"CLOSE TO BALANCE OR IN SURPLUS": A METHODOLOGY TO CALCULATE FISCAL BENCHMARKS

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1 Introduction[1]

The need to ensure convergence to whatever fiscal position is deemed sustainable in the long run and sufficiently robust to unforeseen shocks of customary intensity is (or should be) common to all simulation exercises which are conducted over an extended period of time. The case at hand is no exception. The present paper constitutes a first attempt to identify a time path to long-run fiscal sustainability for EU countries, which satisfies the requirement that fiscal variables remain in the vicinity of some long-run benchmark values after the foreseen transition to a different demographic structure.

Section 2 tackles the problem of the end-point of convergence in fiscal policy. This Section makes explicit the tight connection that exists between stocks and flows in a world in which flows (deficits) are subject to stringent institutional limits. It is these limits—as represented

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[1] The authors are deeply indebted to José Marín for invaluable discussions and advice, and for laying the foundations upon which this exercise built. We also wish to thank Philippine Cour, Daniele Franco, Vítor Gaspar, Alexander Jung, Dan Knudsen, Ana Lamo, Bernhard Manzke, Sandro Momigliano, Hedwig Ongena, Javier Pérez-García, Philippe de Rougemont and Pierre Sicsic for their insightful comments and suggestions while retaining responsibility for all remaining errors. The views expressed herein represent exclusively the opinion of the authors and do not necessarily reflect those of the European Central Bank.

by the 3 percent deficit ceiling and the recommended safety margins—which help identify a natural and non-trivial limit of convergence for debt ratios under the Stability and Growth Pact. The following Section 3 discusses two policy regimes under which the pursuit of fiscal convergence to the steady state is the primary objective of fiscal authorities. Section 3.1 discusses a policy approach to the problem of fiscal convergence, which builds upon the concept of the tax gap. It proves that such approach, while widely used in the existing literature to calculate long-term benchmarks for fiscal quantities, yields unstable results when correctly applied to a framework subject to random shocks. The following Section 3.2 explores the long-run implications of a simple policy rule prescribing strict adherence to the structural deficit benchmarks recently recommended by the European Commission. While perfectly apt to steer countries towards their steady state, this policy rule proves to lead to some serious distortions in the way fiscal quantities respond to economic developments.

Section 4 presents the results of a simulation exercise in which an alternative policy rule is tested. Under this rule, the authorities are assumed to adjust fiscal variables according to the distance between the current and the target fiscal position. This policy rule is found to stand both the stability and the safety tests discussed in Section 3, and to allow for a more flexible pattern of fiscal response to both cyclical and structural changes.

On the basis of this methodology country-specific budgetary benchmarks can be produced which, in keeping with the letter and the spirit of the Stability and Growth Pact, can provide guidance to countries in search for a solid code of fiscal conduct for the future. Sections 4.2 and 4.3 briefly discuss our preliminary policy results. Section 5 finally establishes a comparison between alternative policy frameworks.

2 The end-point problem

Convergence exercises, by their very nature, require the identification of an end-point of convergence. In the public finance domain, however, an economically meaningful concept of "optimal debt," expressed as a share of output or in per-capita terms, is still unavailable. As a result, it is difficult to form an objective judgement on the appropriate magnitude of a steady state debt level using economic theory.

The Stability and Growth Pact (SGP), however, provides an institutional environment in which it becomes operationally possible to define a target debt ratio for each European Union (EU) member country—as a percentage of GDP—which would perhaps not be optimal in an economic sense, but which, if consistently maintained on average in the long-run, would guarantee compliance with the agreed code of fiscal conduct. The criterion invoked in the identification of such end-point of convergence is twofold.

The target debt ratio—as a percent of GDP—must be such that, once attained as the end-point of a convergence process, it can always be maintained as the average debt ratio through all the subsequent economic cycles (*stability*).

It must be such that, if consistently maintained as the average debt ratio through all the economic cycles occurring after the completion of convergence, it can be expected—with a reasonable degree of confidence—to safeguard the economy from ever drifting to deficit situations that could be deemed excessive under the rules of the Treaty (*safety*).

In order to impose the *stability* condition, we start off from the following simple debt accounting identity:

$$(1) \quad B_{t+1} \equiv (1+r)\,B_t - S_{t+1}$$

stating that the government debt level—in money terms—observed at the end of time t+1, B_{t+1}, is equal to its level one period before, plus the absolute value of the overall deficit realised at t+1, i.e. $rB_t - S_{t+1}$. Notice that S_{t+1} and rB_{t+1} are the primary surplus and the debt servicing payments at t+1, respectively, and r is the average effective interest rate—supposed constant—being paid by the country on each unit of outstanding government liabilities. Dividing both sides of (1) by the level of the GDP at t+1 yields:

$$(1a)\quad b_{t+1} \equiv \frac{1+r}{1+g} b_t - s_{t+1}$$

where g is the average (trend) growth rate and all variables are expressed as ratios to the level of contemporary output. In keeping with both the economics of overlapping generations frameworks and with the available empirical evidence, we also postulate a positive differential between the (central) rate of interest paid on average on outstanding debt and the (trend) growth rate of the economy[2]. Hence, a particular debt ratio is stable over the long run at some value b^* if and only if the associated long-term primary surplus as a ratio of output, s^*, is consistent with the following equation:

$$(2)\quad b^* = \left(\frac{1+g}{r-g}\right) s^*$$

which provides the target debt ratio in the steady state, given the associated target primary surplus and the interest-growth rate differential that is anticipated to prevail in the future. Hence, provided both targets are maintained on average over the cycle, the stability condition is indefinitely met.

The second criterion to identify the debt (and the primary surplus) target of convergence under the SGP rules—*safety*—requires a measure of the *margin of confidence* that a country should build into its *overall deficit* in order to be reasonably sure that it would not violate the –3 percent limit at the trough of a normal economic downturn. Indeed, defining this margin as *m*, fiscal policy in a member country would not be deemed to comply with the rules imposed by the SGP in the long term, unless it were to observe the following rule:

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2 On the theoretical reasons justifying a positive interest rate-growth rate differential, see the exchange between M. Feldstein and R. Barro published by Journal of Political Economy (1976). For an empirical assessment of the degree of dynamic efficiency among G-7 countries—whether historical risk-adjusted interest rates prove to have been above or below the growth rates of the respective economies—see A. Abel *et al*.: "Assessing Dynamic Efficiency: Theory and Evidence," Review of Economic Studies 56 (1989).

$$(3)\quad d \geq d^* = -0.03 + m$$

under normal economic circumstances, that is whenever operating at the midpoint of an economic cycle of customary intensity. Box 1 briefly reviews the method followed by the European Commission to obtain such fiscal safety margins and the associated structural deficit benchmarks for each member country.

Over the long run, after the convergence process has been completed, the trend-growth deficit ratio d^* in (3) can itself be expressed as a function of the target debt and the primary surplus ratios b^* and s^* of equation (2). Resorting to the identity, which defines the overall deficit ratio as a function of the contemporary debt and primary surplus ratios, we know that, after convergence is attained, the following condition must hold:

$$(4a)\quad d^* \equiv -\frac{r}{1+g} b^* + s^*$$

Therefore, by solving equation (4a) with respect to b^*, we can easily obtain the second condition that the debt target has to meet in order to be deemed *safe* under the rules of fiscal conduct stipulated by the Pact. Using the definition of d^* given in (3), equation (4) below provides the second *safety* condition as a function of the safety margin m and the macroeconomic parameters of the system:

$$(4)\quad b^* = \left(\frac{1+g}{r}\right)(0.03 + s^* - m)$$

Finally, condition (2) and (4) can be used to solve for the debt ratio and the primary surplus ratio that, if aimed at as the end-points of the fiscal convergence process, can guarantee both *stability* and *safety* under the rules of the Pact over the long run. Equations (5a) and (5b) below provide the solution to the system for the steady state target debt and primary surplus ratios, respectively, as functions of the safety margin m and the macroeconomic parameters:

$$(5a)\quad b^* = \left(\frac{1+g}{g}\right)(0.03-m) = -\left(\frac{1+g}{g}\right)d^*$$

$$(5b)\quad s^* = \left(\frac{r-g}{g}\right)(0.03-m) = -\left(\frac{r-g}{g}\right)d^*$$

In anticipation of what follows, we can thus conclude that equations (5a) and (5b) bring to light the tight connection that exists between stocks and flows in a world in which flows (deficits) are subject to stringent institutional limits. It is these limits—as represented by the 3 percent ceiling and the recommended safety margins—which help identify a natural and non-trivial limit of convergence for debt ratios within the Stability and Growth Pact.

Box 1. The European Commission's Deficit Benchmarks

Available country-specific measures of budgetary safety margins—and associated structural deficit benchmarks—for signatory countries have recently been estimated by the European Commission. The methodology followed made use of the following two indicators of budgetary uncertainty:

- **the amplitude of individual countries' cyclical fluctuations over the past;**
- **the sensitivity of individual countries' budgetary balances to macroeconomic swings.**

The wider the macroeconomic fluctuations recorded in the past, and the more responsive revenue and primary spending to economic conditions, the larger the margins to be built into government structural balances to insure against the risk of incurring into an excessive deficit should things turn for the worse.

