Godley and Lavoie's work (2007). SFC models are well suited for this kind of analysis as they described in a consistent manner the real and financial spheres with an explicit balance sheet for each agent. Monetary reforms can be described in a rather detailed manner. Two levels of analysis are considered.

The first one, at the international level, is based on a four countries SFC multinational model (United States, Euro area, China and the rest of the world). It analyzes the transition from the Bretton Woods system to an hybrid regime dominated by the dollar where floating exchange rates between the dollar and the euro coexist with anchoring on the dollar for the yuan and the rest of the world. Different alternative scenarios are proposed for the future in order to reach several objectives: limit the volatility of the exchange rates, reduce the global imbalances and obtain a better financing of the development. The first one is a simple international cooperation with target zones, the second one is a regulation of the international liquidity with an increasing role played by the Special Drawing Rights (SDR) and the International Monetary Fund (IMF), the third one is a more ambitious version of the SDR where these one can be issued by the IMF without counterpart and can contribute to an improvement of the financing of the development, the last one is the settlement of a radically new international regime based on the bancor and on an International Clearing Union in the line of Keynes' (1945) proposals. Some of these alternatives will be evaluated within the SFC framework.

The second level of analysis is European and is also based on a four countries SFC model (Germany for North Europe, Spain for South Europe, United States and the rest of the world). The different steps of the European monetary construction from the European Monetary System (EMS) to the Monetary Union are described in this framework. Alternative scenarios are also proposed to avoid the insufficiencies of the adjustment mechanisms of the euro zone: return to a system of fixed, but adjustable, exchange rates, settlement of a system of national euros combined with a global euro which would be floating, creation of an euro bancor with fixed, but adjustable, exchange rates and a ECB acting as a Clearing Union.

2. Institutional changes and SFC modeling of the International Monetary System

2.1 The general framework

The main feature of these SFC models is the complete integration of the real sectors of the economy with the financial sector, so that the linkages between money and credit on one side, and investment and growth on the other, are clearly set out. Godley and Lavoie's (2007) laid the foundations for the construction of multi-country models within a watertight accounting structure that guarantees the dynamic consistency of the results produced by each scenario. Later, Lavoie and Zhao (2010) developed a three-country model of China, Europe and the US where the exchange rate between the US dollar and the euro is floating, while the Chinese yuan is pegged to the US dollar. Mazier and Tiou-Tagba Aliti (2012) expanded Lavoie and Zhao (2010) to include four countries in order to study global imbalances under the present system. Based on this structure, Valdecantos and Zezza (2015) showed a first attempt to model the working of the SDR under the framework of the "substitution account" and how Keynes' (1945) proposal for an international clearing union could be modeled and implemented.

The intuitions embedded in the model can be briefly presented. We assume that production is demand determined. The functional distribution of income is the wage bill, together with interest and dividends paid by banks. They determine household income, which is taxed by the government. Households spend out of disposable income and the residual saving determines the end-of-period stock of household wealth, which can be held under the form of money or bank deposits. Non-financial firms have to pay taxes and interest on the existing stock of loans. Retained earnings are available for investment, which is determined by the profit rate, the cost of servicing the debt and an accelerator term. The demand for loans is given by the desired investment which cannot be financed by retained earnings.

These loans are provided on demand, with no credit rationing. Banks distribute all of their profits—obtained from net interest payments from financial assets which are purchased according to portfolio choice equations—to households, although we keep the possibility of changing these assumptions in different versions by computing net bank profits and net wealth. Additionally, banks are required to hold reserves as a share of deposits, and ask for advances from the Central bank whenever the amount of liquidity from deposits—or eventually own capital—is insufficient to provide loans plus satisfying their demand for domestic and foreign bills. The Central bank is assumed to transfer its 'profits' to the government and to provide advances to commercial banks on demand with no restriction on credit. The government deficit is obtained as the difference between expenditure on goods and services, which grow at a constant rate, plus interest payments and tax receipts. Any deficit is financed by issuances of new bills. Imports are determined on a bilateral basis from GDP and the exchange rate, since we assume fixed prices in this version of the model. Six bilateral exchange rates are used in the model: 1 $ = E1 € = E2 ¥ = E4 #; 1 € = E6 # = E3 ¥; 1 # = E5 ¥. Table 1 gives the balance sheet of the rest of the world with the main assets and liabilities.

Table 1: Balance sheet of the rest of the world

Asset/Liability	Households	Firms	Banks	Government	Central Bank
Capital		$+K^{RW}$			
Central Bank Money	$+Hd^{RW}$				$-Hs^{RW}$
Deposits	$+Md^{RW}$		$-Md^{RW}$		
Loans		$-Ld^{RW}$	$+Ls^{RW}$		
Advances			$-Ad^{RW}$		$+As^{RW}$
Reserves			$+Rd^{RW}$		$-Rs^{RW}$
U.S. Bills			$+Bd, b_{RW}^{US}$		$+Bd, cb_{RW}^{US}$
Eurozone Bills			$+Bd, b_{RW}^{EZ}$		
Chinese Bills			$+Bd, b_{RW}^{CH}$		
RoW Bills			$+Bd, b_{RW}^{RW}$	$-Bs^{RW}$	$+Bd, cb_{RW}^{RW}$
SDR					$+SDRd^{RW}$

2.2 Four alternative closures

The dollar pegged regime

This regime where the euro and the dollar are floating while the yuan and the rest of the world currency are pegged to the dollar corresponds roughly to the hybrid regime which settled after the collapse of the Bretton Woods regime.

The exchange rate E1 is floating and clears the euro-denominated bonds market.

$$E1_t = \frac{Bs_t^{EZ} - Bs,b_{EZ_t}^{EZ} - Bs,cb_{EZ_t}^{EZ} - Bs,b_{CH_t}^{EZ} - Bs,b_{RW_t}^{EZ}}{Bd,b_{US_t}^{EZ}}$$

Foreign reserves of the ECB under the form of US bonds ($Bs, cb_{EZ_t}^{US}$) remain constant and the central bank's demand for domestic bonds in the euro zone adjusts the balance sheet identity.

$$\Delta Bd, cb_{EZ_t}^{EZ} = \Delta H_t^{EZ} + \Delta H_t^{EZ} - \Delta A_t^{EZ}$$

The yuan and the rest of the world currency are pegged to the dollar (E2 and E4 fixed) and the central banks of China and rest of the world adjust their foreign reserves (kept under the form of US bonds).

$$\Delta Bs, cb_{CH_t}^{US} = \frac{\left(\Delta H_t^{CH} + \Delta R_t^{CH} - \Delta A_t^{CH} - \Delta Bd,cb_{CH_t}^{CH}\right)}{E2_t}$$

$$\Delta Bs, cb_{RW_t}^{US} = \frac{\left(\Delta H_t^{RW} + \Delta R_t^{RW} - \Delta A_t^{RW} - \Delta Bd,cb_{RW_t}^{RW}\right)}{E4_t}$$

The domestic bond markets of China, rest of the world and US are equilibrated by the purchases of the central banks which absorb as many bonds as necessary.

$$Bd, cb_{CH_t}^{CH} = Bs_t^{CH} - Bs, b_{CH_t}^{CH} - Bs, b_{EZ_t}^{CH} - Bs, b_{US_t}^{CH} - Bs, b_{RW_t}^{CH}$$

$$Bd, cb_{RW_t}^{RW} = Bs_t^{RW} - Bs, b_{RW_t}^{RW} - Bs, b_{EZ_t}^{RW} - Bs, b_{CH_t}^{RW} - Bs, b_{US_t}^{RW}$$

$$Bd, cb_{US_t}^{US} = Bs_t^{US} - Bs, b_{US_t}^{US} - Bs, b_{EZ_t}^{US} - Bs, b_{CH_t}^{US} - Bs, b_{RW_t}^{US} - Reserves_t$$

$$Reserves_t = Bs, cb_{EZ_t}^{US} + Bs, cb_{CH_t}^{US} + Bs, cb_{RW_t}^{US}$$

The balance sheet of the US central bank is not written, as it is the missing equation.

The dollar regime with pure floating

This regime, rather theoretical, would correspond to an achievement of the financial liberalization. The exchange rates of the yuan (E2) and rest of the world (E4) are now floating and are clearing the bond markets of China and rest of the world while foreign reserves are kept constant. The balance sheet identity of the central bank of China and rest of the world are modified consequently.

$$E2_t = \frac{Bs_t^{CH} - Bs,b_{CH_t}^{CH} - Bs,cb_{CH_t}^{CH} - Bs,b_{EZ_t}^{CH} - Bs,b_{RW_t}^{CH}}{Bd,b_{US_t}^{CH}}$$

$$E4_t = \frac{Bs_t^{RW} - Bs,b_{RW_t}^{RW} - Bs,cb_{RW_t}^{RW} - Bs,b_{EZ_t}^{RW} - Bs,b_{CH_t}^{RW}}{Bd,b_{US_t}^{EZ}}$$

$$Bs,cb_{CH_t}^{US} = \overline{Bs,cb_{CH}^{US}}$$

$$Bs,cb_{RW_t}^{US} = \overline{Bs,cb_{RW}^{US}}$$

$$\Delta Bd,cb_{CH_t}^{CH} = \Delta Hd,h_{CH_t}^{CH} + \Delta Rd,h_{CH_t}^{CH} - \Delta Ad_t^{CH}$$

$$\Delta Bd,cb_{RW_t}^{RW} = \Delta Hd,h_{RW_t}^{RW} + \Delta Rd,h_{RW_t}^{RW} - \Delta Ad_t^{RW}$$

The SDR regime

The bancor model

Following Keynes (1945) proposal, an International Clearing Union would be created and the dollar would be no more an international currency. An international unit account, the bancor, would be used as a tool for settling international payments. The balance sheet identity of each central bank would be equilibrated through changes in the reserves in bancor.

$$\Delta Bancor,s_t^{US} = \frac{\left(\Delta H_t^{US} + \Delta R_t^{US} - \Delta A_t^{US} - \Delta Bd,cb_{US_t}^{US}\right)}{E7_t}$$

$(with\ similar\ equations\ for\ the\ other\ areas)$

As aggregate trade deficits and surpluses are balanced, the sum of changes in the bancor balances equals zero. This will be the missing equation.

$$\Delta Bancor,s_t^{US} + \Delta Bancor,s_t^{EZ} + \Delta Bancor,s_t^{CH} + \Delta Bancor,s_t^{RW} = \Delta V_t^{ICU} = 0$$

The closure of the domestic bond markets is obtained thanks to purchase of each domestic central bank.

