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Résumé

In this paper we use the notion of distributable surplus, introduced by Allais (1943) and Luenberger (1992), to evaluate the capacity of European countries to repay their debts. In our analysis, we use Computable General Equilibrium (CGE) models to simulate different policies that can be implemented to achieve debt sustainability. We first evaluate the quantity of distributable surplus that can be extracted from policies aiming at increasing the quantity of labor and/or capital available in the economy. We show that the results are very sensitive whether we consider deficits before and after the recent financial and economic crises. Then, assuming that governments are able to capture all the distributable surpluses, we compute the date at which they are able to repay their debts. In particular, we find that most EU countries, excepted Germany and to lesser extent France and the UK, cannot achieve debt sustainability. We finally discuss the usefulness of Eurobonds.

Keywords : Distributable surplus, public deficit, sovereign debt, debt sustainability, CGE models.

JEL classification : D61 ; H61 ; H62 ; H63 ; E62 ; C68 ;

1 Introduction

Over the years European governments have built huge public debts. With the recent economic crisis the deficits have reached unprecedented levels as it seemed necessary to support the economy with budgetary measures (consider for example, the help to the French automobile industry). Table 1 shows the level of public deficits and debts in 2005, 2009 and 2010, i.e. before and after the financial and economic crises. We can see that deficits have worsen considerably for most countries except Germany and in particular for Greece, Spain, Ireland and the UK. Consequently the public debt has dramatically increased in this period.

TABLE 1 – Public deficits and debts for several European countries

	2005		2009		2010	
	Public deficit / GDP	Public debt / GDP	Public deficit / GDP	Public debt / GDP	Public deficit / GDP	Public debt / GDP
France	2.9	66.4	7.5	78.3	7.0	81.7
Germany	3.3	68.0	3.0	73.5	3.3	83.2
Greece	5.2	100.0	15.4	127.1	10.5	142.8
Ireland	-1.6	27.4	14.3	65.6	32.4	96.2
Italy	4.3	105.9	5.4	116.1	4.6	119.0
Spain	-1.0	43.0	11.1	53.3	9.2	60.1
UK	3.4	42.5	11.4	69.6	10.4	80.0

Source: Eurostat

The question arises as to whether European governments will be able to repay their debt or whether they will have to resort to inflationary measures, or explicit default. Governments need the cooperation of taxpayers to be able to levy enough taxes to repay their debts. However, if taxes are too high, people could modify their behavior in the labor market by reducing labor supply and in the capital market by transferring capital offshore, implying that the State will not be able to levy enough taxes. So, it is not possible as often advocated in the popular press, to simply take money from the relatively wealthy.

The idea of our paper is that only surpluses can be taxed away by the governments. Surplus can be loosely defined as the difference between the maximum

price a buyer is ready to pay and the minimum price a seller is ready to accept for any trade. In the absence of state intervention, the surplus is shared by the buyer and the seller according to their bargaining power. The government can potentially take all the surplus in the transaction but not more as the buyer and/or the seller would get less then their reservation price and would then withdraw from the trade. Because of its excessive greediness, the state would dry out the source of income on which it draws.

The surplus indicates the maximum amount that is taxable by the State. We will assume here that governments are able to tax all surpluses even if, in practice, the effective amount that can be extracted depends on the available fiscal tools as well as the information available to the State. The specific notion of surplus that is used in our paper is that of the distributable surplus proposed by Allais (1943, 1981) or, equivalently, of the benefit function proposed by Luenberger (1992, 1995). In particular, Allais and Luenberger define surplus as the maximum quantity of a reference good that can be taken away from a consumer with a given level of utility.

Several methods permit the evaluation of distributable surplus. For example, methods based on contingent evaluation are particularly well suited for experimental microeconomic analysis. The method we follow in our paper is based on the use of Computable General Equilibrium (CGE) models as they seem more suitable for macroeconomic analysis. However, independently of the method used to compute the distributable surplus, it represents the upper limit of taxable output.

The aim of our paper is to use the concept of distributable surplus to evaluate how much surplus can be extracted from European economies in order to investigate whether European public debts are sustainable. Given that the distributable surplus represents the maximum taxable output that governments can extract from their respective taxpayers, we are able to compute the maximum level of debt that governments can afford and to determine the date at which governments are able to repay their debts. The result of our analysis is that most EU countries, excepted Germany and to lesser extent France and the UK, cannot achieve debt sustainability.

It is important to note that the methodology used in our paper differs from that of previous studies. Public debt sustainability has been empirically tested by assuming that past behavior of fiscal policies remains constant. Hamilton and Flavin (1986) propose a framework for analyzing whether governments can run a Ponzi scheme or not and find sustainability of US fiscal policy. A number of studies have tested the sustainability of public deficits by analyzing the stationarity and the cointegration properties of total public expenditures and revenues as ratios of GDP. Concerning European countries, Santos Bravo and Silvestre (2002), assuming that cointegration of expenditures and revenues is a sufficient condition for sustainability, find sustainable fiscal policies in Germany, the UK, Austria, France and the Netherlands, but not in Belgium, Denmark, Ireland, Portugal, Italy and Finland. Greiner *et al.* (2007), find that fiscal policies in some European countries are sustainable following the approach developed by Bohn (1995, 1998) implying that the intertemporal budget constraint of the government holds in the case in which the public debt to GDP ratio is a mean-reverting process.

