A Multi Speed Europe : is it viable ?

_A stock-flow consistent approach_

Jacques Mazier       Sebastian Valdecantos

Abstract

Based on the evidence that shows that one of the major reasons of the imbalances in the Eurozone is the misalignment of the exchange rates within the monetary union (both because of the unfavorable parities at which some countries joined the Eurozone and due to the lack of coordination in wage policies) we propose a series of simulation exercises aimed at assessing the viability of some of the proposals that have been being put forward during the last years. In all cases we assume that the Eurozone is split into a northern and a southern zone, each with its own currency. We analyse how the institutional setting would have to be and the different adjustment criteria that could be introduced. We address a wide set of proposals that range from a simple revaluation of the northern euro (or a depreciation of the southern euro) to the more sophisticated idea of an improved European Monetary System. All these experiments are carried out using a four country stock flow consistent model specifically adapted to the institutional structure of the Euro Area. We conclude that some of the proposals would produce more sustainable macroeconomic dynamics, which would also allow Europe to enjoy a higher level of welfare.
1 Introduction

After a period of a seemingly successful implementation of the euro (2002-2007) the Eurozone has been immersed in a crisis of equal length (2008-2013). One of the immediate impacts of the crisis, as in most countries in the world, was the sore of budget deficits. This is no surprise since the governments attempted to mitigate the effects of the global financial crisis on production and employment. However, the dominant paradigm in economics interpreted the crisis as a process directly linked to profligate behavior by deficit countries. The problem of this explanation of the crisis is that it neglects the role played by financial liberalization in the periphery of the Eurozone (Spain, Portugal, Greece, Ireland, etc) combined with the export-led growth strategy pursued by the core (Germany, the Netherlands, Austria, Finland). In this regard, as Lapavitsas (2012) explains, the introduction of the euro and the parities at which each of the member countries joined the Eurozone, as well as the differential wage policies implemented by the member states, have been playing a major role in the determination of macroeconomic imbalances within the Eurozone which would eventually arise under the form of current account and budget deficits in the periphery (and surpluses in the core).

According to this second vision, the order of causation has been the opposite, meaning that it was the weak external performance (derived from the unfavorable conditions at which southern countries joined the Eurozone) what produced the imbalances that ended up emerging as large budget deficits. Thus, if these imbalances are to be reduced, instead of tackling the symptom, the real source of the crisis must be solved. In this regard, many alternatives have been being put forward since the beginning of the crisis. A wider role of the ECB, the convergence towards a banking union and a higher degree of fiscal integration are among the mostly discussed proposals. In our view, these proposals, apart from being unlikely from a political point of view, would not solve the real problem, i.e., the structural differences that make impossible for southern countries to compete against Germany at the same nominal exchange rate parity. Hence, an adjustment of exchange rates within the Eurozone may imply an immediate positive competitiveness shock that may help some of the troubled countries to deal with the crisis and, in the medium run, stay in the Eurozone in a sustainable way.

This is the idea of what may be called a Multi-Speed Europe, i.e., a Eurozone with two euros: a southern euro and a northern euro, each with a value that is consistent with both the internal and external equilibrium of the corresponding sub-regions. In the next section we present four-country stock-flow consistent model that will allow us to examine the potential impact of the alternative ways-out of the crisis that have been being put forward. This model describes the Eurozone as it works today. Based on this description of reality, in section 3 we explain in detail how each of these proposals would work and how the model can be modified to simulate each scenario. In section 4 we run some simulation experiments aimed at assessing the macroeconomic viability of these potential solutions. Finally, in section 5 we present our main conclusions.
### Table 1: Balance Sheet

<table>
<thead>
<tr>
<th>Spain</th>
<th>Households</th>
<th>Firms</th>
<th>Commercial Banks</th>
<th>Government</th>
<th>Central Bank</th>
<th>ECB</th>
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<td>$+A_t^{SP}$</td>
<td>$-R_t^{SP}$</td>
<td>$+R_t^{SP}$</td>
<td>$-H_s, cb_t^{SP}$</td>
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<td>$-B_s^{SP}$</td>
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<td>$+Bd, cb_t^{SP}$</td>
<td>$+Bd, cb_t^{SP}$</td>
<td>$+Bd, cb_t^{SP}$</td>
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<td>$+V_f_t^{SP}$</td>
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<td>$-B_s^{SP}$</td>
<td>$+V cb_t^{SP}$</td>
<td>$+V^{ECB}$</td>
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## 2 The Baseline Model

This study is purely theoretical and makes use of the stock-flow consistent models developed by Godley & Lavoie (2006). Basically, we build a four-country model where we identify the following country blocks: the US, Germany, Spain and the rest of the world. Whereas Spain represents the Eurozone’s periphery, i.e., the countries that have been accumulating persistent current account and budget deficits since the introduction of the euro, Germany represents the surplus countries of the Eurozone. The structure of the model is quite standard since our aim is to try out different closures to see which alternative (if any) of a multi-speed Europe is viable.

Some previous studies upon which this model is based are those of Godley and Lavoie (2007), who deal with three countries, two of them sharing a common currency and a single central bank, and Duwicquet et al (2012), who aim at developing a more sophisticated financial structure within a two-country model representing the Eurozone. Other attempts to describe the adjustment process in a monetary union can be found in Duwicquet and Mazier (2010). Finally, we take Daigle and Lavoie (2009) approach to exchange rate expectations.

To give the reader a general idea of the financial assets that enter the model we present the balance sheet of Spain, which also includes the ECB. In the next pages, the whole social accounting matrix and flow of funds (which includes all the real and financial transactions that take place between the four countries of the model) are presented. Finally, the reader will find the description of each of the equations of the model.
Table 1: Matrix of Flows
United States

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<th>Households</th>
<th>Firms</th>
<th>Com. Banks</th>
<th>Government</th>
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<td>Current</td>
<td>Capital</td>
<td>Current</td>
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<td>$I^US_t$</td>
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<td>$-Th^US_t$</td>
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<tr>
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### Table 1: Matrix of Flows

Spain

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<th>Central Bank</th>
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<td>Capital</td>
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<td>Int. Bonds $^{GE}$</td>
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<td>$\Delta Md_{t}^{SP}$</td>
<td></td>
<td></td>
<td>$H_{t}, b_{t}^{SP}$</td>
</tr>
<tr>
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<td>$-\Delta Md_{t}^{SP}$</td>
<td></td>
<td>$\Delta L_{t}^{SP}$</td>
<td>$\Delta Md_{t}^{SP}$</td>
<td></td>
</tr>
<tr>
<td>ΔReserves</td>
<td></td>
<td></td>
<td>$\Delta R_{t}^{SP}$</td>
<td>$\Delta Md_{t}^{SP}$</td>
<td></td>
</tr>
<tr>
<td>ΔAdvances</td>
<td>$\Delta A_{t}^{SP}$</td>
<td></td>
<td></td>
<td>$\Delta A_{t}^{SP}$</td>
<td></td>
</tr>
<tr>
<td>ΔBonds $^{US}$</td>
<td>$-\Delta Bd, b_{t}^{US}$</td>
<td></td>
<td></td>
<td>$\Delta A_{t}^{SP}$</td>
<td></td>
</tr>
<tr>
<td>ΔBonds $^{RW}$</td>
<td>$-\Delta Bd, b_{t}^{RW}$</td>
<td></td>
<td></td>
<td>$\Delta A_{t}^{SP}$</td>
<td></td>
</tr>
<tr>
<td>ΔBonds $^{SP}$</td>
<td>$-\Delta Bd, b_{t}^{SP}$</td>
<td></td>
<td>$\Delta Bs_{t}^{SP}$</td>
<td>$\Delta A_{t}^{SP}$</td>
<td>$\Delta A_{t}^{SP}$</td>
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<tr>
<td>ΔBonds $^{GE}$</td>
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<td></td>
<td>$\Delta A_{t}^{SP}$</td>
<td>$\Delta A_{t}^{SP}$</td>
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<td>Com.Banks</td>
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<td>Central Bank</td>
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<td>$I_t^{t-1}$</td>
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<td>I</td>
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<td></td>
<td></td>
<td>$-W_t^{t-1}$</td>
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<td>$-rd_{t-1}^{t-1} M_{t-1}$</td>
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<tr>
<td>rs.R</td>
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<td></td>
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<td>$-rs_{t-1}^{t-1} R_{t-1}$</td>
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<td>r.A</td>
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<td></td>
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<tr>
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<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
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<tr>
<td>rb\textsuperscript{RW}, b\textsuperscript{SP}</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
</tr>
<tr>
<td>rb\textsuperscript{GE}, b\textsuperscript{GE}</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
<td>$rb_{t-1}^{t-1} Bd, b_{t-1}^{t-1}$</td>
</tr>
<tr>
<td>Div</td>
<td>$-P_{t-1}^{t-1} F_{t-1}$</td>
<td>$P_{t-1}^{t-1} F_{t-1}$</td>
<td>$-P_{t-1}^{t-1} F_{t-1}$</td>
<td>+$Z$</td>
<td>$-P_{t-1}^{t-1} F_{t-1}$</td>
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</tbody>
</table>

\[ Z = P_d^{t-1} + (1 - \alpha)P_{ECB} + P_{t-1}^{t-1} \]
Since the bilateral exchange rates will be used right from the beginning of the model it is worth starting by defining the six bilateral exchange rates that are considered.

\[
1\$ = E1.GE = E2.SP = E4# = E9.€
\]

\[
1GE = E3.SP = E6#
\]

\[
1# = E5.SP
\]

Let us take E1 as an example. This variable should be interpreted as the German euro/dollar exchange rate. Thus, if E1 goes up (down), this means that the German euro depreciates (appreciates) against the dollar. The five remaining exchange rates have an identical interpretation. Now we are able to proceed to the system of equations that conform the model that, as in every stock-flow consistent model, is constituted by both accounting identities and behavioural equations.