$$Bd,cb_{US_t}^{US} = Bs_t^{US} - Bs,b_{US_t}^{US} - Bs,b_{EZ_t}^{US} - Bs,b_{CH_t}^{US} - Bs,b_{RW_t}^{US}$$

$(with\ similar\ equations\ for\ the\ other\ areas)$

Exchange rates of each currency against the bancor (E7 to E10) would be fixed, but adjustable in case of persistent deficits.

$$E7_t = \begin{cases} E7_{t-1} & if\ \sum_{i=1}^{5} \frac{CA_{t-i}^{US}}{Y_{t-i}^{US}} \geq \lambda \\ E7_{t-1}.(1+\kappa) & if\ \sum_{i=1}^{5} \frac{CA_{t-i}^{US}}{Y_{t-i}^{US}} < \lambda \end{cases}$$

(with similar equations for the other areas)

Last, two specific adjustment mechanisms could be introduced to reduce global imbalances and produce higher levels of activity. Firstly, based on the fact that bancor balances held at the ICU (be them positive or negative) are subject to interest payments, the ICU collects interests paid on existing Bancor balances (profit of the ICU P_t^{ICU}) and could transfer them as

foreign aid. This flow of aid is sent by the ICU to each recipient country whose GDP is below the world average. Since these flows of aid are expressed in bancors, accounting consistency requires to transform these flows into the currencies of each country. The equations describing the accumulation of bancor balances must be slightly modified.

$$P_t^{ICU} = \left|r_{t-1}^b.Bancor, s_{t-1}^{US}\right| + \left|r_{t-1}^b.Bancor, s_{t-1}^{EZ}\right| + \left|r_{t-1}^b.Bancor, s_{t-1}^{CH}\right| + \left|r_{t-1}^b.Bancor, s_{t-1}^{RW}\right|$$

$$Y_t^W = Y_t^{US} + \frac{Y_t^{EZ}}{E1_t} + \frac{Y_t^{CH}}{E2_t} + \frac{Y_t^{RW}}{E4_t}$$

$$Aid, s_t^{ICU} = \frac{P_t^{ICU}}{\sigma}$$

$$Aid, s_{ICU_t}^{US} = \begin{cases} Aid, s_t^{ICU} & if\ Y_t^{US} \leq \frac{Y_t^W}{4} \\ 0 & if\ Y_t^{US} > \frac{Y_t^W}{4} \end{cases}$$

$$Aid, r_t^{US} = Aid, s_{ICU_t}^{US}.E7_t$$

$$\Delta Bancor, s_t^{US} = \frac{\left(\Delta H_t^{US} + \Delta R_t^{US} - \Delta A_t^{US} - \Delta Bd, cb_{US_t}^{US} - \left|r_{t-1}^b.Bancor, d_{t-1}^{US}\right| + Aid, r_t^{US}\right)}{E7_t}$$

(same equations for other areas)

Secondly, the monetary arrangement embedded in the bancor-system, in which the accumulation of foreign reserves does no longer make any sense, entails that since surplus countries also have to pay interests on their bancor balances they would be encouraged to pursue more expansionary policies that eventually reduce their current account surpluses. This would eliminate the recession-bias that characterizes the current international regime. Consequently, an additional term, based on their bancor balances, is added to the public spending of the surplus countries.

$$G_t^i = Go_t^i + \left(1 + w^i\right).G_{t-1}^i + GG_t^i \qquad \forall\ i = US, EZ, CH, RW$$

$$GG_t^i = \begin{cases} \chi^i.rb_{t-1}.Bancor_{t-1}^i & if \quad Bancor, s_{t-1}^i > 0 \ \wedge \ \frac{CA_{t-1}^i}{Y_{t-1}^i} > 0 \\ 0 & if \quad Bancor, s_{t-1}^i \leq 0 \ \wedge \ \frac{CA_{t-1}^i}{Y_{t-1}^i} \leq 0 \end{cases}$$

Table 2 summarizes the alternative closures of the different regimes for the bonds markets and the central banks.

Table 2: Summary of alternative closures of international monetary regimes

	Dollar model (fixed)	Dollar model (floating)	SDR model (substitution account)	Bancor model
B^{US}	Bd, cb_{US}^{US}	Bd, cb_{US}^{US}	Bd, cb_{US}^{US}	Bd, cb_{US}^{US}
B^{EZ}	$E1$	$E1$	$E1$	Bd, cb_{EZ}^{EZ}
B^{CH}	Bd, cb_{CH}^{CH}	$E2$	Bd, cb_{CH}^{CH}	Bd, cb_{CH}^{CH}
B^{RW}	Bd, cb_{RW}^{RW}	$E4$	Bd, cb_{RW}^{RW}	Bd, cb_{RW}^{RW}
CB^{US}	Missing equation	Missing equation	Missing equation	$Bancor^{US}$
CB^{EZ}	Bd, cb_{EZ}^{EZ}	Bd, cb_{EZ}^{EZ}	Bd, cb_{EZ}^{EZ}	$Bancor^{EZ}$

CB^{CH}	Bd, cb_{CH}^{US}	Bd, cb_{CH}^{CH}	SDR^{CH}	$Bancor^{CH}$
CB^{RW}	Bd, cb_{RW}^{US}	Bd, cb_{RW}^{RW}	SDR^{RW}	$Bancor^{RW}$
IMF	-	-	Bd_{IMF}^{US}	-
ICU	-	-	-	Missing equation

2.3 Assessment of the different international monetary regimes

The nature of the adjustment mechanisms in the different monetary regimes which have been considered can be analyzed using demand or supply shocks. A restrictive fiscal policy in the US is taken as an example.

The dollar pegged regime, where only the euro and dollar are floating, illustrates the regime which has prevailed after the collapse of the Bretton Woods system until the end of the 1990. A restrictive US policy induces a slowdown in the US with a dollar appreciation against the euro and a negative impact in China and the rest of the world leading to a world slowdown. Current account imbalances appear without any adjustment mechanism.

The pure floating regime is rather unrealistic, as it would suppose that all countries renounce to any kind of interventions in foreign exchange markets and adopt a full financial liberalization. However, in this regime, thanks to the exchange rate flexibility, global imbalances can be quickly reduced. One of the main drawbacks is its high instability. This question has not been analyzed in this contribution but it could be done by introducing expectations of exchange rates' variations, as it has been done by Lavoie and Daigle (2012).

The SDR regime

The bancor based model shows how the self-correcting mechanisms that have been introduced allow a progressive reduction of the global imbalances. In case of a US restrictive policy the initial US current surplus is reduced as the US begin to import more from the deficit countries. Adjustment mechanisms are amplified when the possibility of exchange rate adjustment is introduced.

3. Alternative monetary regimes for the euro area

The successive monetary regimes which have prevailed since the end of the 1970 in Europe can be represented using a four- country SFC model with a general framework similar to the one used at the world level in the previous section. Europe will be composed of Germany and Spain, as representing the Northern and the Southern countries. The US dollar will be floating against the European currency while the rest of the world will be pegged to the dollar. Alternative closures of this general model can represent the different European monetary regimes from the EMS of the 1980 to the euro area, before 2008 and after 2008. New monetary arrangements can also be simulated to try to find a way out of the current

euro crisis, from a multiple euros zone to an euro area without Germany or, more ambitiously, to an euro bancor system.

3.1 A SFC model of the euro area

The euro area before 2010

The starting point is a SFC model of the euro area, first with fixed interest rates. The balance sheets of each country or area are the same as before, except for the two European areas which include two specific financial assets, the TARGET2 balances and the Intra-Eurosystem Adjustment Accounts (IEA). The national central banks of the European countries accumulate TARGET2 which correspond to all bilateral real and financial net transactions and are considered as assets or liabilities according to their signs. The difference between the stock of cash that is issued by each national central banks (Hs, cb_t^{SP}) and the effective amount that is allocated by the Eurosystem (Hd_t^{SP}) is adjusted via Intra-Eurosystem accounting adjustments. Table 3 gives the balance sheet for Spain.

$$\Delta TG2_t^{SP} = X_{SP_t}^{GE} - IM_{SP_t}^{GE} + rb_{t-1}^{GE}.Bd, b_{SP_{t-1}}^{GE} - rb_{t-1}^{SP}.Bd, b_{GE_{t-1}}^{SP} + \Delta Bs, b_{SP_t}^{GE} - \Delta Bd, b_{SP_t}^{GE}$$

$$IEA_t^{SP} = Hs, cb_t^{SP} - Hd_t^{SP}$$

$$IEA_t^{GE} = Hs, cb_t^{GE} - Hd_t^{GE}$$

$$IEA_t^{ECB} = Hs_t^{ECB}$$

Table 3: Balance sheet of Spain

	Spain					
	Households	Firms	Commercial Banks	Government	Central Bank	ECB
Capital		$+K_t^{SP}$				
Cash	$+Hd_t^{SP}$				$-Hs, cb_t^{SP}$	$-Hs_t^{ECB}$
Deposits	$+Md_t^{SP}$		$-Md_t^{SP}$			
Reserves			$+R_t^{SP}$		$-R_t^{SP}$	
Advances			$-A_t^{SP}$		$+A_t^{SP}$	
Loans		$-L_t^{SP}$	$+L_t^{SP}$			
$Bonds^{SP}$			$+Bd, b_{SP_t}^{SP}$	$-Bs_{SP_t}^{SP}$	$+Bd, cb_{SP_t}^{SP}$	$+Bd_{ECB_t}^{SP}$
$Bonds^{GE}$			$+Bd, b_{SP_t}^{GE}$			$+Bd_{ECB_t}^{GE}$
$Bonds^{US}$			$+Bd, b_{SP_t}^{US}$		$+Bd, cb_{SP_t}^{US}$	$+Bd_{ECB_t}^{US}$
$Bonds^{RW}$			$+Bd, b_{SP_t}^{RW}$			
TARGET2					$+TG2_{SP_t}$	$-TG2_{ECB_t}$
IEA					$-IEA_{SP_t}$	$+IEA_{ECB_t}$
Wealth	$+Vh_t^{SP}$	$+Vf_t^{SP}$	$+Vb_t^{SP}$	$-Bs_{SP_t}^{SP}$	$+Vcb_t^{SP}$	$+V_t^{ECB}$

The domestic bonds are used to close the balance sheet of national central banks of Spain and Germany.

$$\Delta Bd, cb_{SP_t}^{SP} = \Delta R_t^{SP} + \Delta Hs, cb_t^{SP} - \Delta A_t^{SP} - \Delta IEA_t^{SP} - \Delta TG2_t^{SP}$$

The euro-dollar exchange rate is flexible and clears the market bonds denominated in euros (1$= E1€ =E4#).

