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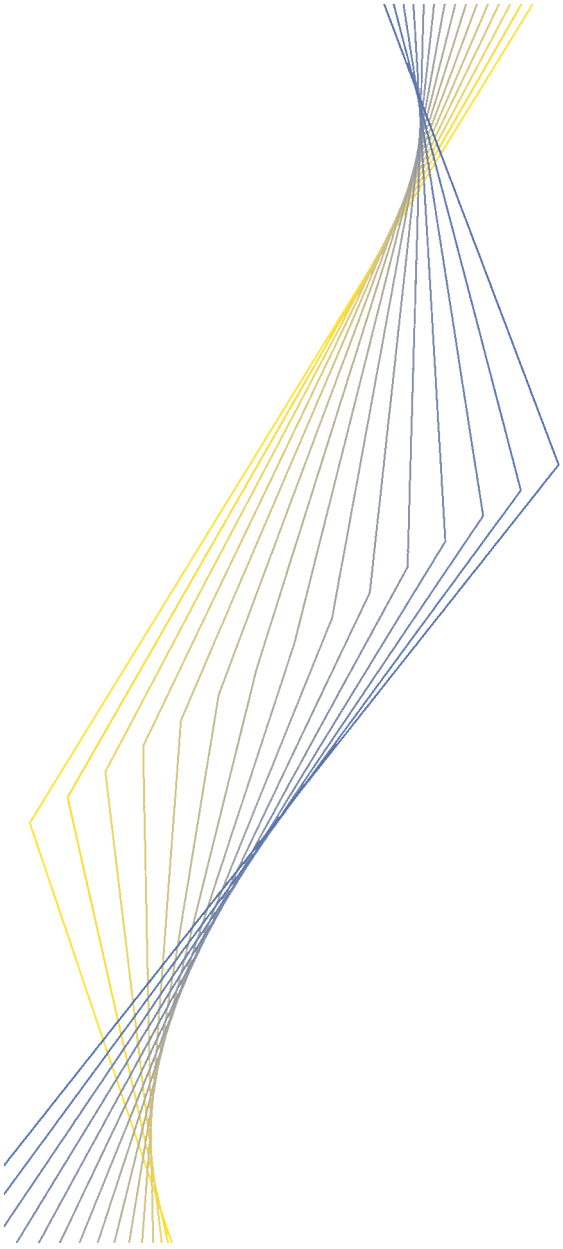

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SUSTAINABILITY OF PUBLIC FINANCES AND AUTOMATIC STABILISATION UNDER A RULE OF BUDGETARY DISCIPLINE[1]

BY JOSÉ MARÍN[2]

November 2002

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2 *European Central Bank*

Address	**Kaiserstrasse 29** **D-60311 Frankfurt am Main** **Germany**
Postal address	**Postfach 16 03 19** **D-60066 Frankfurt am Main** **Germany**
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

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Abstract

This paper addresses the question of how a fiscal rule of a general type can preserve the sustainability of public finances and provide automatic stabilisation, taking as given interest rates and price stability. This issue can be considered complementary to the analysis of monetary policy rules, whose targets are price stability and often also output stabilisation, assuming that fiscal policy guarantees the sustainability of public finances. Considering the institutional framework provided by the Stability and Growth Pact, the paper also draws some policy conclusions.

JEL Classification codes: E61, H62, H63

Keywords: Fiscal policy; Sustainability of public finances; Automatic stabilisation; Fiscal policy rules; Stability and Growth Pact.

Non-Technical summary

There are a number of issues under discussion in the current debate on rules of fiscal discipline in EMU: the way to implement the rules of budgetary discipline, the appropriate medium-term targets, the importance of allowing automatic stabilisers operate symmetrically over the cycle, the possibility of temporary deviations from close to balance or in surplus budgetary positions towards deficits, the operational assessment of the sustainability of public finances, etc. This paper analyses these questions in a simple but consistent theoretical framework and considers a general type of fiscal policy rule that makes sustainability and automatic stabilisation fully compatible.

The rules of budgetary discipline in EMU set up some constraints on fiscal policies in order to preserve the sustainability of public finances and allow a stabilising role to these policies. The EC Treaty imposed on governments of Member States the obligation to avoid excessive deficits, fixing maximum reference values for the deficit (3% of GDP) and the debt (60% of GDP). The Stability and Growth Pact further developed these criteria and Member States committed themselves to respect budgetary positions close to balance or in surplus in the medium term. This would allow automatic stabilisers to operate without risk of breaching the 3% reference value for the deficit in normal circumstances.

The analysis of monetary policy rules has received much more attention in the literature than the investigation of fiscal policy rules. The analysis of monetary rules usually assumes that the fiscal policy regime is Ricardian, in the sense that the government adjusts fiscal variables to guarantee its solvency whatever the price level. Under this hypothesis, the central bank is "functionally" independent and it can pursue a policy of price stability. This paper is focused on a complementary aspect. Assuming price stability and exogenous interest rates, it examines how can the government manage public finances following some rules in order to guarantee its sustainability and perform an automatic stabilisation role. We claim that the rules of budgetary discipline in EMU, while sufficient to preserve the sustainability of public finances, allow for the full operation of automatic stabilisers.

The analytical framework used in the paper seems appropriate to study fiscal policy decisions in the institutional environment of EMU. National governments, which remain exclusively responsible for fiscal policy, have to take interest rates as given and can safely assume price stability in the euro area. Interest rates will also be kept constant throughout the analysis. In order to introduce saving and domestic demand for public debt in the

analysis, an open economy overlapping generations model is chosen. Private agents are non-Ricardian in the sense that they do not care about the welfare of future generations. This makes it possible that fiscal policy affects the levels of output, consumption and leisure and creates an incentive for private agents to demand lax fiscal policies that would increase their lifetime utility at the expense of future generations.

The value added of this paper is twofold. From the theoretical point of view, it presents a model in which the intertemporal budget constraint of the government is replaced in the analysis of sustainability by a rule of budgetary discipline of a general type. This policy rule gives operational content to the theoretical constraint, guarantees the global stability of equilibrium and makes sustainability and automatic stabilisation compatible. Furthermore, the paper emphasises the use of nominal budget balance targets as percentages of GDP rather than cyclically adjusted figures, and estimates the discretionary adjustment required as a function of the observed values of the debt and deficit ratios.

1. Introduction

It has been argued that, while in a monetary union fiscal policies might have to play an enhanced role in stabilising the economy, at least in response to country-specific shocks, the rules of fiscal discipline in EMU are unduly restrictive. According to these arguments, the necessary flexibility for the conduct of fiscal policy was sacrificed to the concern with the sustainability of public finances and with the effective independence of the new central bank from budgetary pressures at the time the Treaty and the Stability and Growth Pact were negotiated. At present, the policy debate continues on the way to implement the rules of budgetary discipline in EMU, the appropriate medium-term targets, the importance of allowing automatic stabilisers operate symmetrically over the cycle, the possibility of temporary deviations from the close to balance budgetary positions towards deficits, the operational assessment of the sustainability of public finances, etc.

This paper studies these questions in a simple but consistent theoretical framework and analyses a general type of fiscal policy rule that makes sustainability and automatic stabilisation fully compatible. The criteria of budgetary discipline set up in the Treaty and the Stability and Growth Pact can be interpreted as a particular case of this rule. Given that the concepts used in the paper might have different interpretations in different contexts, it would be useful to clarify from the beginning the specific meaning in which these terms will be used here.

Sustainability means that the government can implement its pre-announced fiscal policy in equilibrium, i.e. that the fiscal policy chosen by the government is compatible with the behaviour of the others agents in the economy. Consistency requires that fiscal policy variables satisfy both a period-by-period or flow budget constraint and an intertemporal or solvency budget constraint. The first is simply an accounting identity that is always satisfied when the variables are correctly defined. In contrast, the second one is an equilibrium condition, which is only fulfilled when the decisions of all the agents in the economy are mutually consistent.

