Exchange Rate Misalignments, Fiscal Federalism and Redistribution: How to Adjust in a Monetary Union

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8 June 2012

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Preliminary draft

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9^{th} Euroframe Conference on Economic Policy Issues in the European Union, 8 June 2012, Kiel Institute for the World Economy

Abstract

The euro zone crisis illustrates the insufficiency of adjustment mechanisms in a monetary union characterized by a large heterogeneity. Exchange rate adjustments being impossible, they are very few alternative mechanisms. This situation reflects a simple diagnosis. At the level of the whole euro zone, the euro is close to its equilibrium parity. But the euro is strongly overvalued for Southern European countries, France included, and largely undervalued for Northern European countries, especially Germany. In a first step, the paper gives an evaluation of these exchange rate misalignments inside the euro zone, using a FEER approach. Using panel econometric techniques over the period 1994-2011, we confirm that the exchange rate misalignments in the euro zone have diverged, reflecting unsustainable evolutions. Last, we give an estimation of the equivalent transfers in % of GDP implied by these misalignments in the different European countries. In a second step, we use a 'stock-flow consistent' model of a monetary union with two countries along the lines of Godley and Lavoie (2007) and Duwicquet and Mazier (2010). A federal budget is introduced with federal expenditures and social transfers financed by federal taxes and euro-bonds issuing. Three results are obtained. The stabilizing role of such a federal budget is confirmed facing asymmetric shock or the negative impact of exchange rate misalignments inside the monetary union. Without such a federal mechanism the overvaluation of the Southern currency (Greek or Spanish euro), facing the undervaluation of the Northern currency (German euro), induces a strong slowdown in the South and a cumulative imbalances within the monetary union. Similarly, the stabilizing role of euro-bonds used to finance European investment projects is illustrated. Their role in the pooling of national debts would be the last point to examine.

JEL Classification: F31, F32, F41, F37, E12.
Key words: Exchange Rate Misalignments, Adjustments, Monetary Union, Euro Zone Crisis.

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1 Introduction

The euro zone crisis illustrates the insufficiency of adjustment mechanisms in a monetary union characterized by a large heterogeneity. Adjustments mechanisms are defined in a broad sense as mechanisms which permit a country after a shock to return to the initial situation or, possibly, to recover towards full employment after a slowdown. Exchange rate adjustments being impossible, they are very few alternative mechanisms. Fiscal policy could play an active role and in a federal state like the USA its stabilization coefficient is around 20% (Italianer and Pisani-Ferry, 1992). But there is no equivalent in the European case. Well integrated capital markets, with portfolio diversification and intra-zone credit, have been proposed as a powerful adjustment mechanism by the 'international risk sharing' approach. Intra-zone credit and capital income from international portfolio would have stabilization coefficients around 20-30% each (Asdrubali and Kim, 2004). These results have been used during the 2000 by advocates of a liberal economic policy in the EU to promote deeper financial integration without having to develop a federal budget (Commission européenne, 2007; Trichet, 2007). However, the theoretical basis and the results appear highly questionable (Clévenot and Duwicquet, 2011). Consequently, relative wage and price flexibility are proposed in order to take place, at least partially, of exchange rate adjustments. Actually these mechanisms allow only a very slow and partial return to equilibrium with an important cost in terms of growth and employment and with large differences between countries, due to strong structural specificities. They are more inefficient when they are implemented simultaneously in interdependent countries, as it is presently the case in the euro zone, especially in the Southern European countries (Mazier and Saglio, 2008). This situation reflects a simple diagnosis. At the level of the whole euro zone current account is close to equilibrium and fiscal deficit is smaller than in many other OECD countries. The euro is close to its equilibrium parity. But intra-European imbalances are huge. The euro is strongly overvalued for Southern European countries, France included, and largely undervalued for Northern European countries, especially Germany (Jeong et al., 2010). These exchange rate misalignments block growth and induce fiscal and current deficits in the South while growth is boosted in the North by exports, especially towards the rest of the euro zone, and deficit are reduced. This situation is equivalent to implicit positive transfers in favour on the North and negative transfers at the detriment of the South, which are largely ignored in the public debate. The paper is organised as follow. In a first step, we give a new evaluation of these exchange rate misalignments inside the euro zone, using a FEER approach, and compare it with other estimations. Using panel econometric techniques over the period 1994-2010, we confirm that the exchange rate misalignments in the euro zone have diverged, reflecting unsustainable evolutions. Last, we give an estimation of the equivalent transfers in % of GDP implied by these misalignments in the different European countries. We compare these results with the evaluation of the system of fiscal insurance proposed by the Commission to fight asymmetric evolutions (Italianer and Pisani-Ferry, 1992). In a second step, we use a 'stock-flow consistent' model of a monetary union with two countries along the lines of Godley and Lavoie (2007) and Duwicquet and Mazier (2010). The model describes the real sector and assets and liabilities of all the agents in order to analyze financial integration in a consistent manner. A federal budget is introduced with federal expenditures and social transfers financed by federal taxes and euro-bonds issuing. Three results are obtained. The stabilizing role of such a federal budget is confirmed facing asymmetric shock or exchange rate misalignments inside the monetary union. Similarly, the stabilizing role of euro-bonds used to finance European investment projects is illustrated. Their role in the pooling of national debts would be the last point to examine.

2 Intra-European exchange rates misalignments and implicit transfers

2.1 Heterogeneity of misalignments within the euro area

Since the beginning of the 2000's, we observe a surge of current account imbalances inside the euro area in spite of a rather balanced current account for the whole area. On the one side, Northern European countries have accumulated huge current account surpluses and on the other side, Southern European countries have ran important current account deficit (see figure 1). These evolutions reflect, at least partially, increasing heterogeneity of exchange rate misalignments (ERM, hereafter) inside the euro area. By using a FEER approach, introduced by Williamson (1994), Jeong et al. (2010) show that Northern countries are increasingly undervalued and Southern countries are increasingly overvalued.

Figure 1: Current account imbalances as % of euro area GDP

Notes: IMF WEO, April 2012. Current account balances are expressed in percentage of euro area GDP. Surplus sample: Germany, Netherlands, Austria, Finland. Deficit sample: France, Italy, Spain, Portugal, Ireland, Greece. Source: authors'calculations.

In this section, we estimate FEERs for ten European countries (Austria, Finland, France, Germany, Italy, Ireland, Netherlands, Spain, Portugal and Greece) over the period 1994-2011. The FEER is defined as the exchange rate prevailing when the economy simultaneously reaches the external equilibrium and the internal equilibrium for all the trading partners. This measure was derived from a standard world trade model in which all the variables are endogenous ex-

cept the external equilibrium (sustainable current account determined by structural variables) and the internal equilibrium (full utilization of the productive potential). The external equilibrium is estimated with panel regression techniques. The internal equilibrium is reached when the output gap is closed[1].

Table 1: Undervaluation (rc > 0) or overvaluation (rc < 0) for each 'national euro' in real effective terms (in %)

rc[a]	EU	AUT	FIN	FRA	GER	IRL	ITA	NLD	PRT	SPA	GRC
1994	-3.4	-5.9	-4.6	0.3	-13.4	0.9	6.3	-2.1	6.7	3.8	16.8
1995	1.2	-5.8	9.7	3.9	-6.9	6.3	13.7	3.3	17.1	13.4	9.0
1996	4.2	-3.6	14.9	9.5	0.9	6.4	15.0	6.1	0.8	7.1	0.5
1997	3.5	-6.5	19.2	17.4	-1.0	2.8	10.5	4.0	-13.8	5.5	-5.0
1998	0.6	-3.0	18.0	15.9	-4.7	-0.2	5.6	-1.6	-19.7	0.5	-2.3
1999	2.0	0.3	20.7	22.7	-4.9	3.6	5.0	2.5	-25.0	-4.7	-8.6
2000	0.1	6.7	27.1	13.0	-2.8	3.4	5.0	1.9	-29.9	-7.4	-11.7
2001	6.9	8.6	34.3	19.6	8.6	6.6	10.9	5.6	-28.6	-4.6	-5.7
2002	6.6	19.9	33.1	12.4	13.5	3.9	5.9	1.9	-20.7	-5.1	-6.1
2003	2.2	8.8	17.9	2.9	8.1	-0.9	-1.0	3.0	-14.5	-9.8	-8.1
2004	6.6	9.7	21.4	1.6	17.8	1.3	6.8	7.8	-22.7	-16.1	3.5
2005	1.8	9.2	11.2	-7.0	17.3	-1.8	4.6	7.4	-36.1	-30.3	-5.1
2006	0.3	10.6	12.2	-7.4	19.3	-2.5	2.1	9.0	-37.3	-40.0	-20.9
2007	0.1	15.4	16.7	-9.0	23.6	-6.2	4.9	8.4	-31.5	-48.3	-31.4
2008	-2.6	20.3	12.0	-13.9	22.2	-7.6	1.9	7.8	-41.9	-48.8	-33.4
2009	0.6	12.2	4.4	-9.6	21.4	0.3	2.9	6.3	-30.8	-17.1	-20.7
2010	1.6	10.9	4.8	-11.8	21.8	7.6	-1.2	9.1	-25.1	-15.2	-18.5
2011	3.3	14.4	1.5	-13.0	23.1	7.0	3.1	11.5	-7.9	-5.5	-21.8

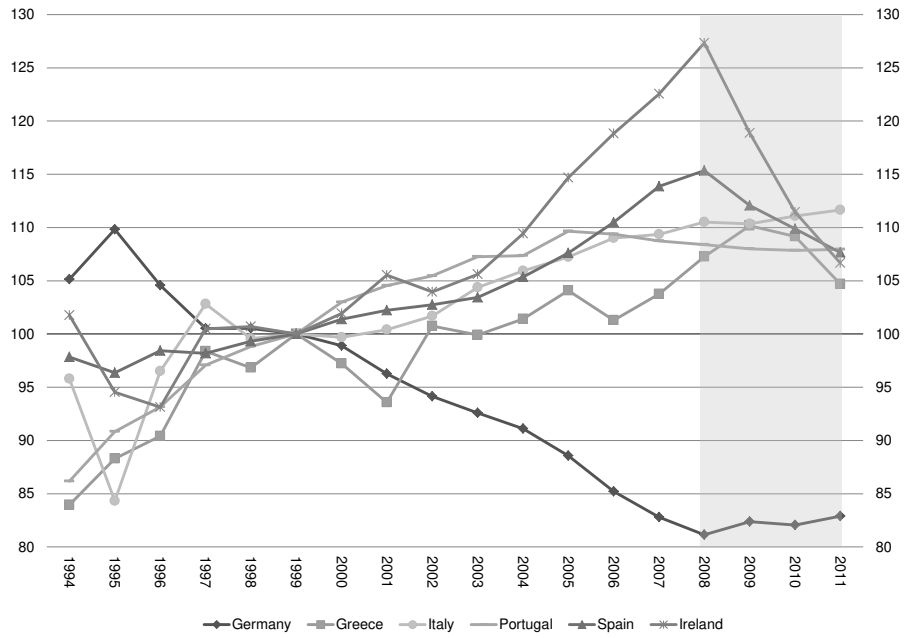
[a] Note: Forecasts for 2011 based on IMF WEO April 2012; See Jeong et al. (2010) for a complete description of the model of world trade and the methodology used to compute ERM. Source: authors' calculations.

Since the early 2000's, we assist to a sharp increase of heterogeneity of misalignments in the euro area (table 1 and figure 1). We can observe a split in the euro area between some countries increasingly undervalued (like Germany, Austria, Netherlands and Finland) and others increasingly overvalued (like Greece, Portugal, Spain and France). On average since 2005, Germany, Austria, Netherlands and Finland have been undervalued by 13% while Greece, Portugal, Spain and France have been overvalued by 23%. This structural heterogeneity is at the heart of current problems of the Euro.