$$E1_t = \frac{Bs_t^{GE} + Bs_t^{SP} - Bs,b_{SP_t}^{SP} - Bs,b_{GE_t}^{GE} - Bs,b_{SP_t}^{GE} - Bs,b_{GE_t}^{SP} - Bs,b_{RW_t}^{SP} - Bs,b_{RW_t}^{GE}}{Bd,b_{US_t}^{SP} + Bd,b_{US_t}^{GE}}$$

Since the rest of the world is in fixed exchange rate against the dollar (E4 constant), the foreign reserves held by the rest of the world's central bank ($Bd, cb_{RW_t}^{US}$) are variable and the closure of the bond market of the rest of the world is achieved through central bank interventions ($Bd, cb_{RW_t}^{RW}$).

$$\Delta Bd, cb_{RW_t}^{US} = \Delta Hd_t^{RW} + \Delta Rd_t^{RW} - \Delta Ad_t^{RW} - \Delta Bd, cb_{RW_t}^{RW}$$

$$Bd, cb_{RW_t}^{RW} = Bs_t^{RW} - Bs, b_{US_t}^{RW} - Bs, b_{SP_t}^{RW} - Bs, b_{GE_t}^{RW} - Bs, b_{RW_t}^{RW}$$

Regarding the dollar-denominated bond market, this asset plays a specific role as they are supposed to be used as foreign reserves by the other countries. The US central bank intervenes in the bond market to keep interest rate constant.

$$Bd, cb_{US_t}^{US} = Bs_t^{US} - Bs, b_{US_t}^{US} - Bs, b_{GE_t}^{US} - Bs, b_{SP_t}^{US} - Bs, b_{RW_t}^{US} - Res_t - Bs_{ECB_t}^{US}$$

$$Res_t = Bs, cb_{GE_t}^{US} + Bs, cb_{SP_t}^{US} + Bs, cb_{RW_t}^{US}$$

Last, the balance sheet equation of the US central bank is the missing equation which is not written.

$$\Delta Rd_t^{US} + \Delta H_t^{US} - \Delta Ad_t^{US} - \Delta Bd, cb_{US_t}^{US} = 0$$

The main equations of the SFC model of the euro area have been presented. They give a representation of the euro area adjustments during the first part of the 2000 when interest rates were kept constant in spite of huge intra-European imbalances. Due to large structural heterogeneity inside the euro area, the South Europe suffered from overvaluation and loss of competitiveness while the German block benefited of undervaluation and gains of competitiveness. This can be introduced in the model by assuming a loss of competitiveness of Spain against the three other blocks. This shock induces a slowdown with increasing current and public deficits in Spain while Germany benefits of a stronger growth with current and public surpluses. The euro-dollar exchange rate remains unchanged as only intra-European adjustments occur.

The euro area after 2010

However this configuration was hardly sustainable and, after the burst of the financial crisis, international investors began doubting about southern countries capacity to pay their increasing euro-denominated debts. Massive sales of southern countries bonds and difficulty to issue new debt lead to increasing rates of interest in the South Europe and to the euro area crisis.

The model has to be modified to simulate this evolution and interest rate in Spain has to become endogenous. Spanish bonds are now defined in volume and value with a price

(pbl_t^{SP}) which is the inverse of the rate of interest ($rb_t^{SP} = \frac{1}{pbl_t^{SP}}$). Spanish bonds now pay a fixed coupon, instead of interest, and portfolio equations depend of this coupon. The price of Spanish bonds is determined by confrontation of the portfolio demand and of the supply. This supply of Spanish bonds to US, German and rest of the world is the residual of the total supply net of the domestic demand. The whole structure of the model remains unchanged, except some modifications which are to be introduced due to this new treatment of the Spanish bonds.

Adjustment mechanisms in the euro area can be studied in the same way as before with a shock of loss of Spanish competitiveness. The same shock produces a deeper recession in Spain with a sharp rise of the Spanish rate of interest due to the increasing public deficit and new issuance of bonds, facing a demand which is not sufficient to compensate this excess supply. On the whole, the results are rather coherent with what has been observed in South Europe after 2010.

3.2 Alternative monetary regimes

Alternative monetary regimes can be considered to explore ways out of the euro crisis, using the same basic SFC model. Two kinds of monetary arrangements can be distinguished, the first ones can be labeled multi-speed Europe, the seconds, more ambitious, are based on euro bancor proposal with an European Clearing Union.

A multi-speed Europe

A multi-euros area

A multi-euros area is the first proposal based on the idea that exchange rate misalignments between North and South Europe are one of the main sources of the euro crisis. In this arrangement national euros in South and North would cohabit with a global euro which would keep the role of the current euro in international financial markets.

The exchange rate of the global euro vis-à-vis the US dollar would be determined as a result of the interaction between supply and demand for euro-denominated bonds. The global euro/dollar exchange rate is called E9 in order to keep E1 and E2 as the exchange rates between Germany and Spain vis-à-vis the US. Unlike the current setting of the euro area, where Spain and Germany only issue bonds denominated in euros, the issuances to foreign creditors are denominated in global euros ($Bs, b_{GE_t}^{SP,€}$ is the supply of Spanish bonds in global euros to German banks) whereas domestic banks purchase domestic bonds denominated in national currency ($Bs, b_{SP_t}^{SP,SP}$).

$$E9_t = \frac{Bs_t^{GE,€} + Bs_t^{SP,€} - Bd,b_{SP_t}^{GE,€} - Bd,b_{RW_t}^{GE,€} - Bd,b_{GE_t}^{SP,€} - Bd,b_{RW_t}^{SP,€} - Bd_{ECB_t}^{GE,€} - Bd_{ECB_t}^{SP,€}}{Bd_{US_t}^{GE,€} + Bd_{US_t}^{SP,€}}$$

Since the government debt could be denominated in national euros, in this institutional framework each sub-region would regain its monetary sovereignty. The gap between the financing needs (B_t^{SP}) and the total demand for bonds denominated in domestic currency

(Bd,b_{SP}^{SP}) is filled with issuances of bonds denominated in global euros ($Bs_t^{SP,€}$). E7 and E8 are the bilateral exchange rate of Spanish and German euros to global euros.

$$Bs_t^{GE,€} = \frac{Bs_t^{GE} - Bs,b_{GE_t}^{GE}}{E7_t}$$

Germany and Spain can adjust their exchange rates E7 and E8 according to their external performance vis-à-vis their regional trading partner. The criterion consists of keeping exchange rates fixed as long as the intra-European current account is in surplus or, if in deficit, only for a certain period of time

$$E7_t = \begin{cases} E7_{t-1} & if \ \frac{CA_{SP_{t-i}}^{GE}}{Y_{t-i}^{SP}} \geq 0 \quad \forall\, i = 1,2,3,4,5 \\ E7_{t-1}.(1+\pi) & if \ \frac{CA_{SP_{t-i}}^{GE}}{Y_{t-i}^{SP}} < 0 \quad \forall\, i = 1,2,3,4,5 \end{cases}$$

$$E8_t = \begin{cases} E8_{t-1} & if \ \frac{CA_{GE_{t-i}}^{SP}}{Y_{t-i}^{GE}} \geq 0 \quad \forall\, i = 1,2,3,4,5 \\ E8_{t-1}.(1+\pi) & if \ \frac{CA_{GE_{t-i}}^{SP}}{Y_{t-i}^{GE}} < 0 \quad \forall\, i = 1,2,3,4,5 \end{cases}$$

$$E1_t = E8_t.E9_t$$

$$E2_t = E7_t.E9_t$$

Since Spain and Germany are now engaged in a fixed (but adjustable) exchange rate arrangement where bilateral nominal exchange rates indeed exist (not like in the current situation, where there are no nominal exchange rates within the Eurozone), national central banks must intervene in the foreign exchange markets in order to ensure that the parity holds over time. These interventions are carried out via purchases/sales of foreign reserves. We make the assumption that both countries accumulate these reserves under the form of dollar-denominated bonds issued by the US.

$$\Delta Bs, cb_{SP_t}^{US} = \frac{\Delta R_t^{SP} + \Delta H_t^{SP} - \Delta A_t^{SP} - \Delta Bs, cb_{SP_t}^{SP}}{E2_t}$$

A return to the European Monetary System (EMS)

The ideas embedded in the EMS could be taken up in order to give the euro area a higher degree of stability. As previously the Eurozone would be split up into two sub-regions but, instead of keeping a global euro used as an international currency, there would be a European Currency Unit (ECU) that would only play the role of being a unit of account. As it did in the past, it would be the reference to which the national currencies are pegged. Hence, the ECU could be written as follows, where β represents the share of Germany in total output of the euro area:

$$\frac{1}{E9_t} = \beta.\frac{1}{E1_t} + (1-\beta).\frac{1}{E2_t}$$

The way the ECU is constructed implies that it is a basket currency constituted partly by the German currency and partly by the Spanish currency. It is expressed in ECUs with respect to

units of US dollars, i.e., 1$ = E9 ECU. The determination of each European currency vis-à-vis the ECU would be the same as the one described in the previous scenario, and would depend on the external performance of each country. However, even if Spain and Germany's currencies were pegged to the ECU, they would float against the US dollar. This implies that the bilateral nominal exchange rate could adjust in such a way that the domestic bond market is in equilibrium. As regards the exchange rates of the Spanish currency against the German currency, it can be deduced from the other exchange rates (equation 3.184d).

$$E7_t = \begin{cases} E7_{t-1} & if\ \frac{CA^{SP}_{t-i}}{Y^{SP}_{t-i}} \geq 0 \quad \forall\, i = 1,2,3,4,5 \\ E7_{t-1}.(1+\pi) & if\ \frac{CA^{SP}_{t-i}}{Y^{SP}_{t-i}} < 0 \quad \forall\, i = 1,2,3,4,5 \end{cases}$$

$$E8_t = \begin{cases} E8_{t-1} & if\ \frac{CA^{GE}_{t-i}}{Y^{GE}_{t-i}} \geq 0 \quad \forall\, i = 1,2,3,4,5 \\ E8_{t-1}.(1+\pi) & if\ \frac{CA^{GE}_{t-i}}{Y^{GE}_{t-i}} < 0 \quad \forall\, i = 1,2,3,4,5 \end{cases}$$

$$E1_t = \frac{Bs^{GE}_t - Bs, b^{GE}_{GE_t} - Bs, cb^{GE}_{GE_t} - Bs, b^{GE}_{SP_t} - Bs, b^{GE}_{RW_t}}{Bd, b^{GE}_{US_t}}$$

$$E2_t = E1_t.E3_t$$

$$E3_t = E7_t/E8_t$$

The adjustment of E1 ensures that the German bond market is always cleared. This closure implies that the changes in E1 and E2 are such that E3 is constant since the institutional arrangement of the EMS implies that intra-European parities are fixed. Given that E2 cannot adjust in such a way that the Spanish bond market is in equilibrium, it is the Spanish central bank that, via its purchases/sales of domestic bonds, clears the bond market.

