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How Important are Automatic Stabilizers in Europe? A Stochastic Simulation Assessment

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How Important are Automatic Stabilizers in Europe? A Stochastic Simulation Assessment

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In this paper we formalize budgetary stabilizers as a set of simple policy rules, and assess their operation in an uncertain environment by performing stochastic simulations in a forward-looking multi-country macroeconometric model, NiGEM, comprising individual blocks for 10 Euroland economies. Automatic stabilizers make output volatility fall in all countries, but such decreases, ranging from 5 to 18 per cent, are smaller than commonly believed, and display significant international variation. We also find that, provided countries comply with their announced fiscal consolidation programmes, built-in stabilizers and the Stability and Growth Pact are broadly compatible.

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1. Introduction

The start of Stage III of Economic and Monetary Union (EMU) on 1 January 1999 has brought about not only a new regime for monetary policy in Europe but also a new set of rules and constraints as regards the national fiscal policies - since countries joining the Euro have concomitantly become bound by the provisions of the Stability and Growth Pact (SGP).

One of the issues that has received considerable attention in the recent economic policy literature is the scope for the use of fiscal policy as a stabilization tool under the SGP, and in particular whether there will still be room for automatic stabilizers to operate (e.g. Url, 1997; Buti *et al.*, 1998; Eichengreen and Wyplosz, 1998; Dalsgaard and De Serres, 1999). Although it can be argued (as Buti *et al.* (1998) do) that once a fiscal position close to balance or in surplus has been attained automatic stabilizers will be 'restored', in contrast with the distortions characterising European fiscal policy in the recent past, it is widely accepted that while countries are still close to the 3 per cent threshold a potential incompatibility between built-in stabilizers and the SGP exists (e.g. Eichengreen, 1997). Several studies aim at determining a 'safe' budgetary position that allows stabilizers to operate without inducing SGP violations; in doing so, simple computations based on past output gaps and how a 1 percentage point (p.p.) change in the latter affects the budget are often used (see Buti *et al.* (1998) for an example and Dalsgaard and De Serres (1999) for a SVAR-based approach).

A related question, at least as important, regards the actual effectiveness of automatic stabilizers at smoothing output. Existing evidence (e.g. OECD (1993), Bayoumi and Eichengreen (1995), European Commission (1997), Allsopp *et al.* (1997)) suffers from a number of shortcomings – for instance, it is based on a limited number of deterministic simulations, and often does not consider the new monetary environment of EMU. Yet it seems uncontroversial that an assessment of fiscal policy in Europe requires comparable, up-to-date estimates of the decrease in macroeconomic volatility due to automatic stabilizers in the several countries.

In this paper we have developed a modified version of NiGEM[1] – the Global Econometric Model of the National Institute of Economic and Social Research (NIESR) – to address the two sets of issues mentioned above. Two policy regimes have been defined: one where automatic stabilizers are allowed to operate, thus making fiscal policy responsive to the output gap; the other where they are effectively suppressed, and hence the *actual* and *structural* fiscal policy stances coincide. Further, drawing on Dury and Pina (2000), we have also formalized the provisions of the SGP regarding the stages and timings of the excessive deficit procedure (EDP). Then, under both policy regimes, we apply the technique of stochastic simulation: over the 1999-2005 period, the model is subject to vectors of shocks that purport to represent typical macroeconomic turbulence. All eleven countries having joined the Euro, bar Luxemburg, are individually analysed.

[1] Taking its April 1999 release (cf. NIESR, 1999) as a starting point.

Several features of NiGEM make it particularly suited for our purposes. It has been widely used for policy analysis and model comparison studies[2], and can be solved under rational expectations for a variety of policy regimes. Demand and supply sides are fully modelled, alongside an extensive monetary and financial sector. NiGEM is largely estimated (as opposed to calibrated) and its equations regularly tested for econometric misspecification. Last but not least, all EU countries have individual models with a similar theoretical structure, so that cross-country variation in simulation properties reflects genuine differences resulting from estimation.

Our analysis contains innovative features both in terms of methodology and at the level of results. Unlike in previous studies, the operation of budgetary stabilizers is formalized as set of simple policy rules, which private agents take into account when forming model-consistent expectations. In a similar vein, the new monetary environment in Europe is explicitly modelled. We thus reduce the vulnerability of our findings to the Lucas critique[3]. Further, long-run government solvency is ensured, ruling out increasing debt ratios as a consequence of countercyclical policies. The use of stochastic simulation makes it possible to consider the multiple sources of uncertainty impinging on the economy, rather than restricting attention to a few demand disturbances, as in most of the literature. When assessing whether SGP violations will ensue from the operation of built-in stabilizers, account is taken of the fact that output variability is in itself regime-dependent: we model output gaps and their interaction with the budget explicitly, rather than resorting to simple rules of thumb based on the past. Finally, our formalization of the EDP allows us to study how serious violations might be: not only whether excessive deficits will occur but also whether they are likely to be persistent enough to make the country concerned receive a notice, or suffer pecuniary sanctions.

A flavour of our results can be stated as follows. First, provided countries pursue the fiscal consolidation efforts announced in their Stability Programmes, automatic stabilizers will not be greatly hampered by the SGP deficit ceilings. Second, budget stabilizers reduce output variability by less than the standard literature estimates; besides, cross-country variation is very significant, and can only be partly explained by differences in the size of those stabilizers or in the degree of openness to foreign trade.