Since 2008, we observe a reduction of misalignments for some Southern European countries (Portugal, Ireland and, up to a certain point, Greece). These movements have been mainly driven by large real effective devaluations in Ireland, Spain and Greece, as shown by the evolutions of the unit labor cost (ULC) based real effective exchange rates in figure 2. These politics of internal devaluation are very painful and had led to an acceleration of the crisis in Greece. This important point will be discussed in the third part of this section.

[1] See Jeong et al. (2010). The methodology used is a synthesis of previous works on the FEER (Borowski and Couharde, 2003; Jeong and Mazier, 2003) and of the Symmetric Matrix Inversion Method (SMIM) proposed by Cline (2008).

Figure 2: Real effective exchange rates relative to the euro area (unit labor costs based, 1999 = 100)



Notes: European Commission's Price and Cost Competitiveness database. Available at http://ec.europa.eu/economy_finance/db_indicators/competitiveness/documents/areea17.xls

2.2 Comparison with other estimates of ERM

Firstly, we compare our results with those of Cline and Williamson (2011). These authors use a FEER approach based on the Symmetric Matrix Inversion Method (SMIM) methodology described in Cline (2008). The main differences with our own FEER approach are, in the one hand, a simpler treatment of foreign trade and, in the other hand, ad hoc current account targets.
More prosaically, in the case of the euro area countries of table 2, Cline and Williamson calculate the needed change in the real effective exchange rate to reach a current account target in 2011 which stabilizes the Net International Investment Position of 2011. They, also, calculate the needed change in the real effective exchange rate to reach a current account target of 3% of GDP in absolute value in 2011. This standard assumption of imbalances of 3 percent of GDP in absolute value was adopted in their precedent works.
On the whole, the results are largely similar Greece and Portugal exhibit large overvaluations. Germany is more undervalued in our results mainly due to population aging. In our approach, we estimate the equilibrium current account thanks to panel econometric techniques with some explanatory variables like the dependency ratios. A larger part of dependent population reduces the national saving rate and so the equilibrium current account.
Secondly, we compare our own results obtained thanks to the FEER approach with misalignments obtained by a BEER (Behavioral Equilibrium Exchange Rate) approach (Coudert et al.,

Table 2: Comparison with estimates of Cline and Williamson for 2011 (in%)

rc	Germany	Italy	Spain	Ireland	Portugal	Greece
2011[a]	23.1	3.1	-5.5	7.0	-7.9	-21.8
2011[b]	10.8	-11.2	-3.2	0.0	-22.0	-27.0
2011[c]	5.4	-2.0	-3.5	0.0	-20.7	-27.0

[a] Note: Our forecasts are based on the IMF's WEO of April 2012.

[b] Forecasts of Cline and Williamson were based on the IMF's WEO of April 2011 (Cline and Williamson, 2011). The current account targets stabilize the Net International Investment Position of 2011.

[c] Note: Forecasts of Cline and Williamson were based on the IMF's WEO of April 2011 (Cline and Williamson, 2011). The current account targets follow the standard assumption of imbalances of 3 percent of GDP in absolute value.

2012). This approach, introduced by Clark and MacDonald (1998), consist to assess the impact of long run determinants on the dynamics of the real exchange rate thanks to econometric techniques. Many authors have selected parsimonious specifications with variables like the net foreign assets and the relative productivity. An accumulation of foreign assets induces an appreciation of the exchange rate and an increase of the productivity in the tradable sector relatively to the non-tradable implies an appreciation of the exchange rate (this variable captures the well-known Balassa-Samuelson effect). After the estimation of a cointegration relationship, the misalignments are given by the gap between the real effective exchange rate and the equilibrium exchange rate (i.e. the product of the cointegration vector and the observed values of the explanatory variables). In this approach, it is supposed that the real effective exchange rate was at equilibrium on average over the period.

Table 3: Comparison with estimates Coudert et *al.* for 2010 (in %)

	2010[a]	**2010**[b]
Euro area	1.6	-8.0
Austria	10.9	-3.2
Finland	4.8	7.3
France	-11.8	0.4
Germany	21.8	0.5
Greece	-18.5	-20.0
Ireland	7.6	-5.3
Italy	-1.2	-6.6
Netherlands	9.1	-3.0
Portugal	-25.1	-13.8
Spain	-15.2	-10.0

[a] Our real effective misalignments obtained by a FEER approach.

[b] Real effective misalignments obtained by a BEER approach (Coudert et al., 2012)

As the BEER misalignments are, mainly, deviation from the average value of the real effective exchange rates on the studied period, countries with higher inflations rates, in a monetary union, will experienced higher real effective appreciation. If this appreciation has not stemmed

from improvement in the net foreign assets or relative productivity, these countries will be increasingly overvalued. On the contrary, the FEER misalignments are, mainly, deviation from the average value of the current account on the studied period. In a monetary union, a widening of the current account deficit will produce an increasing overvaluation.
In the BEER approach, France and Germany are close to equilibrium thanks to lower inflation rates than in peripheral countries. In the FEER approach, France is increasingly overvalued since the middle of the last decade (from 7 percent in 2005 to 13 percent in 2011) because of persistent current account deficits. On the contrary, Germany is increasingly undervalued (from 8 percent in 2003 to 23 percent in 2011) because of large current account surpluses even during the crisis (around 6 percent of GDP since 2008). In our view, this divergence between FEER and BEER approaches in the case of France and Germany reflects the fact that the FEER take into account structural evolutions which are ignored with the BEER. Especially the decline of the French structural competitiveness contrasts with the German improving performances, as it is illustrated by the evolution of observed and equilibrium current accounts. The BEER approach seems to be unsuited to describe structural problems of current account imbalances in the euro area because of its temporal horizon (López-Villavicencio et al., 2012).
For peripheral countries, the results are more convergent. They indicate double-digits overvaluations during the 2000's. For Spain (overvalued by around 10 %), Portugal (overvalued by around 15 %) and Greece (overvalued by around 20 %), the two measures of equilibrium exchange rate are close because of current deficits which move away from their average values and in reason of a strong real effective appreciation which deviates the real effective exchange rates from their average value.

2.3 Divergence of ERM inside the euro area

In other approaches of equilibrium exchange rate like the Behavioral Equilibrium Exchange Rate approach (BEER), the misalignments are necessarily stationary on the studied period. In this approach, the misalignments are residuals from long run relationship between the real effective exchange rates and its determinants thus the misalignment is stationary, by definition. In the case of European countries during the period 1994-2010, the hypothesis of exchange rates on average in equilibrium on the studied period (i.e. the misalignment is stationary) seems to be unrealistic since these countries have experienced diverging path concerning their competitiveness as evidenced by the evolution of current account imbalances (figure 1).
In the long run and at the world level, the FEERs and the REERs are integrated and cointegrated. In other words, the misalignments are stationary for a large panel of industrialized and emerging countries on the period 1982-2007 to ensure external debt sustainability (Saadaoui, 2011). Nevertheless for European countries on the period 1994-2010, it seems improbable that the misalignments have been stationary.
In a first step, we implement various panel unit root tests on the series of natural logarithms of REERs[2] and on the series of natural logarithms of FEERs. This step allows to determine if the REERs and FEERs are non-stationary I(1) series. A series is I(1) if it achieves stationarity after first differencing. As in previous empirical studies (Zhou, 1993; Barisone et al., 2006; Saadaoui, 2011), we detect the presence of unit roots in the series of real effective exchange rates (REERs) and in the series of fundamental equilibrium exchange rates (FEERs).
As we can see, in table 4, the series of REERs and FEERs are non-stationary in level since we accept the null hypothesis of the presence of unit root in all tests (except in the LLC test at the

[2] Source: Bank for International Settlements for the real effective exchange rate basis 100 in 2000 (annual average of monthly data).

5 percent level for the feer series). Besides, the series of REERs and FEERs are stationary in first difference since we reject the null hypothesis of the presence of unit root in all tests.

Table 4: Panel unit roots tests for REERs and FEERs

Test[a]	LLC	Breit.	F_ADF	F_PP	LLC	Breit.	F_ADF	F_PP
Difference	No	No	No	No	Yes	Yes	Yes	Yes
Exo. var.	C, T	C, T	C, T	C, T	None	None	None	None
Null Hyp.	UR	UR	UR	UR	UR	UR	UR	UR
Common UR	Yes	Yes	No	No	Yes	Yes	No	No
reer	0.77	0.87	8.60	9.02	-1.90**	-2.97***	36.53**	49.38***
feer	-1.75**	-0.57	22.48	21.68	-6.07***	-2.95***	49.32***	84.14***

[a] Note: "UR" indicates the null hypothesis of the presence of unit root. The symbol ***, ** indicates statistical stationarity at the 1 percent and 5 percent level, respectively. The table shows different panel unit root tests: Levin et al. (2002) (LLC); Breitung (2000); Maddala and Wu (1999) and Choi (2001) Fisher-type panel unit root tests (F_ADF and F_PP). Source: authors's calculations.

One limit of the previous tests is the assumption of cross section independence. This assumption is, clearly, too restrictive for a panel of European countries which share the same currency. In order to check the results, we implement the CADF test introduced by Pesaran (2007) which allows for cross section dependencies (i.e. existence of common shocks) by subtracting cross section averages of lagged levels in addition to the standard ADF equation, this test is robust to cross section dependencies.
As we can see in table 5, the series of REERs and FEERs are non-stationary in level and stationary in first difference. We can conclude that the series are nonstationary I(1) series. After having established this first result, the second step will consist to test if there is a long run relationship between these two variables (i.e. the misalignment is stationary) during the studied period.

Table 5: Integration of REERs and FEERs

CADF[a]	Level	First Difference
reer	-0.505	-5.211***
	(0.307)	(0.000)
feer	3.069	-2.755**
	(0.999)	(0.003)

[a] The p-values are in parentheses. The symbol ***, ** indicates statistical stationarity at the 1 percent and 5 percent level, respectively. Source: authors' calculations.

In order to test if there is a long run relationship between REERs and FEERs inside the euro area, we can proceed in two distinct ways:

1. We can test the presence of unit root in the series of misalignments (i.e. the difference between the REERs and the FEERs). However, in this case, we made the implicit assumption that the series are cointegrated with (1; -1) coefficient.

2. Another way consists to test if there is a long run relationship between REERs and FEERs by using panel cointegration tests (Pedroni, 1999). In this case, we made any assumption on the value of the cointegrating vector.

If the misalignments are non-stationary or if we failed to detect a long run relationship between REERs and FEERs, we can conclude that the ERM have diverged during the period 1994-2010. As you can see in table 6, we accept the null hypothesis of presence of unit root in all tests (except in the LLC test at the 5 percent level). As it is mentioned above, we check the robustness of the results (to the hypothesis of cross section independence) by implementing the CADF test (Pesaran, 2007). We can conclude that the series of misalignments are non-stationary (see table 7).

Table 6: Panel unit roots tests for misalignments

Test[a]	**LLC**	**Breit.**	**F_ADF**	**F_PP**
Difference	No	No	No	No
Exogenous variable	Constant, Trend	Constant, Trend	Constant, Trend	Constant, Trend
Null Hypothesis	UR	UR	UR	UR
Common UR	Yes	Yes	No	No
mis	-2.25**	0.17	23.90	25.82

[a] Note: "UR" indicates the null hypothesis of the presence of unit root. The symbol ***, ** indicates statistical stationarity at the 1 percent and 5 percent level, respectively. The table shows different panel unit root tests: Levin et al. (2002) (LLC); Breitung (2000); Maddala and Wu (1999) and Choi (2001) Fisher-type panel unit root tests (F_ADF and F_PP). Source: authors'calculations.