The paper is organized as follows. In the following section we define distributable surplus through the Allais (1943) and Luenberger (1992) benefit function and Boiteux' (1951) distributable income function. Then we investigate whether European countries have generated sufficient surplus during the period 2005-2009 to cover their public deficits. In section 4, we analyze the sustainability of European public debts. We then present CGE models for seven European countries and evaluate, using different fiscal rules, whether various policies are able to generate sufficient surplus. We conclude in the last section.

2 The distributable surplus

Let an economy be composed by two consumers $j = 1, 2$ and two goods $i = 1, 2$. They have the following utility function $U_j(x_j) = U_j(x_j^1, x_j^2) = \prod_i (x_j^i)^{\alpha_j^i}$ with $\alpha_j^1 + \alpha_j^2 = 1$ and they are endowed with the bundle of goods $\omega_j = \{\omega_j^1, \omega_j^2\}$.

Let $g \in \Re_+^2$ be a reference bundle of goods, arbitrarily defined. Let u be a reference utility level which represents the minimum utility level that is acceptable by the individual. We can define the distributable surplus relative to the reference

utility u and the bundle of good x as :

$$\begin{cases} b_j(x_j, u_j) & = & \max_\beta \beta \\ s.t. \quad u_j(x_j - \beta g) & \geq & u_j \end{cases} \tag{1}$$

In words, the distributable surplus represents the maximum number of units of bundle g that the consumer j is ready to give up to obtain bundle x_j when his initial utility level is u_j. If g is a unit of gold, then $b_j(x_j, u_j)$ can be interpreted as the maximum price that the agent will agree to pay in order to acquire x_j knowing that he has a utility level of u_j. Hence, $b_j(x_j, u_j)$ can be interpreted as the reservation price of x_j for individual j as gold can be taken as the *numéraire*.

In the case of the above Cobb-Douglas utility function, for $g = (1, 0)$, the distributable function is given by :

$$b_j(x, u) = x_j^2 - \left(\frac{u_j}{(x_j^1)^{\alpha_j^1}} \right)^{\frac{1}{\alpha_j^2}}$$

Alternatively, it is possible to use Boiteux' surplus function to evaluate total distributable surplus in the economy. Boiteux' (1951) and Courtault *et al.* (2008) present an analogue of the benefit function in the dual space of price-income pairs, ranked with the agent's indirect utility functions v_j. Agent j's Boiteux' surplus at utility level u_j, relative to the price-income pair $(\mathbf{p}, R_j)$, is defined by :

$$d(\mathbf{p}, R_j, u_j) = \min_d d \;\; s.t. \;\; v_j(\mathbf{p}, R_j + d) \geq u_j \tag{2}$$

The Boiteux' distributable income function $d(\mathbf{p}, R_j, u_j)$ measures the income that must be given to an individual to move from a reference utility level u_j to an environment $(\mathbf{p}, R_j)$ which represents the new allocation. The Boiteux's distributable income function, being defined in terms of income, is more intuitive than the benefit function which is defined in terms of an arbitrary bundle of goods. In the case of the Cobb-Douglas utility function, the distributable income function is given by :

$$d(\mathbf{p}, R_j, u_j) = R_j - u_j \cdot \prod_i \left(\frac{p^i}{\alpha_j^i}\right)^{\alpha_j^i}$$

In the Appendix we determine the distributable surplus in a 2x2 pure exchange economy. In particular, we compute the equilibrium of this economy and we deduce the total maximal distributable surplus using both measures that can be extracted from this economy. This distributable surplus, that is also expressed as a percentage of GDP, is computed using as reference utility level for each consumer the utility of his initial endowment, as this represents the minimum utility level that an individual can achieve if he chooses not to trade.

3 CGE model for several European countries

In this section we use CGE models in order to evaluate the distributable surplus that European governments can extract from their taxpayers. The analysis is carried out by using CGE models for seven countries : France, Germany, Greece, Ireland, Italy, Spain and the United Kingdom.

It is important to note that computable general equilibrium models are built in such a way that observed situation represents the equilibrium of the economy. Hence, the initial allocation in CGE models is already Pareto-optimal as first welfare theorem is always verified in the absence of externalities and market frictions. However, fiscal policies or other macroeconomic shocks can change the equilibrium of the economy. So, for each shock, we are able to compute the distributable surplus which can be generated from this shock. This will give us an idea as to which policy can be implemented to generate maximum possible surplus.