### 2.1 Good’s Market Equilibrium and International Trade

Equilibrium in the good’s market is given by the identity that states that aggregate supply or total production, \(Y_t\), is equal to aggregate demand, which in turn is given by the sum of household’s consumption, \(C_t\), firm’s investment, \(I_t\), government spending, \(G_t\), and net exports (i.e., the difference between exports, \(X_t\), and imports, \(IM_t\)). Thus, our model is one in which economic growth is demand-led.

\[
Y_t = C_t + I_t + G_t + X_t - IM_t \quad \forall i = US, RW, SP, GE \tag{1-4}
\]

All the components of aggregate demand, except for government spending (which is given by the following equations) are considered endogenous and will be defined shortly. Unlike the previous versions of the model, in which we incorporated that rule stating that member countries cannot run deficits larger that 3% of GDP, we now assume that the division of the Eurozone in two sub-regions allows each of them to manage their fiscal policy with more freedom. Thus, government spending can be considered fully exogenous (although a more detailed description of this component of aggregate demand should account for automatic stabilizers).

\[
G_t = Go_t + (1 + g^i).G_{t-1} \quad \forall i = US, RW, SP, GE \tag{5-8}
\]

Hence, government spending in each period, \(G_t\), is given by a constant term, \(Go_t\),
plus an exogenous rate of growth, \( g \). The constant term is initially set equal to zero, but its presence will be useful later on when we introduce an exogenous shock on aggregate demand through government spending.

We now turn to the equations that describe international trade transactions. Since the four economies that we are considering embody the whole world economy, the sum of total exports (i.e., \( \sum X^i = US, RW, SP, GE \)) has to be equal to total imports (i.e., \( \sum IM^i = US, RW, SP, GE \)). Otherwise, there would be leaks and the model would turn out to be inconsistent. Thus, we can define only the equations corresponding to one of the two trade flows (either exports or imports) and, since one is the mirror of the other, we can obtain the value for the other flow implicitly. The equations describing international trade flows (9 - 20) are the ones usually used in the literature, which account for both income and price effects (the latter being both direct and indirect).

\[
\begin{align*}
\log(IM^{GE}_{US}) &= \mu^0_{US} + \mu^1_{US} \log(Y^US_t) + \mu^2_{US} \log(E1_t) + \mu^3_{US} \log\left(\frac{1}{E4t} \cdot \frac{1}{E2t}\right) \quad (9) \\
\log(IM^{SP}_{US}) &= \mu^0_{US} + \mu^1_{US} \log(Y^US_t) + \mu^2_{US} \log(E2_t) + \mu^3_{US} \log\left(\frac{1}{E1_t} \cdot \frac{1}{E4t}\right) \quad (10) \\
\log(IM^{RW}_{US}) &= \mu^0_{US} + \mu^1_{US} \log(Y^US_t) + \mu^2_{US} \log(E4_t) + \mu^3_{US} \log\left(\frac{1}{E1_t} \cdot \frac{1}{E2t}\right) \quad (11) \\
\log(IM^{US}_{GE}) &= \mu^0_{GE} + \mu^1_{GE} \log(Y^GE_t) + \mu^2_{GE} \log\left(\frac{1}{E1_t}\right) + \mu^3_{GE} \log\left(\frac{1}{E3t} \cdot \frac{1}{E6t}\right) \quad (12) \\
\log(IM^{SP}_{GE}) &= \mu^0_{GE} + \mu^1_{GE} \log(Y^GE_t) + \mu^2_{GE} \log(E3_t) + \mu^3_{GE} \log\left(\frac{1}{E1_t} \cdot \frac{1}{E6t}\right) \quad (13) \\
\log(IM^{RW}_{GE}) &= \mu^0_{GE} + \mu^1_{GE} \log(Y^GE_t) + \mu^2_{GE} \log(E6_t) + \mu^3_{GE} \log\left(\frac{1}{E3t} \cdot \frac{1}{E1t}\right) \quad (14) \\
\log(IM^{US}_{SP}) &= \mu^0_{SP} + \mu^1_{SP} \log(Y^SP_t) + \mu^2_{SP} \log(E2_t) + \mu^3_{SP} \log(E3_t, E5t) \quad (15) \\
\log(IM^{GE}_{SP}) &= \mu^0_{SP} + \mu^1_{SP} \log(Y^SP_t) + \mu^2_{SP} \log(E3_t) + \mu^3_{SP} \log(E2_t, E5t) \quad (16) \\
\log(IM^{RW}_{SP}) &= \mu^0_{SP} + \mu^1_{SP} \log(Y^SP_t) + \mu^2_{SP} \log(E5t) + \mu^3_{SP} \log(E2_t, E3t) \quad (17) \\
\log(IM^{US}_{RW}) &= \mu^0_{RW} + \mu^1_{RW} \log(Y^RW_t) + \mu^2_{RW} \log(E4_t) + \mu^3_{RW} \log\left(\frac{1}{E3t} \cdot \frac{1}{E6t}\right) \quad (18) \\
\log(IM^{SP}_{RW}) &= \mu^0_{RW} + \mu^1_{RW} \log(Y^RW_t) + \mu^2_{RW} \log\left(\frac{1}{E5t}\right) + \mu^3_{RW} \log(E4_t, E6t) \quad (19) \\
\log(IM^{GE}_{RW}) &= \mu^0_{RW} + \mu^1_{RW} \log(Y^RW_t) + \mu^2_{RW} \log(E6t) + \mu^3_{RW} \log(E4t, \frac{1}{E5t}) \quad (20)
\end{align*}
\]

Total imports can then be obtained by adding up bilateral import flows.

\[
IM^i_t = \sum IM^i_{-i_t} \quad \forall i = US, RW, GE, SP \quad (21-24)
\]
As it was mentioned before, a trade flow is the mirror of the other. Thus, \( IM_{US}^{RW} \) has to be equal to \( X_{RW}^{US} \). Since it is required that every trade flow is written in the domestic currency of the corresponding country, the following conversion is applied.

\[
\begin{align*}
X_{US}^{GE} &= IM_{US}^{GE} \cdot (1/E_{1t}) \\
X_{US}^{RW} &= IM_{US}^{RW} \cdot (1/E_{4t}) \\
X_{US}^{SP} &= IM_{US}^{SP} \cdot (1/E_{2t}) \\
X_{US}^{GE} &= IM_{US}^{GE} \cdot E_{1t} \\
X_{GE}^{GE} &= IM_{GE}^{GE} \cdot (1/E_{3t}) \\
X_{GE}^{RW} &= IM_{GE}^{RW} \cdot (1/E_{6t}) \\
X_{GE}^{SP} &= IM_{GE}^{SP} \cdot E_{2t} \\
X_{GE}^{GE} &= IM_{GE}^{GE} \cdot E_{3t} \\
X_{SP}^{SP} &= IM_{SP}^{SP} \cdot E_{5t} \\
X_{SP}^{GE} &= IM_{SP}^{SP} \cdot E_{6t} \\
X_{SP}^{SP} &= IM_{SP}^{SP} \cdot (1/E_{5t}) \\
\end{align*}
\]

Finally, we did with imports, we can obtain aggregate exports by adding up bilateral exports flows.

\[
X_t^i = \sum X_{ii}^{-i} \quad \forall i = US, RW, GE, SP
\]

### 2.2 Household’s Income and Consumption

According to national accounting, total income, \( Y_t \) is distributed between firms and households in return for their participation in the production process. Households supply their labour and in exchange receive a wage, \( W_t \) - firms contribute to the production process with their capital goods, and they earn a profit, \( P_t \). Normally, the proportion of national income that is taken by each sector is endogenous and depends not only on exogenous
variables such as the wage level or the profit rate, but also on inflation. Nevertheless, 
given that in this model prices are fixed, income distribution is assumed to be exogenous 
and given by the parameter $\psi$, which represents the share of wages out of total income.

$$W_t^i = \psi^i Y_t^i \quad \forall i = US, RW, GE, SP$$ (41-44)

Although labour income may constitute the main source of income that finances house-
hold’s consumption, there are other processes that need to be taken into account. On the 
one hand, households may earn income out of other activities. In this model, households 
are assumed to hold two types of assets: bank deposits, $Md_t$, which earn a yield, $rd_t$, and 
cash, $Hd_t$, which earns no yield. Regarding tax payments, in this model, it is assumed 
that a fraction $\theta_h$ of total income is levied, leading to the total amount of taxes that 
households pay, $Th_t$.

$$Th_t^US = \theta_h^US (W_t^US + rd_t^US . Md_t^US) \quad \forall i = US, RW, GE, SP$$ (45-48)

It is the after-tax income what households use to finance consumption, though not 
entirely (unless the savings rate is null). Thus, disposable income can be written as 
follows:

$$YD_t^i = W_t^i + rd_{t-1} . Md_{t-1} - Th_t^i \quad \forall i = US, RW, GE, SP$$ (49-52)

The consumption function that is used in this model is a Modigliani type function 
that incorporates the propensity to consume and additional term to account for wealth 
effects. It is worth mentioning that the propensity to consume on disposable income is 
much bigger than that on past accumulated wealth $\alpha 1 > \alpha 2$.

$$C_t^i = \alpha 1 . YD_t^i + \alpha 2 . VH_{t-1}^i \quad \forall i = US, RW, GE, SP$$ (53-56)

The part of disposable income that is not used to finance consumption is saved. Hence, 
the change in household’s wealth is given by the flow of savings, which in turn is given by 
the difference between disposable income and consumption.
\[ \Delta Vh_i^t = YD_i^t - C_i^t \] \hspace{1cm} \forall i = US, RW, GE, SP \] (57-60)

Households can hold their wealth in two kinds of assets: bank deposits and cash, which were previously defined as \( Md_i \) and \( Hd_i \). We assume that households keep a constant share of their wealth, \( \varphi \), under the form of cash in order to finance daily consumption expenditures. The rest of their wealth is held as deposits at the commercial banks.

\[ Hd_i^t = \varphi_i . Vh_i^t \] \hspace{1cm} \forall i = US, RW, GE, SP \] (61-64)

\[ Md_i^t = Vh_i^t - Hd_i^t \] \hspace{1cm} \forall i = US, RW, GE, SP \] (65-68)