Table 7: Integration of misalignments

CADF[a]	**Level**
mis	-0.023
	(0.491)

[a] The p-value is in parentheses. Source: authors' calculations.

The previous results indicate that ERM have diverged inside the euro area during the period 1994-2010. However, the previous tests made a strong assumption on the value of the cointegrating vector. In order to test the divergence without assumption on the value of the cointegrating vector, we implement Pedroni's panel cointegration tests (1999).
In table 8, we accept the null hypothesis of no cointegration in most of test (except for the panel ADF and the group ADF statistics at the 5 percent level). The results indicate, clearly, a divergence on the studied period for these European countries. To ensure of the quality of the results, we implement cointegration test which allows for cross section dependencies introduced by Westerlund (2007). The existence of a negative and significant error correction term is taken as proof for cointegration. In case of cross section dependencies between members of the panel, critical values need to be obtained through bootstrapping.

The panel and group mean statistics suggested by Westerlund (2007) indicate clearly that the null hypothesis of no cointegration is accepted even in presence of cross section dependencies (see table 9).

Table 8: Panel cointegration tests

Pedroni residual cointegration tests	
Null Hypothesis: No cointegration	
Included observations	170
Cross-sections included	10
Alternative hypothesis: common AR coefficients (within-dimension)	
Panel-v	-0.59 (0.72)
Panel-rho	0.37 (0.64)
Panel-PP	-0.20 (0.42)
Panel-ADF	-2.04 (0.02)
Alternative hypothesis: individual AR coefficients (between-dimension)	
Group rho-Statistic	1.62 (0.94)
Group PP-Statistic	0.48 (0.68)
Group ADF-Statistic	-2.13 (0.02)

[a] The p-value is in parentheses. Source: authors' calculations.

Table 9: Cointegration of REERs and FEERs

	Gτ	Gα	Pτ	Pα
reer, feer	-1.711	-4.551	-3.834	-3.277
	(0.308)	(0.530)	(0.445)	(0.466)

[a] P-values for cointegration tests are based on bootstrap methods, where 800 replications are used. See Persyn and Westerlund (2008) for the details. Source: authors' calculations.

Panel unit root tests and panel cointegration tests show that ERM inside the euro area have diverged during the 1994-2010 period. We failed to detect a long run relationship between REERs and FEERs (i.e. the misalignment is non-stationary). This result indicates that European countries have experienced unsustainable evolution of their competitiveness during the period. This raises the question of necessary adjustments to restore competitiveness of overvalued countries. The balance of payment identity indicates that the current account is equal to the opposite of the capital account. Countries which run a current account deficit have to borrow to the rest of the world thus a current account deficit correspond to a capital account surplus. If a country run large current account deficit on an extended period of time, the question of the sustainability of its net external debt can be raised.
Even if the current euro area crisis was triggered by concerns on high levels of public debt, the question of the sustainability of net external debts is a crucial issue since the deficit countries

will have to run surpluses in the future in order to pay their current stock of external debt in order to avoid Ponzi strategies. All measures of European policy makers are focused on the competitiveness of (overvalued) countries which have problems to refinance their debts. The aim is to restore competitiveness in order to allow these countries to run current account surpluses (or at least, reduced current account deficit) to reduce the net external debt to GDP ratio.
As argued by Belke and Dreger (2011), a reduction of unit labor cost (ULC) is on the top of the agenda for overvalued countries. However, they propose (as a reduction of competitiveness for surplus countries is not a feasible strategy) an asymmetric response through reduction of unit labor cost only for Southern European countries in order to reduce imbalances inside the euro area.
Such an asymmetric proposal raises two kinds of questions. Firstly, are the overvalued countries able to restore their competitiveness only through reduction of ULC and such measures can (alone) really achieve a reduction of current account imbalances inside the euro area? Secondly, this kind of asymmetric proposal is a threat for economic growth of overvalued countries so we can wonder if the total effect on the external debt to GDP ratio is positive since slower growth tends to raise the external debt to GDP ratio.
As pointed out by Felipe and Kumar (2011), even a reduction of 20%-30% in nominal wage for Southern European firms would not restore competitiveness relatively to German firms, since the export basket is completely different and they would not be able to struggle with Chinese's wages in the export markets.
Since last ten years, the asymmetric evolution of misalignments in the euro area have reflected diverging path in terms of competitiveness. These evolutions are one of the main underlying causes of the current euro area crisis. In order to deal with these asymmetric evolutions, a federal budget could help overvalued countries to switch to new activities and improve their international specialization (Jeong et al., 2010; Duwicquet and Mazier, 2010).
In absence of coordination of national economic policies inside the euro area, the current euro area crisis leads to pressures of financial markets on countries with deteriorated competitiveness and weak perspectives of growth. These pressures push these countries to accept austerity plan to restore foreign investor confidence. A better macroeconomic management of the asymmetric evolutions of competitiveness could be a more efficient way to restore confidence and reduce imbalances inside the euro area.

2.4 Implicit transfers: Northern euro area versus Southern euro area

Exchange rate misalignments are meaningful at the intra-European level if we recognize the existence of an equilibrium current account related to structural specificities of each member of the Euro Area. This kind of concept has been considered in discussions on the extended stability pact which includes other criteria than the public deficit and debt. Such hypothesis implies that an exchange rate misalignment generates a gain or a loss in terms of cost competitiveness. In a monetary union, an equivalent transfer associated to the exchange rate misalignment can be computed. Two cases will be considered, the first one with only a bilateral exchange rate, the second with a two countries euro zone facing the rest of the world. Empirical evaluation will be given after.

2.4.1 The bilateral case

Such hypothesis implies that an ERM generates a gain or a loss in terms of price competitiveness. In monetary union, a transfer equivalent to the ERM can be computed. The ERM is

expressed in deviation from equilibrium, we have:

$$\frac{Ep^*}{p} = (1+e).\frac{E_e p^*}{p} \tag{1}$$

with E, observed bilateral exchange rate[3] , E_e, equilibrium bilateral nominal exchange rate, e, bilateral misalignment, p, domestic prices, p^*, foreign prices.
As we can see in equation 1, in case of overvaluation ($e < 0$), we observe a lower price competitiveness and in case of undervaluation ($e > 0$), we observe a higher price competitiveness. The equivalent transfer T, associated to the ERM and which is, in fact, an additional unit cost, positive or negative, can be obtained by equalizing the actual level of competitiveness and the equilibrium level of competitiveness, corrected by the unit transfer T. We obtain:

$$\frac{E_e p^*}{p}.\frac{1}{(1+T)} = \frac{Ep^*}{p} = (1+e).\frac{E_e p^*}{p} \tag{2}$$

$$T = \frac{1}{(1+e)} - 1 \tag{3}$$

In case of overvaluation ($e < 0$), we have a negative unit transfer which corresponds to an additional positive unit cost, the country transfer a part of its national income to the other countries. In case of undervaluation ($e > 0$), we have a positive unit transfer which correspond to an additional negative unit cost, this reduction of unit cost will enhance the external trade of the country.
In case of overvaluation ($e < 0$), we have a positive unit transfer which corresponds to an additional positive unit cost. The country suffers of a loss of competitiveness. In case of undervaluation ($e > 0$), we have a negative unit transfer which corresponds to a reduction of the unit cost. This reduction improves the competitiveness of the country.
In level, ex ante, in a case of overvaluation, the transfers represent an additional cost for exports ($T.pX$) and, in a symmetric way, an additional cost for local producers in competition with imported products ($T.pmM$). For the overvalued country, the total transfer in percent of GDP is equal to $\frac{T.(pX+pmM)}{pY}$. In practice, an important share of imports corresponds to products which are not in competition with domestic products (raw materials, goods not locally produced). This share depends of the characteristics of the international specialization of each country. For simplicity, we will suppose in the evaluation of these implicit transfers that only half of the imports is in competition with domestic products. This will give a total transfer in percent of GDP equal to $\frac{T.(pX+0.5pmM)}{pY}$. It is worthwhile to notice that the total transfer is positive function of the openness ratio. For the same misalignment, very open countries like Ireland will suffer of higher negative transfer in case of overvaluation than less open countries like Greece or Portugal.

2.4.2 The case of a two countries Eurozone

We consider now a euro zone with two countries North (N) and South (S) and the rest of the world (the USA to simplify).

$$1\$ = E€$$

[3] An increase of e corresponds to a bilateral nominal depreciation.

The euro zone is supposed to be at its equilibrium parity, which is close to the observed facts ($E = E_e$). On the opposite the two countries N and S are not at the equilibrium parity, the country S euro is overvalued, the country N euro undervalued.

$$e_N = \frac{E - E_{Ne}}{E_{Ne}} > 0 \text{ (undervaluation)}$$

$$e_S = \frac{E - E_{Se}}{E_{Se}} < 0 \text{ (overvaluation)}$$

$$1\$ = E_{Ne}€N = E_{Se}€S$$

$$1€N = \frac{E_{Se}}{E_{Ne}}€S \text{ (equilibrium exchange rate between €N and €S)}$$

The overvaluation of the South is reflected in a real effective exchange rate inferior to its equilibrium value, which means a reduced competitiveness.

$$\frac{(p_{US}.E)^{\alpha SUS}.(p_N)^{\alpha SN}}{p_S} < \frac{(p_{US}.E_{Se})^{\alpha SUS}.(p_N E_{Se}/E_{Ne})^{\alpha SN}}{p_S}$$

(with, to simplify, $\alpha SUS = \frac{XS \to US}{XS}$ et $\alpha SN = \frac{XS \to N}{XS}$)
For the estimation of the equivalent transfer associated to an overvalued South euro, we must evaluate, as previously, the additional unit cost T_S which is necessary to pass from the level of competitiveness associated to the equilibrium exchange rate $\frac{(p_{US}.E_{Se})^{\alpha SUS}.\left(\frac{p_N E_{Se}}{E_{Ne}}\right)^{\alpha SN}}{p_S}$ to the observed and less favorable level $\frac{(p_{US}.E)^{\alpha SUS}.(p_N)^{\alpha SN}}{p_S}$. It gives:

$$\frac{(p_{US}.E_{Se})^{\alpha SUS}.\left(\frac{p_N E_{Se}}{E_{Ne}}\right)^{\alpha SN}}{p_S\,(1 + T_S)} = \frac{(p_{US}.E)^{\alpha SUS}.(p_N)^{\alpha SN}}{p_S}$$

$$1 + T_S = \frac{\left(\frac{E_{Se}}{E}\right)^{\alpha SUS}\left(\frac{E_{Se}}{E}\right)^{\alpha SN}}{\left(\frac{E_{Ne}}{E}\right)^{\alpha SN}} = \frac{\frac{E_{Se}}{E}}{\left(\frac{E_{Ne}}{E}\right)^{\alpha SN}}$$

$$1 + T_S = \frac{(1 + e_N)^{\alpha SN}}{(1 + e_S)}$$

With $e_N > 0$ as the North euro is undervalued in relation with the dollar, $e_S < 0$ as the South euro is overvalued. T_S is positive and corresponds to an additional unit cost associated to the overvaluation of the South euro ($1/1 + e_S$), but also to the undervaluation of the North euro in relation to the dollar $(1 + e_N)^{\alpha SN}$.
As previously, the equivalent transfer associated to an overvalued South euro can be computed in % of GDP with:

- a transfer from the South to the North equal to $\frac{Ts.(pX_{S \to N} + 0.5 p_m M_{S \leftarrow N})}{pY_S}$
- a transfer from the South to the rest of the world equal to $\frac{Ts.(pX_{S \to US} + 0.5 p_m M_{S \leftarrow US})}{pY_S}$. (with $T_S > 0$)