$$Bd, cb^{SP}_{SP_t} = Bs^{SP}_t - Bs, b^{SP}_{SP_t} - Bs, b^{SP}_{US_t} - Bs, b^{SP}_{GE_t} - Bs, b^{SP}_{RW_t}$$

The balance sheet of the central banks of Spain and Germany are kept in equilibrium through reserves accumulation, taking into account that they are engaged in a fixed exchange rate arrangement with respect to the ECU. In practice, this does not differ from the case presented in the previous scenario.

$$\Delta Bs, cb^{US}_{SP_t} = \frac{\Delta R^{SP}_t + \Delta H^{SP}_t - \Delta A^{SP}_t - \Delta Bs, cb^{SP}_{SP_t}}{E2_t}$$

$$\Delta Bs, cb^{US}_{GE_t} = \frac{\Delta R^{GE}_t + \Delta H^{GE}_t - \Delta A^{GE}_t - \Delta Bs, cb^{GE}_{GE_t}}{E1_t}$$

A Euro zone without the current surplus countries

One of the alternatives that has been put forward by Soros (2012) and Lordon (2013) among others is a situation in which Germany leaves the Eurozone and lets its currency float, while the remaining European countries keep the euro, which could either be pegged to the German currency or float freely. The German currency/dollar exchange rate (E1) is determined explicitly as the ratio of the supply of German bonds to the US and the demand for German bonds by the US. The Spanish currency/German currency exchange rate (E3) could either be pegged or float freely.

In the case where the euro is pegged to the German currency (1 GE= E3 euro= E3 SP), the possibility of exchange rate adjustment would remain in case of external imbalances. Since the exchange rate E1 would be floating, the domestic bond market would be cleared in the process of the determination of the exchange rate. The German central bank would no longer purchase foreign assets since there is no exchange rate to be defended. Thus, its balance sheet would be closed through purchases/sales of domestic bonds. As regards the central bank of Spain, its exchange rate would still be fixed and the monetary authority would keep on purchasing/selling US bonds as foreign reserves.

$$E1_t = \frac{Bs_t^{GE} - Bs,b_{GE_t}^{GE} - Bs,cb_{GE_t}^{GE} - Bs,b_{SP_t}^{GE} - Bs,b_{RW_t}^{GE}}{Bd,b_{US_t}^{GE}}$$

$$E3_t = \begin{cases} E3_{t-1} & if\ \frac{CA_{SP_{t-i}}^{GE} + FA_{SP_{t-i}}^{GE}}{Y_{t-i}^{SP}} \geq 0 \quad \forall\, i = 1,2,3,4,5 \\ E3_{t-1}.(1+\pi)\ if\ \frac{CA_{SP_{t-i}}^{GE} + FA_{SP_{t-i}}^{GE}}{Y_{t-i}^{SP}} < 0 \quad \forall\, i = 1,2,3,4,5 \end{cases}$$

$$E2_t = E1_t.E3_t$$

$$\Delta Bs, cb_{GE_t}^{GE} = \Delta R_t^{GE} + \Delta H_t^{GE} - \Delta A_t^{GE}$$

$$\Delta Bs, cb_{SP_t}^{US} = \frac{\Delta R_t^{SP} + \Delta H_t^{SP} - \Delta A_t^{SP} - \Delta Bs, cb_{SP_t}^{SP}}{E2_t}$$

In the case where the euro (SP) floats against both the German currency and the US dollar, this alternative should ensure that every external imbalance is automatically corrected via exchange rate adjustments, thereby releasing the central bank from the task of accumulating reserves in order to defend an exchange rate. The drawback of this scenario is that one of the main reasons why the euro was introduced – avoiding the permanent fluctuations of intra-European exchange rates, with the associated adverse effects on international trade – would not be fulfilled. However, all the countries that stay in the Eurozone would still be having a fixed exchange rate arrangement (since they would share the same currency), which means that at least between them the benefits of a stable exchange rate on international trade would still be reaped.

Adapting the model to this possible alternative is quite simple. We just need to let the euro/German currency exchange rate, E3, float. In this case, the euro-bond market would be automatically cleared via exchange rate movements and the central bank would ensure the

equilibrium in its balance sheet through purchases/sales of domestic bonds. The rest of model would be closed as in the fixed exchange rate case.

To summarize the different proposals that we have been presenting, table 4 describes how each of the equations implicit on the crucial roles and columns of the flow of funds would be satisfied. The first three columns describe which variable ensures the equilibrium in the market of Spanish, German and European bond markets. The last two columns show which asset adjusts in such a way that the balance sheet identity of the central banks of Spain and Germany holds at every point of time.

Table 4: Alternative closures of the multispeed Europe

Model	B^{SP}	B^{GE}	B^{EZ}	CB^{SP}	CB^{GE}
Current setting	$E1 = E2$	$E1 = E2$	-	Bd, cb_{SP}^{SP}	Bd, cb_{GE}^{GE}
Multiple euros	Bd, b_{SP}^{SP}	Bd, b_{GE}^{GE}	$E9$	Bd, cb_{SP}^{US}	Bd, cb_{GE}^{US}
EMS	Bd, cb_{SP}^{SP}	$E1$	-	Bd, cb_{SP}^{US}	Bd, cb_{GE}^{US}
Euro zone without GE (fixed)	Bd, cb_{SP}^{SP}	$E1$	-	Bd, cb_{SP}^{US}	Bd, cb_{GE}^{GE}
Euro zone without GE (flexible)	$E3$	$E1$	-	Bd, cb_{SP}^{SP}	Bd, cb_{GE}^{GE}

Assessing the viability of a multi-speed Europe

The aim of this section is to show the behavior of some key macroeconomic variables in each of the scenarios described in the previous section. In the remaining of this section we present a comparative analysis of the different scenarios after a negative competitiveness shock in Spain (which is due to the overvaluation of the euro for the Spanish economy, in line with the evidence shown by Duwicquet et al (2013)).