The structure of the model we used in our paper is fairly standard, along the lines of Devarajan and Lewis (1990) and Shoven and Whalley (1992). CGE models are widely used to analyze the effects of macroeconomic shocks and policies in a coherent framework that takes into account the interrelations existing among economic agents (firms, households, government, and the rest of the world).

3.1 Description of the CGE models

In this paper, we use a CGE model for each of the seven countries considered. Each CGE model is multisectoral (we consider 16 sectors) and considers a representative household. The models are built by using 2005 input-ouput data provided by OECD and data concerning national accounts. In order to take into account the effects of the recent crisis on the possibility of surplus extraction, we use 2009 data from national accounts and we use the same structure for input-output.

In each sector, production depends on the quantity used of primary factors (labor and capital) and of intermediate goods. We use a two-stage CES production function where in the first stage production depends on primary factors and total intermediate good, and in the second stage the total intermediate good depends on the intermediate goods produced by the other sectors. The production is sold in the domestic market or exported, where exports depend on the relative price, i.e. the ratio between the foreign price and the domestic price. The production that is sold in the domestic market and the imports constitute a composite good that is sold in the market to the firms (as intermediate goods), the households, the government, or used as investment good. The production that is sold in the domestic market and the imports are assumed to be imperfect substitutes (Armington assumption).

Concerning the households, the disposable income is given by the difference between the revenues (labor and capital incomes, transfers from the government and interests on the public debt) and direct taxation. An exogenous and constant fraction of the disposable income is saved and the complementary fraction is consumed. Households have CES preferences that allow them to determine the optimal quantity of goods demanded for each sector.

Concerning the budget constraint of the government, the difference between the total expenditure (for goods demanded, transfers to households and interests on the public debt) and revenues (direct and indirect taxation) determines the government deficit. We discuss the fiscal rule in the next section.

The equilibrium of the balance of payments is guaranteed by capital inflows or outflows that are endogenously determined by the net exports. This implies that the exchange rate is fixed exogenously. Another possibility is to fix the capital inflows and determine the exchange rate endogenously in order to equilibrate the

balance of payments. This is the case for the United Kingdom.

We use the neoclassical macro-closure implying that investments are determined by aggregate savings, i.e private and public savings and international capital flows.

All markets clear. For each sector, the domestic price adjusts in order to equalize the quantity produced and demanded (domestic and foreign). The real wage adjusts in order to equalize the total labor demanded by the sectors and the (exogenous) labor supplied by the households and the real capital remuneration adjusts in order to equalize the total capital demanded by the sectors and the (exogenous) capital supplied by the households. The models are solved by considering the producer price index as the *numeraire*.

3.2 Fiscal rules

The government budget constrain can be written as :

$$Def = G + \Gamma + r \cdot B - \left(\sum_i \tau_{VA_i} \cdot VA_i + \sum_i \tau_{prod_i} \cdot Y_i + \tau_Y \cdot Y \right) \tag{3}$$

where G represents the total government expenditure for goods and services, Γ the transfers to families, $r \cdot B$ the interests paid on the public debt, τ_{VA_i} the VAT rate differentiated by sector i, τ_{prod_i} the tax rate on products, τ_Y the income tax rate. The government can set any of the following variables (except one) : the deficit, the total expenditure, transfers to households, the income tax rate, the VAT rates and the tax rates on products. We will not consider as instruments the transfers, the VAT rates and the tax rates on products and we consider to following five fiscal rules.

In the first fiscal rule, the government deficit and the income tax rate are assumed to be exogenous and fixed at the initial level ($Def = Def_0$ and $\tau_Y = \tau_{Y_0}$), and the total government expenditure (G) is endogenously determined in order to satisfy the budget constraint.

In the second fiscal rule, the government deficit is assumed to be exogenous and fixed at the initial level ($Def = Def_0$), the total government expenditure per

worker is kept constant ($\frac{G}{L} = \alpha$) and the income tax rate (τ_Y) is endogenously determined in order to satisfy the budget constraint.

In the third fiscal rule, the government deficit is determined such that the ratio between the deficit and GDP remains constant ($\frac{Def}{GDP} = \beta$), the income tax rate is assumed to be exogenous ($\tau_Y = \tau_{Y_0}$) and the total government expenditure (G) is endogenously determined in order to satisfy the budget constraint.

In the fourth fiscal rule, the government deficit is determined such that the ratio between the deficit and GDP remains constant ($\frac{Def}{GDP} = \beta$), the total government expenditure is kept constant ($G = G_0$) and the income tax rate (τ_Y) is endogenously determined in order to satisfy the budget constraint.

In the fifth fiscal rule, the total government expenditure and the income tax rate are exogenous ($G = G_0$ and $\tau_Y = \tau_{Y_0}$) and the government deficit (Def) is endogenously determined in order to satisfy the budget constraint.

3.3 Reference bundle

In our analysis we consider two reference bundles : in the first case we consider the equilibrium consumption bundle of the representative household. In the second case, we will use instead the distributable income as the reference unit.