Symmetrically the equivalent transfer associated to an undervalued North euro can be computed in the same way. The undervaluation of the North euro gives:

$$\frac{(p_{US}.E)^{\alpha NUS}.(p_S)^{\alpha NS}}{p_N} > \frac{(p_{US}.E_{Ne})^{\alpha NUS}.\left(\frac{p_S E_{Ne}}{E_{Se}}\right)^{\alpha NS}}{p_N}$$

(with $\alpha NUS = \frac{X_{N\to US}}{X_N}$ et $\alpha NS = \frac{X_{N\to S}}{X_N}$)

$$\frac{(p_{US}.E_{Ne})^{\alpha NUS}.\left(\frac{p_S E_{Ne}}{E_{Se}}\right)^{\alpha NS}}{p_N\,(1+\ T_N)} = \frac{(p_{US}.E)^{\alpha NUS}.(p_S)^{\alpha NS}}{p_N}$$

$$1 + T_N = \frac{\left(\frac{E_{Ne}}{E}\right)^{\alpha NUS}\left(\frac{E_{Ne}}{E}\right)^{\alpha NS}}{\left(\frac{E_{Se}}{E}\right)^{\alpha NS}} = \frac{\left(\frac{E_{Ne}}{E}\right)}{\left(\frac{E_{Se}}{E}\right)^{\alpha NS}}$$

$$1 + T_N = \frac{(1+e_S)^{\alpha NS}}{(1+e_N)}$$

With $e_S < 0$ et $e_N > 0$, T_N is negative and represents a subvention received by the North, induced by the undervaluation of the North euro in relation to the South euro ($e_N > 0$), but also by the overvaluation of the South euro in relation to the dollar $(1+e_S)^{\alpha NS}$.
As previously, the equivalent transfer associated to an undervalued North euro can be computed in % of GDP ($T_N < 0$) with:

- a negative transfer from the North to the South equal to $\frac{T_N.(pX_{N\to S}+0.5p_mM_{N\leftarrow S})}{pY_N}$, which means a transfer in favor of the North equal to the opposite $-\frac{T_N.(pX_{N\to S}+0.5p_mM_{N\leftarrow S})}{pY_N}$
- a negative transfer from North to the rest of the world equal to $\frac{T_N.(pX_{N\to US}+0.5p_mM_{N\leftarrow US})}{pY_N}$, which means a positive transfer equal to the opposite $-\frac{T_N.(p\ X_{N\to US}+0.5p_mM_{N\leftarrow US})}{pY_N}$

The rest of the world receives from the South $\frac{Ts.(pX_{S\to US}+0.5p_mM_{S\leftarrow US})}{pY_S}$ but gives to the North $-\frac{T_N.(pX_{N\to US}+0.5p_mM_{N\leftarrow US})}{pY_N}$. In the case of the relations between the Eurozone and the rest of the world, the euro is close to its equilibrium parity. It means that the two previous transfers balance each other. It looks as if the South was making a transfer to the rest of the world, which was after repaid to the North by the rest of the world.
On the whole, due to the intra-European exchange rate misalignments, the South gives to the North directly $\frac{Ts.(pX_{S\to N}+0.5p_mM_{S\leftarrow N})}{pY_S}$ and indirectly $\frac{Ts.(pX_{S\to US}+0.5p_mM_{S\leftarrow US})}{pY_S}$, which gives a total amount of $\frac{Ts.(pX_S+0.5p_mM_S)}{pY_S}$. The result is the same as in the previous bilateral case, which is by this way generalized.

2.4.3 Empirical evaluation of the implicit transfers between Southern and Northern Europe

For a misalignment of 10 %, the flow of income received by Northern euro area countries (Germany, Finland, Austria and Netherlands) ranged between 3.8% and 9.4% (see table 10)[4]. We

[4]In table 10 and figure 3 the signs of the transfers have been inverted.

observe similar values for Southern euro area countries (Ireland, Portugal, Spain, France, Italy and Greece), the flow of income paid by these countries ranged between 2.5% and 14.2%.
In spite of relatively low openness ratio, Greece experienced an important overvaluation related notably to an increase of its relative ULC. We compute the implicit transfers by summing on the one hand, overvalued countries (Southern countries) and on the other hand, undervalued countries (Northern countries). Since the introduction of the Euro, the implicit transfers within the euro area have been favorable to Northern countries (see figure 3).

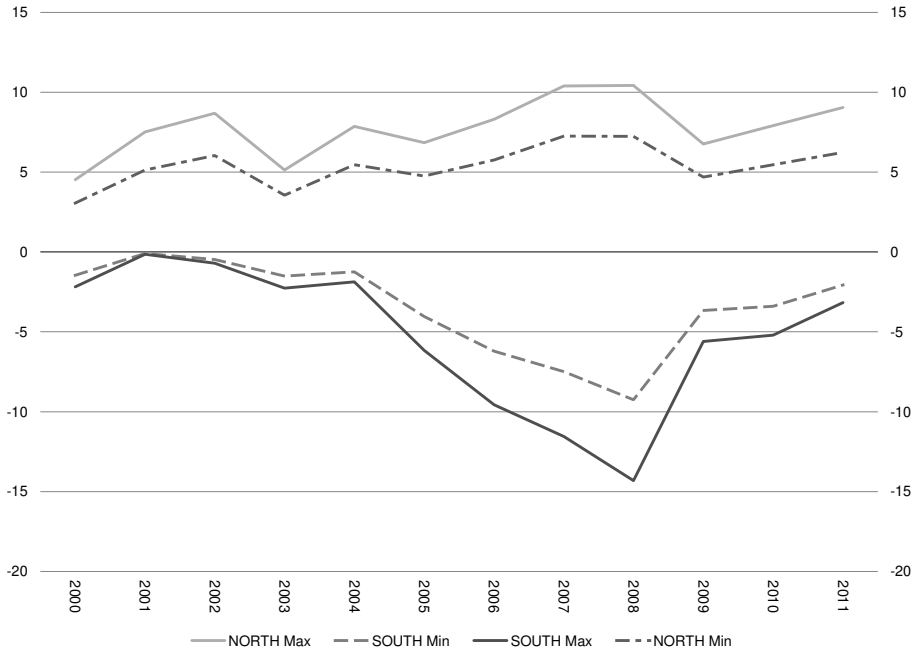
Table 10: Implicit transfers for a misalignment of 10 percent

		Degree of openness[a]		Implicit transfers	
		MIN	**MAX**	**MIN**	**MAX**
North	**Netherlands**	71.3	103.3	6.5	9.4
	Austria	52.7	76.9	4.8	7.0
	Finland	42.1	60.5	3.8	5.5
	Germany	41.6	60.0	3.8	5.5
South	**Greece**	22.3	38.9	-2.5	-4.3
	Italy	26.7	40.2	-3.0	-4.5
	France	26.7	40.3	-3.0	-4.5
	Spain	26.7	41.9	-3.0	-4.7
	Portugal	29.8	48.9	-3.3	-5.4
	Ireland	90.0	127.7	-10.0	-14.2

[a] Notes: Undervaluation for Northern countries and overvaluation for Southern countries. Openness ratios are averaged over the period 2000-2011. Degree of openness MIN = $\frac{X}{Y}$; Degree of openness MAX = $\frac{(X+0.5M)}{Y}$.

Between 2000 and 2004, Southern countries was overvalued and transferred to the rest of the world around 2% of their GDP each year. Received income by Northern countries amounted to 6% GDP on average over the same period. Since 2005, we observe a sharp increase of Southern countries' overvaluation which reached 25% in 2008. This inappropriate level of the euro have had a strong impact on foreign trade since the equivalent transfer amounted to 9% of GDP in the minimal case and 14% of GDP in the maximal case. During this period, we observe an inverse situation in the North: the flow of income extracted from the undervaluation increases to reach an amount ranged between 7% and 10% of GDP in 2008. Since the opening of the crisis in 2008 a reduction of these transfers has been observed, thanks to a decrease of the exchange rate misalignments, partly induced by strong ULC adjustments in Ireland, Spain and Greece. However Northern countries continued to receive important transfers (between 4% and 6% of GDP) whereas Southern countries paid transfers of a similar amount (figure 2). With the austerity plans implemented since 2010 in most of Southern countries, we observe a reduction of current deficit (excepted in Greece) through recession or at least strong slowdown. As a result, ERM and related transfers have been reduced. This situation of imbalances between Northern and Southern countries related to structural heterogeneity in terms of competitiveness increase the debt-to-GDP ratio of Southern countries without any implementation of stabilization mechanisms.

Figure 3: Implicit transfers in percent of GDP for Southern and Northern euro area countries



Source: authors' calculations.

2.5 Transfers and fiscal insurance system

These implicit transfers due to exchange rates misalignments can be compared with the fiscal insurance system proposed during the 1990s by the European Commission itself to compensate the effects of asymmetric evolutions. To simplify, we retain the mechanism suggested by Italianer and Pisani-Ferry (1992). In case of an increase of the rate of unemployment larger in one country than in the rest of the Union, this country would benefit of a transfer provided by the European budget. This transfer would be calculated according to the following rule:

$$T_i{=}0.01\,(dU_i - dU_{iUE}) * GDP_i \text{ if } 0 < dU_i - dU_{iUE} < 2 \tag{4}$$

$$dU_i = U_i\,(t) - U_i\,(t-12)$$

with U_i, rate of unemployment in % of the country i, U_{iUE}, rate of unemployment of the rest of the EU.

The estimations calculated for the 1980s, with transfers limited to a maximum of 2% of the GDP, gave an annual average cost for the European budget rather reduced (around 0.2% of GDP). The estimations have been updated for the period 1996-2011. They give rather close results: an average cost of 0.21% of GDP when the transfers are limited to 2% of GDP; 0.26% of GDP without this ceiling when the fiscal insurance is applied to the members of the euro

area; 0.26% and 0.28% of GDP (with or without ceiling) when this mechanism is supposed to be enlarged to all the countries of the EU, including the United Kingdom. Table 11 gives the results for the EU 27 without ceiling[5]. The transfers are, on average, more important for the Southern European countries (Greece 0.75%, Portugal 0.71%, Spain 1.05%, Ireland 0.87%), except for France and Italy, and for the Baltic countries. Germany also benefits (0.27% on average, concentrated at the beginning of the 2000s). During some years transfers can reach a significant level around 4 to 5% of GDP, when there is no ceiling.

Although proposed since long time, this fiscal insurance mechanism has never received very favorable attention for two main reasons. First, its opponents consider this kind of transfer encourages bad behavior, as, in case of higher unemployment, the rest of the EU will pay to limit the negative effects. This argument cannot be ignored, but is not essential. Second, this insurance mechanism could play permanently in favor of the same countries which suffer of poor performances on the long run. Indeed it would be a mechanism of permanent transfer and not an insurance mechanism. The argument is more important, but does not seem relevant according to the observed results.

However this question is sensible in the context of the euro zone crisis where the Southern countries are structurally affected by the overvaluation of their national euro and by problems of competitiveness. In such a case, the cost can be high for the other countries of the euro area, especially if there is no ceiling to the mechanism. According to estimations of the previous table, transfers could have reached 3 to 5% of GDP in Greece, Spain and Ireland at the end of the 2000s. These results are of the same magnitude as those obtained before with the implicit transfers due to the overvaluation of the South national euro[6]. Indeed it could be logic that the countries of the rest of the euro area support such transfers in order to avoid the South European countries to be trapped in recession and zero growth during a long period. Overall, this would help to preserve growth in the whole zone and to solve the public debt problems. These transfers would be better suited than intra zone credits which are actually the only form of help used in the euro area, except the partial cancellation of the Greek debt. These credits give time and help to transfer problems in the future, but with a permanent debt burden.