Figure 4: Effect of a loss of competitiveness on Spain's trade balance

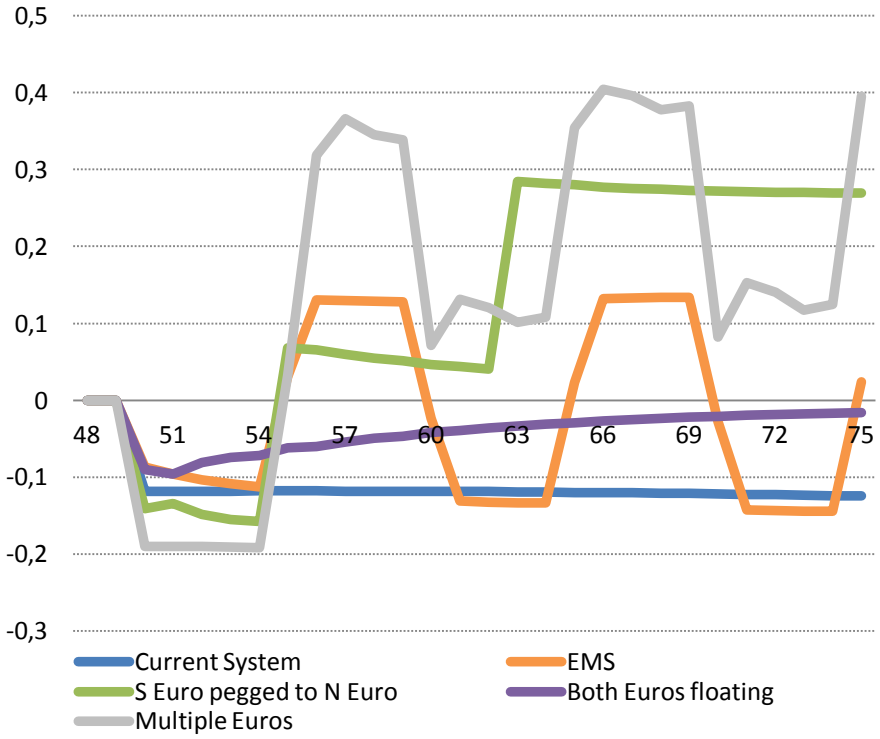


Figure 5: Effect of a loss of competitiveness on the Spanish euro

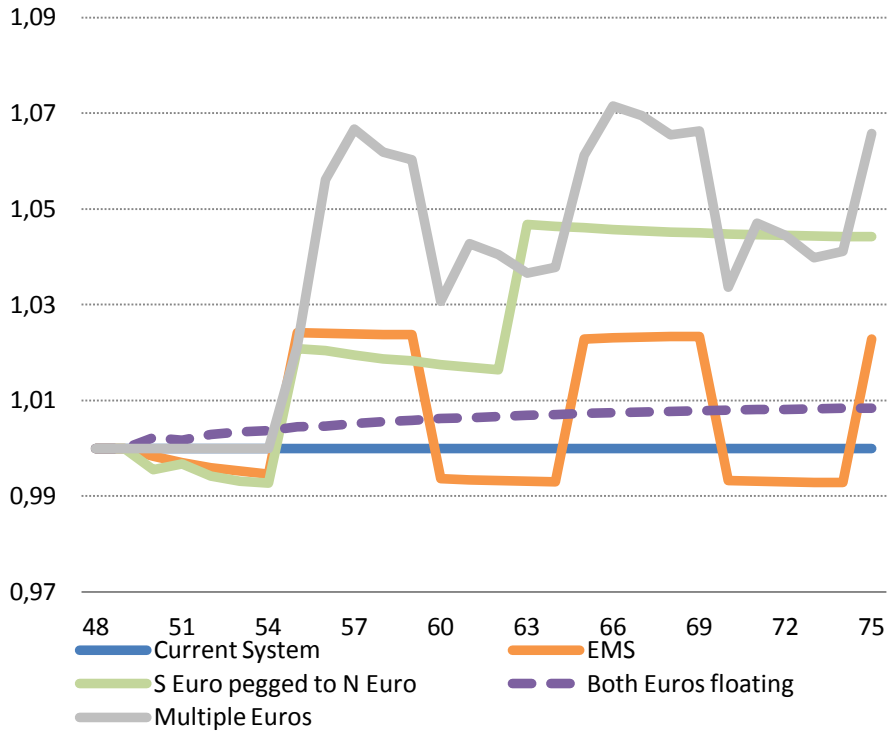


Figure 6: Effect of a loss of competitiveness on the German euro

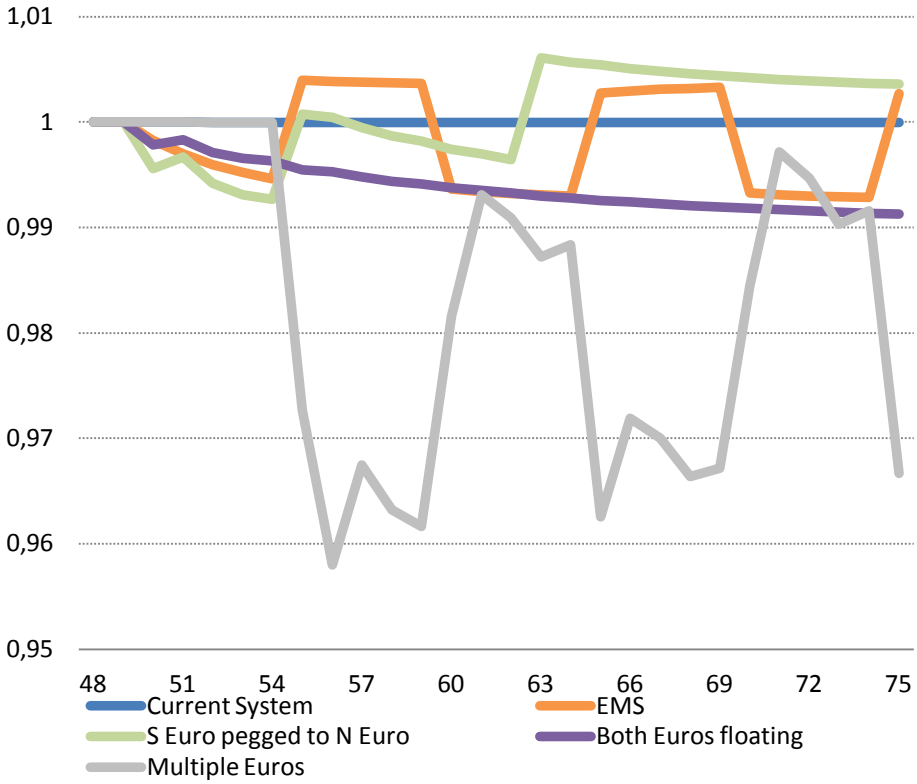


Figure 7: Effect of a loss of competitiveness on the Spain's GDP

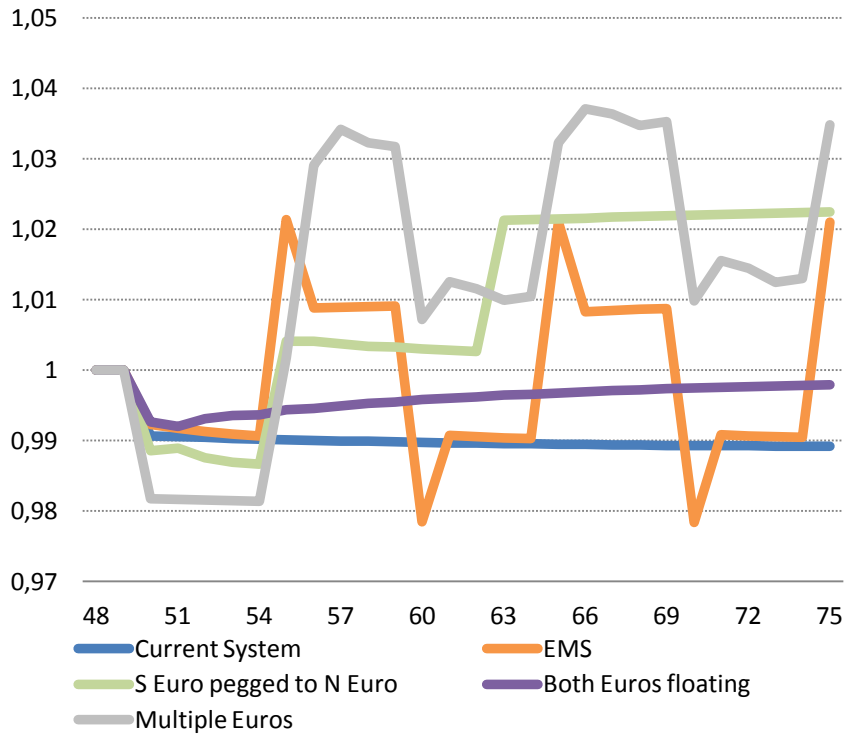
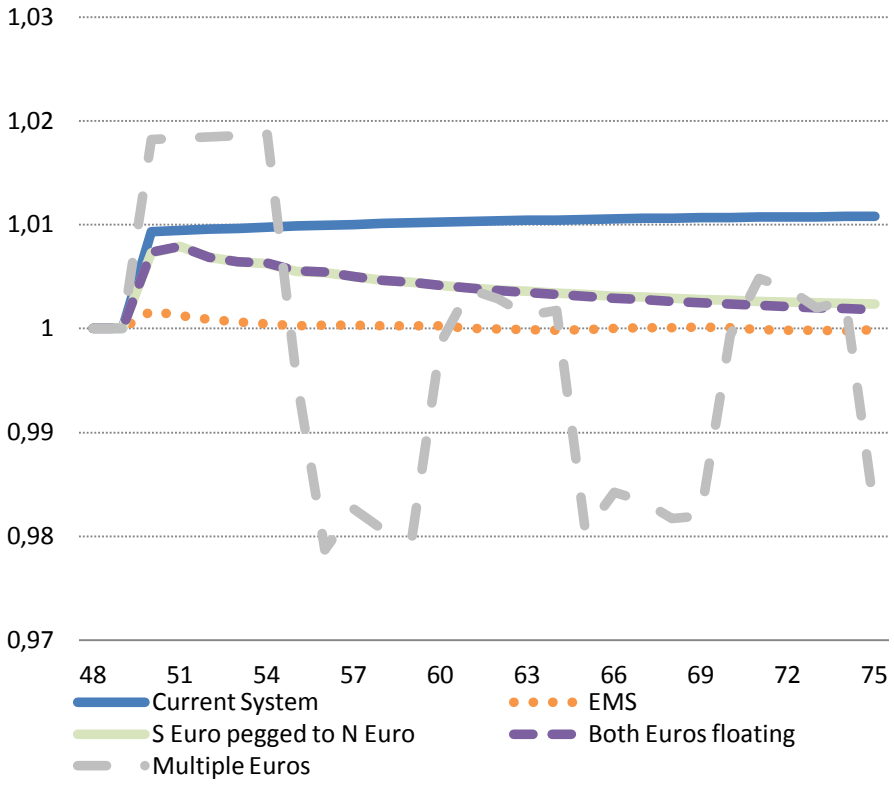


Figure 8: Effect of a loss of competitiveness on the Germany's GDP



The multi-euros scenario

In this scenario national currencies are restored and coexist with the euro. The advantage of this setting is that each country (or group of countries) would have more degrees of freedom to conduct its fiscal and monetary policy. This gain of economic sovereignty would not come at the cost of destroying the achievements of the process of economic integration that took place during the last decades. In other words, the benefits of the unification would be kept, while the drawbacks would be replaced for newly designed institutions.

The negative impact of the competitiveness shock on Spain's GDP can be observed in figure 7, most of which is explained by the deterioration of the trade balance. Figure 8 shows that the effect is the opposite in Germany, i.e., the trade balance goes into surplus, which in turn increases the rate of growth. Since the positive impact in Germany is neutralized by the negative effect in Spain, there is no impact in the rate of growth of the global economy. Thus, the global euro remains unchanged vis-à-vis the US dollar.

However, the negative competitiveness shock implies that Spain starts to accumulate current account deficits. After five consecutive periods of deficits, the Spanish currency is devalued against the global euro. This adjustment is also observed in the exchange rate vis-à-vis the US dollar (see figure 5). This devaluation restores Spain's competitiveness, bringing the trade balance into surplus and the growth rate to a positive path. As a result of the higher level of activity, the government starts running a surplus, which implies that the supply of bonds decreases (since the financing needs of the Treasury decrease). This lower supply of bonds denominated in euros translates into an appreciated global euro, which also appreciates the German currency.

The adjustment of the Spanish currency erodes Germany's competitiveness to such an extent that some periods later the German currency needs to be devalued. This improves Germany's trade balance, but worsens that of Spain. As a result, after some periods the Spanish currency is devalued once again. These dynamics are repeated infinitely. This implies that this setting does not produce stable results over time. In an extended version of this model we tried out different adjustment criteria for intra-European exchange rates. In some cases, instead of setting the adjustment threshold equal to a 0% deficit, we allow for small deficits. This modification helps to stabilize the dynamics, but such a scenario could not last too much since it would imply a continuous loss of foreign reserves. We also set an alternative adjustment criterion that states that the exchange rate is kept fixed as long as the stock of reserves is positive. In this case, balance of payments deficits can persist depending on the initial stock of foreign reserves.

The EMS scenario

In this EMS scenario Spain has the capacity to devalue its currency against the ECU (and hence to the German currency) after some periods of accumulating current account deficits. Hence, in period 55 a devaluation of 2% vis-à-vis the ECU is introduced. This gain of competitiveness against Germany improves Spanish trade surplus, thereby inducing an increase in the domestic level of activity. As regards Germany, the appreciation of its

currency vis-à-vis the Spanish currency erodes its competitiveness, reducing its trade, current account and fiscal surpluses. As a consequence, the German government increases the supply of bonds, which is reflected in a slight depreciation of the German currency. The global appreciation of the dollar that results from these movements ends up bringing about a larger devaluation of the Spanish currency vis-à-vis the US dollar (compared to the devaluation against the German currency), which is observed in figure 5.

The main conclusion is that in a context in which Spain is allowed to devalue its currency with respect to the ECU the initial loss of competitiveness can be easily corrected, thereby preventing first a process of unsustainable current account deficits and, more importantly, the recessionary effect that the trade deficit may have on the level of activity and employment. However the instability of such a monetary regime has to be underlined. As it is observed in the figures, imposing an adjustment criterion on the exchange rate that is based on the bilateral performance of the current account is prone to generating cycles of continuous devaluations of the intra-European parities. During the times of the EMS this was considered a drawback of the system, mainly because of the difficulties that imposes on international trade. In this regard, the model confirms that taking up the EMS would imply the return to an undesirable situation.