The Commission Services estimated the safety margin by making reference to three different measures of cyclicality: the maximum output gap recorded in the past, its historical standard deviation multiplied by two, and a hypothetical output gap set uniformly equal to 4 percent for all countries to account for homogeneously defined "severe economic conditions." The safety margin was then derived by multiplying the average between the maximum and the minimum of these three measures of cyclicality by the sensitivity of countries' deficits to output gaps. This latter parameters— referred to as "α" in the following Section—measure the change in the overall deficit ratio as a consequence of a 1 point of GDP change in the output gap.

Given an estimate of the budgetary safety margin *m*, the corresponding cyclically adjusted deficit benchmark *d was then derived by simply adding *m* to the deficit ceiling of –3 percent, according to condition (3) in the text.**

3 Guaranteeing convergence

Having defined the targets of fiscal convergence, the analytical problem reduces to determining a policy rule which, if consistently observed through the entire transition horizon as well as along the steady state, can reduce the debt ratio from its initial value to its target steady-state level within a given period of time. In what follows, we cast the normative problem at hand in terms of a simple stochastic simulation model of six equations capturing the basic interactions between fiscal and economic variables:

$$(1)\ B_{t+1} \equiv (1+r)\,B_t - S_{t+1}$$

$$(4b)\ D_t \equiv -r\,B_{t-1} + (T_t - G_t) \equiv -r\,B_{t-1} + S_t$$

$$(6)\ G_t = G_{t-1}\left(1+g_t^*\right) - \alpha\left(\frac{\left(y_t - y_t^*\right)}{y_t} - \frac{\left(y_{t-1} - y_{t-1}^*\right)}{y_{t-1}}\right) y_t + \beta_t\, y_t^*, \quad G_0 = \bar{G}$$

$$(7)\ T_t = T\left(\Gamma_t\right)$$

$$(8)\ g_t = g_t^* + \sigma(g_t)\cos(\pi t/6) + \varepsilon_t, \quad g_t^* \equiv \frac{y_t^*}{y_{t-1}^*} - 1 \cong \varphi\left(y_{t-n}, \ldots, y_{t-1}, y_t, y_{t+1} \ldots y_{t+n}\right)$$

$$(9)\ r_t = \left[r^* + \gamma\left(E_{t-1}\, g_t^{DE} - g_{t-1}^{DE}\right)\right] + \rho_t$$

Equations (1) and (4b) simply reproduce the definitions of government debt and deficits, respectively, already referred to above. Equation (6) draws up the time path of primary expenditures in money terms. G_t is assumed to increase at the trend growth rate of money output g^*, and to respond to contemporary changes in the output gap, defined by the difference between actual and trend output levels, y_t and y^*. The reaction of primary expenditures to the macroeconomic conditions is calibrated according to a parameter α, which measures the country-specific built-in sensitivity of the overall deficit as a share of GDP to the output gap. A drift factor β_t accounts for the prospective average increase in age-related spending items. Equation (7) states that fiscal authorities set money revenue according to a policy reaction formula whose generic parameters are represented by Γ_t. Regime-specific tax reaction formulae are specified and analysed in turn in what remains of Section 3 and in Section 4.

Two general remarks are in order at this point. As it is clear from equation (6), the entire budgetary effect of cyclical fluctuations is relegated to the expenditure side, while policy measures are on the revenue side of the budget. In other words, as we assume an exogenous expenditure path and confine policy action to the revenue side, it is revenues which bear the entire brunt of preserving the sustainability of public finances in the long run. This modelling strategy has two sources of justification. The first is that it is in keeping with the neo-classical tradition of framing theoretical and simulation exercises on debt dynamics[3]. The second justification is that the assumption is convenient to separate clearly the full impact of "exogenous shocks" on the one side of the budget, and the necessary "fiscal effort" to absorb the budgetary consequences of the shocks, on the other[4].

Growth rates are assumed to describe deterministic cosine-shaped cycles around their contemporary trend values g_t^* with the amplitude of the normal underlying swings $\sigma(g_t)$ matching the variability of output growth rates that each country experienced over the period 1980-1997. In calculating the historical standard deviation of countries' real growth rates between 1980 and 1997, observations below –2 percent and above 10 percent were excluded[5]. In order to mimic as close as

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3 See, for example, R. Barro: "On the Determination of Public Debt," Journal of Political Economy 87, October 1979. More recently, A. Baxter and R. King: "Fiscal Policy in General Equilibrium," American Economic Review vol. 83 (3), June 1993, uses this modelling strategy in a simulation exercise building on the so-called "equilibrium approach to fiscal policy."

4 It goes without saying, however, that from an economic point of view it should be more efficient to distribute fiscal adjustment more evenly between revenues and expenditures.

5 The rationale for censoring "extreme" observations is twofold. On the one hand, occurrences whereby output declines by more than 2 percent in absolute terms would be considered exceptional under Stability and Growth Pact. Hence, we considered that constructing a measure of output variability on the basis of such observations would only inflate the expected cyclicality of countries' growth pattern over the future, and thus result in unnecessarily stringent deficit benchmarks along the steady state. Similarly, growth rates above 10 percent per annum appear to reflect a catch-up process that, by its very nature, should die out relatively rapidly in the future as productivity levels tend to converge across member countries. Again, estimating countries' cyclicality on the basis of such extraordinary growth conditions would unduly penalise countries along the steady state.

possible the "de-trending" methodology followed by the European Commission, the country and time-specific trend rate g_t* is calculated by means of a Hodrick-Prescott filter applied to actual output. An additional source of motion is imposed by means of a random shock ε_t drawn from a normal zero-mean distribution with a standard deviation of 0.5 percent[6]. The nominal effective interest rate paid by governments on the entire stock of their outstanding liabilities, r_t, is supposed to vary randomly around a forecastable value as expressed by the term in squared brackets of equation (9). Such forecastable value is a steady state norm of r*, plus a deterministic cycle which is linked to the deterministic cycle described by the rate of growth in the Union's largest economy, Germany. In other words, a one-percentage point change in the *forecastable* component of Germany's output growth rate—as from equation (8)—is assumed to cause a change in r_t across all member countries equal to γ basis points[7]. The stochastic innovation ρ_t is drawn from a zero-mean uniform distribution defined over a 300 basis point wide interval.

The behaviour of the economy under each of the three policy scenarios analysed below was studied on the basis of some 3,600 realisations of fiscal outcomes. The worst values attained by the generated series of deficits as percentages of contemporary GDP—always at the trough of each successive cycle—were averaged out, along with the number of times that a breach of the 3 percent rule was recorded. A similar monitoring mechanism was implemented for the number of times in which debt ratios were observed to climb from one year to the next before declining below the 60 percent reference value. The results of a particular iteration round was deemed unacceptable if the average of the worst observed deficit ratios exceeded the 3 percent limit by more than

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6 Similar exercises using a uniform, rather than normal, distribution defined over the support [-0.01, 0.01] did not prove to change the results.

7 A number of authors have studied functional forms expressing the risk-free interest rate as a function of the changes in trend consumption, with the coefficient attached to the latter being a function of agents' degree of relative risk aversion. See, among others, Hansen and Singleton: "Stochastic Consumption, Risk Aversion, and the Temporal Behaviour of Asset Returns," Journal of Political Economy 91 No 2, 1983. We used the elasticity estimated for Germany by J. Campbell ("Asset Prices, Consumption and the Business Cycle," Harvard University Mimeo, 1998) as a proxy for the sensitivity of the average rate paid by governments—on the entire stock of their outstanding liabilities—with respect to the changes in the forecastable component of *output* growth rates.

0.4 percent of GDP, and the number of times in which a breach occurred was 2.5 percent of total observations or more. Deficit benchmarks were transformed into target debt ratios using equation (5a), with a rate of growth in nominal terms converging to a uniform 3¼ percent for all countries. The steady state effective interest rate norm r^* was set at 5 percent. The elasticity of the nominal effective interest rate with respect to the changes in the forecastable component of output growth rates, γ, was calibrated according to its estimated value for Germany[8]. The behaviour of the system under the three different policy regimes was studied, first in the case of primary spending ratios constant as shares of trend GDP—with drift age-related factors β_t posed equal to zero—then imposing non-zero country-specific β_ts[9].

Finally, all simulations were launched assuming country-specific output gaps in 1999 equal to those estimated by the European Commission for the same year, while the parameters measuring the overall built-in sensitivity of the budgets to the output gap, α, were those reported in a recent publication of the OECD[10]. Table 1 provides numerical values of the basic parameters to which the model is calibrated.

In the remainder of Section 3 we explore the long-run implications of two different policy rules which have gained some prominence in the policy debate over fiscal sustainability in general, and fiscal monitoring in the EU in particular. Section 4 will then proceed to an alternative policy reaction function that will constitute the basis for the new benchmarks qualitatively described in the remainder of Section 4. The tax-gap approach presented in Section 3.1, while widely popular in the existing literature, either fails to ensure convergence, or realises

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8 See above.

9 A uniform ageing scenario was constructed for all countries via linear interpolations of the 25-year estimated impact of ageing on primary expenditure through 2050, as recently provided by the European Commission (see: McMorrow K. and W. Roeger: "The Economic Consequences of Ageing Populations—A Comparison of the EU, US and Japan," EC Economic Papers No. 138, November 1999). For most countries, β_t are positive between the present and 2050and zero thereafter.