However such transfer mechanism raises the problem of its duration and of its efficiency. Past experiences, like the German reunification during the 1990s or the permanent transfers from the North to the South of Italy, show that, if these transfers are a net gain for the beneficiary regions, they are not sufficient to solve structural problems. These transfers must be completed by more active policies in the fields of innovation, infrastructures and industries. The effect of federal transfers will be examined now using a two countries SFC model of a monetary union to have an assessment of their macroeconomic impact and their stabilizing role.

[5] Other estimations are available with a ceiling and a limitation to the euro area. Results are always close.

[6] With the exception of France and Portugal, highly penalized by the overvaluation of their national euro, but which would only slightly benefit of the fiscal insurance mechanism as it is designed, due to the average evolution of their unemployment rates, which raises the problem of the type of indicators to be used.

Table 11: Estimation of transfer linked to fiscal insurance mechanism at the level of EU27 without ceiling in percent of GDP

T/GDP[a]	AUT	BEL	CYP	EST	FIN	FRA	DEU	GRC	IRL
2001	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.30	0.60	0.00	0.00	0.00	0.00	0.50	0.00	0.30
2003	0.00	0.50	0.40	0.00	0.00	0.40	0.90	0.00	0.00
2004	0.50	0.10	0.40	0.00	0.00	0.30	0.60	0.70	0.00
2005	0.50	0.30	0.90	0.00	0.00	0.20	1.00	0.00	0.00
2006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20
2008	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00	1.80
2009	0.00	0.00	0.00	6.40	0.00	0.00	0.00	0.00	3.70
2010	0.00	0.00	0.20	2.40	0.00	0.00	0.00	2.40	1.10
2011	0.00	0.00	1.60	0.00	0.00	0.00	0.00	5.10	0.70
Average	0.14	0.14	0.32	0.88	0.00	0.08	0.27	0.75	0.87
T/GDP	**ITA**	**LUX**	**MLT**	**NLD**	**PRT**	**SVK**	**SVN**	**SPN**	**BGR**
2001	0.00	0.00	1.10	0.00	0.30	0.70	0.00	0.00	3.30
2002	0.00	0.40	0.00	0.30	0.80	0.00	0.00	0.60	0.00
2003	0.00	1.00	0.10	0.90	1.20	0.00	0.20	0.00	0.00
2004	0.00	1.10	0.00	0.80	0.30	0.50	0.00	0.00	0.00
2005	0.00	0.00	0.30	0.40	1.30	0.00	0.40	0.00	0.00
2006	0.00	0.70	0.00	0.00	0.70	0.00	0.00	0.00	0.00
2007	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00
2008	0.70	0.80	0.00	0.00	0.00	0.00	0.00	3.10	0.00
2009	0.00	0.00	0.00	0.00	0.20	0.60	0.00	4.80	0.00
2010	0.00	0.00	0.00	0.10	0.70	1.70	0.70	1.40	2.70
2011	0.00	0.20	0.00	0.00	0.90	0.00	0.90	1.60	1.00
Average	0.06	0.38	0.14	0.23	0.71	0.32	0.20	1.05	0.64
T/GDP	**CZE**	**DNK**	**HUN**	**LVA**	**LTU**	**POL**	**ROU**	**SWD**	**GBR**
2001	0.00	0.40	0.00	0.00	0.30	2.40	0.00	0.40	0.00
2002	0.00	0.00	0.00	0.00	0.00	1.40	0.60	0.00	0.00
2003	0.30	0.60	0.00	0.00	0.00	0.00	0.00	0.40	0.00
2004	0.40	0.00	0.10	0.00	0.00	0.00	1.10	0.70	0.00
2005	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.50	0.30
2006	0.00	0.00	1.00	0.00	0.00	0.00	0.80	0.00	1.30
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.50	1.60	1.60	0.00	0.00	0.20	0.40
2009	0.40	0.70	0.30	7.70	6.00	0.00	0.00	0.20	0.10
2010	0.00	0.80	0.50	0.90	3.40	0.70	0.00	0.00	0.00
2011	0.00	0.10	0.00	0.00	0.00	0.10	0.10	0.00	0.20
Average	0.10	0.24	0.34	0.93	1.03	0.42	0.24	0.22	0.21

[a] Source: Eurostat, ILO, authors' calculations.

Table 12: Balance Sheet

	Households N	Firms N	State N	Banks N	Federal budget	ECB	Households S	Firms S	State S	Banks S
Capital		$+K^N$						$+K^S$		
Deposits	$+BD^N$			$-BD^N$			$+BD^S$			$-BD^S$
Currency	$+H_h^N$			$+H^N$		$-H$	$+H_h^S$			$+H^S$
Credits		$-L^N$		$+L_N^N$						$+L_S^N$
				$+L_N^S$				$-L^S$		$+L_S^S$
Refinancing				$-RF^N$		$+RF^N + RF^S$				$-RF^S$
Bonds	$+p_b^N.B_N^N$		$-p_b^N.B^N$				$+p_b^N.B_S^N$			
	$+p_b^N.B_N^S$						$+p_b^S.B_S^S$		$-p_b^S.B^S$	
Eurobonds	$+BT_{Nh}^E$			$+BT_{Nb}^E$	$-BT^E$		$+BT_{Sh}^E$			$+BT_{Sb}^E$
Bills			$-BT^N$	$+BT_N^N$						$+BT_S^N$
				$+BT_N^S$					$-BT^S$	$+BT_S^S$
Equities		$-p_e^N.E^N$								
	$+p_e^N.E_{hN}^N$	$+p_e^N.E_{eN}^N$					$+p_e^N.E_{hS}^N$	$+p_e^N.E_{eS}^N$		
								$-p_e^S.E^S$		
	$+p_e^S.E_{hN}^S$	$+p_e^S.E_{eN}^S$					$+p_e^S.E_{hS}^S$	$+p_e^S.E_{eS}^S$		
Wealth	$-VH^N$	$-V^N$	$-D^N$	$-VB^N$	$-D^E$		$-VH^S$	$-V^S$	$-D^S$	$-VB^S$
Total	0	0	0	0	0	0	0	0	0	0

3 A SFC model of two countries in a Monetary Union with federal budget or Eurobonds

A SFC model with two countries in monetary union allows a consistent description of assets and liabilities and of all the associated real and financial flows. The monetary union is composed of two countries (N and S) with an asymmetry of size. The country N is five times larger than the country S. This configuration facilitates analyzing the adjustment mechanisms of the country S facing the rest of the monetary union. We introduce federal budget with federal social transfers, public federal expenditure and Eurobonds. This will allow studying the stabilising effect of fiscal insurance system, as it has been proposed previously.
This model is inspired by Godley and Lavoie (2006, 2007), Lavoie (2003) and Duwicquet and Mazier (2010). Firms accumulate both real and financial capital. They can finance their investments by undistributed profit, banking credit, or equities. We introduce two commercial banks able to supplying credit and also, possibly, rationing credit. Households hold banking deposits, bonds, and equities. We keep a similar representation of the central bank and the two governments which issue bonds and treasury bills. Taxes on capital income (banks and firms profit, households capital income) finance federal budget. Lastly, the model has been calibrated to represent the structure of the European Monetary Union.
Table 12 describes the balance sheet in terms of assets (written with a positive sign) and liabilities (written with a negative sign) of each sector: households, firms, government, commercial banks, a single central bank and a federal budget. The transaction matrix, national accounts in flows, is provided in appendix A. Beyond fixed capital (K), eight kinds of monetary or financial assets are distinguished[7]: bank deposits (BD) held by households, bonds issued by governments ($p_b.B$) and held by households of both countries, loans (L) supplied by each commercial bank to firms of the two countries, the equities issued by firms ($p_e.E$) and held by households and firms of both countries, treasury bills issued by each State (BT) and held by commercial banks of both countries, high powered money (H) held by households (H_h) as well as commercial banks (reserve requirements), advances supplied by the ECB to commercial banks (RF) and finally Eurobonds (BT^E) issued by federal government and held by banks and households.

Households

Households exhibit traditional consumption behaviour with a wealth effect, taking into account of capital gains on equities and bonds held. We specify a constant ratio of wealth to disposable income in the long run. Households' portfolio choice follows the approach developed by Godley (1999) and Tobin (1969), with an arbitrage between cash (H_h), bank deposits (BD), bonds ($p_b.B$), equities ($p_e.E_h$) and Eurobonds (BT_h^E), depending on the relative rates of return of each asset: r_b for the interest rate on bonds of each country; i_d for the interest rate on bank deposits which is the same in the two countries; r_{ee} for the rate of return on equities in each country and r_e for the interest rate on Eurobonds. The cash demand follows a simple transaction demand of money. The demand for bank deposits is not written and determined as a residual, using the accounting equation of the households' balance sheet. Households pay the taxes at the national level (T) and at the federal level (T_h^E). In addition, households receive social transfers: ST are national social transfers and FT are federal transfers.

[7] When there are two symbols (N and S), the subscript denotes the country where the asset is held, the superscript the country where the asset is issued. For example, BT_N^S represents the bills held by country N and issued by the country S.

Households' equations for country N
Consumption

$$C^N = a0^N + a1.YHS_h^N + a2.VH_{-1}^N$$

(VH^N = households' wealth, YHS_h^N = disposable income with capital gains)
Disposable income

$$YD_h^N = W^N + i_d.BD_{-1}^N + B_{N-1}^N + B_{N-1}^S + r_e.BT_{Nh-1}^E + DIV_{hN}^N + DIV_{hN}^S + ST^N - T^N - CL^N + FT^N - T_{Nh}^E$$

$$YHS_h^N = YD_h^N + CG_h^N$$

(YD = disposable income, W = compensation of employees, $i_d.BD_{-1}$ = interests on bank deposits, B_{N-1}^N and B_{N-1}^S = interest on domestic and foreign bonds, $r_e.BT_{Nh-1}^E$ = interest on Eurobonds DIV_{hN}^N and DIV_{hN}^S = received dividends on domestic and foreign equities, ST = national social transfers, T= national taxes, CL = national social contributions, FT = Federal transfers, T^E = Federal taxes on capital incomes , CG_h = households' capital gains)
Taxes paid by households

$$T^N = \theta^N.W^N$$

with $\theta^N = 12.5\%$

$$T_{Nh}^E = \theta_{Nh}^E.\left(B_{N-1}^N + B_{N-1}^S + id.BD_{-1}^N + DIV_{hN}^N + DIV_{hN}^S\right)$$

with $\theta_{Nh}^E = 10\%$
Social transfers and contributions

$$\Delta ST^N = \Delta T^N + \Delta T_f^N$$

$$CL^N = \tau.W^N$$

with $\tau = 36\%$
Federal transfers
Federal transfers FT are entirely financed by federal taxes TE (taxes on households, firms, banks and central bank) and represent 3% of euro area GDP.

$$FT = TE$$

The allocation of transfers between North and South is made according to GDP differences.

$$FT^S = \frac{1}{5}.FT + \beta\left[\frac{Y^N}{Y_{baseline}^N} - \frac{Y^S}{Y_{baseline}^S}\right]$$

$$FT^N = FT - FT^S$$

(FT^S = Federal transfers received by South's households, FT^N = Federal transfers received by North's households)

Households' bonds demand

$$\frac{p_b^N.B_N^N}{VH^N} = v0 + v1.r_b^N - v2.r_b^S - v3.i_d - v4.r_{ee}^N - v5.r_{ee}^S - v6.r_e$$

$$\frac{p_b^S.B_N^S}{VH^N} = v0 + v1.r_b^S - v2.r_b^N - v3.i_d - v4.r_{ee}^N - v5.r_{ee}^S - v6.r_e$$