Two choices are possible : either we fix the reservation utility at the 2005 utility level, or at 2009 utility level. In the first case we are able to answer whether there was enough surplus in the economy to cover the 2009 deficit, or whether it would have been necessary to cut spending. We will also be able to compute the reduction of well-being necessary to generate sufficient surplus in the case in which diminution of spending is not politically feasible. In the second case, one considers implicitly that no reduction of well-being is acceptable by the community, hence we consider whether the government is able to generate surplus through the introduction of a policy aiming at increasing the quantity of labor and/or capital available in the economy. [1]

1. This kind of policy is the only possible in order to increase GDP in a CGE model that is not demand-driven.

4 Have European economies generated sufficient surpluses ?

We examine now whether the economies have generated sufficient surpluses in the period 2005-2009 to cover the public deficits during the same period. Surpluses are sufficient when the quantity of surplus generated by each economy is greater or equal than actual deficit.

In order to compute the surplus it is necessary to fix a reservation utility level defined as the minimum utility level that households will accept. We assume that the reference utility level is the level in 2005 i.e. before the crisis.

Table 2 shows that the surplus generated between 2005 and 2009 was not sufficient to cover the 2009 deficit for Greece, Ireland and Spain. For these countries in order to generate a surplus equal to the 2009 deficit, it would be necessary to reduce the initial well-being (measured by the disposable income devoted to consumption) by 11% in Greece, 13% in Ireland and Spain, and 9% in the UK. Indeed to sustain such level of deficit, Ireland for example, would have to accept a level of disposable income lower than 13% than the 2005 level, corresponding to the 2002 level. This table clearly shows that some countries (Ireland, Spain, the UK, and more particularly Greece) have increased their level of consumption between 2005 and 2009 even if they should have reduced it drastically. France has increased its consumption over and above the feasible level, while Italy has slightly decreased consumption as necessary. In contrast, Germany has increased consumption well below what they could have done.

Each government could have extracted more surplus each year instead of running deficits. But they didn't. Hence, they have to repay past deficits with current surplus. Here, we consider the case whether countries are able to repay past deficits (cumulated in the period 2005-2009) with the 2009 surplus. The only country that could have done that is Germany and could maintain the 2003 well-being level. All the other countries should accept a strong reduction in their well-being, comparable to their early 1990 level.

TABLE 2 – Analysis of the capacity of EU countries to cover public deficits

	France	Germany	Greece	Ireland	Italy	Spain	Uk
Surplus 2009 (reference utility 2005) / GDP (2009)	8.0%	7.1%	7.6%	8.9%	5.1%	4.0%	5.8%
Deficit (2009) / GDP (2009)	7.5%	3.0%	15.4%	14.3%	5.4%	11.1%	11.4%
% actual variation of consumption wrt 2005	5.1%	1.8%	9.2%	3.1%	-0.3%	2.4%	1.1%
% variation of consumption wrt 2005 compatible with budget equilibrium	1.2%	8.2%	-11.8%	-13.3%	-0.3%	-13.4%	-9.2%
Year corresponding to the reference utility necessary to achieve budget equilibrium	2005-2006	> 2010	2002	2002	2005	2001	2001
Cumulate deficits 2005-2009 / GDP (2009)	18.7%	7.5%	42.5%	17.0%	17.3%	10.4%	25.2%
% variation of consumption wrt 2005 compatible with budget equilibrium	-21.2%	-0.4%	-53.1%	-13.3%	-22.8%	-12.4%	-33.1%
Year corresponding to the reference utility necessary to achieve budget equilibrium	1994	2003	< 1980	2002	1998	2001	1993

5 Simulation results of different macroeconomic shocks on distributable surpluses

In this section we consider the case in which people do not accept any reduction of their well-being and we analyze the policies that government could implement in order to generate sufficient surplus. Indeed, we are entitled to consider that the reference utility level of agents is equal to the utility level that they achieved in the absence of the policies under consideration. In fact, the government is perfectly free to introduce or not these policies and, as a consequence, it can capture all the surpluses that can be generated by these policies.

The analysis is carried out by using the CGE models. The initial equilibrium used to calibrate our models gives us the reference utility level. Starting from this level, a macroeconomic shock or policy will move the economy out of the initial equilibrium and will allow us to compute the surplus generated by such a shock.

We consider three types of shocks under different fiscal rules : a shock on the labor supply and on the capital supply and on both. These shocks may be interpreted as government policies. An increase in the labor supply may be induced, for example, by an immigration policy, an increase in the retirement age, or an increase in the legal number of work hours per week. An increase in capital supply may be induced, for example, by policies stimulating foreign investments or the

repatriation of national capitals invested abroad. Some of the fiscal rules considered in our simulations permits to consider the cost of these policies. For example, an immigration policy requires an increase in expenditures (health, education, infrastructures) which is explicitly taken into account by the second fiscal rule in which per capita public expenditure is kept constant.

In our analysis, we consider two distinct periods, before and after the 2009 economic crisis. This allows us to reach a more balanced view of the possibility to generate distributable surplus, since both periods of expansion and depression tend to give a biased evaluation of the effect of government policies.