Automatic stabilisation means that certain changes in fiscal variables, contingent to the cyclical position of the economy and not requiring any specific action from the government, contribute to smoothing the impact of the fluctuations in endogenous variables induced by an exogenous source on the utility or welfare of individuals.

A rule of budgetary discipline is a way to guarantee the sustainability of public finances. It is defined by a target for fiscal policy and the specification of the variables under control of the government that would allow this target to be attained. It plays the role of an equilibrium condition that "replaces" or makes operational the intertemporal budget constraint of the government. There are far too many ways in which fiscal policies can comply with a budget constraint encompassing infinite periods and, for practical purposes, the concept itself is not very useful[1]. From the policy point of view, what seems operational is the implementation of simple rules for the conduct of fiscal policies that can be easily monitored by individuals and guarantee the solvency of the government. The EMU rules of budgetary discipline play such role. If the rules are followed, the government remains solvent and the intertemporal budget constraint is satisfied.

The rules of budgetary discipline in EMU[2] set up some constraints that fiscal policies must respect in order to preserve the sustainability of public finances and allow these policies to play a stabilising role. The EC Treaty imposed on governments of Member States the obligation to avoid excessive deficits, fixing maximum reference values for the deficit (3% of GDP) and the debt (60% of GDP). The Stability and Growth Pact further developed these criteria and Member States committed themselves to respect budgetary positions close to balance or in surplus in the medium term, which would allow automatic stabilisers to operate without risk of breaching the 3% reference value for the deficit in normal circumstances.

In the definition of an economic policy regime[3], the interaction of monetary and fiscal rules is crucial. The analysis of monetary policy rules, which have received much more attention in the literature than the investigation of fiscal policy rules, usually assumes that the fiscal policy regime is Ricardian, in the sense that the government adjusts fiscal variables to guarantee its solvency whatever the price level. Under this hypothesis, the central bank is "functionally" independent[4] and it can pursue a policy of price stability. However, EMU fiscal rules have been criticised as being unnecessarily restrictive to preserve the solvency of the government and positively damaging for the stabilising role of fiscal policy (Canzoneri, M. R. Cumby and B. Diba (2002)). Against this criticism it can be argued that, in order to deal with the free-riding problem generated by a common interest rate and differentiated fiscal policies in a monetary union, it is appropriate to set up some rules of

1 Perotti, R., R. Strauch and J. von Hagen (1997, p. 8) consider such notion useless for practical purposes.
2 A thorough exposition and analysis of the EMU framework for fiscal policies can be found in Buti, M., D. Franco and H. Ongena (1998).
3 See, for example, Woodford (2000), Taylor, J. B. (2001), Artis, M. J. and M. Buti (2000), M. Buti, J. von Hagen and C. Martinez-Mongay (Ed.) (2002).
4 And not just "legally" independent, see Canzoneri, M., R. Cumby and B. Diba (2002).

fiscal discipline that are easily understood and monitored by the public[5] and mitigate the incentive to undertake expansionary fiscal policies.

This paper is focused on the complementary question of how a government can manage public finances, following some rules, in order to guarantee its sustainability and perform an automatic stabilisation role in a model of a small open economy, under the assumptions of price stability and exogenous interest rates. We claim that the rules of budgetary discipline in EMU, while sufficient to preserve the sustainability of public finances, allow for the full operation of automatic stabilisers.

The analytical framework of the paper seems appropriate to study fiscal policy decisions in the institutional environment of EMU. National governments, which remain exclusively responsible for fiscal policy, have to take as given interest rates and can safely assume price stability in the euro area. Interest rates will also be kept constant throughout the analysis, although this is not a restrictive hypothesis. What affects the sustainability of public finances is the differential between the rate of interest and the growth rate of the economy. As we will consider random shocks to growth, interest rates might also be allowed to change exogenously. Nevertheless, the absence of capital accumulation and the exogeneity of interest rates exclude from the analysis the influence of alternative fiscal policies on financial conditions and investment, which is one of the main channels through which unsustainable public finances affect negatively growth and welfare[6], reinforcing the case for fiscal discipline. The assumption of small open economies is also deemed adequate, given the relatively high proportion of intra-trade and the absence of any barrier to the mobility of capital, goods and persons in the EU.

In order to introduce saving and domestic demand for public debt in the analysis, an overlapping generations model is chosen. Private agents are non-Ricardian in the sense that they do not care about welfare of future generations. This enables fiscal policy to affect the levels of output, consumption and leisure and creates an incentive for private agents to demand lax fiscal policies that would increase their lifetime utility at the expense of future generations. In an open economy, agents would be in favour of ever larger budget deficits, as long as the imbalance can be financed by non-residents and the debt repaid by future

[5] See Andrés et al. (2000). They show that, in a monetary union, the intertemporal budget constraint does not need to hold any more for an individual country but as an aggregate for all countries. However, one country running a non-Ricardian fiscal policy can induce a rise in the price level for the union as a whole. A change in the price level would not occur if the other country would be willing to transfer an indefinite amount of wealth to the "insolvent" country, in order to compensate for its irresponsible fiscal policy and back up public debt.

[6] See Auerbach, A. and L. Kotlikoff (1987, Chapter 2) and Blanchard O, and S. Fisher (1989, Chapter 3).

generations. The intertemporal budget constraint of the government imposes, however, the restriction that this policy has to be sustainable and be perceived as such by private agents (residents and non-residents) for them to demand public debt and trust in the hypotheses of price, exchange rate and interest rate stability.

Finally, note that the openness of the economy is also essential for the analysis of automatic stabilisation. In a closed economy, whatever mechanism is in place to adjust supply and demand, there is no possibility of shifting to the future through the trade and credit channels the consequences of shocks affecting all agents simultaneously. In an open economy, a generalised decline in real income leading to a decline in taxes, private consumption and saving can be moderated by the operation of automatic stabilisers, which generates higher budget and external deficits and indebtedness to finance higher private consumption from imports.

The value added in this paper is twofold. From the theoretical point of view, it presents a model in which the intertemporal budget constraint of the government is replaced in the analysis of sustainability by a rule of budgetary discipline of a general type. This policy rule gives operational content to the theoretical constraint, guarantees the global stability of equilibrium and makes sustainability and automatic stabilisation compatible. From the applied point of view[7], the paper emphasises the use of nominal budget balance targets as percentages of GDP rather than cyclically adjusted figures, and estimates the discretionary adjustment required as a function of the observed values of the debt and deficit ratios. There is, however, an allowance to take into account the possible impact of cyclical developments on the current budgetary position, which depends on the deviations of actual GDP growth from its trend and on the estimated sensitivity of the budget balance to such deviations.

The structure of the paper is the following. In Section 2, the basic growth model of overlapping generations is described and the existence of a steady state equilibrium is shown. This equilibrium is unique, but unstable, so that a small change in one of the exogenous variables keeping the values of the other variables constant would cause the debt ratio to diverge without limit. In Section 3, the general conditions to guarantee the global stability of the steady state equilibrium are examined. In Section 4, assuming that the economy is subject to random shocks, the operation of automatic stabilisers and their impact on consumers´ utility, on the budget balance and on the sustainability of public

[7] From that perspective, the present paper is the continuation of Marín, J. (1999), and Hiebert, P and M. Rostagno (2000).

finances are discussed. When considering the stabilisation aspects of fiscal policy, the overlapping generations model is used simply as a device to escape Ricardian equivalence. A literal interpretation of the model is unwarranted and should be avoided. From a qualitative point of view, the conclusions of the analysis hold whatever the supposed duration of the two periods lived by each generation is. Therefore, assuming a one-year-long reference period, these conclusions can be applied to the interpretation of the institutional provisions set up in the Stability and Growth Pact. In Section 5, a "close to balance or in surplus" (CBS) rule is derived from the previous analysis, as a formalisation of the requirements of budgetary discipline in EMU. This discipline is shown to allow the operation of automatic stabilisers and to preserve the sustainability of public finances. The last section summarises some policy conclusions.