($p_b^N.B_N^N$ = government N bonds held by country N households, $p_b^S.B_N^S$ = government S bonds held by country N households, r_b = interest rate on bonds, i_d = interest rate on bank deposits, r_{ee} = rate of return on equities, r_e = interest rate on Eurobonds)
Households' Eurobonds demand

$$\frac{BT_{Nh}^E}{VH^N} = v0 - v1.r_b^N - v2.r_b^S - v3.i_d - v4.r_{ee}^N - v5.r_{ee}^S + v6.r_e$$

(BT_h^E= Eurobonds issued by federal government and held by households)
Households' equities demand

$$\frac{p_e^N.E_{hN}^N}{VH^N} = v0 - v1.r_b^N - v2.r_b^S - v3.i_d + v4.r_{ee}^N - v5.r_{ee}^S - v6.r_e$$

$$\frac{p_e^S.E_{hN}^S}{VH^N} = v0 - v1.\ r_b^N - v2.r_b^S - v3.i_d - v4.r_{ee}^N + v5.r_{ee}^S - v6.r_e$$

($p_e^N.E_{hN}^N$ = equities issued by country N firms and held by country N households, $p_e^S.E_{hN}^S$ = equities issued by country S's firms and held by country N households)
Cash demand

$$H_h^N = \lambda 0.C^N$$

Households' transaction equilibrium

$$\Delta BD^N = YD_h^N - C^N - p_b^N.\Delta B_N^N - p_b^S.\Delta B_N^S - p_e^N.\Delta E_{hN}^N - p_e^S.\Delta E_{hN}^S - \Delta H_h^N - \Delta BT_{Nh}^E$$

(BD = bank deposits)
Households' balance sheet

$$VH^N = BD^N + p_b^N.B_N^N + p_b^S.B_N^S + p_e^N.E_{hN}^N + p_e^S.E_{hN}^S + H_h^N + BT_{Nh}^E$$

(VH= households' net wealth)
Households' capital gains on equities and bonds held

$$CG_h^N = \Delta p_b^N.B_{N-1}^N + \Delta p_b^S.B_{N-1}^S + \Delta p_e^N.E_{hN-1}^N + \Delta p_e^S.E_{hN-1}^S$$

This gives on the whole:

$$\Delta VH^N = YD_h^N - C^N + CG_h^N = \text{households' savings + capital gains} = YHS_h^N - C^N$$

Firms
Firms have both real and financial accumulation following a Post-Keynesian theoretical framework (Clévenot et al., 2010). Their desired fixed investment (I^d) depends positively on the

profit rate $\left[r_f = \frac{UP}{K_{-1}}\right]$ and negatively on the debt structure $\left[\frac{L}{K_{-1}}\right]$ and the cost of credit (r_l), with a possible positive demand effect. Their financial accumulation, i.e. firms' demand for equities ($p_e.E_e$), is mainly related to the rate of return on equities held (r_e) with an arbitrage between domestic and foreign assets and a positive effect of the rate of profit reflecting the global environment. Firms can finance their investments through undistributed profit (UP), bank credit, or by issuing equities. New equities issued by firms ($p_e.\Delta E$) are determined as a percentage of the total real and financial investment, with positive effects of both credit cost and the debt ratio whose respective increases lead firms to issue more equities. The rate of return on equities r_e is determined by dividends and capital gains. Lastly, income distribution is analyzed in a simple way with a constant share of wages. Undistributed profit is determined by a constant rate of saving by firms (s_f). Distributed dividends between shareholders (households and firms of both countries) are related to the held equities structure.

Firms' equations for country N

Fixed investment

$$\frac{I^{dN}}{K^N_{-1}} = k0^N + k1.r_{f\,-1}^{\ N} + k2.\frac{\Delta Y^N}{Y^N_{-1}} - k3.\frac{L^N}{K^N_{-1}} - k4.r_l$$

(I^d = desired investment, K = fixed capital stock, Y= GDP; r_f = rate of profit = $\frac{UP}{K_{-1}}$, UP = undistributed profit, L = loans, r_l = interest rate on loans)

Financial accumulation (firms' equities demand)

$$\frac{p_e^N.E_{eN}^N}{\left(K^N + p_e^N.E_{eN}^N + p_e^S.E_{eN}^S\right)} = f0 + f1.r_e^N - f2.r_e^S + f3.r_f^N$$

$$\frac{p_e^S.E_{eN}^S}{\left(K^N + p_e^N.E_{eN}^N + p_e^S.E_{eN}^S\right)} = f0 + f1.r_e^S - f2.r_e^N + f3.r_f^N$$

($p_e^N.E_{eN}^N$ = equities issued by country N firms and held by country N firms, $p_e^S.E_{eN}^S$= equities issued by country S firms and held by country N firms, $K^N + p_e^N.E_{eN}^N + p_e^S.E_{eN}^S$ = total real and financial assets held by country N firms, p_e= equities' price, E = number of equities)

New equities issued

$$\frac{p_e^N.\Delta E^N}{\left(I^N + p_e^N.\Delta E_{eN}^N + p_e^S.\Delta E_{eN}^S\right)} = g1.r_l + g2.\left(\frac{L^N}{L^N + p_e^N.E^N + V^N}\right)_{-1} + g3$$

($p_e.\Delta E$ = new issued equities, $I^N + p_e^N.\Delta E_{eN}^N + p_e^S.\Delta E_{eN}^S$ = real and financial investment, $\frac{L}{L + p_e.E + V}$ = debt ratio in percentage of firms' total liability, $p_e.E + V$ = firms' own funds equal to issued equities + firms' net wealth)

Rate of return on equities

$$r_{ee}^N = \frac{\left(E_{-1}^N.\ \Delta p_e^N + DIV^N\right)}{\left(p_e^N.\ E^N\right)_{-1}} = \frac{\Delta p_e^N}{p_{e-1}^N} + \frac{DIV^N}{p_e^N\ .\ E_{-1}^N}$$

($E_{-1}.\Delta p_e$ = capital gains, DIV = distributed dividends)

Firms' balance sheet

$$K^N + p_e^N.E_{eN}^N + p_e^S.E_{eN}^S = L^N + p_e^N.E^N + V^N$$

Wages

$$W^N = \rho . Y^N$$

(W = wages)
Distributed dividends

$$DIV^N = \left(1 - s_f\right) . \left(Y^N_{-1} - W^N_{-1} - \mathrm{r_l} . L^N_{-2}\right)$$

Distribution of dividends

$$DIV^N_{eN} = DIV^N . \left[\frac{E^N_{eN}}{E^N}\right]_{-1}$$

$$DIV^N_{hN} = DIV^N . \left[\frac{E^N_{hN}}{E^N}\right]_{-1}$$

$$DIV^N_{eS} = DIV^N . \left[\frac{E^N_{eS}}{E^N}\right]_{-1}$$

$$DIV^N_{hS} = DIV^N . \left[\frac{E^N_{hS}}{E^N}\right]_{-1}$$

(DIV^N_{eN}, DIV^N_{hN}, DIV^N_{eS}, DIV^N_{hS} = dividends of country N's firms distributed to country N and S firms and households in relation with the number of equities held E^N_{eN}, E^N_{hN}, E^N_{eS} and E^N_{hS}).
Taxes

$$T^N_f = \theta^N_f . \left(Y^N_{-1} - W^N_{-1} - rl . L^N_{-2} - DIV^N + DIV^N_{eN} + DIV^S_{eN}\right)$$

with $\theta^N_f = 35\%$

$$T^E_{Nf} = \theta^E_{Nf} . \left(Y^N_{-1} - W^N_{-1} - rl . L^N_{-2} - DIV^N + DIV^N_{eN} + DIV^S_{eN}\right)$$

with $\theta^E_{Nf} = 5.5\%$
(T = national taxes, T^E = Federal taxes)
Undistributed profit

$$UP^N = \left(Y^N - W^N - rl . L^N_{-1} - DIV^N + DIV^N_{eN} + DIV^S_{eN} - T^N_f - T^E_{Nf}\right)$$

Banks
Firms can get from banks all the credits demanded without restriction; credit demand is determined by the balance of the firms' flow of funds. Investment is equal to the desired investment. The share between domestic and foreign banks' loans is simply related to the degree of openness of the economy. Reserve requirements in high powered money represent a fixed share of bank deposits and do not provide interest payments. A highly simplified treatment of interest rates is retained. The interest rate on loans (r_l) is presumed equal to the key interest rate of the central bank (i_b) plus a constant mark-up. To realize profits, banks apply a spread between the key rate and the rate on deposits (i_d). The central bank provides advances (RF) to commercial banks to allow the latter to provide the cash that households are asking for. These advances are made at a rate of interest (i_b) which is the key instrument of the monetary policy. They are determined

as banks' balance. The central bank pays taxes, equal to its profit, which are shared between the two national governments in relation with each country's size.

Country N banks' equations

Credit

$$\Delta L^{dN} = I^{dN} - UP^N - p_e^N.\Delta E^N + p_e^N.\Delta E_{eN}^N + p_e^S.\Delta E_{eN}^S$$

(ΔL^d = credit demand)

$$\Delta L^N = \Delta L_N^N + \Delta L_S^N$$

$$L_S^N = \left(\frac{X^N}{Y^N}\right).L^N$$

(L_S^N= credit supplied by country S banks to country N firms; L_N^N = credit supplied by country N banks to country N firms, $\frac{X}{Y}$ = openness ratio)

Reserves requirements

$$H^N = \varepsilon.BD^N$$

(H = reserve requirements in high powered money, BD = bank deposits)

Eurobonds

$$BT_{Nb}^E = BT^E - BT_{Nh}^E - BT_{Sh}^E - BT_{Sb}^E$$

(BT^E = Total Eurobonds issued, BT_b^E = Eurobonds purchased by banks, BT_h^E = Eurobonds purchased by households)

Taxes paid by commercial banks to federal government

$$T_{Nb}^E = \theta b.\left(r_l.L_{N-1}^N + r_l.L_{N-1}^S + r.BT_{N-1}^N + r.BT_{N-1}^S + r_e.BT_{Nb}^E - i_d.BD_{-1}^N - i_b.RF_{-1}^N\right)$$

with $\theta b = 18\%$

Banks' profit

$$PB^N = (1-\theta b).\left(r_l.L_{N-1}^N + r_l.L_{N-1}^S + r.BT_{N-1}^N + r.BT_{N-1}^S + r_e.BT_{Nb}^E - i_d.BD_{-1}^N - i_b.RF_{-1}^N\right)$$

Banks' net wealth

$$\Delta VB^N = PB^N$$

Refinancing

$$\Delta RF^N = \Delta H^N + \Delta L_N^N + \Delta L_N^S + \Delta BT_N^N + \Delta BT_N^S + \Delta BT_{Nb}^E - \Delta BD^N - PB^N$$

(RF= refinancing by the central bank, BT= Treasury bills purchased by commercial banks, ΔBT_b^E= Eurobonds held by commercial banks, BD = bank deposits, PB = banks' profit)