### 2.3 Firm’s Investment and Credit Demand

As it was mentioned before, income distribution is considered exogenous. Since total income is divided into wage and profits, the latter can be defined as a residual:

\[ P_i^t = Y_i^t - W_i^t \] \hspace{1cm} \forall i = US, RW, GE, SP \] (69-72)

However, \( P_i \) are nothing but gross profits. Firms also have to pay interests on the loans taken in the past. Thus, net profits, \( Pf_i \), result from the difference between gross profits and the sum of interest payments and taxes.

\[ Pf_i^t = P_i^t - rl_{i-1}^t . L_{i-1}^t - Tf_i^t \] \hspace{1cm} \forall i = US, RW, GE, SP \] (73-76)

\[ Tf_i^t = \theta_i^f . (P_i^t - rl_{i-1}^t . L_{i-1}^t) \] \hspace{1cm} \forall i = US, RW, GE, SP \] (77-80)

The investment decision of the firms will be assumed to take the form of a Kaleckian-type formula, which accounts for crucial features that determine the accumulation of the capital stock. Hence, the profit rate (given by the ratio of gross profits to the stock of capital), the structure of the debt of the firms (given by the loans that they demanded to finance past investment) and the utilization rate, \( u_i \), are incorporated into the model.
Each term of this function is accompanied by a constant, $z$, which measures the sensibility of investment to each of its components.

$$\frac{I_i^t}{K_{i-1}^t} = z_0^i + z_1^i . \frac{Pf_i^t}{K_{i-1}^t} - z_2^i . \frac{r_{i-1}^t . L_{i-1}^t}{K_{i-1}^t} + z_3^i . u_{i-1}^t \quad \forall i = US, RW, GE, SP \quad (81-84)$$

The utilization function, which represents the proportion of the total physical capital available in the economy that is used in the production process, is written as follows:

$$u_i^t = \frac{Y_i^t}{K_i^t} \quad \forall i = US, RW, GE, SP \quad (85-88)$$

Capital accumulation follows the traditional rule, given by the previously accumulated capital stock adjusted for its depreciation plus the current investment flow.

$$K_i^t = (1 - \delta_i) . K_{i-1}^t + I_i^t \quad \forall i = US, RW, GE, SP \quad (89-92)$$

Finally, firms finance their investment through net profits. If the latter are not sufficient to cover for the whole value of the current investment flow, firms obtain the lacking funds in the credit market, thereby acquiring a liability. In this model we assume that the totality of credit demand is fulfilled, i.e., there is no credit rationing.

$$\Delta L_i^t = I_i^t - Pf_i^t \quad \forall i = US, RW, GE, SP \quad (93-96)$$

Firm’s wealth is computed as the difference between their assets (given by the capital stock) and liabilities (given by the total loans that they have been granted in the past).

$$Vf_i^t = K_i^t - L_i^t \quad \forall i = US, RW, GE, SP \quad (97-100)$$
2.4 The Government

Many features of the behaviour of the government have already been introduced. Government spending, as defined by equations (5-8), was considered exogenous. Taxes on households and firms have been defined in equations (45-48) and (77-80), respectively. Finally, it is assumed that commercial banks transfer their profits, which are defined in the following subsection, to the government as taxes payments. Thus, total tax income by the government is given by the sum of taxes on households, firms and banks.

\[ T^i_t = Th^i_t + Tf^i_t + Pb^i_t \quad \forall i = US, RW, GE, SP \] (101-104)

The government is assumed to finance its consumption not only via tax collection, but also through the profits that the central bank transfers yearly, which are result of the interest payments that the monetary authority earns on its bond holdings as well as on any valuation effect that could occur as a result of exchange rate movements. Moreover, there is an additional expenditure that the government needs to finance each year: the interest payments on its debt. Should the value of public spending be higher than the sum of tax collection and central bank profits, the government finances the gap through bond issues. Hence, supply of government bonds can be defined as follows:

\[ \Delta Bs^i_t = G^i_t - T^i_t + r b^i_{t-1}.B s^i_{t-1} - P c b^i_t \quad \forall i = US, RW \] (105-106)
\[ \Delta Bs^{SP}_t = G_t^{SP} - T_t^{SP} + r b_t^{SP}.B s_t^{SP} - P c b_t^{SP} \] (107)
\[ \Delta Bs^{GE}_t = G_t^{GE} - T_t^{GE} + r b_t^{GE}.B s_t^{GE} - P c b_t^{GE} \] (108)

2.5 Commercial Banks

Thus far, commercial banks have been introduced implicitly and in a passive manner. It was shown that households could hold their wealth under different types of assets, both issued by commercial banks. Moreover, firms demanded loans in order to finance the part of their investment that could not be paid with current profits. However, the role that commercial banks were hitherto playing is passive since the supply of credit to firms and deposits to households is totally demand-led, i.e., banks supply as much credit and deposits as are demanded.

However, banks play an active role in the financial sphere in the economy, since they buy and sell securities. These capital movements play major roles determining both long-term interest rates and exchange rates. In this model, is is assumed that long-term
interest rates are constant since, on the one hand, the US and the rest of the world have the monetary tools to achieve this goal and, on the other hand, the Outright Monetary Transactions programme launched by the ECB in 2012 should ensure that interest rates are stable within the Euro area. The decision regarding how many bonds to buy from each government is a portfolio decision mainly driven by the return of each type of bond, given by the interest rate, plus the expectation on the movement of the exchange rate, which in turn will determine gains or losses due to valuation effects. These portfolio decision can thus be written using Tobin and Godley’s criteria, which are standard in the SFC literature. Regarding the introduction of expectations in the foreign exchange market, we follow the approach proposed by Daigle and Lavoie (2009).
\begin{align*}
\text{Bd, } b_{U_{S_i}}^{GE} &= (M_{t}^{US} - R_{t}^{US}).(\gamma_{10}^{US} + \gamma_{11}^{US}.r_{t}^{US} + \gamma_{12}^{US}.(r_{t}^{GE} + \Delta \frac{1}{E_{1US}})) \\
&+ \gamma_{13}^{US}.(r_{t}^{SP} + \Delta \frac{1}{E_{2US}}) + \gamma_{14}^{US}.(r_{t}^{RW} + \Delta \frac{1}{E_{4US}})) \\
\text{Bd, } b_{U_{S_i}}^{SP} &= (M_{t}^{US} - R_{t}^{US}).(\gamma_{20}^{US} + \gamma_{21}^{US}.r_{t}^{US} + \gamma_{22}^{US}.(r_{t}^{GE} + \Delta \frac{1}{E_{1US}})) \\
&+ \gamma_{23}^{US}.(r_{t}^{SP} + \Delta \frac{1}{E_{2US}}) + \gamma_{24}^{US}.(r_{t}^{RW} + \Delta \frac{1}{E_{4US}})) \\
\text{Bd, } b_{U_{S_i}}^{RW} &= (M_{t}^{US} - R_{t}^{US}).(\gamma_{30}^{US} + \gamma_{31}^{US}.r_{t}^{US} + \gamma_{32}^{US}.(r_{t}^{GE} + \Delta \frac{1}{E_{1US}})) \\
&+ \gamma_{33}^{US}.(r_{t}^{SP} + \Delta \frac{1}{E_{2US}}) + \gamma_{34}^{US}.(r_{t}^{RW} + \Delta \frac{1}{E_{4US}})) \\
\text{Bd, } b_{U_{S_i}}^{US} &= (M_{t}^{US} - R_{t}^{US}) - \text{Bd, } b_{U_{S_i}}^{GE} - \text{Bd, } b_{U_{S_i}}^{SP} - \text{Bd, } b_{U_{S_i}}^{RW}
\end{align*}

\begin{align*}
\text{Bd, } b_{G_{E_{t}}}^{GE} &= (M_{t}^{GE} - R_{t}^{GE}).(\gamma_{10}^{GE} + \gamma_{11}^{GE}.(r_{t}^{US} + \Delta E_{1e_{t}}) + \gamma_{12}^{GE}.r_{t}^{GE} \\
&+ \gamma_{13}^{GE}.(r_{t}^{SP} + \Delta \frac{1}{E_{2e_{t}}}) + \gamma_{14}^{GE}.(r_{t}^{RW} + \Delta \frac{1}{E_{4e_{t}}})) \\
\text{Bd, } b_{G_{E_{t}}}^{SP} &= (M_{t}^{GE} - R_{t}^{GE}).(\gamma_{20}^{GE} + \gamma_{21}^{GE}.(r_{t}^{US} + \Delta E_{1e_{t}}) + \gamma_{22}^{GE}.r_{t}^{GE} \\
&+ \gamma_{23}^{GE}.(r_{t}^{SP} + \Delta \frac{1}{E_{2e_{t}}}) + \gamma_{24}^{GE}.(r_{t}^{RW} + \Delta \frac{1}{E_{4e_{t}}})) \\
\text{Bd, } b_{G_{E_{t}}}^{RW} &= (M_{t}^{GE} - R_{t}^{GE}).(\gamma_{30}^{GE} + \gamma_{31}^{GE}.(r_{t}^{US} + \Delta E_{1e_{t}}) + \gamma_{32}^{GE}.r_{t}^{GE} \\
&+ \gamma_{33}^{GE}.(r_{t}^{SP} + \Delta \frac{1}{E_{2e_{t}}}) + \gamma_{34}^{GE}.(r_{t}^{RW} + \Delta \frac{1}{E_{4e_{t}}})) \\
\text{Bd, } b_{G_{E_{t}}}^{US} &= (M_{t}^{GE} - R_{t}^{GE}) - \text{Bd, } b_{G_{E_{t}}}^{GE} - \text{Bd, } b_{G_{E_{t}}}^{SP} - \text{Bd, } b_{G_{E_{t}}}^{RW}
\end{align*}