10 See OECD: "Automatic Fiscal Stabilisers," Working Party No. 1 on Macroeconomic and Structural Policy Analysis, ECO/CPE/WP1(99)12.

Table 1. Simulation parameters

	Sensitivities of the budget balance to the cycle (OECD)	*Memorandum:* Sensitivities of the budget balance to the cycle (Commission)	Standard Deviation of output growth rates, 1980-97(*)	Public expenditure increase, 2000-2050(**)
Belgium	0.68	0.6	1.67	7.23
Germany	0.49	0.5	1.41	7.39
Spain	0.45	0.6	1.76	10.78
France	0.49	0.5	1.31	6.25
Ireland	0.36	0.5	2.48	0.54
Italy	0.50	0.5	1.31	9.18
Luxembourg	-	-	-	-
Netherlands	0.84	0.8	1.51	8.40
Austria	0.34	0.5	1.23	8.82
Portugal	0.37	0.5	2.38	10.38
Finland	0.72	0.7	1.81	10.38
Denmark	0.85	0.7	1.83	6.32
Greece	0.40	0.4	2.02	10.38
Sweden	0.86	0.9	1.54	4.88
United Kingdom	0.51	0.7	1.97	0.47
EUR11	**0.51**	**0.5**	**1.45**	**7.86**
EUR15	**0.52**	**0.6**	**1.55**	**6.62**

** excluding observations below -2% of GDP or above 10% of GDP*
*** McMorrow and Roeger (1999)*

convergence through an unacceptable path. By contrast, what Section 3.2 denotes as the "deficit benchmark" regime proves stable—that is converging—and sufficiently well-behaved. However, some serious drawbacks affect both the transition period and the steady state of an economy strictly complying with this second fiscal rule. The third avenue to convergence presented in Section 4, instead, entails a reactive policy rule whereby governments constantly adapt fiscal variables according to the distance between current and target quantities. The rule, stable by construction, also allows for a high degree of flexibility.

3.1 The Tax-Gap Approach

While first devised as a "static" index to assess the sustainability of current policies, the *tax gap* concept has rapidly developed into the analytical foundation of a family of fiscal policy convergence exercises, which are "dynamic" by their very nature. This section argues that such an extension should be made only with caution and that the basic tax gap methodology, applied over long periods, cannot be considered as a robust analytical tool on the basis of which to assess sustainability of current fiscal policies when fiscal and economic magnitudes are subject to uncertainty.

Work conducted by Blanchard (1990) and Blanchard *et al* (1990) under the auspices of the OECD defined the tax gap as the immediate and permanent adjustment in the tax (or spending) ratio that would be needed to keep the debt ratio from rising over the medium and long run[11]. The same concept was subsequently used by Franco and Munzi (1997)—for the European Commission—to provide an estimate of the tax rate that, if kept constant throughout the simulation exercise, would allow member countries to both absorb the projected costs of population ageing and to converge to a given debt target by the end of the simulation horizon. Figure 1 provides a graphical representation of the logic behind the tax-gap-based approach to convergence, b_0* being the starting debt ratio, b_N the targeted end-point of transition, and p_t describing the expected path of future primary spending. Following a roughly similar methodology, here we assess the long-run implications of a tax rate calibrated constantly at its "equilibrium" level according to the tax gap formula, on the basis of our simple stochastic environment as portrayed by conditions (1), (4b), and (6)-(9).

First, we had to identify an end-point of fiscal convergence. A natural candidate to act as a long-term target is the debt ratio that is consistent—in the sense of equation (5a)—with the deficit safety margins calculated by the European Commission according to the methodology

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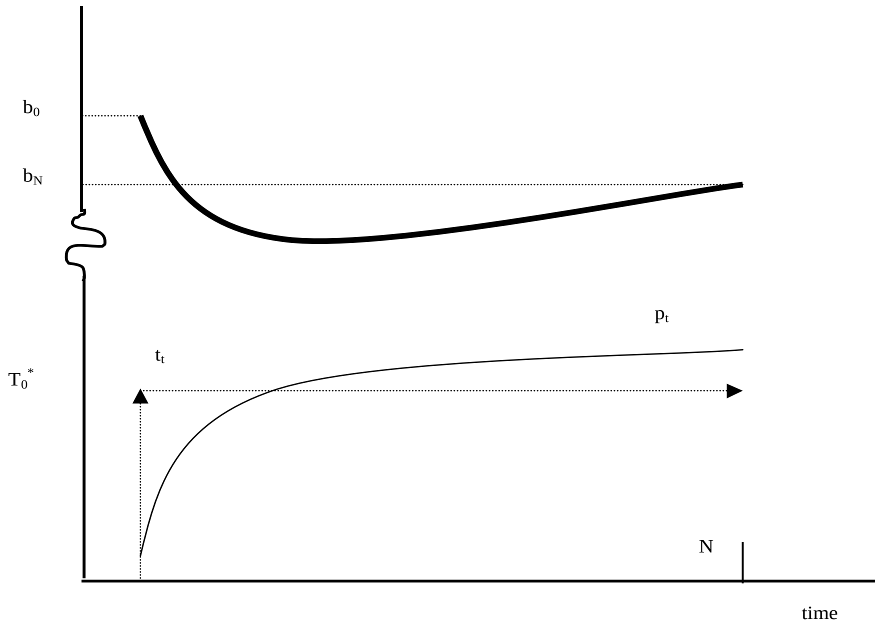
11 See O. Blanchard: "Suggestions for a New Set of Fiscal Indicators," OECD Department of Economics and Statistics Working Paper No. 79 (1990) and O. Blanchard, J. C. Chouraqui, R. Hagemann and N. Sartor: "The Sustainability of Fiscal Policy: New Answers to an Old Question," OECD Economic Studies No. 15 (1990).

Figure 1. Tax rate and debt ratio profile under the tax gap approach to convergence



surveyed in Box 1. Hence, we first calculated the steady state debt ratios that countries would have on average—that is, whenever operating at the midpoint of normal economic fluctuations—if the deficit benchmarks of the EU Commission were to be observed *after full completion of the convergence process*. The last column of Table 2 provides the results of these calculations. Countries' safety margins and the associated deficit benchmarks as estimated by the European Commission are also provided in the first two columns for ease of reference[12].

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12 It should be recalled that the built-in budgetary sensitivities used by the EU Commission to calculate the safety margins (and thus the deficit benchmarks) reported in Table 2 differ for a number of countries from the built-in sensitivities recently estimated by the OECD and reported in Table 1 above, used in the present simulations. The extent to which the EU Commission sensitivities depart from the new estimates made available by the OECD can be seen by comparing the first two columns of Table 1.

Figure 1. Tax rate and debt ratio profile under the tax gap approach to convergence

(percent of GDP)

	Safety margins for structural deficits (EU Commission) (2)	Deficit benchmarks (EU Commission) = –3% + (2)	Steady state debt ratios (consistent with EU Commission safety margins)
Germany	1.9	-1.1	34.9
Italy	1.8	-1.2	38.1
Spain	2.6	-0.4	12.7
Netherlands	2.9	-0.1	3.2
Belgium	2.0	-1.0	31.8
Finland	4.3	1.3	– 41.3
Sweden	3.8	0.8	– 25.4
Denmark	2.3	-0.7	22.2
France	1.5	-1.5	47.7
Ireland	2.1	-0.9	28.6
Portugal	2.4	-0.6	19.1
Austria	1.7	-1.3	41.3
Greece	1.6	-1.4	44.5
United Kingdom	2.9	-0.1	3.2

We then proceeded to two different exercises. In the first one, we derived the tax rate that *in a perfect foresight framework*, if legislated in the current period and always observed subsequently until convergence finally occurs, would suffice to bring the economy from its current debt ratio b_0 to the target debt ratio b^* of Table 2, within a given period of time N. Annex I reviews the algebra underlying the calculation of such constant "equilibrium" tax rate in a discrete time, fully deterministic environment:

$$(10)\ t_0^* = \left(\frac{r^*-g^*}{1+g^*}\right)\left[\frac{b_0 - b^*\left(\frac{1+g^*}{1+r^*}\right)^N + \sum_{i=1}^{N}\left\{\left(\frac{1+g^*}{1+r^*}\right)^i\left(\frac{G_i}{y_i}\right)\right\}}{1-\left(\frac{1+g^*}{1+r^*}\right)^N}\right]$$

Having determined such t_0* according to (10), we then imposed a "degenerate" revenue policy reaction rule:

$$(7a)\ T_t = t_0^*\, y_t$$

whereby tax policy was never allowed to deviate from a tax rate of t_0* after the first-period adjustment needed to bring it discretely from the initial level inherited from history to its "equilibrium" value consistent with (10).