The euro zone without Germany scenario

If the euro is pegged to the German currency, after having accumulated five consecutive balance of payments deficits, Spain is allowed to devalue its currency 2%. Once this happens, a positive effect on the Spanish trade balance and economic growth is observed. However there is a positive income effect on imports, which slightly erodes the trade balance. After this adjustment has been made, Spain's overall trade balance is in surplus, but deteriorating. The bilateral trade balance with Germany is in deficit, which means that a 2% devaluation is not enough to bring the intra-European exchanges rates back to equilibrium. Thus, in period 63 a new devaluation is introduced, after which the same effects that had occurred after period 55 take place. The only difference is that in this case the new exchange rate parity is sufficient to restore Spain's initial competitiveness. No more adjustments take place.

Compared to the two previous scenarios, the case where Germany leaves the Eurozone and the remaining countries are pegged to the German currency seems to provide the whole system with a higher level of stability and sustainability in the medium-long run. Moreover, as shown in figure 8, this higher stability in the south does not come at the cost of a recession in Germany, which exhibits a lower level of growth with respect to the baseline scenario, but positive growth still. The conclusion that can be drawn from this exercise is that a situation in which Germany leaves the Eurozone and the south is allowed to adjust its currency to a level that is more consistent with its external equilibrium can be beneficial for all: the south would not find itself immersed in a long-lasting recession with associated high levels of unemployment, and Germany would grow at a slower pace, but it would avoid the politically uncomfortable subsidizing of troubled countries. Compared to a pure fiscal union

or a scenario where Germany finances the bailout of the deficit countries, the institutional setting that was described in these simulations would also save Germany significant fiscal burdens.

Finally, in an institutional setting where Germany leaves the Eurozone and the euro (now the currency of Spain) floats freely, soon after the competitiveness shock the euro starts to depreciate as a result of the current account deficits. The opposite behavior is observed in the case of the German currency. As it may be intuited, an exchange rate arrangement where everything floats freely is prone to produce situations where the variables return to equilibrium. This is indeed what happens, since the initial trade deficit of Spain is progressively corrected as the euro depreciates. Eventually, the trade balance reaches equilibrium and the exchange rate stabilizes.

Our simulations of the different possible reforms of the Eurozone show under which conditions each institutional framework could work, which we consider an interesting contribution to the debate on the ways out of the crisis. We find that there are different alternatives to solve the causes that, from our point of view, explain the external fragility to which southern countries were exposed (and that finally materialized under the form of the crisis that has been affecting these economies lately). We find that a multiple euro framework (or a take-up of the EMS) might produce high levels of instability, unless the system allows for persistent but small deficits (presumably, lower than the ones observed before the crisis thanks to the possibility of adjusting exchange rates). The results would be much better if Germany left the euro area, but this would come at the cost of the loss of many of the benefits of the process of integration as a whole. In order to prevent this from happening and to keep some of these benefits, in the next section we present an alternative that could be more viable from a political point of view.

A more constructive solution: the European Clearing Union

The Euro-bancor model takes what we consider the most useful features of each of the systems that found implementation in Western Europe during the last decades. First, we borrow from the EMS the existence of a non-material unit of account to which national currencies are pegged. This fictitious currency, which in the EMS was called ECU, in Keynes' proposal was called bancor. In this model, the Euro-bancor is determined in the same way as the ECU was determined in the EMS, i.e., as a basket currency of national currencies, all measured with respect to the US dollar. Second, in Keynes' proposal countries accumulated bancor balances according to their external performance – whereas those countries that exhibited trade surpluses registered an increase in their bancor account at the ICU, countries running trade deficits registered a decrease in their stock of bancors. The idea of accumulating balances of a fictitious currency as a result of international transactions is the

same that we observe in the current TARGET2 system. This is a noteworthy issue, since it implies that most of the institutions that are required to implement a regime of this nature (a clearing union, an international unit of account and a system that registers the transactions within the region) already exist (the ECB could play the role of the ICU and the SEPA is the system that registers all the transactions) or have existed and could easily be restored (the ECU, that would play the role of the bancor).

Alternative closures of the euro-bancor model

The Euro-bancor (E9) is a basket currency composed by European currencies. Unlike Keynes' proposal, where all the countries in the world are engaged in the bancor framework and thus have all fixed exchange rates, in this case European currencies are pegged to the Euro-bancor (thereby fixed with respect to each other) but they float against the currencies of the rest of the world. This feature of the system is also borrowed from the EMS. The adjustment criterion of European currencies vis-à-vis the Euro-bancor (E7 for Spain and E8 for Germany) depends on the intra-regional external performance of each country, unlike the case of the EMS where the overall performance was considered. The external performance of each country is evaluated taking a certain sustainability threshold for the bilateral current account. The exchange rate of each European currency against the US dollar (E1 for Germany and E2 for Spain) is such that the domestic bond market is in equilibrium. As was the case in the EMS, it should happen that the exchange rate of Spain vis-à-vis Germany is the same either computed through their exchange rates against the Euro-bancor or against the US dollar.

As regards the balance sheet identity of national central banks of Spain and Germany, even though they are engaged in a fixed exchange rate arrangement, the fact that the currency to which they are pegged (the Euro-bancor) does not have a physical existence, there is no need to accumulate reserves. This is one of the advantages of Keynes' proposal – the lack of a need to hoard foreign reserves could prevent potential flows of effective demand from leaking outside the system. Thus, the stock of dollar-denominated bonds by the central banks of Spain and Germany will be constant, although when expressed in domestic currency this stock may be subject to changes due to variations in the exchange rate. In terms of the dynamics of the model, even though reserves are not accumulated in a context of fixed but adjustable exchange rates within Europe, the fact that the European currencies float against the currencies of the US and the rest of the world allows for consistency to be achieved.

$$\frac{1}{E9} = \frac{Y^{GE}}{Y^{GE}+Y^{SP}} \cdot \frac{1}{E1} + \frac{Y^{SP}}{Y^{GE}+Y^{SP}} \cdot \frac{1}{E2}$$

$$E7 = \begin{cases} E7_{-1} & if\ CA^{SP}_{GE_{t-i}} \geq T\ \ for\ all\ i = 1, \dots, 5 \\ E7_{-1}.(1+\varepsilon) & if\ CA^{SP}_{GE_{t-i}} < T\ \ for\ all\ i = 1, \dots, 5 \end{cases}$$

$$E8 = \begin{cases} E8_{-1} & if\ CA^{GE}_{SP_{t-i}} \geq T\ \ for\ all\ i = 1, \dots, 5 \\ E8_{-1}.(1+\varepsilon) & if\ CA^{GE}_{SP_{t-i}} < T\ \ for\ all\ i = 1, \dots, 5 \end{cases}$$

$$E1 = \frac{Bs^{GE} - Bd, b^{GE}_{GE} - Bd, cb^{GE}_{GE} - Bs, b^{GE}_{RW} - Bs, b^{GE}_{SP}}{Bd, b^{GE}_{US}}$$

$$E2 = \frac{Bs^{SP} - Bd, b^{SP}_{SP} - Bd, cb^{SP}_{SP} - Bs, b^{SP}_{RW} - Bs, b^{SP}_{GE}}{Bd, b^{SP}_{US}}$$

$$E3 = \frac{E7}{E8} = \frac{E2}{E1}$$

$$Bs, cb^{US}_{SP} = \overline{Bs, cb^{US}_{SP}}$$

$$Bs, cb^{US}_{GE} = \overline{Bs, cb^{US}_{GE}}$$

The clearing union is the institution where all the payments are cleared. Thus, every country would have an account at the clearing union. This account would be an asset for each national central bank and a liability for the clearing union, just as it happens in the current TARGET2 system. However, unlike the current system, Euro-bancor balances (EB) would not only be composed of international trade and portfolio investment within Europe, but there would also be some specific flows characterizing Keynes' proposal.

First, in order to make the external adjustment process more symmetric than it is today, this system would make both debtor and creditor countries share the burden of the debts. Thus, all countries would pay interests on their bancor balances, shall them be positive or negative. This rule should encourage countries to make their accounts at the clearing union be as close to zero as possible, since it would always be better to consume a real good (an import) than paying an interest that entails no consumption at all.

A second flow that must be incorporated in the accumulation of Euro-bancor balances is the one related to the distribution of the funds collected by the clearing union, which result precisely from the aforementioned interest payments on Euro-bancor balances. We call these flows resulting from the redistribution process "intra-European adjustment" (IEA). The sum of all these flows determines the change in the stock of Euro-bancors held by each country's central banks. The sum of all the interest payments on Euro-bancor balances determines the profits of the clearing union (P^{CU}), which distributes these funds to member countries according to the performance of the current account of each member country. Finally, we ensure that the balance sheet identity of the central banks of Spain and Germany holds through the purchases/sales of domestic bonds.

$$\Delta EB^{SP} = X^{GE}_{SP} - IM^{GE}_{SP} + r^{GE}_{-1}.Bd, b^{GE}_{SP_{-1}} - r^{SP}_{-1}.Bd, b^{SP}_{GE_{-1}} + \Delta Bs, b^{GE}_{SP} - \Delta Bd, b^{GE}_{SP} - |r^{EB}_{-1}.EB^{SP}_{-1}| + IEA^{SP}.E7$$

$$P^{CU} = \left| r_{-1}^{EB} . \frac{EB_{-1}^{SP}}{E7} \right| + \left| r_{-1}^{EB} . \frac{EB_{-1}^{GE}}{E8} \right|$$

$$IEA^{SP} = \begin{cases} P^{CU} & if \ \frac{CA_{SP}^{GE}/E7}{\frac{Y^{SP}}{E7}} < \theta \\ 0.5 \ P^{CU} & if \ \frac{CA_{SP}^{GE}/E7}{\frac{Y^{SP}}{E7}} \geq \theta \end{cases}$$

$$IEA^{GE} = P^{CU} - IEA^{SP}$$

$$\Delta Bd, cb_{SP}^{SP} = \Delta R^{SP} + \Delta H^{SP} - \Delta A^{SP} - \Delta Bd, cb_{SP}^{US} - \Delta EB^{SP}$$

In the previous paragraph we mentioned that in Keynes' proposal countries are encouraged to use their positive bancor balances to increase imports, since otherwise they would be wasting these balances - if balances are going to be cleared it is better to use them to purchase real goods than giving them to the clearing union for nothing. This incentive to increase imports can be modeled by expanding the standard import equations. We add an additional term that depends on the burden of the stock of Euro-bancors. The intuition behind this term would be that the higher the burden (represented by the interest payments associated to them) the higher the incentive to increase imports. Now, if imports are increased it needs to be specified what sector is going to purchase this additional flow of goods from abroad. In this model we assume that it is the government, since in principle it is the only agent that could internalize the loss that the central bank would incur if Euro-bancor balances were gradually extinguished due to the payment of interests to the clearing union. Thus, we augment the traditional public spending equations, which consider government consumption exogenous, to incorporate this additional flow of imports. The import equation is only augmented when Euro-bancor balances are positive. This implies that whereas surplus countries are forced to pursue more expansive policies, deficit countries are not forced to undertake a contractionary fiscal policy that restores the long-term balance of payments equilibrium through a recession.