\begin{align*}
\text{Bd, } b_{S_{P_{t}}}^{US} &= (M_{t}^{SP} - R_{t}^{SP}).(\gamma_{10}^{SP} + \gamma_{11}^{SP}.(r_{t}^{US} + \Delta E_{2e_{t}}) + \gamma_{12}^{SP}.(r_{t}^{GE} \\
&+ \Delta E_{3e_{t}}) + \gamma_{13}^{SP}.r_{t}^{SP} + \gamma_{14}^{SP}.(r_{t}^{RW} + \Delta E_{5e_{t}})) \\
\text{Bd, } b_{S_{P_{t}}}^{SP} &= (M_{t}^{SP} - R_{t}^{SP}).(\gamma_{20}^{SP} + \gamma_{21}^{SP}.(r_{t}^{US} + \Delta E_{2e_{t}}) + \gamma_{22}^{SP}.(r_{t}^{GE} \\
&+ \Delta E_{3e_{t}}) + \gamma_{23}^{SP}.r_{t}^{SP} + \gamma_{24}^{SP}.(r_{t}^{RW} + \Delta E_{5e_{t}})) \\
\text{Bd, } b_{S_{P_{t}}}^{RW} &= (M_{t}^{SP} - R_{t}^{SP}).(\gamma_{30}^{SP} + \gamma_{31}^{SP}.(r_{t}^{US} + \Delta E_{2e_{t}}) + \gamma_{32}^{SP}.(r_{t}^{GE} \\
&+ \Delta E_{3e_{t}}) + \gamma_{33}^{SP}.r_{t}^{SP} + \gamma_{34}^{SP}.(r_{t}^{RW} + \Delta E_{5e_{t}})) \\
\text{Bd, } b_{S_{P_{t}}}^{SP} &= (M_{t}^{SP} - R_{t}^{SP}) - \text{Bd, } b_{S_{P_{t}}}^{US} - \text{Bd, } b_{S_{P_{t}}}^{GE} - \text{Bd, } b_{S_{P_{t}}}^{RW}
\end{align*}
In order to facilitate the understanding of the notation used above, let us take equation (109) as an example. This equation states that the demand of US’ commercial banks of bonds denominated in euros issued by Germany $Bd_{RW}^{GE}$ is financed by funds which are available at the commercial banks, i.e., household’s deposits less the reserves that banks are forced to keep at the central bank, $R_t$. The parameters $\gamma$ represent the sensibility of the demand of each type of bond to changes on the relative returns that these assets yield. These parameters are written in such a way that they fulfill Tobin-Godley criteria.

Let us now describe how exchange rate expectations are formed. Following the contributions of behavioral finance applied to the exchange rate determination proposed by De Grauwe and Grimaldi (2006), Harvey (1991), Harvey (2009) and Daigle and Lavoie (2009), we assume that there are two types of speculators interacting in the foreign exchange market. On the one hand, fundamentalists consider that there is one "fundamental" exchange rate towards which the spot exchange rate should tend. This "fundamental" exchange rate may be given by a set of variables that analysts consider relevant (for instance, the rate of inflation, the current account balance, etc.). On the other hand, chartists believe that the exchange rate follows a random walk. Thus, each movement of the spot exchange rate will determine the future path. This kind of expectation formation, which is strongly related to bandwagon effects, tends to generate bubbles in financial markets. In sum, the market’s expectation of the future spot exchange rate is a weighted average of the expectation of fundamentalists and chartist. As it was shown by Daigle and Lavoie (2009) in order to get stable results it is required that the proportion of fundamentalists is larger than the one of chartists.

Equations (125 - 126) describe the process of expectation formation of US’ fundamentalists and chartists speculators, respectively. Equation (127) describes the market’s expectation of the german currency/dollar exchange rate, which is in turn the variable that was introduced in the portfolio equations. These expectations concern only the german currency/dollar exchange rate. Additional equations need to be written for expectations that other countries’ speculators make on the remaining relevant bilateral exchange rates.
\[ \Delta E_{1_{e_t}}^{F,US} = -\omega.(E_{1_{t-1}} - E_{1}^{*}) \]  
(125)

\[ \Delta E_{1_{e_t}}^{C,US} = \beta \Delta E_{1_{t-1}} \]  
(126)

\[ \Delta E_{1_{e_t}}^{US} = \tau \Delta E_{1_{e_t}}^{F,US} + (1 - \tau) \Delta E_{1_{e_t}}^{C,US} \]  
(127)

\[ \Delta E_{2_{e_t}}^{F,US} = -\omega.(E_{2_{t-1}} - E_{2}^{*}) \]  
(128)

\[ \Delta E_{2_{e_t}}^{C,US} = \beta \Delta E_{2_{t-1}} \]  
(129)

\[ \Delta E_{2_{e_t}}^{US} = \tau \Delta E_{2_{e_t}}^{F,US} + (1 - \tau) \Delta E_{2_{e_t}}^{C,US} \]  
(130)

\[ \Delta E_{4_{e_t}}^{F,US} = -\omega.(E_{4_{t-1}} - E_{4}^{*}) \]  
(131)

\[ \Delta E_{4_{e_t}}^{C,US} = \beta \Delta E_{4_{t-1}} \]  
(132)

\[ \Delta E_{4_{e_t}}^{US} = \tau \Delta E_{4_{e_t}}^{F,US} + (1 - \tau) \Delta E_{4_{e_t}}^{C,US} \]  
(133)

\[ \Delta E_{1_{e_t}}^{F,GE} = -\omega.(E_{1_{t-1}} - E_{1}^{*}) \]  
(134)

\[ \Delta E_{1_{e_t}}^{C,GE} = \beta \Delta E_{1_{t-1}} \]  
(135)

\[ \Delta E_{1_{e_t}}^{GE} = \tau \Delta E_{1_{e_t}}^{F,GE} + (1 - \tau) \Delta E_{1_{e_t}}^{C,GE} \]  
(136)

\[ \Delta E_{3_{e_t}}^{F,GE} = -\omega.(E_{3_{t-1}} - E_{3}^{*}) \]  
(137)

\[ \Delta E_{3_{e_t}}^{C,GE} = \beta \Delta E_{3_{t-1}} \]  
(138)

\[ \Delta E_{3_{e_t}}^{GE} = \tau \Delta E_{3_{e_t}}^{F,GE} + (1 - \tau) \Delta E_{3_{e_t}}^{C,GE} \]  
(139)

\[ \Delta E_{6_{e_t}}^{F,GE} = -\omega.(E_{6_{t-1}} - E_{6}^{*}) \]  
(140)

\[ \Delta E_{6_{e_t}}^{C,GE} = \beta \Delta E_{6_{t-1}} \]  
(141)

\[ \Delta E_{6_{e_t}}^{GE} = \tau \Delta E_{6_{e_t}}^{F,GE} + (1 - \tau) \Delta E_{6_{e_t}}^{C,GE} \]  
(142)

\[ \Delta E_{2_{e_t}}^{F,SP} = -\omega.(E_{2_{t-1}} - E_{2}^{*}) \]  
(143)

\[ \Delta E_{2_{e_t}}^{C,SP} = \beta \Delta E_{2_{t-1}} \]  
(144)

\[ \Delta E_{2_{e_t}}^{SP} = \tau \Delta E_{2_{e_t}}^{F,SP} + (1 - \tau) \Delta E_{2_{e_t}}^{C,SP} \]  
(145)
\[ \Delta E^{5,SP}_{e_t} = -\omega (E^{5}_{t-1} - E^{5*}) \]  

(146)

\[ \Delta E^{C,SP}_{e_t} = \beta \Delta E^{5}_{t-1} \]  

(147)

\[ \Delta E^{SP}_{e_t} = \tau \Delta E^{5,SP}_{e_t} + (1 - \tau) \Delta E^{C,SP}_{e_t} \]  

(148)

\[ \Delta E^{3,SP}_{e_t} = -\omega (E^{3}_{t-1} - E^{3*}) \]  

(149)

\[ \Delta E^{C,SP}_{e_t} = \beta \Delta E^{3}_{t-1} \]  

(150)

\[ \Delta E^{3,SP}_{e_t} = \tau \Delta E^{3,SP}_{e_t} + (1 - \tau) \Delta E^{C,SP}_{e_t} \]  

(151)

\[ \Delta E^{4,FW}_{e_t} = -\omega (E^{4}_{t-1} - E^{4*}) \]  

(152)

\[ \Delta E^{C,FW}_{e_t} = \beta \Delta E^{4}_{t-1} \]  

(153)

\[ \Delta E^{4,FW}_{e_t} = \tau \Delta E^{4,FW}_{e_t} + (1 - \tau) \Delta E^{C,FW}_{e_t} \]  

(154)

\[ \Delta E^{5,FW}_{e_t} = -\omega (E^{5}_{t-1} - E^{5*}) \]  

(155)

\[ \Delta E^{C,FW}_{e_t} = \beta \Delta E^{5}_{t-1} \]  

(156)

\[ \Delta E^{5,FW}_{e_t} = \tau \Delta E^{5,FW}_{e_t} + (1 - \tau) \Delta E^{C,FW}_{e_t} \]  

(157)

\[ \Delta E^{6,FW}_{e_t} = -\omega (E^{6}_{t-1} - E^{6*}) \]  

(158)

\[ \Delta E^{C,FW}_{e_t} = \beta \Delta E^{6}_{t-1} \]  

(159)

\[ \Delta E^{6,FW}_{e_t} = \tau \Delta E^{6,FW}_{e_t} + (1 - \tau) \Delta E^{C,FW}_{e_t} \]  

(160)

As it happened before with international trade of goods (exports and imports) it is necessary to define the supply side of the international trade of bonds. Based on bilateral demands, supply can be obtained by transforming the former through the bilateral exchange rate.

\[ Bs, b^{US}_{GE_t} = Bd, b^{US}_{GE_t} / E_{1t} \]  

(161)

\[ Bs, b^{US}_{SP_t} = Bd, b^{US}_{SP_t} / E_{2t} \]  

(162)

\[ Bs, b^{US}_{RW_t} = Bd, b^{US}_{RW_t} / E_{4t} \]  

(163)

\[ Bs, b^{US}_{Si_t} = Bd, b^{US}_{Si_t} \]  