In the second exercise, we allowed for rolling updates of the "equilibrium" tax rate throughout the simulation horizon. In particular, we imposed a tax rule such that:

$$(7a')\ T_t = t_t^*\, y_t = \left(\frac{r^*-g^*}{1+g^*}\right)\left[\frac{b_t - b^*\left(\frac{1+g^*}{1+r^*}\right)^{N-t} + \sum_{i=t+1}^{N}\left\{\left(\frac{1+g^*}{1+r^*}\right)^i\left(\frac{G_i}{y_i}\right)\right\}}{1-\left(\frac{1+g^*}{1+r^*}\right)^{N-t}}\right] y_t$$

whereby authorities were assumed to discretely adjust the "equilibrium" tax rate according to the *constantly updated* starting conditions prevailing from time to time. Notice that in (7a'), contrary to (7a), both the current debt ratio and the time span left to complete the planned transition get routinely updated at each successive re-optimisation date[13]. Charts 1.a-c

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[13] Notice also that equation (7a') is a straightforward generalisation of (7a).

represent the results of these two exercises for a representative country whose distance between b_{1999} and b^* is among the largest within the Union. Chart 1.a describes the profile of simulated debt and overall deficit ratios between 1999 and 2219 in the *perfect foresight-constant trend growth* counterpart to the stochastic model described above, i.e. with $\sigma(g_t), \varepsilon_t$ and ρ_t set identically equal to zero. Charts 1.b-c, instead, show the time profile of debt and deficit when deterministic fluctuations and random innovations to macroeconomic and financial quantities are added[14].

What a comparison of Chart 1.a, on the one side, and Charts 1.b-c, on the other, reveal is that, while apt to steer countries towards their pre-defined end-points of convergence *in a perfectly foreseeable environment*, a pure tax-gap policy rule fails when applied to an economy subject to random innovations. It fails altogether in guaranteeing that a foreseeable end-point of convergence is finally attained, in its rigid version of (7a) and Chart 1.b[15]. Or it fails, in that convergence is finally achieved through a totally inadmissible transition path, in the flexible version of condition (7a') and Chart 1.c. In the first case, very small unforeseen disturbances suffice to derail governments from their pre-specified convergence plans. At a certain point the economy gets trapped in some perverse explosive trajectory with probability one, thus making the policy rule established on the basis of a perfectly foreseeable world obsolete. In the second case, the path of convergence to the final target becomes crucially dependent on the length of the planned transition. The more distant in the future the projected date of convergence *N*, the more erratic the transition to the steady state.

These features of the tax-gap exercise are rather disquieting. Formula (7a) even fails to respect the first, necessary, requirement that the system should indeed converge to a steady state: what we called the

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[14] Different time intervals *N* dictating the speed of convergence to b^*—between a minimum of 50 and a maximum of 220 years from present—were proved to assay the robustness of the results.

[15] Successive realisations of the random shocks to growth and interest rates led to very different simulation outcomes with the end-point debt ratios varying within a range of some 300 percent of final GDP, with upper bounds close to gross debt ratios of 100 percent and lower bounds around asset positions of 200 percent.

Chart 1.a. Tax-gap based convergence under certainty

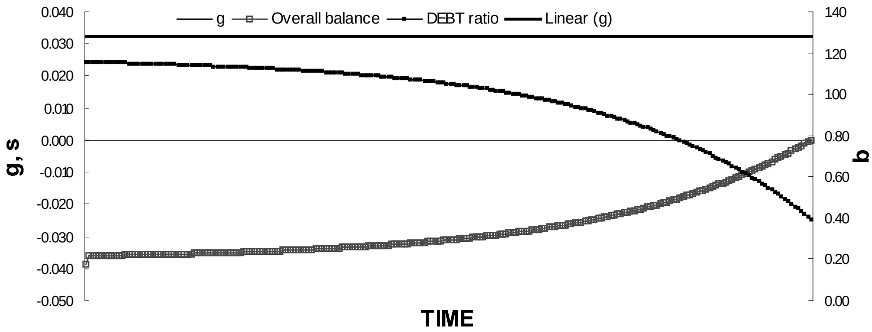
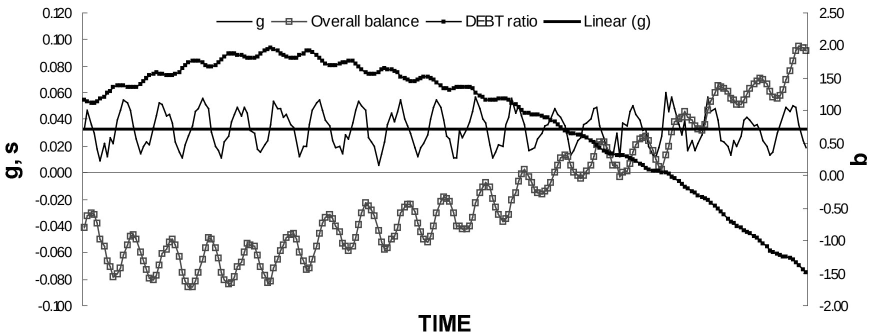
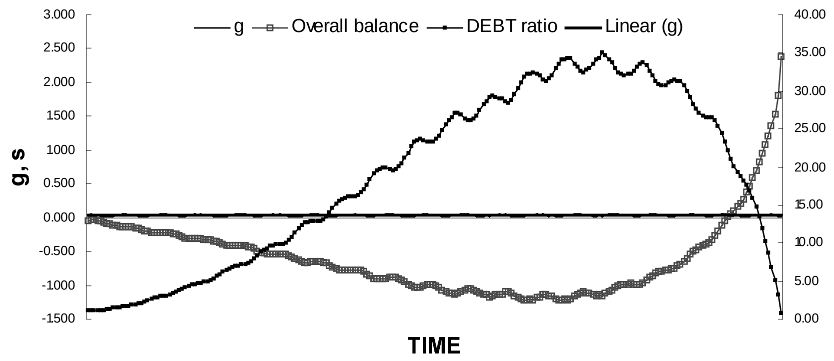


Chart 1.b Tax-gap based "convergence" under uncertainty (constant equilibrium tax rate)



stability condition. But the kind of end-point dependency that we obtain from the second version of the exercise, based on (7a'), makes even the more flexible version of the tax-gap methodology seriously misleading as an analytical tool to assess the stability properties of a system, never mind to give guidance to governments aiming at convergence. Notice, in this regard, that the time path followed the simulated debt ratio in Chart 1.b would be observationally equivalent to a purely explosive trajectory while in transition.

Chart 1.c – Tax-gap based "convergence" under uncertainty (updated equilibrium tax rate)



The conclusion we draw from the preceding findings is twofold. Firstly, caution should be exercised in assessing the sustainability properties of fiscal policies on the basis of the tax gap concept. Secondly, over long periods of time, the dynamic properties of a pure tax-gap framework, even when allowing for tax rate adjustments in each period, are unstable and yield erratic results.

3.2 The deficit benchmark approach

Leaving aside the issue of the *timing* of convergence, condition (5a) states that a country perennially running a cyclically-corrected deficit ratio equal to some d^* would asymptotically tend to a debt ratio of $b^* = -d^*(1+g^*)/g^*$, whatever its starting position.

Hence, we explored a policy scenario in which member countries were assumed to observe a revenue reaction rule which imposes compliance with a deficit target equal *on average* to the cyclically adjusted benchmark ratios recommended by the Commission:

$$(7b)\ \ T_t \equiv S_t^* + G_t = d_t^* \, y_t + r_t \, B_{t-1} + G_t = \left(d^* + \alpha \left(\frac{y_t - y_t^*}{y_t} \right) \right) y_t + r_t \, B_{t-1} + G_t =$$

$$= \left(d^* + \alpha \left(\frac{y_{t-1} - y^*_{t-1}}{y_{t-1}} \right) \right) y_t + r_t B_{t-1} + G_{t-1}(1 + g^*_t) + \beta_t y^*_t$$

In words, taxes in each country are assumed to be residually adjusted to maintain the actual overall deficit ratio d_t always in line with the benchmark ratio d^* that the European Commission recommends a country should target whenever operating at potential output—i.e. with a zero output gap. Consequently, deficit ratios in this scenario were allowed to diverge from the Commission's country-specific benchmarks d^* (as reported in the second column of Table 2) only to absorb the budgetary impact of positive (or negative) output gaps.

Charts 2.a-b show the results of this second round of simulations. Chart 2.a illustrates in a visual manner a general feature of this second policy rule which sets it apart from the approach tested in Section 3.1: its *stability* property. The Chart describes the time profile of the simulated deficit and debt ratios over the long run if a high-debt country were to always comply with an overall deficit benchmark of around 1 percent on average over the economic cycle with average budgetary sensitivity and output cyclicality. Contrary to the previous case defined by (7a) and (7a'), the self-correcting nature of the policy rule postulated by (7b) clearly preserves the country from ever being trapped in the sort of divergent trajectories that arise whenever a rigid policy rule faces a changing macroeconomic environment. If the country were to always obey the Commission's policy prescription, it would be certain to complete transition between its current position and its steady state debt target no matter how strong the shocks hitting its economy along the way. In more general terms, this policy rule dictating steady compliance with the EU Commission deficit benchmarks guarantees convergence for *all* member countries, irrespective of their initial conditions. However, the twin issues of the *time* needed to complete convergence and the *safety* property of the transition to the steady state under this policy rule also need to be investigated. Chart 2.b, summarising the convergence profile for a high-debt country with above average built-in budgetary sensitivity and output cyclicality, offers a less reassuring picture in these respects.