$$ln(IM_{GE}^{SP}) = \begin{cases} \mu_0^{SP} + \mu_1^{SP} . \ln(Y^{SP}) + \mu_2^{SP} . \ln\left(\frac{1}{E3}\right) + \mu_3^{SP} . \ln\left[1 + \left(r^{eb} . EB_{-1}^{SP}\right)\right] & if \ EB_{-1}^{SP} > 0 \\ \mu_0^{SP} + \mu_1^{SP} . \ln(Y^{SP}) + \mu_2^{SP} . \ln\left(\frac{1}{E3}\right) & if \ EB_{-1}^{SP} \leq 0 \end{cases}$$

$$G^{SP} = \begin{cases} G_0^{SP} + G_{-1}^{SP} . (1 + \rho) + \mu_3^{SP} . \ln\left[1 + \left(r^{eb} . EB_{-1}^{SP}\right)\right] & if \ EB_{-1}^{SP} > 0 \\ G_0^{SP} + G_{-1}^{SP} . (1 + \rho) & if \ EB_{-1}^{SP} \leq 0 \end{cases}$$

Another closure implying a real-side adjustment could consist of the utilization of the flows of redistributed interests by the clearing union to finance the imports of capital goods that increase the stock of capital and eventually change the productive structure of the economy, thereby increasing competitiveness and, in the long run, reducing the demand for imported

goods. This would require the augmentation of Spain and Germany's import equations by the amount of "intra-European adjustment" flows received from the clearing union. The amount of imported capital goods that results from these flows of "aid" would be added to the traditional investment function. As it is shown in the simulations presented in the next section, the structural change effect is introduced as a gradual decrease in the income elasticity of imports of the deficit country.

$$ln(IM_{GE}^{SP}) = \mu_0^{SP} + \mu_1^{SP}.\ln(Y^{SP}) + \mu_2^{SP}.\ln\left(\frac{1}{E3}\right) + \mu_4^{SP}.\ln\left[1 + IEA^{SP}.E7\right]$$

$$\frac{I^{SP}}{K_{-1}^{SP}} = \gamma_0^{SP} + \gamma_1^{SP}.\frac{P^{SP}}{K_{-1}^{SP}} + \gamma_2^{SP}.\frac{r_{-1}^{SP}.L_{-1}^{SP}}{K_{-1}^{SP}} + \gamma_3^{SP}.u_{-1}^{SP} + \mu_4^{SP}.\ln\left[1 + IEA^{SP}.E7\right]$$

If the structural change process if satisfactory it would be expected to observe that after some periods the deficit country starts being able to substitute imports, thereby reducing the dependence on foreign goods. In order to model this particular scenario we either endogenize the productive structure or we introduced structural change as an exogenous shock that gradually takes place some periods after the country has started to import the capital goods that will contribute to the process of import substitution. For the sake of simplicity, in this model we treat structural change as exogenous.

On the whole five different closures of the Euro-bancor model can be considered. Eurobancor 1 consists of the introduction of the clearing union and Euro-bancor balances that entail interests, which are collected and distributed by the clearing union. Eurobancor 2, is the same as before, but with a lower threshold on the devaluation rule, such that after an initial adjustment of the Spanish exchange rate no exchange rate adjustments take place (current account balances remain above the threshold). Euro-bancor 3 considers a very low threshold (no current account deficits are allowed). As a result, a devaluation of the currency of Spain is followed by a devaluation of the German currency and so forth. Eurobancor 4 is the one where countries use the "aid" provided by the clearing union (i.e., the redistribution of interests by the clearing union) to purchase imported capital goods that in the medium term allow for a higher degree of import substitution. We represent this by saying that after five periods of importing capital goods the country's income elasticity of imports starts decreasing gradually for ten periods, after what it remains constant over time. Finally, the model Euro-bancor 5 introduces the additional terms on the imports equations, in order to represent the higher incentive to import that surplus countries may have in this institutional setting. As mentioned before, these imports are computed as part of government consumption. For the Eurobancor 4 and 5 cases we have introduced the more generous devaluation threshold, in order to emphasize the real effect of the adjustment.

Dynamic effects of the euro-bancor regime

Figure 9 represents the reaction of each model to the same competitiveness shock analyzed before. The European Monetary Union (EMU) is used as a reference with the negative impact on Spanish current account and growth due to the loss of competitiveness. The trajectory followed by the bilateral current account of Spain with respect to Germany in model Euro-bancor 1 reflects the improvement due to the transfers of interests collected by the clearing union. (recall that in this framework the clearing union collects interests on Euro-bancor balances and transfers them to member countries according to their external performance). Since in the periods after the shock it is Spain whose current account is in deficit, the clearing union transfers the totality of the interests to Spain. This improvement is limited since in Euro-bancor 1 the threshold allows for so large deficits that no devaluation takes place.

As regards models Euro-bancor 2 and 3, the initial trajectories are very similar. Thanks to the transfers of the interests by the clearing union, Spain's current account is improved, but not sufficiently to be brought above the threshold (neither the lower nor the higher one). Thus, the Spanish currency is devalued in period 55. The immediate effect is an increase in the current account balance, to the extent that turns into surplus. Hereafter, the trajectories of models Euro-bancor 2 and 3 diverge. The reason is given by the effect that the predetermined threshold has on Germany's current account.

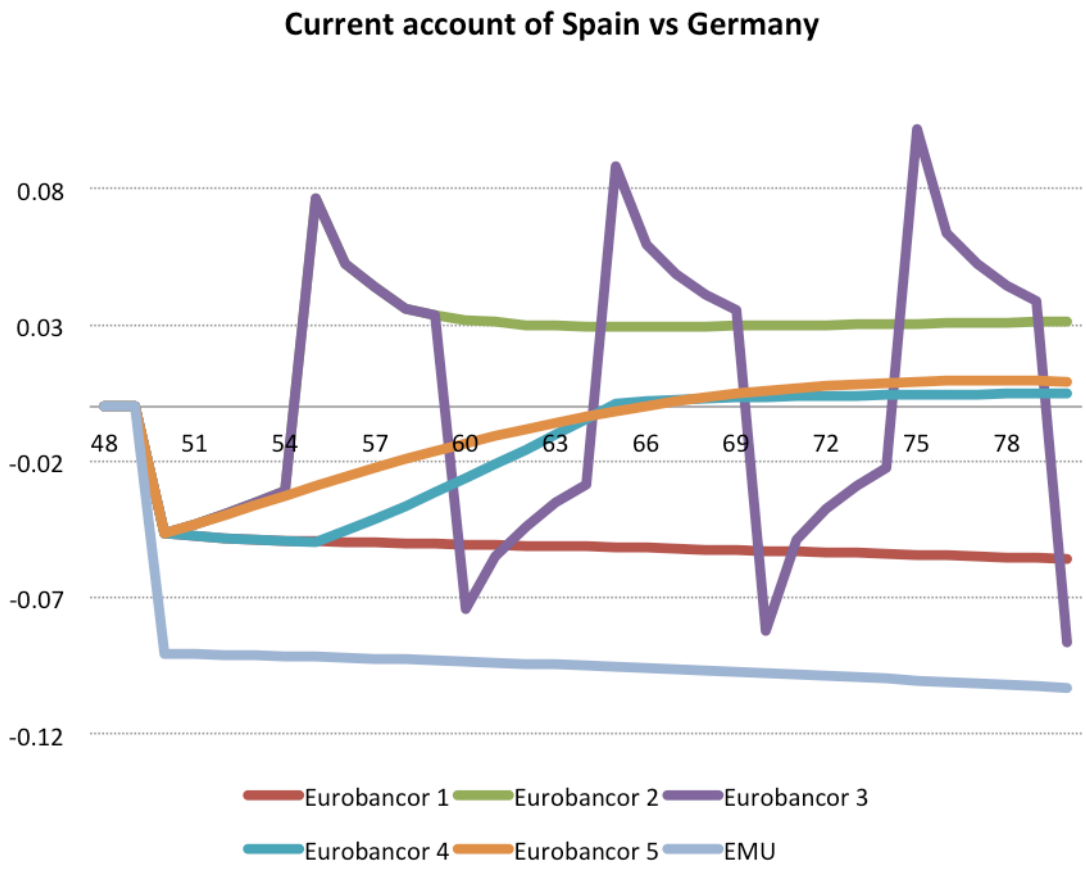
In model Euro-bancor 3, where the threshold is lower (smaller deficits are tolerated), the devaluation of the Spanish currency and the consequent current account surplus of Spain imply a current account deficit in Germany that falls below it. This brings the German current account into surplus, at the expense of Spain. From then on, the dynamics are similar to the ones observed in model EMS where one exchange rate adjustment followed another. We concluded that these dynamics were not desirable. Model Euro-bancor 2 shows more stable dynamics for the simple reason that the devaluation threshold is higher. Thus, Germany "accepts" the current account deficit brought about by the devaluation of the Spanish currency and no more exchange rates adjustments take place. It is worth noting that this scenario implies that in the long run Spain runs a current account surplus vis-à-vis Germany.

Finally, models Euro-bancor 4 and 5 seem to provide the more stable adjustment processes. In the case of model Euro-bancor 4, after the initial shock that brings Spain's current account into deficit, the accumulation of Euro-bancor balances and the subsequent redistribution of interests by the clearing union imply an "aid" to Spain that is used to purchase imported capital goods. This additional flow of imports, which is added to the one produced by the initial shock, prevent Spain's current account from reaching equilibrium in the short run. However, after some periods, the effects of structural change take over and the country starts to substitute imports. This is reflected in the gradual improvement of Spain's current account until it finally reaches a position that is close to equilibrium.

As regards model Euro-bancor 5, after the initial shock the accumulation of positive Euro-bancor balances by Germany produces an incentive to increase its purchases of goods from

Spain. These imports are purchased by the government. In the long run, this produces a trend to balance the external positions at the same time that potential flows of effective demand do not leak from the system. We consider that the trajectories described by model Euro-bancor 4 and 5 are the ones that Keynes had in mind when designing the proposal of an international clearing union that he presented at the Bretton Woods conference, which aimed at 'the substitution of an expansionist, in place of a contractionist, pressure on world trade' (Keynes (1943)).