2. A growth model

2.1 Description of the economy

Consider an overlapping generations model of an economy in which all agents have identical preferences and live two periods, where the first is a working period and the second a retirement period. Newborn agents in each generation (**N**) have a given endowment of labour, which is proportional to the length of the working period (both equal to one), and they have to decide how to allocate their time in this period between leisure (**l**) and work (1-**l**). They maximise a lifetime Cobb-Douglas utility function

$$U\left(c_{1,t}, c_{2,t+1}, l_t\right) = c_{1,t}^{\alpha} \cdot c_{2,t+1}^{\beta} \cdot l_t^{1-(\alpha+\beta)} \qquad [1]$$

where $\mathbf{c_1}$ is consumption in the first period (when active), $\mathbf{c_2}$ is consumption in the second period (which is decided when young and realised when retired) and $\alpha+\beta<1$. This is a simple and flexible enough way to represent formally the consumption-leisure preference ($\alpha+\beta$) of individuals and the intertemporal substitutability of consumption (or the rate of time preference of consumers, α/β).

The two budget constraints under which the utility function is maximised are:

$$c_{1,t} + a_t = \left(1-\tau_t\right) \cdot w_t \cdot (1-l_t) \qquad [2]$$

$$c_{2,t+1} = a_t\left(1+r\right) + \pi_t \qquad [3]$$

where τ_t is the tax rate; $\mathbf{w_t}$ is the wage rate, $\mathbf{a_t}$ is saving in the first period, **r** is the interest rate on public debt and π_t is a pension paid by the government at the end of the active

period. This can be rationalised on the assumption that newborn agents have different initial endowments of labour skills (some of them more than one, others less) and the government follows a redistributive policy to guarantee a minimum retirement income. In this way, taxes net of transfers are determined as a progressive linear income tax (equal to $-\pi_t + \tau_t \cdot w_t \cdot (1 - l_t)$), which has distortionary effects on the consumption-leisure choice. The young population knows in advance the level of transfers they will receive when retiring. They can also save in order to increase their consumption when retired.

Under these assumptions, the individual faces one single lifetime budget constraint and takes in one shot all the economic decisions of his life, so that [2] and [3] can be consolidated into a single constraint, replacing $\mathbf{a_t}$ from [3] into [2]. Maximising the utility function subject to this single budget constraint with respect to $\mathbf{c_{1,t}}$, $\mathbf{c_{2,t+1}}$ and $\mathbf{l_t}$, the solution of the optimisation problem is:

$$c_{1,t}^{*} = \alpha \cdot \left[(1 - \tau_t) \cdot w_t + \frac{\pi_t}{(1+r)} \right] \qquad [4]$$

$$c_{2,t+1}^{*} = \beta \cdot \{ (1+r) \cdot (1 - \tau_t) \cdot w_t + \pi_t \} \qquad [5]$$

$$l_t^{*} = \frac{1 - (\alpha + \beta)}{(1 - \tau) \cdot w_t} \cdot \left[(1 - \tau_t) \cdot w_t + \frac{\pi_t}{(1+r)} \right] \qquad [6]$$

Replacing these values in [3], the equilibrium saving is:

$$a_t^{*} = \beta \cdot \left[(1 - \tau_t) \cdot w_t + \frac{\pi_t}{(1+r)} \right] - \frac{\pi_t}{(1+r)} \qquad [7]$$

Note that consumption and leisure are increasing functions of pension payments while private saving is a decreasing function of pensions. Consumption and saving are also decreasing functions of the tax rate, while leisure is increasing in the tax rate. Private agents are non-Ricardian in the sense that they do not care about future generations. Fiscal policy has real effect in the short-run. Lower tax rates and/or higher pensions in period t increase the utility of the young generation living in t.

The available technology is represented by the following production function:

$$Y_t = K_t \cdot (N_t - L_t) \qquad [8]$$

where **Y** is the output of the economy, **K** is the productivity of labour, which is equal to the wage rate, **L**= N· l is aggregate leisure and N-L is aggregate labour supply:

$$N - L = N \cdot (1 - l) \qquad [9]$$

Aggregate output is obtained replacing [6] into [9] and [9] into [8], with $w_t = K_t$:

$$Y_t^* = (\alpha + \beta) \cdot K_t \cdot N_t - \frac{1 - (\alpha + \beta)}{(1 - \tau_t) \cdot (1 + r)} \pi_t \cdot N_t \qquad [10]$$

Note that output is a decreasing function of τ and π, a feature that will be crucial later, in the formal proof of the stability of the steady state equilibrium, because it allows to implement fiscal policies aimed at controlling the primary balance without affecting output (or its growth rate).

The government collects taxes (**T**=τ·**Y**), pays pensions (**P** = **N**·π) and interest on the (net) public debt (**B**), subject to a flow budget constraint:

$$B_t = B_{t-1} - T_t + P_t + r \cdot B_{t-1} = (1 + r) \cdot B_{t-1} + N_t \cdot \pi_t - \tau_t \cdot Y_t \qquad [11]$$

Capital is absent and public debt is the only asset in the economy. Prices and the rate of interest are exogenous and constant. We will assume that population and labour productivity grow at constant trend rates **n** and **k**, respectively, although their actual rates of growth might be subject to random shocks. The **structure of the economy** is determined by a specification of the exogenous variables $\{N_0, K_0, n, k, \alpha, \beta, r, B_0\}$. **Fiscal policy** is a set of rules to determine the time paths of the variables $\{\pi, \tau\}$ controlled by the government in order to attain an announced target for the debt ratio or the primary balance ratio. Public finance developments are determined by the reaction of the economy to fiscal policy. We will assume that $r > (1 + n) \cdot (1 + k) - 1$ and there is no uncertainty about the ability of the government to repay its debts. It is assumed that there are perfect international capital and goods markets to lend and borrow at a fixed interest rate and import or export consumption goods at a fixed price. Such assumption is necessary to allow net exports to play an adjustment role in balancing aggregate supply and demand, and capital flows to finance this adjustment.

2.2 Steady state equilibrium

Consider first the case of an economy growing without fluctuations or random shocks. A **steady state equilibrium** in this economy is characterised by two conditions:

1. **Supply and demand equilibrium in each period** at the constant rate of output growth $g = (1+n)\cdot(1+k)-1$, and
2. **Stationary public finances**, defined by a constant tax rate and constant ratios to output of pension transfers, government deficit and debt.

The equilibrium of the economy requires that supply and demand of output are equal in every period:

$$K_t(N_t - L_t) = Y_t = C_{1,t} + C_{2,t} + NX_t \qquad [12]$$

where aggregate private consumption in period t is the sum of consumption by the generation that is young in t ($\mathbf{C_{1,t}} = N_t \cdot c_{1,t}$) and consumption by the generation that is old in t ($\mathbf{C_{2,t}} = N_{t-1} \cdot c_{2,t}$) and NX_t denotes export minus imports.