(164)
As it was mentioned before, in many countries commercial banks are obliged to hold a certain proportion of the deposits that households make under the form of reserves at the central bank. This model incorporates this phenomenon by stating that commercial banks’ demand for reserves are given by a proportion $\rho$ of household’s deposits. These reserves constitute an asset in the balance sheet of commercial banks and a liability on the balance sheet of the central bank. It is worth mentioning that in reality banks may hold a stock of reserves that exceed the legal one. In this case, we neglect the existence of surplus reserves.

\begin{align*}
Bs, b_{US_t}^{GE} &= Bd, b_{US_t}^{GE} * E1_t & (165) \\
Bs, b_{SP_t}^{GE} &= Bd, b_{SP_t}^{GE} / E3_t & (166) \\
Bs, b_{RW_t}^{GE} &= Bd, b_{RW_t}^{GE} / E6_t & (167) \\
Bs, b_{GE_t}^{GE} &= Bd, b_{GE_t}^{GE} & (168) \\
Bs, b_{US_t}^{SP} &= Bd, b_{US_t}^{SP} * E2_t & (169) \\
Bs, b_{GE_t}^{SP} &= Bd, b_{GE_t}^{SP} * E3_t & (170) \\
Bs, b_{RW_t}^{SP} &= Bd, b_{RW_t}^{SP} * E5_t & (171) \\
Bs, b_{SP_t}^{SP} &= Bd, b_{SP_t}^{SP} & (172) \\
Bs, b_{US_t}^{RW} &= Bd, b_{US_t}^{RW} * E4_t & (173) \\
Bs, b_{GE_t}^{RW} &= Bd, b_{GE_t}^{RW} * E6_t & (174) \\
Bs, b_{SP_t}^{RW} &= Bd, b_{SP_t}^{RW} / E5_t & (175) \\
Bs, b_{RW_t}^{RW} &= Bd, b_{RW_t}^{RW} & (176) \\

R_t^{US} &= \rho_t^{US} M_t^{US} & \forall i = US, RW, GE, SP & (177-180)
\end{align*}

Having defined almost all the components of banks’ balance sheet (it only remains to describe how Advances from the central bank are determined, which will be a residual), we are ready to describe the origin of banks’ profits. These will be the result of two sources: interest earnings/payments and valuation effects due to exchange rate movements.
Under the form of taxes, their net worth is null. It is now possible to define Advances from the central bank as a residual which ensures
\[ \Delta V b_{t}^{US} = 0 \quad \forall i = US, RW, GE, SP \quad (185-188) \]

Taking into account that the totality of banks’ profits are transferred to the government under the form of taxes, their net worth is null.

\[ A_{t}^{i} = L_{t}^{i} + R_{t}^{i} + Bd, b_{t}^{i} + Bd, b_{t}^{i-1} - M_{t}^{i} - V b_{t}^{i} \quad \forall i = US, RW, GE, SP \quad (189-192) \]
2.6 Central Bank

Following the Post Keynesian approach to the monetary system, the central bank is considered to be a passive actor in the economy. This includes the notion of endogenous money, i.e., the central bank does not choose how much money to pump into the system but it supplies as much money as it is demanded by creditworthy firms. Regarding the short-term interest rate, it constitutes the policy tool that the central bank can use to achieve its objectives. In line with this theoretical approach to monetary policy, the following equations can be written.

\[
\begin{align*}
    r_i^t &= \bar{r}_i^t & \forall i = US, RW, GE, SP \\
    Hs_i^t &= Hd_i^t & \forall i = US, RW, GE, SP
\end{align*}
\]

(193-196)

(197-200)

Normally, a distinction should be made between the short-run and the long-run interest rate. Whereas the former is the policy tool of the central bank and can be set exogenously by the monetary authority, the latter is determined in the bond market as a result of bond’s supply and demand adjustments. However, if the country issues its own currency, the central bank could intervene in the bond market in order to achieve a certain target for the long-term rate of interest. In this model, it is assumed that all the long-term interest rates are kept constant (we will shortly explain how this is achieved in each particular case).

\[
\begin{align*}
    rb_t^{US} &= r_b^{US} & \forall i = US, RW, GE, SP
\end{align*}
\]

(201-204)

Traditional SFC models, as developed by Godley-Lavoie, describe the clearing of the bond market via exchange rate adjustments (when they are flexible, of course). Therefore, those countries that have a fixed exchange rate will require central bank interventions in the bond market in order to guarantee the clearing of the domestic market. Those cases where the exchange rate is flexible, central bank interventions will not be required since the exchange rate moves in any direction that is necessary such that the market is always cleared.

In this model the rest of the world has a fixed exchange rate vis-a-vis the US dollar, which means that the equilibrium in the bond market is reached through central bank interventions. Note that this mechanism is quite realistic since in a context of free capital movements and a fixed exchange rate, the domestic central bank should intervene if interest rates are kept at a certain predetermined target set by the monetary authority.
\[ E_{4t} = \bar{E}_4 \]  
\[ Bd, cb^{RW}_{RW_t} = Bs_t^{RW} - Bs, b^{RW}_{US_t} - Bs, b^{RW}_{SP_t} - Bs, b^{RW}_{GE_t} - Bs, b^{RW}_{RW_t} \]  
\[ \Delta Bd, cb^{US}_{RW_t} = \Delta H_t^{RW} + \Delta H_t^{RW} - \Delta A_t^{RW} - \Delta Bd, cb^{RW}_{RW_t} \]

Since, as equation (205) describes, the rest of the world has a fixed exchange rate against the US dollar the exchange rate \( E_4 \) becomes exogenous. As a result, it is the demand of US government bonds by the rest of the world’s central bank, \( Bd, cb^{US}_{RW_t} \), what becomes endogenous. This demand is written in such a way that the equilibrium in the balance sheet of the rest of the world’s central bank is fulfilled.

\[ D_t = Bs, b^{SP}_{SP_t} + Bs, b^{GE}_{GE_t} + Bs, b^{SP}_{SP_t} + Bs, b^{SP}_{GE_t} + Bs, b^{rw}_{RW_t} + Bs, b^{GE}_{GE_t} + Bs, cb^{SP}_{SP_t} + Bs, cb^{SP}_{ECB_t} + Bs, cb^{GE}_{ECB_t}, \]

The three remaining exchange rates are endogenously determined through the consistency condition.

\[ E_{3t} = E_{2t}/E_{1t} \]  
\[ E_{5t} = E_{2t}/E_{4t} \]  
\[ E_{6t} = E_{4t}/E_{1t} \]
Since Spain and Germany float their currency against the US dollar, equilibrium in the euro-bond market is reached through the movements of the euro/dollar exchange rate. Hence, the balance sheet of each national central bank is balanced through central bank purchases/sales of domestic bonds.

\[
\Delta Bs_{SP} = \Delta R_{SP} + \Delta Hs_{SP} - \Delta A_{SP} \tag{213}
\]

\[
\Delta Bs_{GE} = \Delta R_{GE} + \Delta Hs_{GE} - \Delta A_{GE} \tag{214}
\]

\[
Bd_{SP} = Bs_{SP} \tag{215}
\]

\[
Bd_{GE} = Bs_{GE} \tag{216}
\]

Regarding the dollar-denominated bond market, the reader should note that not only total supply has already been defined in the sub-section corresponding to the government, but also all the sources of demand have been defined both in the portfolio equations and in the stock of foreign reserves accumulated by the rest of the world. In order to ensure that this market is in equilibrium (otherwise, the price of bonds and the long-term interest rate would have to make the adjustment) the central bank of the US must intervene.

\[
Bd_{US} = Bs_{US} - Bs_{SP} - Bs_{GE} - Bs_{RW} - Bd_{US} - Bs_{SP} - Bs_{GE} - Bs_{RW} - Bs_{ECB} \tag{217}
\]

\[
Bs_{RW} = Bd_{RW} / E4 \tag{218}
\]

Given that the national central banks also hold assets and liabilities they also make profits. These profits must include the adjustment for valuation effects due to the variation of the exchange rate, interest rates earned on advances, interest payments paid on reserves, etc. As it was already mentioned, these profits are transferred each period to the government as an additional source of financing.
Finally, it is required to write the equation of the profits of the ECB, which transfers them to the governments of Spain and Germany. Therefore, its stock of wealth is constant over time. From the equation of profits of the ECB we can deduce what are the assets that conform its balance sheet. Since in the current setting the ECB is not actively intervening in the bond market, we assume that its stock of bonds is constant over time. These bonds could have been issued by the Treasuries of Spain, Germany and the US. The fact that all the components of the balance sheet of the ECB are constant over time implies that there is no need to write an equation describing the accounting equilibrium of the ECB over time.

\[ P_{t}^{ECB} = r_{t-1}^{US}.Bd_{ECB_{t-1}} + r_{t-1}^{SP}.Bd_{ECB_{t-1}} + r_{t-1}^{GE}.Bd_{ECB_{t-1}} + r_{t-1}^{US}.Bs_{ECB_{t-1}}.E1_{t} \]
\[ \Delta V^{ECB} = 0 \]
that the model is consistent.

\[ \Delta R_i^{US} + \Delta H_i^{US} - \Delta A_i^{US} - \Delta Bd, c_l^{US} = 0 \]  

(225)

3 A *Multi-Speed* Europe: Alternative Closures

In Section 2 we presented a general model that with small changes can be adapted to represent the different ways in which the monetary system of the Euro area could be reformed. In this section we describe each of the proposals and then specify how the closure would be in each of the cases.

3.1 A Eurozone with three Euros

The brief description of the causes of the crisis in the Eurozone that we described in section 2 induced us to think that one of the ways-out of the crisis could consist of a return to national exchange rates. This would not require that each country regained its monetary and exchange rate policy, but that the Eurozone could be split into two blocks, each of them gathering countries that are more similar. For instance, it seems more reasonable that Portugal shares a common exchange rate with Greece than with Germany or Finland. Thus, what we propose in this subsection is a scenario where there are two regional euros, each of them associated to a certain sub-region within the Eurozone (we call those sub-regions Spain and Germany). Moreover, there would also be a global euro aimed at keeping the role of the current euro as an international store of value.