Central bank tax to federal budget

$$T€B = i_b.\left(RF_{-1}^N + RF_{-1}^S\right)$$

Central bank money

$$H = H_h^N + H_h^S + H^N + H^S$$

Central bank equilibrium

$$\Delta H = \Delta RF^N + \Delta RF^S$$

(This equation is derived from others in virtue of the Walras law)
Interest rates

$$r_l = i_b + m1_b$$

$$i_d = i_b - m2_b$$

$$r = r_l = r_b^N = r_b^S$$

$$r_e = r - 0.005$$

$$p_b^N = \frac{1}{r_b^N}$$

(i_b = key interest rate of the central bank, exogenous, r_l = interest rate on loans, i_d = interest rate on deposits, r = interest rate on Treasury bills, r_e = interest rate on Eurobonds, r_b = interest rate on bonds, p_b = bonds price)
National government
Public finance is described in a simple way with exogenous expenditures and income taxes paid by households and firms. Treasury bills are purchased by commercial banks without restriction, with the distribution between foreign and domestic bills related to the openness ratio. Interest rates on Treasury bills (r) and on bonds (r_b) are supposed to be equal to interest rates on loans (r_l).
Country N government equations
Budget balance

$$\Delta BT^N = G^N + r_n.BT_{-1}^N + B_{-1}^N - T^N - T_f^N - p_b^N.\Delta B^N + ST^N - CL^N$$

(BT= Treasury bills, G = public expenditures exogenous, T = income taxes on households, T_f = income taxes on firms, r = interest rate on Treasury bills, B = interest on bonds, $p_b.\Delta B$ = new bonds issued by government, ST = Social transfers, CL = Social contributions)
Treasury bills

$$\Delta BT^N = \Delta BT_N^N + \Delta BT_S^N$$

$$BT_S^N = \left(\frac{X^N}{Y^N}\right).BT^N$$

(BT_S^N = country N Treasury bills held by foreign commercial banks of country S, BT_N^N = country N Treasury bills held by domestic banks)

Bonds held by households

$$\Delta B^N = \Delta B_N^N + \Delta B_S^N$$

(B_S^N = country N bonds held by country S households)
Public debt

$$D^N = -BT^N - p_b^N.B^N$$

On the whole we have:

$$VH^N + V^N + VH^S + V^S + D^N + D^S + D^E + VB^N + VB^S = K^N + K^S$$

(Total net wealth at the level of the whole monetary union is equal to the total fixed capital; this equation is derived from others)
Federal government
Federal taxes

$$TE = T_{Nh}^E + T_{Sh}^E + T_{Nf}^E + T_{Sf}^E + T_{Nb}^E + T_{Sb}^E + T€B$$

(T_{Nh}^E = Taxes paid by North's households, T_{Sh}^E = Taxes paid by South's households, T_{Nf}^E = Taxes paid by North's firms, T_{Sf}^E = Taxes paid by South's firms, T_{Nb}^E = Taxes paid by North's banks, T_{Sb}^E = Taxes paid by South's banks, $T€B$ = taxes paid by central bank)
Federal taxes represent 3% of Euro zone's GDP.

$$YE = Y^N + Y^S$$

(YE = Euro zone GDP, Y^N= North GDP, Y^S= South GDP)
Eurobonds are issued to finance the deficit of the federal budget.

$$\Delta BT^E = FT + GE^N + GE^S + r_e.BT_{-1}^E - TE$$

(FT = Federal transfers, GE^N = European investment in North, GE^S= European investment in South, $r_e.BT_{-1}^E$= federal debt service charges, TE= Federal taxes)
Distribution of federal debt between North and south depend on GDP share:

$$BT_N^E = BT^E.\left(\frac{Y^N}{Y^N + Y^S}\right)$$

(BT_N^E= Eurobonds held by North)
Foreign trade and current account
Foreign trade inside the monetary union depends only on the volume effect, since prices and exchange rates are fixed. The current balance is composed of the trade balance, the balance of capital incomes received and paid to the rest of the monetary union, and the exchanges inside the banking system. Commercial banks pay interest to the central bank for their refinancing. But the central bank pays taxes. In case of a deficit incurred by country N, the current balance is financed through three channels: the holding of more assets of country N (bonds, treasury bills, equities) by country S than the opposite (holding of assets of country S by country N); the channel of credit by banks of country S to firms of country N; the refinancing by the central bank which plays a key role as lender of last resort.

Current account equations
Foreign trade

$$\log\left(IM^N\right) = \mu 0 \ + \mu 1 n \log\left(Y^N\right)$$

$$X^N = IM^S$$

(IM = imports, X = exports)
Goods and services equilibrium

$$Y^N = C^N + I^N + G^N + GE^N + X^N - IM^N$$

On the whole, the model has 107 equations for 107 endogenous variables. G^N, G^S (public expenditures) and i_b (key interest rate fixed by the central bank) are exogenous.
Calibration
The model can be calibrated using balance sheets and national accounts in flows from Eurostat for the European countries. Two sets of calibration have been used, the first one with an important share of equities (350% of GDP as in France in 2010) which reflects a high degree of financialization. Dividends are larger than interest. The second calibration retains a smaller share of equities (172% of GDP) and a greater role played by credit. The capital-income ratio is also smaller ($\frac{K}{Y} = 2$ instead of 4), and equities are more held by firms than by households. Lastly, the share of foreign dividends in the total dividends received is kept constant instead of being determined by the structure of equities held. This assumption is more in line with the relative weakness of the capital income received from abroad. Our second calibration can be regarded as more realistic. However, the results of the two calibrations are rather close.
The elasticities in the equations are close to usual estimations. The basic scenarios follow a rate of growth of GDP of 2% and a gross rate of accumulation of 7%.

4 Adjustments inside the monetary union

After the presentation of the model's main characteristics, adjustment mechanisms facing supply or demand shocks can be analyzed. It allows a measure of stabilization coefficients, especially for federal budget and Eurobonds. Results are given with a simplified version of the model where growth rates of equity prices are exogenous.
We present the model in five successive versions in order to identify the stabilization effects specific to each factor:

- Model 1 contains neither federal budget nor Eurobonds;
- Model 2 includes a federal budget of approximately 3% of Eurozone's GDP. This model is divided into three sub-models depending on the parameter β of the following equation:

$$FT^S = \frac{1}{5}.FT + \beta\left[\frac{Y^N}{Y^N_{baseline}} - \frac{Y^S}{Y^S_{baseline}}\right]$$

  - In model 2-a, β=0. In this case, adjustment is done simply by fiscal transfers. If the small country (country S) is affected by a negative shock to its production, it will pay less taxes and the rest of Euro zone (Country N) will pay more taxes;
  - In model 2-b, β=50. The adjustment of the shock happens here by transfers from country N to country S in addition to fiscal transfers;

– In model 2-c, β=110. The extent of federal transfers is very high.

- Model 3 is without federal budget but with Eurobonds to finance projects of European investment. Goods and services equilibrium is:

$$Y^N = C^N + I^N + G^N + GE^N + X^N - IM^N$$
$$Y^S = C^S + I^S + G^S + GE^S + X^S - IM^S$$

(GE^N = European investment in North, GE^S = European investment in South)

European investments are entirely financed in this version by banks that are refinanced with the central bank.

Simulations: loss of country S competitiveness due to exchange rate misalignments
We compare models 2 and 3 with model 1 (model without federal budget and Eurobonds). In the foreign trade equations, we introduce an exogenous effect of higher unit labor costs in southern countries relative to the North. The term TI is set at 0 in the baseline. For illustrate the loss of country S competitiveness, the term TI is equal to 10 between periods 10 and 50.

$$\log\left(IM^N\right) = \mu 0n + \mu 1n.\log\left(Y^N\right) + \mu 2.log\left(\frac{W^N - TI}{Y^N}\right) - \mu 2.log\left(\frac{W^S + TI}{Y^S}\right)$$

$$\log\left(IM^S\right) = \mu 0s + \mu 1s.\log\left(Y^S\right) + \mu 2.log\left(\frac{W^S + TI}{Y^S}\right) - \mu 2.log\left(\frac{W^N - TI}{Y^N}\right)$$

This shock deteriorates the current account of country S and improves North's external trade. Consequently, we observe a decline of the GDP in the South and an increase in the North. We compare the effects of shock in the three model variants. The chart describes the relative change in GDP of southern countries (cf. figure 4 and table 13).

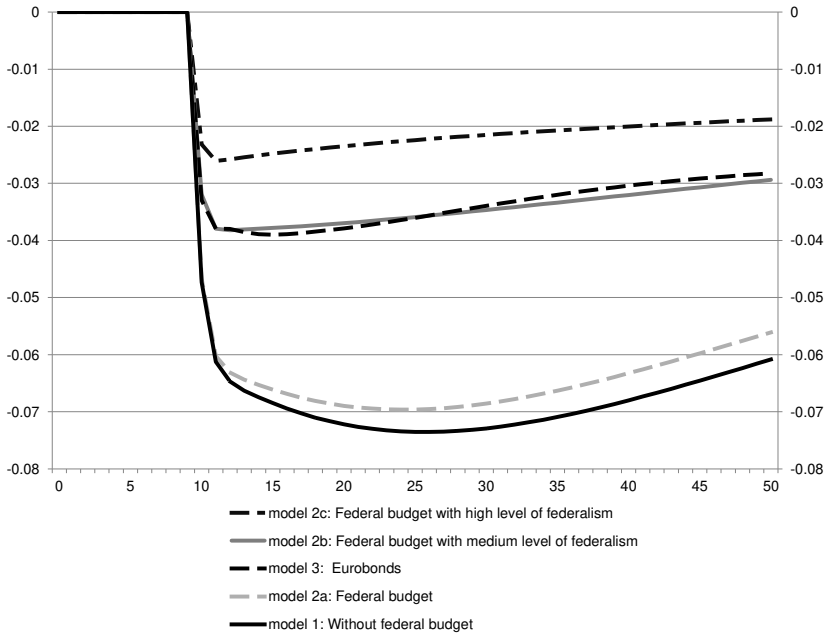
Table 13: Stabilization coefficients in percent

	t=0	t=3	t=10	t=30	t=40
Model 2-a	1.3	2.9	4.5	7.0	7.8
Model 2-b	32.5	42.5	48.8	52.9	51.7
Model 2-c	51.0	61.6	67.4	70.5	69.1
Model 3	30.3	41.9	47.5	55.3	53.6

Source: authors' calculations.

Stabilization coefficients can be calculated by measuring the gap between financial autarky and the other models. For the model 1, the relative decline of the GDP after the shock (at period 10) can be written at period 10: $\frac{(Yn\ after\ the\ shock\ -\ Yn\ before\ the\ shock)}{Yn\ before\ the\ shock}$ =-4.71%. For the model 2-b, we get: $\frac{(Yn\ after\ the\ shock\ -\ Yn\ before\ the\ shock)}{Yn\ before\ the\ shock}$ =-3.18%. The gap between the two models is obtained by the ratio of the relative decrease of GDP: $1 - \left[\frac{Model\ 2b}{Model\ 1}\right] = 1 - \frac{-3.18\%}{-4.71\%} = 32.5\%$
Logically, the stabilization coefficient depends positively on the amount of federal transfers. In model 2-a, stabilization is small in short term (2.9% in t=3). After the shock, country S pay less taxes and country N pay more taxes. In model 2-b, stabilization is higher than model 2-a. After