The existence of equilibrium and the possibility of realising the consumption decisions of agents require that the government remains solvent, i.e. that public finances are sustainable if the government undertakes the announced fiscal policies. Given the structure of the economy, assume a **fiscal policy rule** specifying that the objective is to keep the initial debt ratio constant, with pensions growing at the same rate as output (g) and with a constant tax rate. Then, given the values of the exogenous variables of the model, for each choice of the tax rate the equilibrium value of individual pension transfers π^* guaranteeing that the starting position of the economy is a steady state equilibrium (thus keeping the initial budgetary position stationary) has to satisfy the condition:

$$B_t = B_{t-1}(1+g) \qquad [13]$$

Replacing [13] and [10] in [11] we get:

$$\pi_t^* = \left[1 + \frac{\tau_t}{1-\tau_t} \cdot \frac{1-(\alpha+\beta)}{1+r}\right]^{-1} \cdot \{\tau_t \cdot K_t \cdot (\alpha+\beta) - (r-g)\cdot(B_{t-1}/N_t)\} \qquad [14]$$

Hence, it is possible to conclude that, given the structure of the economy and the specified fiscal policy rule, [14] is the unique relation linking the initial values of $\{\pi, \tau\}$ that guarantees the existence of a steady state equilibrium.

3. Sustainability of public finances and the stability of equilibrium

3.1 The concept of sustainability

In what follows we consider that **public finances are sustainable when the steady state equilibrium is stable under a given policy rule**, i.e. when the application of the rule steers the economy from an out-of-equilibrium starting position towards a steady state equilibrium. Under the fiscal policy rule assumed in the last section, characterised by a constant tax rate and a constant growth rate of public spending at the same rate as the economy, **the steady state equilibrium is unstable**. Given the initial debt ratio, any small change in one of the two values $\{\pi, \tau\}$ defining fiscal policy, while the other remains constant, would make public finances non-stationary, with the debt ratio increasing or decreasing without limit. Similarly, a change in any of the variables defining the structure of the economy would also make public finances non-stationary under the assumed policy rule. The analysis of the stability of the steady state equilibrium requires the specification of another type of rule governing the adjustment of fiscal policy variables when they do not satisfy equation [14].

This concept of sustainability of public finances does not rely on the intertemporal budget constraint of the government and the expectations of individuals about future fiscal policies. However, this does not mean that private agents in the model are not concerned about the future conduct of fiscal policy. There is genuine uncertainty about future consumption possibilities (as specified in [5]) because the government may turn out to be insolvent and unable to pay the announced pensions and repay its debt. In our approach to this problem, we replace the formal analysis of the intertemporal budget constraint of the government and the expectations of private agents about government's future solvency by the requirement that the government should follow certain rules. The intertemporal equilibrium results from two hypotheses: firstly, that individuals expect the government to maintain solvency (i.e. the fiscal policy announced by the government is fully credible), and secondly, that the government follows some rules that guarantee the sustainability of public finances and fulfil such expectation.

Requiring the stability of the debt ratio is a sufficient (but not necessary) condition to satisfy the intertemporal budget constraint of the government, which is the usual notion of

sustainability in the literature[8]. According to this notion, the present value budget constraint is always assumed to hold, but as the defenders of the so-called fiscal theory of the price level point out, the question is what makes it hold in equilibrium. The concept of sustainability retained here requires that the rule of budgetary discipline is not only satisfied in the steady state equilibrium, but also guarantees the global stability of equilibrium.

3.2 Stability of the steady state equilibrium

In order to analyse the stability of the steady state equilibrium, we proceed in two steps. Firstly, assuming a constant growth rate, we consider a general fiscal policy rule targeting the adjustment of the primary balance ratio as a linear function depending positively on the lagged value of the debt ratio and negatively on the lagged value of the primary balance ratio. The conditions for the global stability of a linear difference equations system describing the dynamics of the debt ratio when the government follows that rule are thereby obtained. Secondly, it is shown how the government can attain the target prescribed by the rule using the fiscal policy instruments at its disposal and taking fully into account the endogenous reaction of the economy to changes in fiscal variables.

3.2.1 The dynamics of the debt and primary balance ratios

The dynamics of the debt level (B) in a discrete time setting is determined by the equation

$$B_{t+1} = (1+r)\cdot B_t - S_{t+1}, \qquad [15]$$

where r is the (nominal and real) rate of interest and S is the primary balance. The dynamics of the debt-to-GDP ratio (b=B/Y) is given by the equation

$$b_{t+1} = [(1+r)/(1+g)]\cdot b_t - s_{t+1} \qquad [16]$$

where s=S/Y is the primary balance-to-GDP ratio. Together with this flow budget constraint, we consider a type of general rule that adjusts the primary balance ratio taking into account the distance between the current level of the debt ratio (b_t) and its equilibrium value or objective of convergence (b*) and the distance between the current value (s_t) and the equilibrium value (s*) of the primary balance:

[8] See Canzoneri, M. and B. Diba (1998, Annex to Chapter 5) or Canzoneri M., R. Cumby and B. Diba (2002). In a stochastic model, H. Bohm (1991) shows that a bounded debt ratio is not sufficient for sustainability (defined as solvency expected with probability one) when the government has to use income taxes because even policies with a low bound on debt may postulate high tax rates in certain states of nature.

$$s_{t+1} - s_t = u \cdot (b_t - b^*) - v \cdot (s_t - s^*) \quad [17]$$

where u and v are positive constants smaller than one that determine the velocity of reaction of the primary balance ratio to the divergence of the current debt and primary balance ratios from their long-term equilibrium values[9].

The system of linear difference equations [16] and [17] describing the dynamic behaviour of the ratios is of the form $x_{t+1}=A \cdot x_t+\zeta$:

$$\begin{bmatrix} b_{t+1} \\ s_{t+1} \end{bmatrix} = \begin{bmatrix} \frac{1+r}{1+g} - u & -(1-v) \\ u & (1-v) \end{bmatrix} \cdot \begin{bmatrix} b_t \\ s_t \end{bmatrix} + \begin{bmatrix} \left(u \cdot b^* - v \cdot s^*\right) \\ -\left(u \cdot b^* - v \cdot s^*\right) \end{bmatrix} \quad [18]$$

The stability properties of the system equilibrium (b*,s*) and the dynamics of convergence (or divergence) of the debt and primary balance ratios to this equilibrium position depend on the roots of the characteristic equation: $\lambda^2 - tr(A) \cdot \lambda + \det(A) = 0$, which are:

$$\lambda_{1,2} = 0.5 \cdot \{tr(A) \pm [tr(A)^2 - 4 \cdot \det(A)]^{1/2}\} \quad [19]$$

where $tr(A)=[(1+r)/(1+g)]-u+(1-v)$ and $\det(A)=[(1+r)/(1+g)] \cdot (1-v)$. The conditions for the equilibrium to be globally stable, guaranteeing convergence from any initial position, require that both roots of this equation are smaller than one in modulus. It is easy to show that:

$$\{v > [(r - g)/(1+r)]\} \text{ and } \{u > [(r - g)/(1+g)] \cdot v\} \Rightarrow |\lambda_i| < 1, \; i=1,2 \quad [20]$$

If these conditions are met, the debt and primary balance ratios tend to converge to the equilibrium of the system whatever the starting position. The dynamic path of convergence of the debt and primary balance ratios to the steady state equilibrium depends on the relative values of the policy parameters (u, v). For v satisfying [20] and lower than one, if u is big enough, convergence is cyclical, overshooting and undershooting systematically the steady state equilibrium. It is easy to check that:

$$u > \{[(1+r)/(1+g)] - (1-v)\}^2/4 \cdot (1-v) \Rightarrow \lambda_i \text{ are complex} \quad [21]$$