The exchange rate of the global euro vis-à-vis the US dollar would be determined as usual, i.e., as a result of the interaction between supply and demand for euro-denominated bonds. We call the global euro/dollar exchange rate \( E9 \), in order to keep \( E1 \) and \( E2 \) as the exchange rates between Germany and Spain, vis-à-vis the US. Unlike the current setting, where Spain and Germany only issue bonds denominated in euros, in this case we assume that the issuances to foreign creditors are denominated in global euros (for
instance, $Bs, b_{SP}^{GE,EU}$ is the supply of German bonds in global euros to Spanish banks) whereas domestic banks purchase bonds domestic bonds denominated in national currency. Moreover, we keep the assumption that the ECB holds a certain pre-existing stock of German and Spanish bonds, which are denominated in global euros.

$$E_{9} = \frac{Bs_{SP}^{EU} + Bs_{GE}^{EU} - Bs, b_{SP}^{GE,EU} - Bs, b_{SP}^{GE,EU} - Bs, b_{SP}^{GE,EU} - Bs, b_{GE}^{GE,EU} - Bs_{ECB}^{GE,EU} - Bs_{ECB}^{SP,EU}}{Bd, b_{EU}^{SP,EU} + Bd, b_{EU}^{GE,EU}}$$

Since in this institutional framework each sub-region would regain its monetary sovereignty, the government debt could be denominated in national euros. As mentioned before, the only institutional agent that can purchase domestic bonds in local currency are the home banks. But it should be born in mind that those countries that do not issue reserve currencies (like the national euros would be) may find limits to get external financing by issuing bonds denominated in domestic currency. In those cases, the gap between the financing needs and the total demand for bonds denominated in domestic currency is filled with issues of bonds denominated in a reserve currency. In this case, should there be any gap, it would be filled with issues of bonds denominated in global euros. These supplies are the ones that enter the equation of $E9$. Since the total supply of bonds in each country is expressed in domestic currency (either Spanish or German euros), it is required to transform this stock of debt into global euros. To do so, we divide by the bilateral exchange rate of Spanish and German euros to global euros ($E7$ and $E8$, respectively).

$$Bs_{SP}^{EU} = \frac{Bs_{SP}^{SP} - Bs, b_{SP}^{SP}}{E_{1}^{7}}$$

$$Bs_{GE}^{EU} = \frac{Bs_{GE}^{GE} - Bs, b_{GE}^{GE}}{E_{8}}$$

The multi-speed feature of this model implies that Germany and Spain can have adjustable exchange rates according to their external performance vis-à-vis its regional trading partner. Thus, we define the Spanish/euro and German euro/euro exchange rate based on the sum of the intra-European current account ($CA$). We have chosen this

\(^{1}\)We write the current account of Spain to show how it is built.
variable as the criterion determining the intra-European exchange rate since it reflects the overall performance of the Spanish (German) external sector vis-à-vis the German (Spanish) counterpart. 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 (we base this criterion on the fact that in principle a country cannot accumulate persistent balance of payments deficit indefinitely). If a bad external performance yields a current account deficit for five consecutive periods, then the national currency is allowed to be adjusted. Once these intra-European have been defined, it is also possible to derive the exchange rates vis-à-vis the dollar.

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

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

\[
E1_t = E8_t.E9_t
\]

\[
E2_t = E7_t.E9_t
\]

\[
E3_t = E2_t/E1_t
\]

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. This 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. As it is normal in stock-flow consistent models with fixed exchange rates, the central bank intervention that keeps the exchange rate constant is such that its balance sheet is always in equilibrium.

\[
\text{CA}_{SP}^{t} = X_{SP}^{t} - IM_{SP}^{t} + r_{US}^{t-1}.B_{SP,EU}^{US,t-1}.E2_{t} + r_{t-1}.B_{SP,EU}^{GE,t-1}.E7_{t} + r_{t-1}.B_{SP,EU}^{RW,t-1}.E5_{t} - r_{t-1}^{SP} .(B_{SP,EU}^{US} + B_{SP,EU}^{GE,t-1} + B_{SP,EU}^{RW,t-1}).E7_{t}
\]
\[ \Delta Bs, cb_{SP_t}^{US} = \Delta R_t^{SP} + \Delta H_{s_d}^{SP} - \Delta A_t^{SP} - \Delta Bs, cb_{SP_t}^{SP} \]
\[ \Delta Bs, cb_{GE_t}^{US} = \Delta R_t^{GE} + \Delta H_{s_d}^{GE} - \Delta A_t^{GE} - \Delta Bs, cb_{GE_t}^{GE} \]
\[ \Delta Bd, cb_{SP_t}^{US} = \Delta Bs, cb_{SP_t}^{US} \cdot E2_t + Bs, cb_{SP_t-1}^{US} \cdot \Delta E2_t \]
\[ \Delta Bd, cb_{GE_t}^{US} = \Delta Bs, cb_{GE_t}^{US} \cdot E1_t + Bs, cb_{GE_t-1}^{US} \cdot \Delta E1_t \]

These equations ensure that the model is consistent. As regards the ECB, no changes are introduced with respect to the model described in the previous section since, as described above, we are not allowing of the interventions that it could eventually make. In the next section we will run some simulation experiments in order to assess the economic viability of this proposal.

### 3.2 Taking up the European Monetary System

In a similar line to the one proposed in the previous scenario, the ideas embedded in the European Monetary System (EMS) could be taken up in order to give the Eurozone a higher degree of stability. The proposal would consist of a split-up of the Eurozone into two sub-regions (as we did in the previous case) but instead of keeping a global euro that would be 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:

\[ \frac{1}{E9_t} = \frac{Y_t^{GE}}{Y_t^{GE} + Y_t^{SP}} \cdot \frac{1}{E1_t} + \frac{Y_t^{SP}}{Y_t^{GE} + Y_t^{SP}} \cdot \frac{1}{E2_t} \]

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 value of each country GDP that we use to weigh $E1$ and $E2$ must be expressed in ECU, in order to avoid the distortions.
that movements in the exchange rate may have on the real size of each economy. 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 are 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. We write
this process explicitly for Germany ($E_1$). As regards the exchange rates of the Spanish
currency against the US dollar ($E_2$) and the German currency ($E_3$), they can be deduced
from the other exchange rates.

$$E_{1t} = \begin{cases} 
E_{7t-1}, & \text{if } \frac{CAGF_{t-i}}{Y_{t-i}} \geq 0, \forall i = 1, 2, 3, 4, 5 \\
E_{7t-1} \cdot (1 + \pi), & \text{if } \frac{CAGF_{t-i}}{Y_{t-i}} < 0, \forall i = 1, 2, 3, 4, 5 
\end{cases}$$

$$E_{8t} = \begin{cases} 
E_{8t-1}, & \text{if } \frac{CASP_{t-i}}{Y_{t-i}} \geq 0, \forall i = 1, 2, 3, 4, 5 \\
E_{8t-1} \cdot (1 + \pi), & \text{if } \frac{CASP_{t-i}}{Y_{t-i}} < 0, \forall i = 1, 2, 3, 4, 5 
\end{cases}$$

$$E_{1t} = \frac{B_s^{GE} - B_s^{GE_t} - B_s^{SP} - B_s^{SP_t} - B_s^{RW}}{B_d^{GE_t} - B_d^{GE_t} - B_d^{GE_t} - B_d^{GE_t} - B_d^{GE_t}}$$

$$E_{2t} = E_{1t} \cdot E_{3t}$$

$$E_{3t} = E_{1t} / E_{8t}$$

The adjustment of $E_1$ ensures that the German bond markets is always cleared. It
is also important to note that this closure implies that the changes in $E_1$ and $E_2$ are
such that $E_3$ is constant. This must me the case, since this institutional arrangement of
the EMS that we are examining implies that intra-European parities are fixed. Hence,
if the movements of $E_1$ and $E_2$ were such that $E_3$ changed continuously, the definition
$E_3 = E_7/E_8$ would be violated. Since $E_2$ cannot adjust in such a way that the Spanish
bond market is in equilibrium (recall that $E_2$ is endogenously derived from other exchange
rates in such a way that all exchange rates are consistent with each other) it is the Spanish
central bank who, via its purchases/sales of domestic bonds, clears the domestic bond
market.
It is now necessary to explain how the balance sheet of the European national central banks are kept in equilibrium, taking into account that they are engaged in a fixed exchange rate arrangement with respect to the ECU. In practice, this does not differ to the case presented in the previous scenario. Thus, the balance sheets are closed identically and stock-flow consistency is ensured in the same way.

\[
\Delta B_d, cb_{SP_t}^{US} = \Delta B_d^{SP} - Bs, b_{SP_t}^{SP} - Bs, b_{US_t}^{SP} - Bs, b_{GE_t}^{SP} - Bs, b_{RW_t}^{SP}
\]

Finally, it is worth mentioning that since the exchange rates \(E_1\) and \(E_2\) are clearing the German and the Spanish bond market, domestic central banks no longer need to purchase domestic bonds. Hence, the stock of domestic bonds held by the monetary authority of each European country will be constant over time.