5.1 Before the crisis

The objective of our simulations is to compute the increase in (i) labor supply, or (ii) capital supply, or (iii) both labor and capital supply, that is necessary to generate a surplus sufficient to cover the public deficit. In what follows, we define the "efficiency" of a production factor as the capacity of this factor to generate such a surplus. The higher is the necessary increase in a factor, the lower is the efficiency of this factor.

The simulations are run only for the five countries that display a deficit (Greece, France, Germany, Italy, UK), and not for the two countries that have a surplus in 2005 (Ireland and Spain). For each country and the five fiscal rules, we show in Table 3 the percentage variation of production factors necessary to generate a surplus equal to the budget deficit.

First of all, the results shows that countries can be separated in two groups : France, Germany and UK on one side, and Greece and Italy on the other side. The difference between the two groups is related to the share of labor incomes in total GDP that is quite low in the second group (lower that 50%). The two groups are also different in terms of public deficits over GDP in 2005 : countries in the first group have deficits close to the level fixed by the Maastricht rule, while the countries in the second group have a much higher deficit.

TABLE 3 – Percentage increase in factor supply necessary to cover the 2005 deficits

		1st	2nd	3rd	4th	5th	Average
France	L	7.4%	10.9%	7.7%	10.9%	11.4%	9.7%
	K	16.6%	12.5%	18.2%	12.6%	12.2%	14.4%
	L and K	4.8%	5.4%	5.0%	5.4%	5.4%	5.2%
Germany	L	9.3%	13.4%	9.8%	13.5%	14.5%	12.1%
	K	16.3%	12.8%	17.8%	13.0%	12.4%	14.5%
	L and K	5.5%	6.0%	5.9%	6.0%	6.1%	5.9%
UK	L	7.6%	9.0%	7.9%	9.0%	9.0%	8.5%
	K	19.4%	15.7%	21.8%	15.7%	15.6%	17.6%
	L and K	5.1%	5.3%	5.4%	5.3%	5.3%	5.3%
Italy	L	14.8%	22.9%	15.6%	23.0%	23.5%	20.0%
	K	16.9%	13.2%	19.3%	13.3%	13.1%	15.2%
	L and K	7.2%	7.5%	7.8%	7.5%	7.5%	7.5%
Greece	L	14.8%	23.6%	15.5%	23.2%	21.7%	19.8%
	K	14.3%	12.2%	16.2%	12.0%	12.5%	13.4%
	L and K	6.7%	7.2%	7.3%	7.2%	7.2%	7.1%

By considering the first fiscal rule, in which the government deficit and the income tax rate are exogenous while the public expenditure is determined by the government budget constraint, we can see that, for countries in the first group, it is necessary to increase capital supply by a much larger amount than labor supply while, for Greece and Italy, the difference between the necessary increase in labor and capital supply is much lower. It is interesting to compare Germany and the UK as they have almost identical deficit/GDP ratio. We can note that in order to generate a surplus equal to the deficit, the UK has to increase labor supply by a smaller amount than Germany, but needs a greater increase in capital supply. Overall, the efficiency is greater in the UK, in the sense that UK has to increase both factors by 5.1% vs. 5.5% for Germany. France needs to increase both factors by only 4.8% thanks to the lower deficit/GDP ratio with respect to Germany and the UK. Interestingly, whereas Greece has a greater deficit than Italy, it is necessary to increase labor and capital supply by a lower amount (6.7% versus 7.2% for Italy).

With the second fiscal rule the efficiency of the increase in labor supply is

much smaller for each country than in the first fiscal rule. However, the necessary increase in capital supply is much smaller than in the first fiscal rule. The results are explained by the fact that with this rule, per worker government expenditure is kept constant. This is justified by the fact that the increase in labor supply can be realized by an immigration policy. Consequently, an increase in labor supply produces an increase in public spending which has a negative influence on the government finances. The overall efficiency of the increase in both factors is lower than in the first fiscal rule. Indeed, the first fiscal rule is more overall efficient than any other fiscal rules. If we look at labor supply efficiency, we can see that the most efficient fiscal rule is the first one, whereas in terms of capital supply efficiency, the most efficient fiscal rule is the fourth.

The results obtained with the third fiscal rule are very similar to the ones obtained with the first fiscal rule, although the overall efficiency of labor and capital supply is greater with respect to the first fiscal rule.

5.2 After the crisis

After the crisis, the increase in only one production factor that would be necessary to generate a sufficient surplus to cover the 2009 deficit is too large to be considered as feasible. So, instead, we consider an increase in both factors. Table 4 show that only Germany appears to have maintained its capacity to generate enough surplus to cover the deficit, whereas all the other countries have seen their situation drastically deteriorated. Indeed simple average across fiscal rules shows that for Germany an increase of 5.6% of both labor and capital is sufficient to generate a surplus equal to the deficit, whereas it was 5.9% before the crisis. For all the other countries the percentage shock over both labor and capital is much higher after the crisis, with a maximum average of 41.2% for Ireland. We can rank the countries by increasing order of difficulty of getting out of the budget deficit dilemma : Germany 5.6%, Italy with 9.9%, France with 15%, the UK with 22.7%, Spain with 23.5%, Greece with 24.6% and Ireland with 41.2%.