9 Notice that [17] is a "Ricardian" fiscal policy rule, in the sense of Woodford (2000).

3.2.2 The control of the primary balance ratio and its impact on growth

Now we take the second step in the analysis of the stability of equilibrium showing the way in which the government can control the primary balance ratio using the instruments at its disposal (the tax rate and the rate of growth of public pensions). If the government knows the equilibrium reaction of output to fiscal policy instruments (equation [10]), it can decide and announce its fiscal policy as the rule [17]. To simplify notation, write $KN/Y=\xi$ and $P/Y=\varepsilon$. Then:

$$s_{t+1} - s_t = (\tau_{t+1} - \tau_t) - (\varepsilon_{t+1} - \varepsilon_t) = u\cdot(b_t - b^*) - v\cdot(s_t - s^*)$$

The rate of change of equilibrium output is obtained from equation [10]. Writing $c=\alpha+\beta$ for the propensity to consume, $g(Y_{t+1})\equiv(Y_{t+1}-Y_t)/Y_t$, for the rate of growth of actual output, $g(P_{t+1})\equiv(P_{t+1}-P_t)/P_t$, for the rate of growth of pension payments, $g(K_{t+1}N_{t+1})=(1+k)\cdot(1+n)-1$ for the rate of growth of trend output, and $\Delta(\tau_{t+1})\equiv\{(\tau_{t+1}-\tau_t)/[(1-\tau_{t+1})\cdot(1-\tau_t)]\}$ to simplify notation, we get:

$$g(Y_{t+1}) = c\cdot g(K_{t+1}N_{t+1})\cdot\xi_t - [(1\text{-}c)/(1+r)]\cdot[\Delta(\tau_{t+1}) + \{g(P_{t+1})/(1-\tau_{t+1})\}]\cdot\varepsilon_t \qquad [22]$$

where $[(P_{t+1}/(1-\tau_{t+1})]-[(P_t/(1-\tau_t)]=[\Delta(\tau_{t+1})+\{g(P_{t+1})/(1-\tau_{t+1})\}]\cdot P_t$. Depending on the use of the tax rate or the rate of change of P as instrumental variables, it is possible to distinguish **two basic options to implement the rule**. In each case, given that the rate of change of output in [22] depends, among other things, on fiscal variables whose values depend on the anticipated rate of change in output, fiscal policy is decided in such a way that [22] has a fixed-point.

Firstly, consider the case in which the tax rate is the adjustment tool, while the ratio of pensions to output is kept constant; i.e., assume the government implements the following policy:

$$\tau_{t+1} - \tau_t = u\cdot(b_t - b^*) - v\cdot(s_t - s^*) = \chi \text{ and}$$

$$g(P_{t+1}) = g(K_{t+1}N_{t+1}) - [(1\text{-}c)/(1+r)]\cdot\{\chi/[(1-\tau_{t+1})\cdot(1-\tau_t)]\}\cdot[\varepsilon_t/c\cdot\xi_t] \qquad [23]$$

It is easy to check that, by replacing these formulas in [22] and taking into account that $c\cdot\xi_t=1+[(1-c)/(1+r)]\cdot[\varepsilon_t/(1-\tau_{t+1})]$ from [10], we get the fixed-point $g(Y_{t+1})=g(P_{t+1})$. Notice that, for $\chi>0$ in [23], the trend rate of output growth $g(K_{t+1}N_{t+1})$ is higher than actual output growth, as the increase in the tax rate has a negative impact on output.

Secondly, an alternative type of adjustment would keep the tax rate constant ($\tau_{t+1}=\tau_t$) and rely on the adjustment of pension payments to implement the rule, finding the rate of change of output as a fixed-point of [22].

$$s_{t+1}-s_t = -(\varepsilon_{t+1} - \varepsilon_t) = u\cdot(b_t - b^*) - v\cdot(s_t - s^*) = \chi \;\Rightarrow\; g(P_{t+1}) = g(Y_{t+1})\cdot[1-\chi/\varepsilon_t] - \chi/\varepsilon_t$$

Replacing these in [22] we can find the endogenous rate of change of equilibrium output

$$g(Y_{t+1}) = [g(K_{t+1}N_{t+1}) + \Theta]/\,[1-\Theta]\;;\; \text{where}\;\; \Theta = [(1\text{-}c)/(1+r)]\cdot[\chi/(1-\tau_{t+1})]\cdot(1/\,c\cdot\xi_t) \qquad [24]$$

Notice that, for $\chi>0$ in [24], actual output growth will be higher than trend growth due to the positive impact that lower pension transfers exercise on labour supply and output. Therefore, assuming that the government knows the equilibrium reaction of the economy as summarised in equation [10], it can control the primary balance ratio applying one of these two basic options or a combination of them.

The analysis of stability of equilibrium should also take into account that output growth in equation [16] is determined endogenously in the model, rather than being a constant, as assumed in the formal analysis of the system of difference equations [16] and [17]. Nevertheless, it is easy to see from [23], and [24] that the government can always chose a combination of an adjustment in the growth rate of pensions, together with adjustments of the tax rate, in such a way that output growth is constant[10]: $g(Y_{t+1})=g(K_{t+1}N_{t+1})=1-(1+\mathbf{k})\cdot(1+\mathbf{n})=g^*$. Thus, for example, if the primary balance has to rise following the rule, the exclusive use of the tax rate as instrument would, according to [23], depress actual growth below trend. In contrast, the exclusive use of pension transfers would push actual growth above trend, according to [24]. Hence, by a continuity argument, there is a mix of the two that makes the impact of fiscal policy on output growth neutral. This concludes the analysis of the global stability of equilibrium.

[10] Alternatively, it can be guessed that, as long as there is a lower bound on growth such that stability conditions [20] hold for all the endogenous values of output growth, convergence to equilibrium is granted. For example, in the specific case of a balanced budget rule, this guess would require that fiscal policy decisions do not push the economy into recession. Although no mathematical proof of this last proposition has been worked out, numerical simulations of the model confirm the basic intuition behind it. The pace of convergence to equilibrium is slightly slower (or quicker) when fiscal policy affects negatively (or positively) the growth rate of output, but the deterministic path of convergence does not change qualitatively.

4. **Automatic stabilisation**

In the model presented in this paper, the effect of automatic stabilisers on individual utility, as well as their impact on the budget and the sustainability of public finances can be computed precisely. We will assume that the rate of growth of productivity is a random variable with a certain distribution (e.g. a normal or a uniform distribution around an average k*) in such a way that actual growth g fluctuates around its trend g*.

The automatic stabilising effects on individual utility can be derived analytically replacing [4], [5] and [6] into [1] with w=K:

$$U = V \cdot \left[(1-\tau)\cdot K\right]^{c} \cdot \{1 + \frac{\pi}{(1-t)\cdot(1+r)\cdot K}\} \quad \text{where} \quad V = \alpha^{\alpha} \cdot \left[(1+r)\cdot\beta\right]^{\beta} \cdot (1-c)^{1-c}$$

The elasticity of individual utility to fluctuations in productivity is

$$\frac{dU}{dK} \cdot \frac{K}{U} = c - \frac{\pi}{(1-\tau)\cdot(1+r)\cdot K + \pi}$$

Turning now to the impact of cyclical developments on the budget, the operation of automatic stabilisers is based on the hypothesis that, once the set of values of the variables under control of the government has been fixed (i.e. a fiscal policy has been announced), they will not change[11]. In order to derive an approximate implementation of a "close to balance or in surplus" rule of budgetary discipline in Section 5, we consider the standard decomposition

$$d_t = s_t + i_t = s^s_t + s^c_t + i_t$$

where $\mathbf{d_t}$ is the actual budget balance, $\mathbf{s_t}$ is the primary balance, $\mathbf{i_t}$ is the interest paid for the debt, $\mathbf{s^s_t}$ is the structural or cyclically-adjusted primary balance and $\mathbf{s^c_t}$ is the cyclical component of the primary balance, all figures being percentages of GDP. This expression is useful because it facilitates the analysis of fiscal policies, distinguishing between three factors:

- Developments in the cyclically-adjusted primary balance ratio (a summary measure of the fiscal policy stance and a key determinant of sustainability),
- The impact of the cycle on the budgetary position of the government, and
- Changes in the ratio of interest payments to GDP

[11] See in ECB (2002) a non-technical but rigorous discussion of the operation of automatic stabilisers.