Firstly, the dynamics of debt convergence are very sluggish. While perhaps not a problem *per se* for economies already below or not far above the 60 percent reference value, the slow pace of descent to the steady state would become an issue of concern for countries with debt ratios currently above 100 percent of GDP. Furthermore, the transition to such a minimal target as the 60 percent reference value could be punctuated by recurrent episodes of reversed dynamics (see Chart 2.a). As upward rebounds of the debt ratio would not be infrequent over the period in which they would not be allowed, the country's record of compliance with the rules of the Pact could be questioned[16].

Secondly, and perhaps more importantly, not all countries would satisfy the *safety* requirements that we imposed at the beginning of Section 3, whereby we considered unacceptable—under the rules of the Stability and Growth Pact—a convergence path with deficit observations above 3.4 percent, and in which deficit observations between 3.0 and 3.4 percent were recorded with a higher frequency than 2.5 percent of total realizations. Some countries would run the risk of violating either one of these two conditions, or alternatively, the EU Commission deficit benchmarks would be overly restrictive for other countries.

The result that the EU Commission deficit benchmarks might suffer from either a lack of stringency or, on the other extreme, an excess of severity for a number of countries can be traced to at least three different sources. Firstly, we used a new set of measures of countries' budgetary sensitivities to the state of the economy. By comparing the first two columns of Table 1 it is clear that this difference in model calibration can be sizeable for a number of countries, including Denmark, Spain, Ireland, Austria, Portugal and the UK. Secondly, we adopted different indicators of output cyclicality. Whereas the EU Commission based its deficit benchmark calculations on estimates of historical output gaps, we calibrated our model using historical standard deviations of real growth rates—between 1980 and 1997, excluding "extreme" observations—to generate in each iteration round a cycle whose standard amplitude $\sigma(g_t)$ could replicate the customary intensity of the cycles observed in each country's (recent) past. Finally, unlike the EU Commission, we explicitly accounted for interest rate shocks. This latter source of randomness can be a primary factor of incremental budgetary risk *per se*. Our assumption that governments' cost of finance closely traces the economic cycle in

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16 It should be noted, however, that in our simulations we do not allow for stock-flow adjustments.

Chart 2a. Convergence under the deficit benchmark approach: Case I

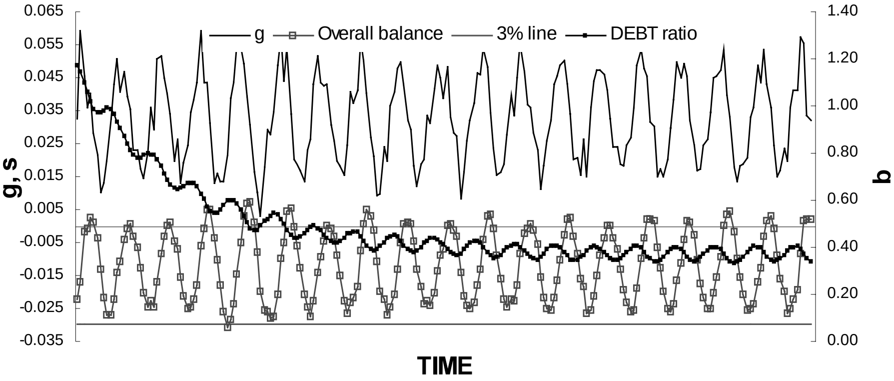
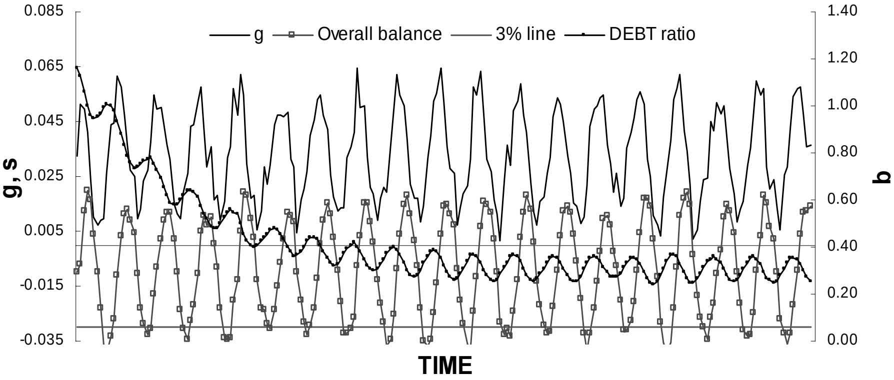


Chart 2b. Convergence under the deficit benchmark approach: Case II



Europe's core economy—condition (9)—might further compound the effect of financial factors on the risk indicators associated to those countries whose economic cycle is less than tightly aligned with that of Germany.

This Section has demonstrated that the deficit benchmarks constructed by the EU Commission to evaluate country members' fiscal plans are often not robust to a change in the summary statistics used to rank countries in terms of output cyclicality and budgetary sensitivity to growth conditions. Section 5 will establish a more comprehensive comparison between the deficit benchmark approach to convergence and the policy rule that we present in Section 4.

4 The debt target approach

The shortcomings affecting the deficit benchmark approach led us to experiment with a new policy reaction formula, explicitly devised to guarantee stability but also manageable enough to strike a balanced compromise between the safety requirement and the authorities' need to retain as much control as possible over fiscal policy throughout the transition and beyond.

Borrowing from Marín (1999), in our third simulation exercise we imposed the following tax reaction rule:

$$(7c)\ \ T_t = T_{t-1}(1+g_t^*) + \left\{ u\left(b_{t-1} - b^*\right) - v\left(s_{t-1} - s^*\right)\right\} y_t$$

Revenues were supposed to track the trend growth of the economy and to be adjusted by a given percentage ($u\ y_t$) of the difference between the debt ratio recorded one period ahead and the steady state debt target, and a given percentage ($v\ y_t$) of the difference between the primary surplus ratio one period before and its target ratio in the long run (remember condition (2) above). Marín (1999) proves that *in a continuous time framework* in which fiscal variables are not allowed to take discrete jumps, the policy reaction function represented in (7c) indeed needs two policy reaction parameters—*u and v*—rather than only one, to guarantee convergence[17]. The same article demonstrates that the family of parameters [*u*, *v*] which guarantee global convergence do not

[17] See J. Marín: "Monitoring Budgetary Discipline: Some simple Indicators," in Banca d'Italia, "Indicators of Structural Budgetary Balances," Roma, 1999.

depend on the target ratios b^* and s^*, but only on the interest rate-growth rate differential. In particular,

- the velocity of adjustment of the primary balance ratio to the discrepancy between its current value and the target should not be lower than the differential between the rates of interest and growth ($v>r^*-g^*$).
- the velocity of adjustment of the primary balance ratio to the discrepancy between the current and the target levels of the debt ratio should be greater than the product of v times the differential of the rates of interest and growth; i.e., $u>v(r^*-g^*)$[18].

If both the above conditions are met, the debt and primary surplus ratios tend to converge to their long-run benchmark values *whatever the initial conditions*, and the equilibrium is thus globally stable.

4.1 The iterative procedure

We investigated the properties of rule (7c) following a four-step simulation methodology.

First step. We first had to identify the targets of fiscal convergence, the d^* and b^* that should be supported in the steady state. Contrary to the methodologies reviewed in Sections 3.1 and 3.2, which built upon the deficit benchmarks estimated by the European Commission, here we produced our own *steady state* deficit benchmarks—by means of an iterative procedure—and, through condition (5a), we used these to find the associated end-point debt ratios that should be maintained over the steady state. We started off by assuming that the economy was already operating along the steady state, with a debt level fluctuating around a $b^*(1)$ consistent—in the sense of

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[18] The analytical conditions for stability are far more complicated in a discrete-time setting as that in which we conduct our simulations. For a fully spelled out solution of the model (1)-(9), see Rostagno M., P. Hiebert, and J. Pérez-García: "'Close to Balance or in Surplus:' A Methodology to Calculate Fiscal Benchmarks," ECB Mimeo (2000).

condition (5a)—with some first-guess deficit ratio benchmark $d^*(1)$[19]. We shocked the system and we searched for the couple of policy parameters [u^*, v^*] according to the following three conditions.

The steady state policy vector [u^*, v^*] should perennially maintain the system around $b^*(1)$ and $d^*(1)$ over the successive economic cycles without violating the –3.0 percent limit more frequently than 2.5 percent of the times, and never by more than 0.4 percent of GDP.