TABLE 4 – Percentage increase in both factors necessary to cover the 2009 deficits

	1st	2nd	3rd	4th	5th	Average
Germany	6.2%	5.0%	6.6%	5.1%	4.9%	5.6%
Italy	11.0%	8.7%	12.6%	8.8%	8.5%	9.9%
France	15.4%	13.8%	18.3%	14.1%	13.6%	15.0%
UK	23.5%	19.5%	31.3%	19.8%	19.2%	22.7%
Spain	23.2%	20.9%	30.9%	22.0%	20.3%	23.5%
Greece	21.3%	24.6%	27.6%	24.7%	24.7%	24.6%
Ireland	36.8%	35.5%	58.9%	39.7%	35.0%	41.2%

The media have particularly stressed the difficulty for Greece to repay its debt whereas its situation is not much worse than that of Spain and, surprisingly, the UK. The situation of Ireland seems catastrophic. This result is only partly explained by the value of the deficits that are different in each country. The deficit of Greece is more important that of Ireland. However the percentage increase in production factors to cover the deficit is smaller.

The third fiscal rule seems to be the worst rule in order to generate a surplus sufficient to cover the deficit. For all countries, except Greece, the best fiscal rule is the fifth, i.e. the case in which public deficits are endogenous. It would seem that a Maastricht rule type is bad during crisis whereas it seems better to adopt a more permissive budgetary policy.

5.3 Equal deficit

Here we make the assumption that the public deficit, for each country, respects the Maastricht criterium, i.e. is equal to 3% of GDP. Table 5 shows that each European country is able to generate sufficient surpluses. Surprisingly, Greece is now in a better position with respect to the other countries, while Ireland is again in the worst position. Except for the UK, where the best fiscal rule is now the second or the fourth, the ordering of the fiscal rules for the other countries has not changed.

TABLE 5 – Percentage increase in both factors necessary to cover a deficit equal to 3% of GDP

	1st	2nd	3rd	4th	5th	Average
France	5.8%	5.2%	6.2%	5.2%	5.1%	5.5%
Spain	5.7%	5.0%	6.0%	5.1%	5.0%	5.4%
Germany	6.1%	5.0%	6.5%	5.0%	4.9%	5.5%
Ireland	6.7%	6.3%	7.2%	6.4%	6.3%	6.6%
Italy	6.1%	4.8%	6.5%	4.8%	4.7%	5.4%
Greece	3.5%	4.0%	3.7%	4.0%	3.9%	3.8%
UK	5.7%	4.6%	6.0%	4.6%	4.7%	5.1%

6 Sustainability of public debts

In this section we compute for each country the year in which the actual public debt plus the present value of future public deficits are compensated by the present value of future distributable surpluses. Public debt is defined as sustainable only in the case in which the date computed exists.

In our analysis we make the following assumptions : for each country, the ratio of public deficit with respect to GDP decreases linearly over time towards zero between 2012 and 2020 ; real GDP and distributable surpluses grow at the constant rate of 1.5%.

In the computation of the present values, we consider four different interest rates. The first one is the ten-year government bond rate observed on November 9 2011.[2] This interest rate is relevant in the case in which all the debt has to be renewed at that date. However, if the time to maturity of the debt is not immediate, this interest rate is not relevant. This is why, secondly, we consider the average ten-year government bond rate observed in 2011 and, thirdly, the current yield interest rate computed as the ratio between actual interests payments and the actual public debt. Finally, we consider the average ten-year government bond rate observed in the Euro zone weighted by the size of public debts. This rate is interesting because it could approximate the rate on Euro bonds in the case

2. This date has been chosen in our analysis as it is one of the worst period in the history of the Euro zone in terms of high interest rates for most of highly indebted countries (Italy, Spain and Greece).

in which European governments decide to introduce this kind of instrument to finance the overall European debt.

The following table shows that, in any interest rate scenario, only France, Germany and the UK are able to repay the current public debt using future surpluses generated by their economies. This is precisely the case of the first scenario in which all the other countries are not able to repay their debts within a finite horizon. If we consider the average 2011 interest bond rate (second scenario) debt is not sustainable for Greece and Ireland, while for Italy and Spain the date computed is so remote that we can have doubts on the sustainability of their debts. If we consider the current yield and the Euro bond scenarios (third and fourth scenarios) the debt is sustainable for all countries. However, the third scenario is not very realistic as financial markets are not willing anymore to lend to most European countries on the basis of past interest rates at which the debt was contracted. It is interesting to note that in the Euro bond scenario the date computed is delayed, with respect to the second scenario, only for France and Germany by only two years. However, even this scenario is not very realistic since for Greece, Ireland, Italy and Spain the date is very remote implying a strong uncertainty concerning the validity of our hypotheses over such a long period.