The third factor will not be separately analysed here, as it is largely outside government control in the short-term and normally of a second order of magnitude. The first factor is decisive for the long-term dynamics of public finances. The second factor is the cyclical component of the primary balance and reflects the operation of automatic stabilisers. It depends on the cyclical position of the economy, i.e. on the value of actual output (Y_t) in relation to **trend output** (Y^*_t).

In our model, automatic stabilisers operate in the following way. On the basis of the observed values of the debt and primary balance ratios, and if population and productivity are expected to grow at their trend rates, a discretionary adjustment of fiscal policy is decided according to rule [17], taking also into account the likely impact of such adjustment on the economy, as analysed in the previous Section. Receipts are proportional to actual output $\left(T_t = \tau \cdot Y_t\right)$, where τ is the constant tax rate, and pension payments are kept constant at the level decided and announced by the government P_t. The primary balance ratio-to-GDP is:

$$s_t = \tau - \varepsilon^* \cdot (Y^*_t / Y_t) = \tau - \varepsilon^* \cdot [1 - GAP_t] = [\tau - \varepsilon^*] + \varepsilon^* \cdot GAP_t \qquad [25]$$

where $\varepsilon^* = [P_t / Y^*_t]$, $s^*_t = \tau - \varepsilon^*$, $s^c_t = \varepsilon^* \cdot GAP_t$ and $GAP_t = (Y_t - Y^*_t)/Y_t$. The impact of cyclical developments on the budget balance is induced by deviations of actual growth (g_t) from trend growth (g^*_t). Thus, the change in the cyclical component of the primary balance is:

$$s^c_t - s^c_{t-1} \cong \varepsilon^* \cdot (GAP_t - GAP_{t-1}) = \varepsilon^* \cdot (g_t - g^*_t) \cdot [(1 - GAP_t)/(1 + g^*_t)] \cong \varepsilon^* \cdot (g_t - g^*_t) \qquad [26]$$

In general, the mechanism and size of automatic stabilisers, as well as the sensitivity of the budget to cyclical developments, depend on the structure of the economy and the nature of the shocks hitting it, and not just on the size of government[12]. In the theoretical model it is possible to exactly identify the impact of automatic stabilisers on the budget. In practice, the size of automatic stabilisers has to be inferred from the estimated sensitivity of fiscal variables to cyclical developments on the basis of available data. There are a number of

[12] See van den Noord (2002, Chapter 8 in Buti, von Hagen and Martinez-Mongay (Eds.)). See also Artis and Buti (2000) and Blanchard (2000) for examples of this statement in a macroeconomic model. In such a framework, the usual distinction is between supply and demand shocks, which have different consequences and require different reactions of fiscal policy. In the present context, shocks to preferences, population and productivity have both supply and demand consequences.

methodologies to estimate this sensitivity[13]. However, the simplest approach is to run bivariate regressions using the change in the output gap (as suggested by [26]) as the independent variable, and the change in the ratio to GDP of the budget balance as the dependent variable[14].

5. The close to balance or in surplus rule of budgetary discipline

5.1 Sustainability and automatic stabilisation

We show that a balanced budget rule is a particular case of the system considered in Section 3, which requires monotonic convergence to zero debt and primary balance ratios along a predetermined path. We are interested in those paths of convergence to equilibrium that are monotonic rather than cyclical, because an overshooting of the long-term equilibrium value makes no sense. This pattern of monotonic convergence requires that both roots are real. More specifically, we are interested in a balanced budget rule, which has two main implications:

$$S_{t+1} = r \cdot B_t \;\Rightarrow\; s_{t+1} = s_t \qquad [27]$$

$$s^* = 0 = b^* \qquad [28]$$

Equation [27] simply states that, when the primary balance equals interest payments, the overall budgetary position is balanced, public finances are on the desired path and no further adjustment of the primary balance is warranted. Equation [28] defines the long-term outcome of convergence, because the consequence of maintaining a continuously balanced budget is that the debt and primary surplus ratios decline asymptotically to zero[15]. Both conditions help to identify the appropriate values for the parameters (u, v). Condition [27] implies that $(s_t/b_t) = r/(1+g)$, i.e. it determines the slope of the path of convergence to the steady state equilibrium in the plane (b, s). In addition, [28] implies that the adjustment rule [17] reduces to $s_{t+1} - s_t = u \cdot b_t - v \cdot s_t$. Therefore, both conditions jointly imply:

$$(u/v) = (s_t/b_t) = r/(1+g) \;\Rightarrow\; u = [r/(1+g)] \cdot v \qquad [29]$$

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[13] See, for example, Carine Bouthevillain, Philippine Cour-Thimann, Gerrit van den Dool, Pablo Hernández de Cos, Geert Langenus, Matthias Mohr, Sandro Momigliano and Mika Tujula, (2001), and Cohen D. and G. Follette (2000). See also Bohn, H. (1998).

[14] See, for example J. B. Taylor (2000), who runs this regression in levels and is therefore subject to the uncertainty implicit in the estimates of the output gap level. The same approach, but taking the difference between actual and trend GDP growth or just actual GDP growth as the independent variable has also been used by J. Marín (1997, 1999). See also Hallerberg and Strauch (2002), for empirical estimates of the cyclicality of budgetary aggregates and expenditure and revenue categories, as well as their structural components.

[15] This also requires the assumption $g \geq 0$, which we have made. In case $g<0$, a balanced budget rule does not guarantee the sustainability of public finances (see Bohn (1991).

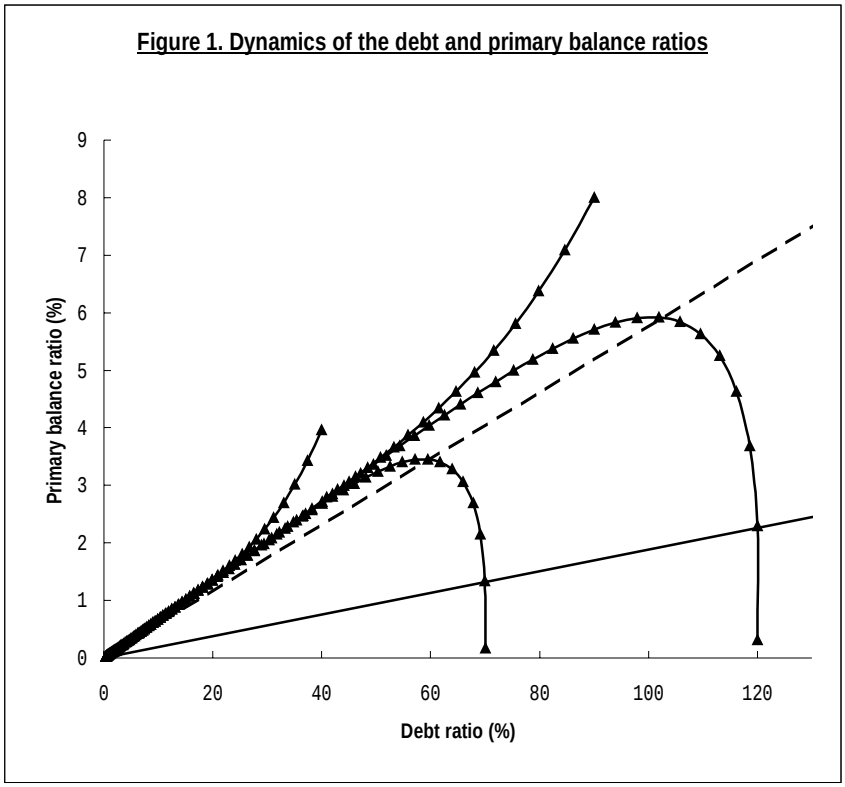
On the other hand, if the close to balance equilibrium or convergence path in the plane (b, s) is a straight line of slope r/(1+g), convergence has to be monotonic, which implies a lower bound for the parameter v. It is easy to check that:

$$v \geq [2(r+g)/(1+r+g)] \Rightarrow \text{tr}(A) - 4 \cdot \det(A) > 0 \qquad [30]$$