The steady state policy vector [u^*, v^*] should guarantee that the built-in sensitivity α assumed for each country— reported in the first column of Table 1—was replicated ex-post by the simulated pattern of response of overall deficits to the cycle. In other words, among all the [u^*, v^*] couples which proved to satisfy condition 1 above, we chose that particular vector which entailed an ex-post pattern of co-movements between the simulated series of deficits and the output gaps whereby a 1 percentage change in the output gap was accommodated by a contemporary change in the deficit ratio equal to α percentage points of GDP. The importance of this constraint becomes apparent if one compares the first column of Table 1 with the last column of Table 3 below. The figures reported in the last column of Table 3, which we define ex-post budgetary sensitivities (as opposed to the built-in sensitivities of Table 1), have been estimated on the basis of a simple regression in which the changes in the historical deficit ratios were made functions of the contemporary differential between the actual growth rates and the corresponding trend. The numbers reported in Table 3 are the estimated coefficients attached to this latter differential in each of the country-specific regressions. Now, although the *automatic* response of revenues and primary expenditures to a 1 percentage change in the output gap as reported in Table 1 is estimated to be strong for a number of countries—notably the Nordic members—Table 3 shows that the *effective* response of the deficits to the economic conditions that one observes historically is generally far more muted[20]. See, for example, the paradigmatic case of Belgium, with an estimated built-in sensitivity of

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[19] Our starting point regarding the value of the steady state overall deficit benchmark d^* was the deficit benchmark calculated by the EU Commission.

[20] The estimated coefficients are taken from Marín (1999).

Table 3. The "quality" of convergence

	Standard deviation of the deficit cycle		Ex-post budgetary sensitivities		*Memorandum:* Historical sensitivities of the budget balance to the cycle*
	EU Commission	Debt-target approach	EU Commission	Debt-target approach	
Belgium	1.82	1.99	0.66	0.68	0.29
Germany	1.08	1.28	0.47	0.49	0.43
Spain	1.27	1.47	0.44	0.45	0.42
France	1.01	1.15	0.47	0.49	0.46
Ireland	1.49	1.62	0.35	0.36	0.07
Italy	1.03	1.39	0.48	0.50	0.43
Luxembourg	-	-	-	-	0.23
Netherlands	2.01	2.14	0.81	0.84	0.40
Austria	0.65	0.86	0.33	0.34	0.39
Portugal	1.44	1.57	0.36	0.37	0.34
Finland	2.10	2.34	0.70	0.72	0.66
Denmark	2.53	2.88	0.82	0.85	0.70
Greece	1.31	1.49	0.39	0.40	0.22
Sweden	2.08	2.24	0.83	0.86	0.90
United Kingdom	1.62	1.75	0.49	0.51	0.85
EUR11	**1.17**	**1.38**	**0.49**	**0.51**	**0.42**
EUR15	**1.29**	**1.49**	**0.51**	**0.53**	**0.51**

almost 0.7 and an ex-post sensitivity of less than 0.3. The comparison between Table 1 and Table 3 suggests two sets of conclusions. The first conclusion is that a number of countries were often *prevented* from fully exploiting the counter-cyclical potential that they had built into their fiscal structures, and forced to conduct pro-cyclical policies instead, by considerations such as the need to counteract potentially destabilising deficit dynamics and the attempt to reassure markets over the sustainability of their public finances in times of economic slump. The second conclusion we draw is that the "unintended" pro-cyclical pattern of response to the cycle observed in the past, however, cannot be considered appropriate along the steady state, whereby the economies fluctuate by assumption around low and stable debt ratios. Under such conditions, we would rather expect countries to fully exploit the automatic stabilising potential that they have introduced in their fiscal apparati.

Hence our second criterion to identify the [u^*, v^*] of steady equilibrium. We searched for that particular [u^*, v^*] vector that did not neutralise—through a systematic pro-cyclical bias—the automatic stabilising potential imparted by its built-in budgetary sensitivity α.

In those cases in which it was not possible to identify such a [u^*, v^*] combination—because no vector was found to satisfy conditions 1 and 2 under the initial first-guess steady state fiscal benchmarks $d^*(1)$ and $b^*(1)$—we started a new search procedure under a different, second-guess, couple of fiscal benchmarks, $d^*(2)$ and $b^*(2)$. The least demanding—that is the worst—deficit ratio d^* for which such a vector [u^*, v^*] proved to exist, was considered the prescriptive cyclically-adjusted deficit that countries should target as a benchmark along the steady state, that is *after completing convergence to* b^*. Similarly, the associated [u^*, v^*] vector was considered the prescriptive policy rule that countries should comply with along the steady state in order to ensure that they would never drift away from it.

Second step. Secondly, the policy reaction parameters [u, v] to be used *in the transition* towards the steady state targets d^* and b^* had to be identified. For countries already below the reference value set by the Treaty (60 percent), or still above but not far from it, we imposed the combination of u and v, which entailed the most "monotonic" path of convergence among all those satisfying conditions 1 and 2 above—the *safety* requirement and the condition on ex-post deficit-cycle co-movements, respectively[21]. For countries with debt ratios above 100 percent (Italy, Belgium and Greece), we identified two different transition policy vectors. The first one was that particular [*u*, *v*] vector which entailed a debt ratio below 60 percent by the year 2012, among all those satisfying conditions 1 and 2 above. In identifying this first policy vector, the *speed* of convergence was thus the leading criterion. After the intermediate objective of a debt burden below 60 percent of GDP was attained (in 2012), we imposed a policy switch. From that time on, until full convergence to the steady state was attained, we imposed that particular [*u*, *v*] vector, which entailed the most "monotonic" path of convergence among all those satisfying conditions 1 and 2 above.

Third step. After identifying the time at which each country, by following the transition policy rule described in the second step, had completed convergence to its steady state, we imposed a policy switch from the transition [*u*, *v*] policy vector to the steady state [*u**, *v**] vector, as found in the first step.

Fourth step. Finally, we added structural spending drifts β_t>0 to our expenditure equation (6) and we went through steps 1 to 3 once more under the new ageing scenario. The reason we had to search for a new set of policy reaction parameters both for the steady state ([*u**, *v**]) and the transition period ([*u*, *v*]) under changed structural spending conditions is the following. It is easy to show (see Annex II) that there exists a tight link between built-in budgetary sensitivities—our α parameters—the shares of government revenue and expenditure in GDP, and revenue and expenditure elasticities to growth:

$$(8)\quad \alpha \approx \left(\frac{\Delta d}{\frac{\Delta Y}{Y}} \right) = \frac{T}{Y}\left[\eta_{T,Y} - 1\right] - \frac{G}{Y}\left[\eta_{G,Y} - 1\right]$$

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21 In a plane representing debt levels along the X-axis and primary surpluses along the Y-axis, monotonicity of the convergence path is measured by the degree to which the curve connecting the starting point to the end point approaches a straight line.

The built-in sensitivity of government overall deficit ratio to the contemporary output gap is approximately equal to the sum of revenue and spending ratios, both multiplied by the difference between their own output elasticities ($\eta_{T,Y}$ and $\eta_{G,Y}$, respectively) and one. Now, with a growth elasticity of revenue approximately equal to 1 in most countries, this relationship does not pose an endogeneity problem to our simulations, insofar as G/Y remains constant over the cycle in the long run, as it is certainly the case under the no-ageing scenario[22]. However, if G/Y tends to rise through time because of the structural pressures exerted upon the budget by population ageing, α should also change as time goes by, unless $\eta_{G,Y}$ adjusts in such a way to completely offset the impact of G/Y on it. And, if the numerical value of α over the steady state is different from its numerical value at the beginning of the simulation period (first column of Table 1), then the fiscal benchmarks in the steady state, d^* and b^*, have to be calculated on the basis of the former, rather than the latter. This is why, with G/Y growing through time, the *safe* fiscal position in the steady state as we defined it—our d^*, b^* and the associated policy vector [u^*, v^*]—can be different from the one that can be found in the absence of structural breaks to primary spending.

Hence, in the presence of an ageing problem, two scenarios are conceivable. One in which α is kept constant through time, notwithstanding the increase in G/Y, via an offsetting adjustment in $\eta_{T,Y}$ and $\eta_{G,Y}$. Another one, in which elasticities of revenue and current expenditure to output growth are constant and thus the αs change. In the latter case—with a new set of αs calculated using (8) and the new shares of budget components to GDP determined by the progressive ageing of populations—a new set of steady state fiscal benchmarks d^* and b^* and the associated policy vectors [u^*, v^*] have to be computed according to the search procedure reviewed in the First Step above.

22 Under a no-ageing hypothesis, equation (6) implies that average G/Y stays constant throughout the simulation horizon.

4.2 Summary of the simulation results

The steady state. In the absence of ageing-related structural changes affecting primary expenditures, our result suggest that a number of countries with average or below-average built-in budgetary sensitivity to macroeconomic conditions should aim for a steady state debt ratio between one third and a half their GDP. Member countries whose fiscal structures are highly responsive to the state of the economy would have to target *asset positions* over the long run.

Along the steady state, that is after fully completing convergence, such debt targets would be associated with steady state deficit targets which, for a small subset of countries, would be less demanding than those recommended by the EU Commission. For the remaining members, these deficit targets would be as stringent or more severe than the benchmarks prescribed by the Commission. As for the policy reaction parameters [u^*, v^*] which could support the steady state fiscal configuration defined by d^* and b^*, most countries should pursue stability *over the steady state* by adjusting revenues (or expenditures) by 1 to 2 percentage points the observed deviation between their current debt ratios and the average target debt ratio over a full steady state cycle, and by some 20-25 percent the deviation between their current primary surplus ratios and the average target primary surplus ratio over a full steady state cycle.

The transition. For countries whose debt ratio is currently far above the target, the crucial parameter driving policy *throughout the transition* would be u, which calibrates the prescribed response to the differential between the starting and the end point (steady state) debt ratios.