3.3 A Eurozone without Germany

One of the alternatives that has been put forward by George Soros (2012) and Frédéric 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 examination of these alternatives does not require many changes with respect to the set up that was presented in the previous scenarios. First, it is required to delete the notion of the global euro or the ECU, \(E_9\), and its associated exchange rates \(E_7\) and \(E_8\). Second, the German currency/dollar exchange rate, \(E_1\), which in the "three euros" case was defined implicitly using \(E_8\) and
$E9$ can now be defined explicitly as the ratio of the supply of German bonds to the US and the demand for German bonds by the US (as we did in the EMS scenario). Finally, what we called the Spanish currency/German currency exchange rate, $E3$, can be now be called euro/German currency exchange rate and could either be pegged or float freely. Let us first analyse the case where $E3$ is pegged to $E1$.

\[
E1_t = \frac{Bs_{SP}^G - Bs_{SP}^E - Bs_{SP}^{GE} - Bs_{SP}^{GE} - Bs_{ECB}^E - Bs_{RW}^E}{Bs_{US}^E - Bs_{SP}^E}
\]

\[
E3_t = \begin{cases} 
E7_{t-1}, & \text{if } \frac{CAGE_{SFt-i} + FASGE_{SFt-i}}{Y_{SP}^{SP}} < 0, \forall i = 1, 2, 3 \\
E7_{t-1}(1 + \pi), & \text{if } \frac{CAGE_{SFt-i} + FASGE_{SFt-i}}{Y_{SP}^{SP}} \geq 0, \forall i = 1, 2, 3
\end{cases}
\]

This new setting requires some small changes in the closure of the model. Basically, the German central bank will no longer purchase foreign assets since there is no exchange rate to be defended. Thus, its balance sheet will be closed through purchases/sales of domestic bonds. Since the exchange rate floats, the domestic bond market is cleared in the process of the determination of the exchange rate. As regards the central bank of Spain, there are no major changes since its exchange rate is still fixed. Thus, the monetary authority keeps on purchasing/selling US bonds in such a way that the exchange rate is fixed at every point of time.

\[
\Delta Bs_{SP}^{US} = \Delta R_{SP}^{SP} + \Delta Hs_{SP}^{SP} - \Delta A_{SP}^{SP} - \Delta Bs_{SP}^{SP}
\]

\[
\Delta Bs_{SP}^{GE} = \Delta R_{t}^{GE} + \Delta Hs_{t}^{GE} - \Delta A_{t}^{GE}
\]

\[
\Delta Bd_{SP}^{US} = \Delta Bs_{SP}^{US} E2_t + Bs_{SP}^{US} \Delta E2_t
\]

Another way in which this alternative institutional framework could be introduced is one in which instead of being fixed, the euro floats against both the German currency and the US dollar. This alternative should ensure that every external imbalances are automatically corrected via exchange rate adjustments and would free the central bank from the task of accumulating reserves in order to be able to sustain a certain parity. The
drawback of this scenario is that one of the main reasons why the euro was introduced (i.e.,
avoid the permanent fluctuations of intra-European exchange rates, with the associated
adverse effects on international trade) would no longer be holding. It is worth mentioning,
however, that 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
be being reaped.

Adapting the model to this possible alternative is quite simple. We just need to let
the euro/German currency exchange rate, $E_3$, 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.

To summarize the different proposals that we have been putting forward, we present
a table that 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 $B^S$, $B^G$ and $B^E$. The last two columns show
the change of which asset ensures the equilibrium in the balance sheet of the central banks
of Spain and Germany.

<table>
<thead>
<tr>
<th>Model</th>
<th>$B^S$</th>
<th>$B^G$</th>
<th>$B^E$</th>
<th>$B^U$</th>
<th>$B^R$</th>
<th>$CB^S$</th>
<th>$CB^G$</th>
<th>$CB^U$</th>
<th>$CB^R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Setting</td>
<td>$E_1 = E_2$</td>
<td>$E_1 = E_2$</td>
<td>-</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_U$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
</tr>
<tr>
<td>Multiple Euros</td>
<td>$Bd, cb^{\alpha}_S, E_2$</td>
<td>$Bd, cb^{\alpha}_G$</td>
<td>$E_0$</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_G$</td>
<td>$Bd, cb^{\alpha}_U$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
</tr>
<tr>
<td>EMS</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$E_1$</td>
<td>-</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_G$</td>
<td>$Bd, cb^{\alpha}_U$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
</tr>
<tr>
<td>Without Germany (fixed)</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$E_1$</td>
<td>-</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_G$</td>
<td>$Bd, cb^{\alpha}_U$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
</tr>
<tr>
<td>Without Germany (flexible)</td>
<td>$E_3$</td>
<td>$E_1$</td>
<td>-</td>
<td>$Bd, cb^{\alpha}_S$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_G$</td>
<td>$Bd, cb^{\alpha}_U$</td>
<td>$Bd, cb^{\alpha}_R$</td>
<td>$Bd, cb^{\alpha}_R$</td>
</tr>
</tbody>
</table>

4 Assessing the viability of a Multi-Speed Europe

Now that several alternatives in which a Multi-Speed Europe could work were presented,
it is time to examine their viability. In order to do so, we make use of the four country
stock-flow consistent model adapted to the institutional framework of the Eurozone with
the corresponding modifications associated to each specific proposal. 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 represents the introduction of the euro, in line with the evidence shown by
4.1 The current system

The adoption of the euro by Spain implied, as mentioned before, a loss of competitiveness due to the unfavorable parity at which it entered the Eurozone. This can be represented in our model through a sudden increase in the autonomous component of Spain’s imports equation and a decrease in the same component of German imports. This shock has a direct effect on the trade balance (as shown in figure 6). As observed during the years that preceded the crisis (and during the crisis itself), the lack of self-correcting mechanisms prevented the Spanish economy from reaching external equilibrium. As a result, persistent trade (and current account) deficits started to accumulate, which in turn implied an increase in the stock of debt (as shown in figure 7) - in some cases, like Greece, the debt was mostly public, whereas in other cases, like Spain, the debt was held by the private sector.

The impact on the exchange rate of the euro vis-à-vis the rest of the currencies is null (figures 8 and 9), since what is lost by Spain is gained by Germany, thereby leaving the overall current account of the Eurozone unaffected. Recall that under the current system, even though Spain and Germany are different countries from a political point of view, the fact that they share a same currency and central bank imply that from a macro-financial perspective they are part of the same entity, i.e., the Eurozone. Thus, the determination of the euro-dollar exchange rate is explained by both, factors that concern Spain and Germany. In the case of a small open economy that issues its own currency, following some years of current account deficits the exchange rate would depreciate. But the particular configuration of the Eurozone prevented this from happening, since the current account deficits of the South were compensated by the surpluses of the North. In fact, most of these imbalances were internal and were compensated by financial flows going from the North to the South.

The contractionary impact of the loss of competitiveness in Spain can be observed in figures 2 and 3, which plot Spain’s GDP in national currency and dollars, respectively. This distinction is not relevant under the present system since, as it was mentioned in
the previous paragraph, the euro remains constant. As a result of the deterioration of the trade balance Spain’s GDP drops by 1% and does not recover since there are no mechanisms that allow for a reversal of the recessionary impact of joining the Eurozone. This produces a negative effect on the level of employment and on investment, given the Kaleckian nature of the investment function specified in the model.

4.2 The three euros scenario

The first proposal that is worth analysing in one where national currencies are restored and made coexist with the euro. The advantage of this setting is that each country (or group of countries, which would be grouped according to their economic structure) 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 by newly designed institutions.

The negative impact of the competitiveness shock on Spain’s GDP can be observed in Figures 3 and 4 (in national currency and US dollars, respectively), most of which is explained by the deterioration of the trade balance (Figure 7). Figures 5 and 6 clearly show 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 effects in Germany are balanced out by the negative effects 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 (Figure 9). This devaluation restores Spain’s competitiveness, bringing the trade balance into surplus and the growth rate to a positive path. It should be mentioned, however, that if GDP is measured in dollars Spain experiences a further decrease, since the size of the devaluation offsets the increase in production. 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 had gone down). This lower supply of bonds denominated in euros is translated into an appreciated global euro, which also appreciates the German currency (recall that the German currency is pegged to the global euro).

The adjustment of the Spanish currency erodes Germany’s competitiveness to such an extent that some periods after the German currency needs to be devalued. This improves Germany’s external position, 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 order to examine whether the unstable dynamics produced by the model are a direct result of the closure of the model, some alternatives could be tried out. For instance, instead of imposing a balanced balance of payments as a condition to avoid devaluations within the Eurozone, small deficits may be allowed to exist. This would just require, as shown in the following equations, a change in the threshold that we use to determine when a devaluation is triggered.

\[
E^7_t = \begin{cases} 
E^7_{t-1}, & \text{if } \frac{C_{A_{GE}}^{SP_{l-1}} + F_{A_{GE}}^{SP_{l-1}}}{Y_{SP_{l-1}}} < -0.005, \forall i = 1, 2, 3, 4, 5 \\
E^7_{t-1}(1 + \pi), & \text{if } \frac{C_{A_{GE}}^{SP_{l-1}} + F_{A_{GE}}^{SP_{l-1}}}{Y_{SP_{l-1}}} \geq -0.005, \forall i = 1, 2, 3, 4, 5 
\end{cases} 
\]  
(1)

\[
E^8_t = \begin{cases} 
E^8_{t-1}, & \text{if } \frac{C_{A_{GE}}^{SP_{l-1}} + F_{A_{GE}}^{SP_{l-1}}}{Y_{SP_{l-1}}} < -0.005, \forall i = 1, 2, 3, 4, 5 \\
E^8_{t-1}(1 + \pi), & \text{if } \frac{C_{A_{GE}}^{SP_{l-1}} + F_{A_{GE}}^{SP_{l-1}}}{Y_{SP_{l-1}}} \geq -0.005, \forall i = 1, 2, 3, 4, 5 
\end{cases} 
\]  
(2)

As it can be observed in Figure 1, when the adjustment criterion allows for a certain (small) balance of payments deficit of Spain vis-à-vis Germany the model produces stable dynamics over time. This is explained by the fact that at the new parity between the Spanish and the German euros (the one that results from the devaluation of the Spanish euro) Spain runs a deficit with respect to Germany but the size of it is such that the threshold is not surpassed. The depreciation of the Spanish euro against the dollar ends up offsetting the initial loss of competitiveness, thereby producing and overall current account surplus (regardless the bilateral deficit with respect to Germany). It can be seen
then that just a small change in the adjustment criterion is sufficient to make the system stable. Note, however, that this result implies that the US pays the cost Spain’s surpluses. As long as the American economy is willing to do so, the system will be stable. Should the US pursue a balanced external position, the results would be significantly different.