TABLE 6 – Analysis of the sustainability of public debts

		November 09/2011 (1)	Average 2011 (2)	Current yield (3)	Euro average (4)
France	Interest rate	3.16%	3.32%	2.76%	4.66%
	Year	2026	2026	2025	2028
Germany	Interest rate	1.81%	2.74%	3.52%	4.66%
	Year	2021	2023	2023	2025
Greece	Interest rate	30.69%	16.66%	4.20%	4.66%
	Year	never	never	2049	2055
Ireland	Interest rate	8.24%	9.87%	2.90%	4.66%
	Year	never	never	2043	2061
Italy	Interest rate	6.76%	5.14%	3.60%	4.66%
	Year	never	2096	2049	2067
Spain	Interest rate	5.71%	5.40%	2.80%	4.66%
	Year	never	2136	2043	2064
UK	Interest rate	2.35%	3.13%	2.51%	
	Year	2034	2037	2035	

Source: Ecowin (November 2011)
(1) Bond yield on November 9 2011
(2) Average bond yield in 2011
(3) Interests / Public debt
(4) Average bond yield in 2011 weighted by the size of public debts

7 Conclusions

In this paper we use the concept of distributable surplus proposed by Allais (1943) and Luenberger (1992) to investigate about (i) the capacity of European governments to generate sufficient surpluses to cover public deficits and (ii) the sustainability of public debts.

After showing that European governments have not generated sufficient surplus with their economic policies implemented over the recent period (2005-2009), we investigate whether a policy aiming at increasing both labor and capital supply could be sufficient to cover actual deficits. Using CGE models for several European countries, we show that public deficits observed before the crisis could be covered by a relatively small increase in labor and capital supply of about 5%. However, in order to cover the 2009 public deficits would require for all countries, except Germany, a much larger increase in both production factors. Given that current public spending cannot be financed by taxing the distributable surplus as the level of the increase in labor and capital necessary to achieve the budget equilibrium is not realistic, European governments will have to reduce their public spending, at the most, to the level observed before the crisis.

Concerning the sustainability of public debts in the Euro zone, that is necessary for the preservation of the Euro system, we found that the best solution is the introduction of Euro bonds. However, even this scenario is not very realistic since for Greece, Ireland, Italy and Spain the date at which the debt is completely repaid is so remote that it raises doubts on the efficiency of this policy. In any case, this policy would imply the strict control of public expenditures of the different European countries by European institutions in order to maintain the debt under control.

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Appendix 1 : An illustration with a 2x2 pure exchange economy

Here, we present numerical simulations within a 2x2 pure exchange economy in which the economy is supposed to be composed by two consumers $j = 1, 2$ and two goods $i = 1, 2$. They have the following utility function $U_j(x_j) = U_j(x_j^1, x_j^2) = \prod_i (x_j^i)^{\alpha_j^i}$ with $\alpha_j^1 + \alpha_j^2 = 1$ and they are endowed with the bundle of goods $\omega_j = \{\omega_j^1, \omega_j^2\}$. We also assume that there exists one unit of each type of good.

The following tables present, for a given initial distribution of endowments and for a specific reference bundle, the effect of varying elasticities of the Cobb-Douglas utility function with respect to each good and the effect of the initial distribution of endowments, on the value of the distributable surplus expressed as the percentage of the total equilibrium value of income.

The first set of tables considers as reference bundle $g = (0, 1)$.

		α_1^1					α_1^1					α_1^1		
$\omega_1^1 = 0.25$ $\omega_1^2 = 0.75$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.50$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.25$		0.25	0.50	0.75
	0.25	8.64%	2.91%	0.00%		0.25	2.50%	0.00%	2.66%		0.25	0.00%	2.22%	6.89%
α_2^1	0.50	20.04%	12.50%	2.97%	α_2^1	0.50	10.99%	3.33%	0.00%	α_2^1	0.50	2.45%	0.00%	2.46%
	0.75	30.58%	23.99%	9.93%		0.75	21.26%	11.24%	2.48%		0.75	8.50%	2.39%	0.00%
$\omega_1^1 = 0.50$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.25$				
	0.25	2.37%	0.00%	2.74%		0.25	0.00%	3.21%	11.09%		0.25	2.37%	9.57%	17.99%
α_2^1	0.50	9.57%	3.33%	0.00%	α_2^1	0.50	3.21%	0.00%	3.29%	α_2^1	0.50	0.00%	3.33%	11.48%
	0.75	17.99%	11.48%	2.61%		0.75	11.09%	3.29%	0.00%		0.75	2.74%	0.00%	2.61%
$\omega_1^1 = 0.75$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.25$				
	0.25	0.00%	2.45%	8.50%		0.25	2.50%	10.99%	21.26%		0.25	8.64%	20.04%	30.58%
α_2^1	0.50	2.22%	0.00%	2.39%	α_2^1	0.50	0.00%	3.33%	11.24%	α_2^1	0.50	2.91%	12.50%	23.99%
	0.75	6.89%	2.46%	0.00%		0.75	2.66%	0.00%	2.48%		0.75	0.00%	2.97%	9.93%

The second set of tables considers as reference bundle $g = (1, 0)$.