The prescriptive policy stance can be easily converted into a set of cyclically-adjusted primary surplus benchmark ratios. For the euro-area as a whole, the prescriptive primary balance—averaged through the first quinquennium of the new century—would exceed the trend primary surplus of the entire area as forecast by the EU Commission for 2001 by some 0.5 percent of GDP. Some countries prove to be widely off the recommended trajectory.

Charts 3a and 3b depict the prescriptive transition paths of the debt and the deficit ratios for two countries with markedly different starting positions.

Chart 3a. Convergence under the debt target approach (without ageing): High debt country

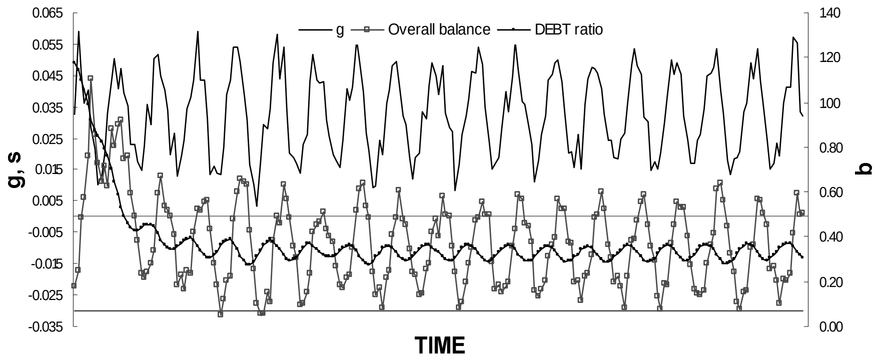
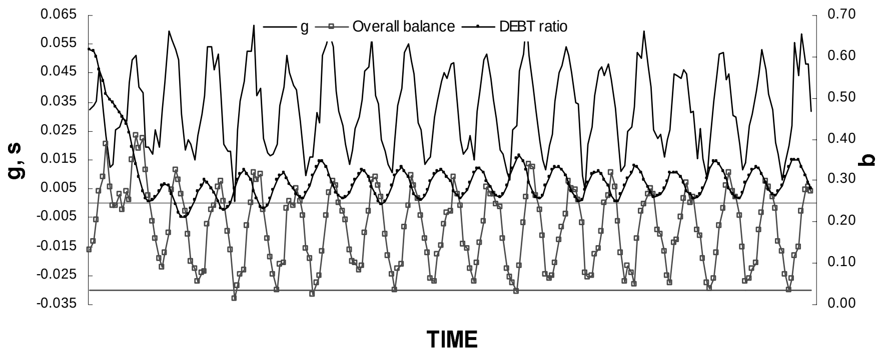


Chart 3b. Convergence under the debt target approach (without ageing): Country with debt ratio at around 60 per cent



4.3 The fiscal benchmarks under ageing-related pressures

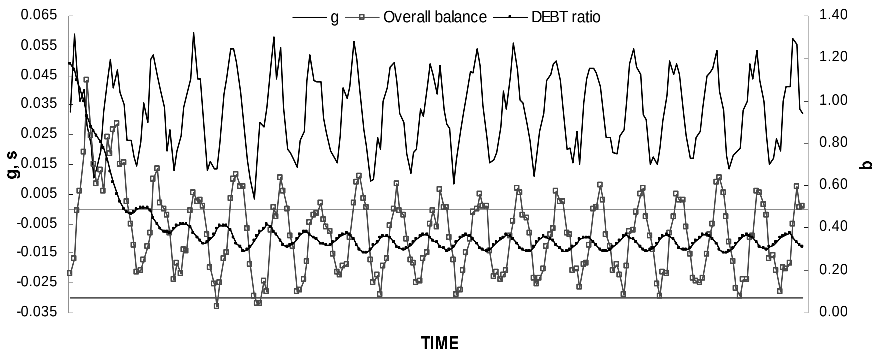
Constant budgetary sensitivity. As deficit (and debt) targets along the steady state only depend on the *variability of fiscal balances*, but not on the *scale of government*, if the ageing-related change in the latter is prevented from exerting an impact on the former (as in the present case) no differences should be detected between the steady state deficit and debt targets *with* or *without* the impact of ageing. This is indeed what we find. Consequently, the associated policy vectors [u^*, v^*] are the same in both spending scenarios.

Less intuitively, our transition policy rules with ageing effects turn out to be basically the same as those identified in the absence of structural breaks on spending. What markedly adjusts in shifting from one scenario to the other is the time to converge to the steady state configuration. Only one country, whose demographics appear immune from any noticeable trend breaks over the upcoming fifty years, will not experience a reduction in the speed of transition towards its steady state position.

Changing budgetary sensitivity. If built-in budgetary sensitivities α are allowed to fully adjust to changing budget components as percentages of GDP—and revenue and spending elasticities, $\eta_{T,Y}$ and $\eta_{G,Y}$, are correspondingly kept constant—the steady state targets become much more stringent. Most countries, except those with a high growth elasticity of spending $\eta_{G,Y}$ and/or a relatively dampened impact from ageing, would see their budget sensitivity increase over the years. This requires a lower target debt (and a more ambitious deficit) ratio in the steady state.

Charts 4 provide a representation of convergence to the steady state under ageing, assuming constant built-in budgetary elasticities.

Chart 4. Convergence under the debt target approach (with ageing): High-debt country



5 Debt-target-based policy rules versus deficit benchmarks

This Section spells out why a policy rule outlining the authorities’ reaction parameters to the state of the economy and the debt burdens to be targeted in the steady state should be regarded as a superior vehicle to fiscal convergence than a straightforward number indicating the deficit the economy should run, no matter what, in the middle of a standard business cycle.

Flexibility. As pointed out already, policy rule (7c) is more flexible. Specifically, it allows for the reconciliation of multiple policy targets, such as *safety*, *speed* and *quality* of convergence, whereas its deficit benchmark counterpart (7b) identifies a convergence path only by focussing on one of the above criteria, namely *safety*. What we called the debt target approach can balance multiple objectives by doing two things. First, it draws a clear distinction between the *equilibrium* state of the system and the *transition* to this equilibrium, and tailors a reaction formula that is most suitable for each phase of policy-making. The methodology of (7b) does not draw this distinction, and in doing so treats the transition and convergence stages symmetrically.

Secondly, and more importantly, the methodology outlined in (7c) brings to light—and provides rigorous tools to exploit—the basic trade-off of fiscal policy under a strict constitutional constraint such as the Stability and Growth Pact. This trade-off, which has already been hinted at in the preceding Sections, exists between the ambitiousness of the deficit (and debt) target and the amplitude of the deficit cycle. The lower the targeted structural deficit—that is, the closer the average deficit to the lower constitutional bound of –3 percent of GDP—the narrower its permitted automatic swings in face of macroeconomic fluctuations. This is confirmed by visual inspection of all the Charts reported in this Section.

Under the debt target approach, an optimal balance between structural stringency and exposure to the cycle can be achieved. Under the alternative approach, this balance is pre-determined and systematically tilted against automatic stabilisation. The pro-cyclical bias that compliance with a deficit benchmark regime would impart to tax policy is outlined in Table 3 above. The amplitude of the deficit cycles reported in the second column are those consistent with the unfettered functioning of automatic stabilisers. By construction, these values are exactly those generated by the debt target-based simulations[23]. The first column, instead, reports the amplitude of the deficit cycles if countries were to always obey the deficit benchmarks recommended by the EU Commission. These values, systematically lower than those in column two, illustrate a systematic dampening of budgets' responsiveness to macroeconomic developments.

Enforceability. Unlike a deficit-benchmark-based avenue to fiscal transition, the approach we presented in Section 4 seems to be impervious to political manipulations. Formula (7c) unambiguously prescribes that governments should adjust their primary surplus at time *t* by, say, 2 percent of the product between current GDP and the distance between the debt ratio at t-1 and its target value, and by 20 percent of the product between current GDP and the difference between the primary surplus ratio at t-1 and its long-run target. No reference is made, in this policy prescription, to unobservable quantities. By contrast, the deficit benchmark rule is verifiable *ex post* only to the extent that a good and widely agreed-upon measure of output gap is available. Otherwise, there could be scope for political manoeuvring among governments based on definitional differences, as deficits would be allowed to depart from their medium-term benchmarks according to the magnitude of the estimated output gap[24].

Notice that the need to franchise economic policy—as much as possible—from too tight a dependency on "unobservables" such as potential output is increasingly been recognised by scholars as the central issue of contemporary theory (and practice) of policy-making[25].

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23 Recall that we adopted those prescriptive policy rules which, if consistently obeyed by the governments over transition and along the steady state respectively, would make the ex-post sensitivity of the deficit ratios to growth equal to the built-in sensitivity of revenue and expenditure to output. See point 2 of the First Step in Section 4.1.

24 Even abstracting from political mis-management, the dependency of the formula on an estimate of output gap could be a problem in itself. A production-function based methodology to calculate potential output—as opposed to a simple statistical filter applied to actual observations—can yield prolonged periods whereby the actual output is below (or above) potential. Any such asymmetries could jeopardize the stability of the system.