Even if the criterion proposed above, i.e., one where the Spanish euro is devalued against the euro if the balance of payments falls below a certain (negative) threshold, produces stable results, it is interesting to assess the viability of an alternative criterion based on stocks. Thus, the exchange rates of the Spanish and the German euros with respect to the global euro could be written in such a way that a devaluation takes place only if the stock of foreign reserves held by each national central bank falls below a certain threshold (for simplicity, we may assume that this threshold is equal to zero, meaning that a fixed exchange rate can be maintained as long as there is a positive stock of reserves at the central bank to intervene in the foreign exchange market).
Figure 2: Loss of Competitiveness in Spain with adjustment criterion based on stocks

\[ E_7_t = \begin{cases} 
E_{7t-1} & \text{if } Bs_{cb}^{GE_S} > 0 \\
E_{7t-1}(1 + \pi) & \text{if } Bs_{cb}^{GE_S} \leq 0 
\end{cases} \]  

(3)

\[ E_8_t = \begin{cases} 
E_{8t-1} & \text{if } Bs_{cb}^{US} > 0 \\
E_{8t-1}(1 + \pi) & \text{if } Bs_{cb}^{US} \leq 0 
\end{cases} \]  

(4)

Figure 2 shows that even if the competitiveness shock occurs in period 50, the Spanish euro is only devalued several periods after. The reason is that in this case what really matters is the initial stock of reserves held by the central bank of Spain, which in the end will determine how long the parity against the global euro can be maintained. Thus, Spain can accumulate persistent current account deficits until the moment its central bank runs out of reserves to keep the exchange rate fixed. The results produced by this alternative criterion only differ from the previous one in the length of the unsustainable growth regime, but in the end the result is the same, i.e., an adjustment has to be made.
When the adjustment criterion is based on a certain flow that cannot fall below a certain threshold during a predetermined number of periods, the negative competitiveness shock is quickly adjusted since the condition for the devaluation is rapidly met. On the other hand, if the criterion for the devaluation of the exchange rate is based on the fact that foreign reserves (a stock) cannot be negative, it may take a long time until the persistent current account deficits combined with a fixed exchange rate regime end up depleting the stock of reserves. In the end, what really matters when we adopt a criterion based on stocks is their initial value.

4.3 The EMS scenario

Another way in which the Eurozone could be reformed to obtain a more sustainable institutional framework could consist of the adoption of some of the ideas embedded in the European Monetary System (EMS). Under this setting all national currencies were pegged to the European Currency Unit (ECU), which was a basket currency that only played the role of unit account. Hence, one way of restoring the competitiveness of the South could be based on the split-up of the euro into a northern euro and a southern euro, both pegged to the ECU, which would be a basket currency of these latter. The ECU would play no role whatsoever, but being the reference to which each regional euro is pegged. The structure of the European Central Bank would change: it would be split into a north and a south division, each of which would carry out the monetary policy of each region. Under this setting, each European currency would float freely against the US dollar. Thus, the exchange rate would be determined by the net inflows of foreign exchange resulting from real and financial transactions with the US.

Let us now analyse the impact of the same shock but in a context in which 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. Figure 9 shows that the immediate impact of the competitiveness shock is such that the Spanish currency appreciates. At first sight, this would seem counterintuitive since Spain is running a trade and current account deficit. However, it should be noted that the shock has an overall positive effect on global economic growth, thereby increasing the wealth of the private sector of all the
country blocks except for Spain. As a result, portfolio investment increases, including the demand for bonds issued by the Spanish government. As long as the financial account surplus resulting from the demand for Spanish assets is larger than the current account deficit that arises from the loss of competitiveness, the exchange rate will appreciate. This is, indeed, what explains the downward movement of the exchange rate that is observed between periods 50 and 54. A similar behaviour is observed for the case of the German currency.

According to the institutional setting of this model, Spain is allowed to devalue its currency against the ECU if it registers five consecutive periods of 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 its trade surplus (figure 7) thereby inducing an increase in the domestic level of activity (figure 3). However, the devaluation implies a loss of purchasing power in dollar terms (figure 4). As regards Germany, the appreciation of its currency vis-à-vis the Spanish currency erodes its competitiveness, thereby reducing its trade, current account and fiscal surpluses. As a consequence, the German government increases the supply of bonds (or reduces the pace at which bonds are withdrawn from the market, in the case the government is running a surplus), which is reflected in a slight depreciation of the German currency (figure 10). 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 9.

The main conclusion that is drawn from this experiment is that in a context in which Spain is allowed to devalue its currency with respect to the ECU (and hence, to the German currency as well) the initial loss of competitiveness can be easily corrected, thereby preventing first a process of unsustainable current account deficits financed by financial account surpluses and, more importantly, the recessionary effect that the trade deficit may have on the level of activity and employment. Since in economics there is no free lunch, the beneficial effects of the devaluation of the Spanish currency would come at the cost of a lower purchasing power of the Spanish consumers. However, we consider that this drawback is a minor detail as long as the domestic level of activity is strong and the
rate of unemployment remains at low levels.

Another point that it is worth making is the instability of such a monetary regime. 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. Hence, another alternatives should be examined.

4.4 The Eurozone-without-Germany scenario

As it was described in the previous section, a possible way out of the current crisis put forward by many economists consists of a euro without Germany (and probably some of the other surplus countries). This would imply that Germany would regain its monetary and exchange rate policy, while the rest of the members of the Eurozone would keep the euro as their currency. This is another way in which the competitiveness problem could be solved, but it implies a lower level of macroeconomic coordination compared to the previous scenario, i.e., a newer version of the EMS. There are, in principle, two relevant experiments to be tested: one in which the euro is pegged to the German currency and another in which both currencies float. Let us start with the first case.

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%. It should be noted that in this case there is a slightly larger appreciation of the European currencies after the shock and before the adjustment of the Spanish currency. This is explained by the fact that in the present scenario the shock produces a relatively higher growth effect in Germany (compared to the EMS scenario) which in turn improves the German fiscal balance (through increased tax collection). As a result, the supply of bonds decreases. In a context where both the US and the rest of the world are growing and hence exhibiting an increasing stock of wealth, there will be an excess demand for German bonds. This disequilibrium is solved through an appreciation of the German currency, which is larger.
than in the EMS scenario since public finances are better in the current case. As regards the euro, since it is pegged to the German currency, it will follow the trajectory of the latter.

The evolution of the rest of the variables (GDP, trade balance and public debt) until the adjustment that takes place in period 55 is the same than the one observed in the EMS scenario. Once the Spanish currency is devalued, it is observed a positive effect on the trade balance (figure 7) and economic growth (figures 3). However, the increase in the level of activity is not enough to compensate for the loss of purchasing power due to the devaluation (figure 4). It should be noted that following the expansion brought about by the devaluation there is a contraction of GDP (figure 3). This is explained by the positive income effect on imports, which slightly erodes the trade balance (figure 7). After this adjustment has been made, Spain’s overall trade balance is in surplus but deteriorating. However, the bilateral trade balance with Germany is in deficit. From this situation, it could be deduced 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. Thenceforth, no more adjustments take place.

Compared to the two previous scenarios, the case where Germany leaves the Eurozone and the remaining countries (in this case, they are all represented by Spain) 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 5, 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 level of unemployment - and Germany would grow at a slower pace but it would avoid playing the uncomfortable political role that is now playing. Compared to a pure fiscal union or a scenario where
Germany finances the bail-outs of the deficit countries, the institutional setting that was described in these simulations would also save Germany a significant fiscal cost.

4.5 The fully-floating scenario

Finally, it is worth examining the impact of an institutional setting where Germany leaves the Eurozone and the euro floats freely (instead of being pegged to the German currency, like in the previous scenario or to a currency unit, like in the case of the EMS). As figure 9 shows, soon after the competitiveness shock the euro starts to depreciate as a result of the current account deficits. The opposite behaviour is observed in the case of the German currency (figure 10). 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 at the corresponding level.

The results of these simulations show that such a system would also be sustainable in the long run, but it may take an unacceptably long time for the economy to return to the initial equilibrium in terms of output and employment. Despite this important caveat, this scenario should also be considered as an alternative compared to the present situation which, according to our simulations and reality itself, cannot perpetuate for much longer, unless the European governments are willing to allow for a degree of social heterogeneity among Europe that, in principle, was not part of the objectives of the process of integration.

A final point that is worth analysing is the one that links the debate on the reform of the European system with the discussion on the reform of the international monetary system. As it is widely known, since the signing of the Bretton Woods agreements (an even after its abandonment in 1971) the US dollar has played the role of being the key currency. One of the problems that arises from an setting in which a certain country issues the currency that the rest use to trade and accumulate reserves is the so-called Triffin dilemma, which basically states that there is a incompatibility between pursuing economic policies oriented to achieve certain domestic targets (for instance, exhibiting
a balanced current account) and, at the same time, providing the whole international system with the level of liquidity that is required to attain a certain growth rate.

Figure 11 shows that under the present situation and the case in which Germany leaves the Eurozone and the euro is floating, there is no impact in the external performance of the US. This seems reasonable since in the first case, what is lost by Spain is entirely gained by Germany, with no major effects for the US economy. In the second case, since the euro floats freely, exchange rates move in such a way that external equilibrium holds permanently. However, the cases of the EMS and where Germany leaves the Eurozone and the euro is pegged to the German currency (i.e., the two most beneficial cases for Spain) imply that the US bears part of the cost of the adjustment of the European periphery. This case would not be very different to the case of China, which for a long period of time kept an artificially undervalued exchange rate which explained an important part of the current account deficit that the US has been accumulating during the last decades.

5 Conclusions

We began this paper by presenting some of the alternative explanations to the current crisis. We then build a four-country stock-flow consistent model that represents the Eurozone. This model was used to examine the hypothetical scenario of a split up of the euro into different possible institutional settings, each of them consistent with the equilibrium exchange rate of the corresponding sub-regions. Our simulations show under which conditions such an 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 the end, the task
consists of finding an institutional setting that produces more balanced results and that can be therefore sustained over time.

References


6 Annex
Figure 5: GDP Germany (national currency)

Figure 6: GDP Germany (US dollars)
Figure 7: Trade Balance Spain (US dollars)

Figure 8: Public Debt Spain (national currency)
Figure 9: Spanish Currency (vs US dollar)

Figure 10: German Currency (vs US dollar)
Figure 11: Current Account US