		α_1^1					α_1^1					α_1^1		
$\omega_1^1 = 0.25$ $\omega_1^2 = 0.75$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.50$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.25$		0.25	0.50	0.75
	0.25	8.64%	2.91%	0.00%		0.25	2.50%	0.00%	2.66%		0.25	0.00%	2.22%	6.89%
α_2^1	0.50	20.04%	12.50%	2.97%	α_2^1	0.50	10.99%	3.33%	0.00%	α_2^1	0.50	2.45%	0.00%	2.46%
	0.75	30.58%	23.99%	9.93%		0.75	21.26%	11.24%	2.48%		0.75	8.50%	2.39%	0.00%
$\omega_1^1 = 0.50$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.25$				
	0.25	2.37%	0.00%	2.74%		0.25	0.00%	3.21%	11.09%		0.25	2.37%	9.57%	17.99%
α_2^1	0.50	9.57%	3.33%	0.00%	α_2^1	0.50	3.21%	0.00%	3.29%	α_2^1	0.50	0.00%	3.33%	11.48%
	0.75	17.99%	11.48%	2.61%		0.75	11.09%	3.29%	0.00%		0.75	2.74%	0.00%	2.61%
$\omega_1^1 = 0.75$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.25$				
	0.25	0.00%	2.45%	8.50%		0.25	2.50%	10.99%	21.26%		0.25	8.64%	20.04%	30.58%
α_2^1	0.50	2.22%	0.00%	2.39%	α_2^1	0.50	0.00%	3.33%	11.24%	α_2^1	0.50	2.91%	12.50%	23.99%
	0.75	6.89%	2.46%	0.00%		0.75	2.66%	0.00%	2.48%		0.75	0.00%	2.97%	9.93%

In the last set of tables we compute the Boiteux' distributable income surplus.

		α_1^1					α_1^1					α_1^1		
$\omega_1^1 = 0.25$ $\omega_1^2 = 0.75$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.50$		0.25	0.50	0.75	$\omega_1^1 = 0.25$ $\omega_1^2 = 0.25$		0.25	0.50	0.75
	0.25	26.27%	13.40%	3.00%		0.25	2.62%	0.00%	2.78%		0.25	0.00%	2.41%	8.91%
α_2^1	0.50	12.21%	3.41%	0.00%	α_2^1	0.50	12.21%	3.41%	0.00%	α_2^1	0.50	2.53%	0.00%	2.53%
	0.75	42.26%	26.27%	10.11%		0.75	24.47%	11.65%	2.50%		0.75	8.91%	2.41%	0.00%
$\omega_1^1 = 0.50$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.50$ $\omega_1^2 = 0.25$				
	0.25	11.65%	3.41%	0.00%		0.25	0.00%	3.33%	12.26%		0.25	2.50%	11.65%	24.47%
α_2^1	0.50	3.33%	0.00%	3.33%	α_2^1	0.50	3.33%	0.00%	3.33%	α_2^1	0.50	0.00%	3.41%	12.21%
	0.75	24.47%	12.21%	2.62%		0.75	12.26%	3.33%	0.00%		0.75	2.78%	0.00%	2.62%
$\omega_1^1 = 0.75$ $\omega_1^2 = 0.75$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.50$					$\omega_1^1 = 0.75$ $\omega_1^2 = 0.25$				
	0.25	2.41%	0.00%	2.41%		0.25	2.62%	12.21%	24.47%		0.25	10.11%	26.27%	42.26%
α_2^1	0.50	0.00%	3.41%	11.65%	α_2^1	0.50	0.00%	3.41%	11.65%	α_2^1	0.50	3.00%	13.40%	26.27%
	0.75	8.91%	2.53%	0.00%		0.75	2.78%	0.00%	2.50%		0.75	0.00%	3.00%	10.11%

Firstly, we can see that the results are not affected by the choice of the reference bundle. Indeed, results are perfectly symmetrical when the reference bundle is $g = (0, 1)$ instead of $g = (1, 0)$. In addition, when we use income as the *numéraire*, the results are qualitatively similar. It is possible to note that when the elasticity with respect to one good is exactly equal to the initial endowment in that good for any agent, then the distributable surplus is nil however measured as the initial distribution is already Pareto-optimal (see for example Bewley, 2007, chapter 3). Moreover, the results show that the farther is the initial distribution from the Pareto-optimal allocation, the greater is the value of the distributable surplus that can be taxed by the government. Indeed, in the particular case where goods are equally distributed among consumers and preferences are identical, the distributable surplus is nil as the initial distribution is already Pareto-optimal, hence there is no incentives to trade.