The values of the roots are positive and less than one for u satisfying [29] and v satisfying [30] and not greater than one. For $v=2\cdot[(r+g)/(1+r+g)]$, the values of the roots are approximately (1-g)/(1+g) and (1-r)/(1+g). For v=1 the roots are 1/(1+g) and 0. However, in order to more precisely determine in practice the appropriate value of the parameter v, it is necessary to have an idea of how long the period allowed to converge to the balanced budget path is, an issue that will be considered later.

The dynamics of the debt and primary surplus ratios under a balanced budget rule can be graphically represented in Figure 1, showing a number of alternative paths of convergence starting from different initial positions. Converging from below, the debt ratio reaches a maximum when the path crosses the continuous line $(r-g)\cdot b/(1+g)$, which is the frontier of fiscal consolidation, while the primary surplus ratio reaches its maximum when the path crosses the broken line $r\cdot b/(1+g)$, which is the balanced budget line, and remains above it.

Figure 1. Dynamics of the debt and primary balance ratios



It is worth noting that the impact of shocks on the sustainability of public finances when automatic stabilisers operate without restrictions depends on the transitory or permanent nature of the shocks. **Transitory** shocks are those affecting the level of an exogenous variable in one period and disappearing in the following one. In such case, the deterministic path of the economy is only temporarily abandoned. These transitory shocks just add some statistical noise to the otherwise deterministic path of convergence of the economy to its steady state equilibrium (see Figure 1). **Permanent** shocks, in contrast, permanently affect the level of an exogenous variable. In this case, the economy does not have a deterministic path of convergence fixed by the initial conditions, but "jumps" to a different path of convergence after each shock, because the level of the debt ratio is affected forever. Nevertheless, although the impact of successive permanent random shocks is cumulative and the actual path of the economy can deviate persistently from the deterministic path on which it was before, the global stability of the steady state equilibrium under a balanced budget rule (when $g \geq 0$) implies that the economy will always be on a path of asymptotic convergence, no matter how far it has drifted away from its starting position.

Combining the qualitative results from Sections 3 and 4, it is possible to formulate a fiscal policy rule to set the target for the primary balance ratio in the institutional framework of the Stability and Growth Pact. Although the structure of the theoretical model in which generations live two periods cannot be interpreted literally, the conclusions of the analysis do not depend on any specific length of such periods or even on the number of periods that each generation lives. Hence, in the rest of the paper the length of the periods taken as reference will be one year.

From the general fiscal policy rule [17], and taking into account [28], we can deduce the discretionary component of the structural adjustment: $s^s_{t+1} = s^s_t + u \cdot b_t - v \cdot s_t$. On the other hand, the cyclical component of the primary balance ratio is $s^c_{t+1} = \varepsilon^* \cdot GAP_{t+1}$ and therefore the target for the primary balance ratio in t+1 should be:

$$s_{t+1} = s^s_{t+1} + s^c_{t+1} = s^s_t + u \cdot b_t - v \cdot s_t + \varepsilon^* \cdot GAP_{t+1}$$

However, replacing the estimate of the cyclically adjusted primary balance ratio in t ($s^s_t = s_t - \varepsilon^* \cdot GAP_t$) in the previous expression and operating as in [26], we have the following **"close to balance or in surplus" (CBS) rule**:

$$s_{t+1} - s_t = u \cdot b_t - v \cdot s_t + \varepsilon^* \cdot (g_{t+1} - g^*_{t+1}) \quad [31]$$

Notice that the formulation of this rule, while theoretically equivalent to a "structural adjustment" rule[16], carefully avoids reliance on estimates of output gaps and cyclically adjusted balances in its implementation. There are two good reasons for that. Firstly, from the institutional point of view, neither the Treaty nor the Stability and Growth Pact make any reference whatsoever to these unobservable concepts. Secondly, from an operational perspective, the estimates of the levels of these variables obtained with all the available methods are subject to a large margin of uncertainty, while the estimates of their changes, the trend output growth rate or the cyclical sensitivity of budget balances are much less controversial. In addition to these estimates of expected actual and trend output growth rates and the cyclical sensitivity of the primary balance (ε^*), it is necessary to fix v in the region defined by [30] and $u = [r/(1+g)] \cdot v$, in order to fully specify the CBS rule.

5.2 Specification of the rule

There are two alternative criteria that can be used to select an appropriate value for v. One is the time permitted to converge to the close to balance or in surplus path, starting from a 3% of GDP budget deficit and assuming that expected and actual output growth is equal to trend growth (e.g. four years[17]). Ignoring the influence of fiscal policy on the economy, it is easy to check mechanically from [31] that, with an initial debt ratio of 60%, for example, reducing the deficit from 3% of GDP to below 0.5% of GDP would take seven years if v=1/5, four years if v=1/3, and three years if v=1/2. Table 1 shows a range of simulations to determine the value of v, taking into account the reaction of the economy in our model to the use of different fiscal policy instruments and also different starting positions for the debt ratio.

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16 This rule is similar to the one proposed by J. B. Taylor (2000, 2001). The main differences are that [31] is formulated in terms of changes rather than levels of the primary balance and is explicit on the adjustment of the primary balance required to keep the budgetary position close to balance or in surplus. In these papers, the focus is on the short-term stabilising effects of alternative policy rules. Taylor does not incorporate into his analysis any explicit constraint on fiscal policies in order to guarantee the long-term sustainability of public finances.

17 The Monetary Committee, in its Opinion on the content and format of stability and convergence programmes (Brussels, 16 September 1998, MC/II/482/98-final) endorsed by the ECOFIN Council on 12 October 1998, stated the following. "It is important to prevent the medium-term budgetary position of close to balance or in surplus from becoming a moving target. The Monetary Committee considers that the stability and convergence programmes to be submitted at the latest by the end of 1998 should show the medium-term objective of the Stability and Growth Pact as being achieved as quickly as possible. Furthermore, the Committee believes, on the basis of the Commission's analysis, that this objective should be achieved not later than by the end of 2002".

Table 1. NUMBER OF PERIODS TO REDUCE THE DEFICIT RATIO FROM 3% TO BELOW 0.5%

	Alternative values of v								
	1/5			1/3			1/2		
Debt ratios	Rule	tax rate	Pension	Rule	tax rate	Pension	Rule	tax rate	Pension
30%	9	14	6	5	8	3	3	5	2
60%	7	10	5	5	7	3	3	5	2
120%	6	7	4	4	5	3	3	4	2

Three main conclusions can be derived from Table 1. Firstly, the higher the debt ratio, the shorter the period the rule allows for convergence to the close to balance or in surplus budgetary position. This is not a policy judgement or an arbitrary discrimination but a necessary consequence of the equal treatment of different initial positions under the same rule. Secondly, the mechanical application of the rule to calculate the length of the convergence period (ignoring the negative reaction of the economy to an increase in taxes) results in a requirement of shorter periods of convergence. Thirdly, when the adjustment instrument used to reduce the deficit is a cut in pensions, the distortionary influence of the tax-transfer system is diminished and the derived positive impact on output makes convergence even quicker than in the case of the mechanical application of the rule. It is clear that different economies would react differently and that different models of the same economy would yield different estimates of the velocity of convergence when pursuing the same targets with alternative instruments. A purely mechanical calculation of the rule can give an objective benchmark to decide a sensible value for the v parameter according to the first criterion. In practice, actual convergence may be somewhat slower or quicker, depending on the instruments used by fiscal policies.