25 See, most recently, A. Orphanides: "The Quest for Prosperity Without Inflation," paper presented at the Conference "Monetary Policy-Making Under Uncertainty," Frankfurt a.M. 3-4 December 1999 (Mimeo, Board of Governors of the Federal Reserve System). The author argues (continues)

Structural breaks. A debt target policy formula, unlike its deficit benchmark alternative, does not hide structural breaks "under the carpet." Since the deficit benchmark rule would allow deficits to deviate from their structural benchmark only to accommodate the budgetary impact of the cycle, any budgetary pressure not strictly related to the position of the economy with respect to its trend would have to be fully compensated by adjusting taxes and/or primary spending accordingly. As a result, simulating the impact of ageing on countries following the deficit benchmark approach to convergence is a futile exercise. The scenario in which β_t is zero is observationally equivalent to the one in which β_t takes on positive values: both primary surpluses and overall deficits are the same in either scenario, implying that the dynamics of the system are totally unaffected.

The incremental budgetary effects of structural changes, on the other hand, are clear and tangible with the debt target approach. In comparing the benchmark structural primary surpluses found under the two spending scenarios, a measurable impact of the consequences of the shift in public expenditure expected to accompany population ageing on budgetary outcomes is readily apparent. The above features of the policy rule under (7b) are of particular concern, as it is not clear—in fact, it is rather doubtful—that a system in which the entire brunt of the adjustment to a structural shock is borne by revenues and/or primary expenditures would be superior to one in which the deficits are also called upon to partly adjust—albeit subject to rigorous constraints—to the new circumstances.

6 Problems and extensions

Although preferable to the deficit benchmark approach, the debt targeting approach has at least two serious shortcomings. Firstly, by its very nature, it is based on a backward-looking formula. In this sense, it

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that: "Examination of the information available to policymakers at the time, clarifies the source of the problem [leading to the Great Inflation]. Both inflation and the output gap appeared to have been mismeasured […] but the bulk of the error was due to the mismeasurement of potential output" (page 4).

Chart 5a. Forward looking debt target approach (with constant tax ratio to end of ageing transition): revenue and spending profiles
(as GDP ratios)

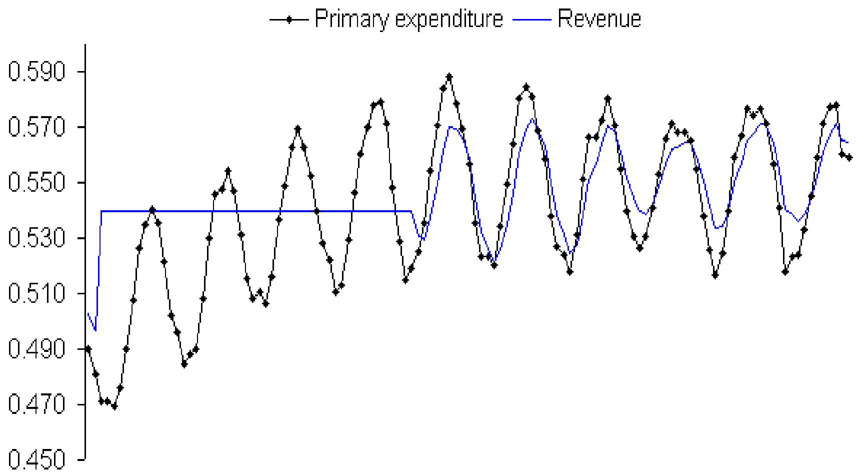
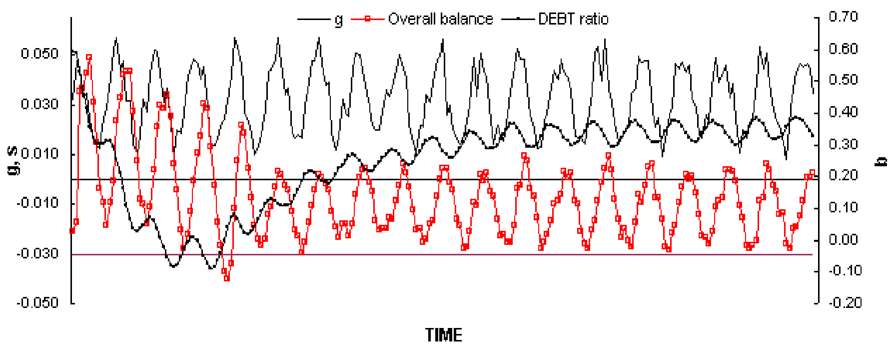


Chart 5b. Forward looking debt target approach (with constant tax ratio to end of ageing transition): debt and deficit profiles
(as GDP ratios)



does not provide explicit guidance as to whether governments should pre-fund future liabilities in a pro-active manner or simply react to such developments after they occur. In Rostagno M., P. Hiebert and J. Pérez-García (2000), we tried to augment our convergence-proof debt-target formula by introducing elements of tax-smoothing, allowing for a more equitable distribution of the adjustment burden across current and future taxpayers. Chart 5a below gives a graphical representation of the revenue and spending ratio profile under a debt-target cum tax-smoothing policy formula, in the hypothesis that the early phase of constant tax rates is prolonged until the end of the projected demographic transition. Chart 5b describes the associated debt profile.

Notice the clear undershooting dynamics displayed by the debt ratio in the transition to its steady state value. In general, this methodology appears to be capable to provide guidance as to the extent to which *pre-funding of future obligations* is an attractive (and feasible) policy response to the ageing crisis.

A second disquieting problem we see concerns the end-points of fiscal convergence. For countries with a high degree of exposure to macroeconomic developments and/or whose economies are subject to large cyclical swings, very low or even negative debt levels result in the steady state. The scale of these negative debt ratios is such in some cases to raise legitimate questions about the economic sustainability—and the dynamic efficiency—of fiscal plans which would entail such dramatic turnarounds in the weight attached to government equity relative to private ownership in the economy. This, however, falls outside the scope of this paper. Further work is needed to investigate how large a share of an economy's assets can be attributed to government, what this would entails for private capital formation, the country's growth prospects, and its long-run welfare indices.

ANNEX I

THE TAX GAP

From (1a) above we know that in a discrete time horizon the debt-to-GDP ratio evolves in line with the following law of motion:

$$(1a)\quad b_t \equiv \frac{1+r}{1+g} b_{t-1} - (t_t - p_t),$$

where t_t and p_t are revenue and primary expenditure ratios, respectively. By repeated substitution, we can thus express the debt ratio at time N as a function of its initial value at time zero and the entire series of primary surplus ratios realised between zero and N:

$$b_N \equiv \left(\frac{1+r}{1+g}\right)^N b_0 - \left(\frac{1+r}{1+g}\right)^{N-1} (t_1 - p_1) - \left(\frac{1+r}{1+g}\right)^{N-2} (t_2 - p_2) - \ldots - \left(\frac{1+r}{1+g}\right)(t_N - p_N)$$

By discounting back to time zero, we obtain:

$$b_N\, \theta^N \equiv b_0 - \sum_{i=1}^{N} \theta^i (t_i - p_i)$$

where we defined $\theta \equiv$ (1+g)/(1+r)<1. Now, assuming that t_i can take a discrete jump at the beginning of history but then must remain constant at some tax rate t^* throughout the whole simulation horizon, we can solve for the "equilibrium" tax rate t^* in the following manner:

$$t^* = \left(\frac{1-\theta}{\theta}\right) \frac{\left(b_0 - b_N\, \theta^N\right) + \sum_{i=1}^{N} p_i\, \theta^i}{1-\theta^N}$$

or, substituting for (1+g)/(1+r),

$$t^* = \left(\frac{r-g}{1+g}\right)\frac{\left(b_0 - b_N\left(\frac{1+g}{1+r}\right)^N\right) + \sum_{i=1}^{N} p_i\left(\frac{1+g}{1+r}\right)^i}{1-\left(\frac{1+g}{1+r}\right)^N}$$

This expression reproduces equation (7c’) in the text.

ANNEX II

BUDGETARY SENSITIVITIES AND BUDGET SHARES

The change in the overall deficit ratio following a 1 percentage increase in output is defined as follows:

$$\left(\frac{\Delta d}{\frac{\Delta y}{y}}\right) \equiv \frac{\Delta\left(\frac{T}{y}\right)}{\frac{\Delta y}{y}} - \frac{\Delta\left(\frac{G}{y}\right)}{\frac{\Delta y}{y}}$$

By differentiating the expressions in the numerators and dividing them by the denominators, we obtain:

$$\left(\frac{\Delta d}{\frac{\Delta y}{y}}\right) \equiv \frac{\Delta T}{\Delta y} - \frac{T}{y} - \frac{\Delta G}{\Delta y} + \frac{G}{y}$$

Recalling the definition of the output elasticity for a generic budgetary component Z, ηZ,Y= (ΔZ/Z)/(Δy/y), we can transform the above expression into the following form:

$$\left(\frac{\Delta d}{\frac{\Delta y}{y}}\right) = \frac{T}{y}\left[\eta_{T,Y} - 1\right] - \frac{G}{y}\left[\eta_{G,Y} - 1\right]$$

Finally, notice that the term on the LHS of the preceding expression is approximately equal to what we called the built-in sensitivity of budget deficit ratios to output gaps, i.e. our parameters α.