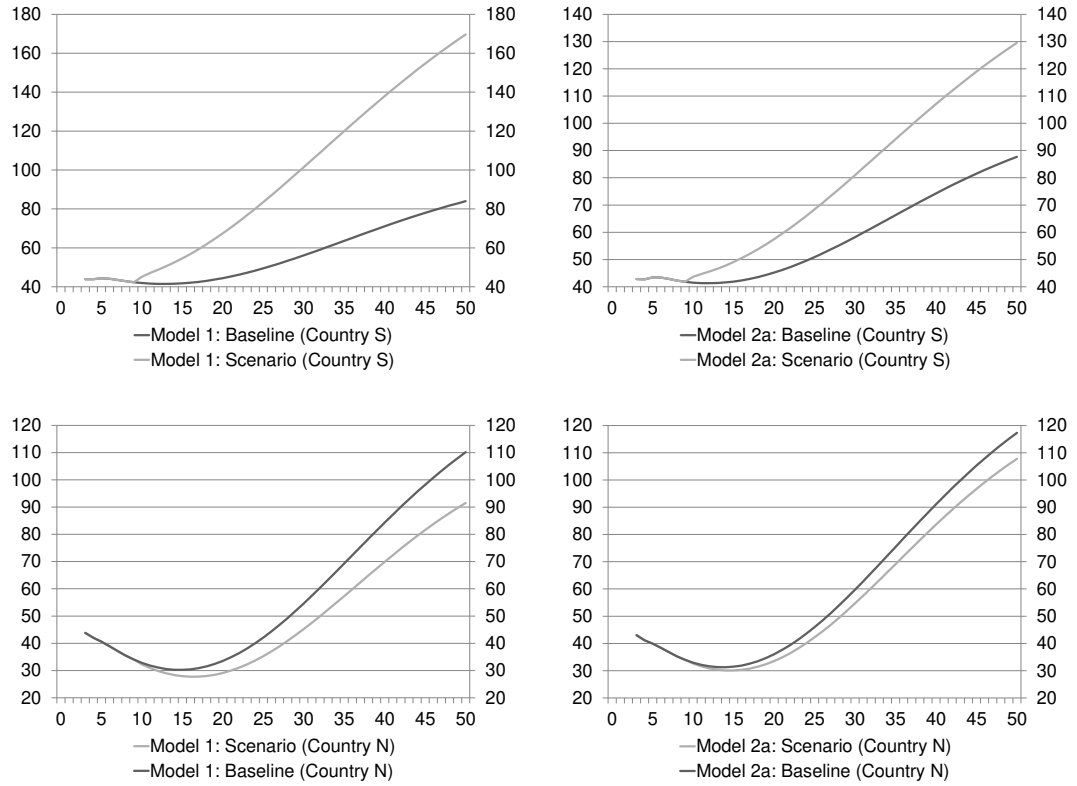
Figure 4: Effect of an overvaluation on GDP of country S GDP



Source: authors' calculations.

the shock, Southern countries receive transfers financed by the federal budget who represent 3% of Euro zone GDP. This amount is divided between the two countries according to their different production change.

Figure 5: Evolution of national public debt in percent of GDP : baseline and scenario (South's overvaluation)



Source: authors' calculations.

The relative decline in GDP of the country *S* induces transfers from the North. Each year in average, the country *N* transfers almost 0.4% of its GDP. In terms of country *S* GDP, transfers represent almost 2% of GDP. This redistribution can stabilize around 40% of the shock in short term and 52% in long term. In model 2-c, transfers from North to South represent in average 0.6% of country *N* GDP and 3% of country *S* GDP. Stabilization effects are more important: 51% in t=0 and 69% in t=40. In model 3, European investments are financed by Eurobonds. Investment in percent of GDP represent in annual average 0.9% in two countries of Euro zone. To counter the loss of competitiveness of South, large European projects are implemented. This 'growth shock' is mutually beneficial and the fasted growing can help southern countries. But it is well known that such European investment projects are complex to implement, which can reduce their macroeconomic impact. The establishment of a federal budget also has the advantage of limiting the rise in public debt of southern countries. The figure 5 highlights the evolution of public debt in model 1 (without federal budget) and model 2-b (with federal bud-

get but without Eurobonds). In the baseline, the public debt will tend to increase. In t=50, public debt is around 80% in percent of GDP in South and 110% in North. In the scenario (South's overvaluation between periods 10 and 50), the public debt of Southern countries increases further due to the loss of competitiveness which leads to a reduction of GDP growth. But with a redistribution mechanism, GDP are less affected and the public debt increases less. Without federal budget, the South public debt increased by 90 points of GDP over forty years. Whereas its relative increase is 50 points with federal budget.

5 Conclusion

The euro zone crisis illustrates the insufficiency of adjustment mechanisms in a monetary union characterized by a large heterogeneity. Exchange rate adjustments being impossible, they are very few alternative mechanisms. Relative wage and price flexibility are proposed in order to take place, at least partially. Actually these mechanisms are combined with fiscal restrictive policy to reduce current and public imbalances. They allow only a very slow and partial return to equilibrium with an important cost in terms of growth and employment and with large differences between countries, due to strong structural specificities. They are more inefficient when they are implemented simultaneously in interdependent countries, as it is presently the case in the euro zone, especially in the Southern European countries. This situation reflects a simple diagnosis. At the level of the whole euro zone current account is close to equilibrium and fiscal deficit is smaller than in many other OECD countries. The euro is close to its equilibrium parity. But intra-European imbalances are huge. The euro is strongly overvalued for Southern European countries, France included, and largely undervalued for Northern European countries, especially Germany. We gave new estimation of these misalignments. Using panel econometric techniques over the period 1994-2010, we confirmed that the exchange rate misalignments in the euro zone have diverged, reflecting unsustainable evolutions. These exchange rate misalignments block growth and induce fiscal and current deficits in the South while growth is boosted in the North by exports, especially towards the rest of the euro zone, and deficits are reduced. This situation is equivalent to implicit positive transfers in favour on the North and negative transfers at the detriment of the South, which are largely ignored in the public debate. We gave estimation of these implicit transfers and compared these results with the evaluation of the system of fiscal insurance proposed by the Commission to fight asymmetric evolutions. In a second step, we used a stock-flow consistent model of a monetary union with two countries along the lines of Godley and Lavoie (2007). The model describes the real sector and assets and liabilities of all the agents in order to analyze adjustment mechanisms and financial integration in a consistent manner. A federal budget is introduced with federal expenditures and social transfers financed by federal taxes and euro-bonds issuing. Three results were obtained. The stabilizing role of such a federal budget is confirmed facing asymmetric shock, especially a loss of competitiveness due to exchange rate misalignments inside the monetary union. Similarly, the stabilizing role of euro-bonds used to finance European investment projects is illustrated. Their role in the pooling of national debts would be the last point to examine.

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A Transaction-flow Matrix

Table A.1: Transaction-flow matrix

	COUNTRY N						
	Households N	Firms N		Government N	Banks N	Federal Budget	Central Bank
Goods N	$-C^N$	$+Y^N$	$-I^N$	$-G^N$		$-GE^N$	
Goods S	$-X^S + IM^S$					$-GE^S$	
Wages	$+W^N$	$-W^N$					
Social transfers	$+ST^N$			$-ST^N$			
Social contributions	$-CL^N$			$+CL^N$			
Federal transfers	$+FT^N$					$-FT$	
Interest on loans		$-r_l.L^N_{-1}$			$+r_l.L^N_{N-1}$ $+r_l.L^S_{N-1}$		
Interest on deposits	$+i_d.BD^N_{-1}$				$-i_d.BD^N_{-1}$		
Interest on refinancing					$-i_b.RF^N_{-1}$		$+i_b\left(RF^N_{-1} + RF^S_{-1}\right)$
Interest on bonds	$+B^N_{N-1}$ $+B^S_{N-1}$			$-B^N_{-1}$			
Interest on Eurobonds	$+r_e.BT^E_{Nh-1}$				$+r_e.BT^E_{Nb-1}$	$+r_e.BT^E_{-1}$	
Interest on bills				$-r.BT^N_{-1}$	$-r.BT^N_{N-1}$ $-r.BT^S_{N-1}$		
Dividends	$+DIV^N_{hN}$	$+DIV^N_{eN}$ $-DIV^N$					
	$+DIV^S_{hN}$	$+DIV^S_{eN}$					

Tax	$-T^N$			$+T^N$				
		$-T_f^N$		$+T_f^N$				
	$-T_{Nh}^E$						$+T_h^E$	
		$-T_{Nf}^E$					$+T_f^E$	
					$-T_{Nb}^E$		$+T_b^E$	
							$+T \in B$	$-T \in B$
Profit		$-UP^N$	$+UP^N$					
					$-PB^N$	$+PB^N$		
Deposit	$-\Delta BD^N$					$+\Delta BD^N$		
Currency	$-\Delta H_h^N$					$-\Delta H^N$		
Loans			$+\Delta L^N$			$-\Delta L_N^N$		
						$-\Delta L_N^S$		
Refinancing						$+\Delta RF^N$		
Bonds	$-p_b^N.\Delta B_N^N$			$+p_b^N.\Delta B^N$				
	$-p_b^S.\Delta B_N^S$							
Eurobonds	$-\Delta BT_{Nh}^E$					$-\Delta BT_{Nb}^E$	$+\Delta BT^E$	
Bills				$+\Delta BT^N$		$-\Delta BT_N^N$		
						$-\Delta BT_N^S$		
Equities	$-p_e^N.\Delta E_{hN}^N$		$-p_e^N.\Delta E_{eN}^N$					
			$+p_e^N.\Delta E^N$					
	$-p_e^S.\Delta E_{hN}^S$		$-p_e^S.\Delta E_{eN}^S$					
Σ	0	0	0	0	0	0	0	0

(continues)

	COUNTRY S						
	Central Bank	Households S	Firms S		Government S	Banks S	Σ
Goods N	$-X^N + IM^N$						0
Goods S		$-C^S$	$+Y^S$	$-I^S$	$-G^S$		0
Wages		$+W^S$	$-W^S$				0
Social transfers		$+ST^S$			$-ST^S$		0
Social contributions		$-CL^S$			$+CL^S$		0
Federal transfers		$+FT^S$					0
Interest on loans						$+r_l.L^N_{S-1}$	0
			$-r_l.L^S_{-1}$			$+r_l.L^S_{S-1}$	0
Interest on deposits		$+i_d.BD^S_{-1}$				$-i_d.BD^S_{-1}$	0
Interest on refinancing						$-i_b.RF^S_{-1}$	0
Interest on bonds		$+B^N_{S-1}$					0
		$+B^S_{S-1}$			$-B^S_{-1}$		0
Interest on Eurobonds		$+r_e.BT^E_{Sh-1}$				$+r_e.BT^E_{Sb-1}$	0
Interest on bills						$+r.BT^N_{S-1}$	0
					$-r.BT^S_{-1}$	$+r.BT^S_{S-1}$	0
Dividends		$+DIV^N_{hS}$	$+DIV^N_{eS}$				0
		$+DIV^S_{hS}$	$+DIV^S_{eS}$				0
			$-DIV^S$				

Tax		$-T^S$			$+T^S$			0
			$-T_f^S$		$+T_f^S$			0
		$-T_{Sh}^E$						0
			$-T_{Sf}^E$					0
						$-T_{Sb}^E$		0
								0
Profit			$-UP^S$	$+UP^S$				0
						$-PB^S$	$+PB^S$	0
Deposit		$-\Delta BD^S$					$+\Delta BD^S$	0
Currency	$+\Delta H$	$-\Delta H_h^S$					$-\Delta H^S$	0
Loans							$-\Delta L_S^N$	0
				$+\Delta L^S$			$-\Delta L_S^S$	0
Refinancing	$-\Delta RF^N - \Delta RF^S$						$+\Delta RF^S$	0
Bonds		$-p_b^N.\Delta B_S^N$						0
		$-p_b^S.\Delta B_S^S$			$+p_b^S.\Delta B^S$			0
Eurobonds		$-\Delta BT_{Sh}^E$					$-\Delta BT_{Sb}^E$	0
Bills							$-\Delta BT_S^N$	0
					$+\Delta BT^S$		$-\Delta BT_S^S$	0
Equities		$-p_e^N.\Delta E_{hS}^N$		$-p_e^N.\Delta E_{eS}^N$				0
		$-p_e^S.\Delta E_{hS}^S$		$-p_e^S.\Delta E_{eS}^S$				0
				$-p_e^S.\Delta E^S$				
Σ	0	0	0	0	0	0	0	0