The second criterion that can be used to determine the value of v is the strength of the reaction of fiscal policy necessary to prevent a breach of the 3% reference value, starting from a balanced budgetary position (i.e. the cumulative deviation of actual from trend output that the application of the rule should withstand with a deterioration of the initial budget balance not exceeding three percentage points of GDP). On the basis of simulation exercises, it can be shown that, when the number of years required in order to reduce the budget deficit from 3% to below 0.5% is less than (say) six years for an initial debt ratio of 60%, the second criterion is also satisfied. For example, when the initial budgetary position is balanced, with v=1/3, u=1/50 and ε^*=1/2, it would take either a very deep recession in a single year or a substantial loss of output accumulated over a number of consecutive years to breach the 3% reference value for the deficit. Both scenarios would probably qualify as exceptional in the framework of the Stability and Growth Pact.

It seems useful to illustrate this assessment with some straightforward calculations shown in Table 2. Assume that the initial budgetary position is balanced and the economy enters into a period of growth at a constant rate, which is below the trend rate observed in the past. Suppose the government expects in each period the economy to grow at the previous trend rate and applies the CBS rule ignoring its debt component. Under these hypotheses of v=1/3, u=0 and ε*=1/2, it can be easily calculated how big the deviation of actual from trend growth has to be before the deficit reaches a level of 3% of GDP. These calculations are presented in Table 2 for a period of up to 10 years.

It would take, for example, five years of growth 2.3 percentage points below trend (i.e. a protracted period of recession for a country with a trend growth rate below 2.3%) to breach the 3% reference value for the deficit. The deficit would follow the pattern detailed in the table, as the rule would request a stronger yearly adjustment as the actual budgetary position declines. Hence, in the first year in which growth falls short of trend by 2.3 percentage points, the negative impact on the budgetary position would be 1.15. In the second year, however, the additional impact of the same growth shortfall would be 1.15 minus the discretionary correction demanded by the rule, which is one third of 1.15, i.e. the increase in the actual deficit would be a little less than 0.8 percentage points, and so on.

Table 2. GROWTH SHORTFALL REQUIRED TO GENERATE A 3% BUDGET DEFICIT

	LENGTH OF THE PERIOD OF LOW GROWTH									
Years	1	2	3	4	5	6	7	8	9	10
(g-g*)	-6,00	-3,60	-2,84	-2,49	-2,30	-2,19	-2,12	-2,08	-2,05	-2,04
Years	CUMULATIVE CHANGES OF THE INITIALLY BALANCED BUDGETARY POSITION									
1	-3,00	-1,80	-1,42	-1,25	-1,15	-1,10	-1,06	-1,04	-1,03	-1,02
2		-3,00	-2,37	-2,08	-1,92	-1,83	-1,77	-1,73	-1,71	-1,70
3			-3,00	-2,63	-2,43	-2,31	-2,24	-2,20	-2,17	-2,15
4				-3,00	-2,77	-2,64	-2,56	-2,51	-2,47	-2,45
5					-3,00	-2,86	-2,77	-2,71	-2,67	-2,65
6						-3,00	-2,91	-2,85	-2,81	-2,78
7		epsilon = 0,5					-3,00	-2,94	-2,90	-2,87
8		v = 0,33333						-3,00	-2,96	-2,93
9									-3,00	-2,97
10										-3,00

The basic conclusion from this exercise is that a sensible choice of the value for v according to the first criterion (say some point in the range between 1/4 and 1/3) would also satisfy the second criterion.

6. **Policy conclusions**

The close to balance or in surplus (CBS) rule of budgetary discipline makes the smoothing of cyclical fluctuations in the short-term via automatic stabilisers compatible with the long-term asymptotic convergence of public finances to a stable equilibrium with zero debt ratio and a balanced budget.

An important practical feature of the CBS rule is that the required "discretionary" adjustment depends on the actually observed values of the lagged government debt and primary balance ratios and on the values of the parameters u and v specified in the rule. Similarly, the estimate of the impact of the cyclical position of the economy on the adjustment path does not rely on the level of the output gap, but on its changes, or what is equivalent, on the difference between actual and trend GDP growth.

A judicious application of the rule requires defining a margin of tolerance for downward deviations of the current budgetary position from a strict balance (say 0.5 percentage point of GDP). There are three reasons for this. One is that recognising the nature of the shocks hitting the economy takes some time, and depending on the nature of these shocks, the desired velocity and strength of the fiscal policy reaction is different. A second reason is that, even if the exact nature of past and current shocks is known, the future cannot be anticipated with similar certainty. Therefore, policy makers might want to wait until a budget imbalance reaches a minimum size to take action, in the expectation that such imbalance might be corrected automatically by future shocks. A third reason of practical relevance is in order to avoid an excessive activism in policy changes which might be costly.

Another noticeable characteristic of the CBS rule is that it incorporates a reaction function specifying a gradual adjustment in response to (accumulated) cyclical developments triggered after a certain threshold of tolerance for the budget deficit is exceeded. Thus, for example, a sequence of negative shocks can push the actual primary balance away from the CBS path due to the operation of automatic stabilisers. However, as long as fiscal targets and outcomes follow the CBS rule and for a value of the v parameter above the lower bound justified in this paper, the illustrative calculations presented and the simulations performed show that it is unlikely that the actual budget deficit breaches the 3% of GDP reference value of the Treaty.

The fiscal adjustment required ex-ante in the CBS rule depends on the speed of adjustment desired (the parameter v, which implicitly also determines the length of the medium-term allowed to reach a close to balance budgetary position when the economy grows at its trend rate) and on the current actual budget balance and debt ratios. The "discretionary" part of the adjustment has to be addressed independently of the cyclical position of the economy, which only affects the cyclical component of the adjustment through the term that allows for the full operation of automatic stabilisers.

As a benchmark for the speed of convergence of budgetary positions to the close to balance or in surplus path, the rule considered in this paper could be useful and remarkably precise. The estimate of the impact of the cyclical position of the economy on the required budgetary adjustment is subject to a relatively narrow margin of uncertainty. For example, a range of 0.2 for the cyclical sensitivity of the budget balance times less than fifty basis points for trend growth would make less than one tenth of a percentage point for the uncertainty of this impact.

This rule can also be used to ex-post monitoring budgetary outcomes, just replacing the expected by the observed nominal growth rate of the economy in [31]. There is, therefore, no ambiguity when assessing whether the targets have been attained or not. Using the same estimates for trend GDP growth and the sensitivity of the budget balance that had been used when the targets were formulated, it will be clear whether the outcome satisfies the rule or not, having taken duly into account the unexpected influences that might explain a difference between expected and realised rates of output growth.

Finally, notice that this rule is "symmetric" and facilitates not only the assessment of convergence from below to close to balance or in surplus budgetary positions, but also the possible divergence from a surplus position towards a deficit. In either case, the adjustment path indicated by the rule has to be interpreted as a lower bound reference for the path of the primary balance (or the overall balance if interest payments are included). It goes without saying, however, that a higher primary balance would also guarantee the sustainability of public finances, being therefore perfectly compatible with the "close to balance or in surplus" requirement of the Stability and Growth Pact.

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