Figure 9



The behavior of the Spanish currency vis-à-vis the US dollar under each of these alternative institutional settings can be seen in figure 10. Since the monetary arrangement is constrained to the European economy, the exchange rate of the Spanish currency vis-à-vis the dollar floats. Taking into account that Spain is running current account deficits (both bilateral and overall) the depreciation of its currency is not surprising. In the case of Eurobancor 1, the negative impact of the shock in terms of the current account balance is followed by a succession of periods where it keeps on deteriorating but at a very slow pace. This is due to the fact that even if the level of activity has decreased, the loss of competitiveness introduced as an exogenous shock prevents the economy from restoring

external equilibrium through the income effect. This slight accumulation of current account deficits is followed by light depreciations.

The cases of Eurobancor 2 and 3 are identical to Eurobancor 1 until a first adjustment in the exchange rate of the Spanish currency against the Eurobancor takes place, in period 54. When this happens, the current account reverses its sign thereby producing an appreciation. As the trade surplus boosts economic growth, imports increase further. This not only erodes the new trade surplus but also produces an upward pressure on the exchange rate towards depreciation of the Spanish currency (see the evolution of the exchange rate in Eurobancor 2 and 3 between 56 and 59). From then on, it is observed that whereas the exchange rate remains stable in Eurobancor 2, it starts fluctuating in Eurobancor 3 (for the reasons that have already been described above).

The cases of Eurobancor 4 and 5 exhibit an initial depreciation followed by and appreciation. After the initial shock the Spanish currency depreciates against the dollar for the same reasons examined above, i.e., the current account deficit produced by the loss of competitiveness. In the case of Eurobancor 4, where Spain is provided with “aid” to import capital goods, the trade and current account starts improving but at a slower pace than in the case of Eurobancor 5, where the adjustment mechanism implies only an increase in exports due to the higher demand for Spanish imports by the German government. Even though the relatively weaker performance of the Eurobancor 4 scenario in terms of the current account balance, Figure 11 shows that the country finds itself better off in terms of economic growth. This is due to the positive effect that the imports of capital goods have on investment and aggregate demand. The structural change derived from this adjustment mechanism should be more beneficial for long-run growth and should also reduce the country’s exposure to another sudden competitiveness shock.

Figure 10

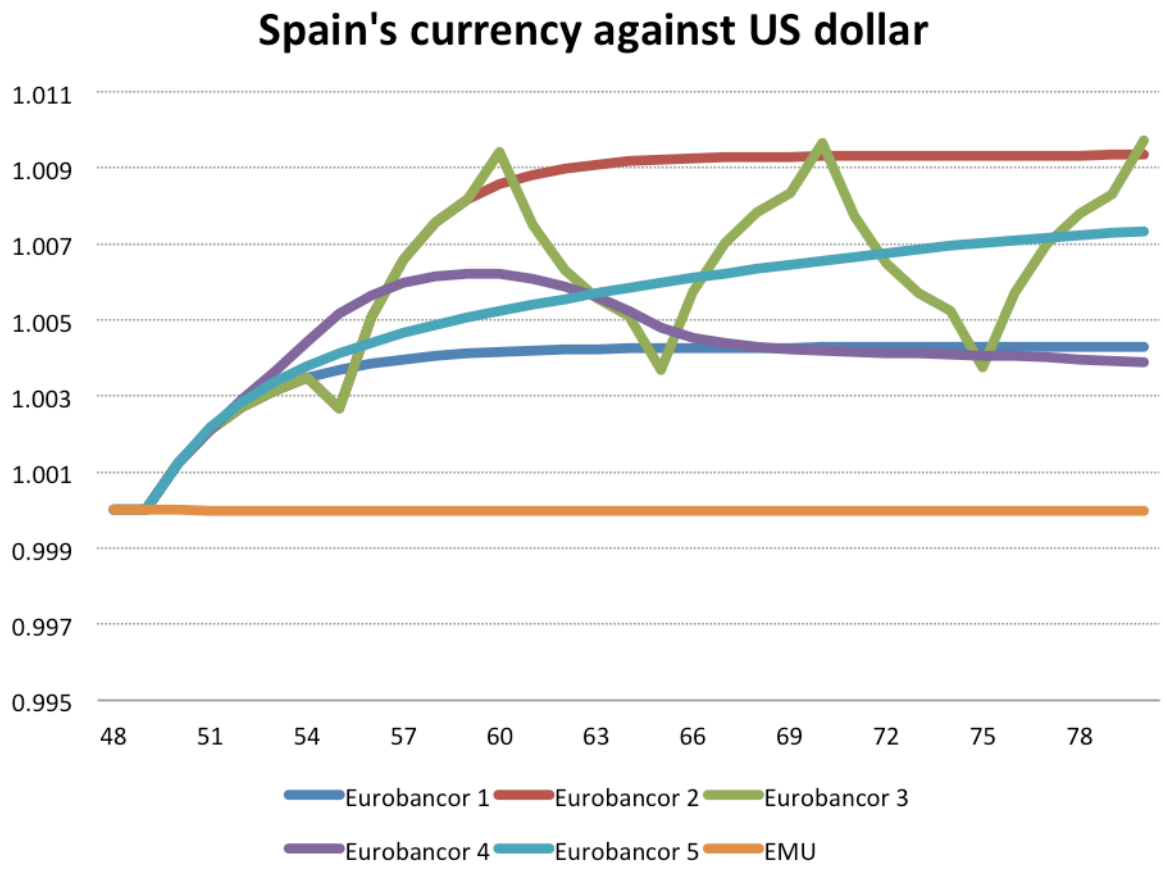
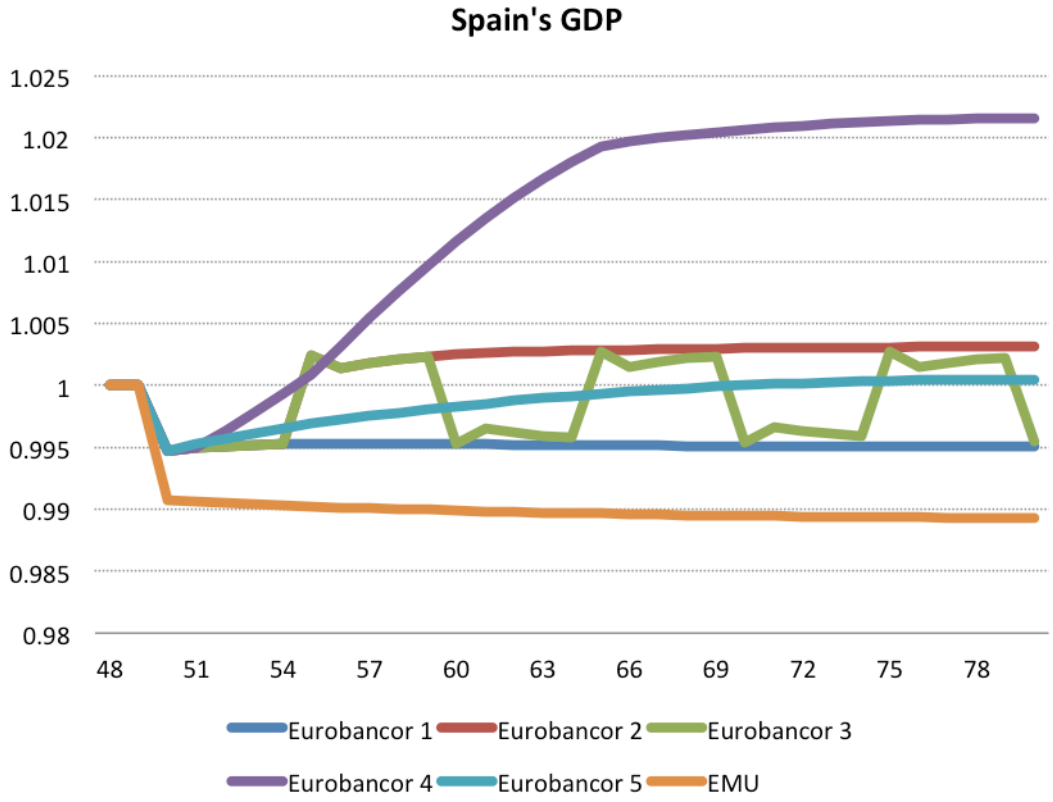

Spain's currency against US dollar
1.011
1.009
1.007
1.005
1.003
1.001
0.999
0.997
0.995
48
51
54
57
60
63
66
69
72
75
78
Eurobancor 1
Eurobancor 2
Eurobancor 3
Eurobancor 4
Eurobancor 5
EMU

Figure 11


Spain's GDP
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
48
51
54
57
60
63
66
69
72
75
78
Eurobancor 1
Eurobancor 2
Eurobancor 3
Eurobancor 4
Eurobancor 5
EMU

To conclude, as Cesaratto (2013) and Lavoie (2014) have shown, the current payments system in the euro area is rather close to the one that Keynes proposed for the reform of the international monetary system at the beginning of the 1940s. In this section we tried to model how the clearing union proposal, associated to an international unit of account that is only used for the settlement of international payments, could be modeled in the framework of a stock-flow consistent model. We found that the Eurosystem already has many of the institutions that would play a key role under such a regime. Our simulations show in which way the existing institutions should be modified in order to make the Eurozone an area less prone to producing large imbalances that, in the absence of either a system of fiscal transfers between regions or a central bank that can provide unlimited liquidity to deficit countries, will inevitably suffer from recurrent crises.

4. Conclusion

Two sets of simulations using SFC international models have been presented to show how institutional changes could be modeled in order to assess their impact on regulation mechanisms.

At the world level the hybrid regime with dollar pegged and free floating for the euro/dollar, close to what has been observed during the 1980 and 1990, has been simply characterized. It appeared to be marked by large world imbalances without appropriate adjustment mechanisms. It has been compared with alternative regimes. A general free floating regime is rather theoretical from a political point of view but could allow reduction of the global imbalances. Its high instability has not been discussed although it could be done in the same approach. A scenario based on SDR

Last, a more radical change has been analyzed with the international regime based on the bancor and on an International Clearing Union. In this framework self-correcting mechanisms, possibly competed by exchange rate adjustments, could allow a reduction of world imbalances.

At the European level the use of SFC models has been helpful to understand both the way in which the Eurosystem currently works and the alternative directions in which it could be modified in order to make of the Eurozone an economic area whose members benefit from higher growth and welfare. Several proposals have been put forward, each of them accompanied by a model that comprehensively explains how it could work in practice: multi-euros regime combining a global euro with national currencies, an euro area without the surplus countries, an euro-bancor regime which could be based on most of the current European monetary institutions (SEPA, TARGET2, clearing union, restoration of the ECU named euro-bancor).