The remainder of this paper is organized as follows. We start by presenting NiGEM's main features, with particular emphasis on fiscal variables, and by describing how stochastic simulations have been performed. Section 3 opens with the main lines of our approach to automatic stabilizers, discussing it both in the light of alternative views on the link between fiscal policy and the business cycle, and taking into account some important methodological shortcomings of previous analyses. Our formalization of fiscal policy is then presented in detail (sections 3.1 and 3.2), together with the way some other issues, such as monetary policy or the choice of a baseline, were handled (section 3.3). The automatic stabilizers regime hence defined makes extensive use of a

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[2] Undertaken by the Brookings Institution (e.g. Bryant *et al.*, 1993) and by the ESRC Macroeconomic Modelling Bureau (e.g. Mitchell *et al.*, 1998), among others.

[3] Vulnerability to such a critique cannot be completely eliminated insofar as NiGEM's equations are based on past data: the estimated coefficients may not reflect 'deep parameters', and likewise the econometric residuals (used for stochastic simulation) may mirror a regime-dependent shock distribution. However, the model's equations have in general been successfully tested for structural stability, while the consideration of structural change is clearly beyond the scope of this paper.

measure of the output gap: section 4 then explains how we employ aggregate production functions and labour market equilibrium concepts to estimate potential output. Section 5 is devoted to the analysis of simulation results: we describe our findings, compare them with those of previous studies, and, despite the multiplicity of economic mechanisms at work, attempt to isolate some major driving forces behind the empirical outcomes. Section 6 concludes.

2. Model and Simulation Technique Overview

In this section we start by outlining NiGEM's main characteristics, drawing heavily on NIESR (1999), where more comprehensive information can be found; then, in a second stage, we present the model's fiscal blocks, as well as the technique of stochastic simulation.

NiGEM is an estimated macroeconometric model, with quarterly periodicity, using a 'New-Keynesian' approach: agents are forward-looking in financial and labour markets, but the process of adjustment to shocks is slowed down by nominal rigidities. Demand and supply sides are fully modelled, alongside an extensive monetary and financial sector.

The model comprises estimated blocks for the whole world: all OECD countries, as well as China, are modelled separately, there being regional blocks for East Asia, Latin America, Africa, Developing Europe, OPEC countries, Visegrad nations and Miscellaneous Developing countries. The major economies have fairly detailed models (60-90 equations in total, with around 20 key behavioural relations) sharing a similar theoretical structure, so that cross-country variation in simulation properties reflects genuine differences resulting from estimation. National or regional blocks are linked through trade, financial variables and asset stocks.

The core structure of NiGEM can be viewed as a Mundell-Fleming model extended in a significant number of ways (Barrell and Sefton, 1997). Consumption is not forward-looking but depends on wealth, which entails the need to ensure that the assets stocks of the private and public sectors are modelled consistently within and across countries. Solvency constraints are imposed on governments, thus ruling out any long-run explosion in public debt stocks. Financial markets are forward-looking: exchange rates follow the uncovered interest parity condition, while long interest rates result from the forward convolution over 10 years of their 3-month counterparts. The latter are assumed to be the monetary authorities' instrument, set according to simple feedback rules (see section 3.3 for an example). Although households are not forward-looking, the impact of future events is brought forward onto them by financial markets, through variables such as long rates and equity prices. As regards the supply side, estimated demands for capital and labour form a basis to calibrate aggregate CES production functions with exogenous labour-augmenting technical progress. Capacity utilisation - defined as the ratio of actual output to a measure of potential output, the latter following from the production functions - feeds into the wage and price system (e.g. fuelling inflation if there is a shortage of capacity), thus playing an essential role in the model's self-stabilising properties. In those countries where evidence supports the existence of forward-looking behaviour in bargaining, wages depends on expected future inflation.

More generally, different institutions in the labour and product markets make the estimated speed of adjustment of wages and prices vary across countries.

For each of the ten countries analysed in this paper, current fiscal revenues are disaggregated into personal taxes (variable TAX, which includes both personal income tax and social security contributions), corporate taxes (CTAX) and miscellaneous taxes (mainly indirect; MTAX). On the expenditure side, one finds government consumption and investment (GC and GI, respectively), interest payments (GIP) and transfers (TRAN)[4]. As GC and GI are expressed at constant prices, a conversion to nominal terms is necessary (using the private consumption deflator CED and the GDP deflator P, respectively). The budget balance thus reads:

BUD = TAX + MTAX + CTAX - TRAN - GIP - GC*CED - GI*P

Government interest payments are modelled as the income on a perpetual inventory, the change in the debt stock each period paying the long interest rate in the issue period until it is replaced[5]. The equations for the remaining budget items are presented in the next section. Variables GC and GI are both components of aggregate demand, and GI also feeds into the public capital stock. Personal taxes and transfers affect disposable income, as do interest payments[6]. Further, all budget items feed into the economic system through their impact on the budget balance, and thus on the economy´s asset stocks.

Stochastic simulation consists in solving the model under a variety of shocks. These shocks are representative of the uncertainty surrounding the economic environment, and can refer either to the model equations' error terms or to their estimated coefficients (or both). As NiGEM's equations have been tested for structural stability, in this work we only shock error terms.

Shocks can either be drawn from an estimated joint distribution (see e.g. Fair, 1993) or 'bootstrapped' from a matrix of actual historical residuals (as in e.g. Blake, 1996), both methods ensuring that the contemporaneous covariance structure is preserved. We take the second route, which relies on the absence of serial correlation in the residuals, and thus successively impose on the model vectors of shocks that are columns of a matrix $M_{N,T}$, where N is the number of behavioural or stochastic equations (around 800 in the current version of NiGEM), and T stands for the number of observations in the historical period whose residual terms we use. In this paper T=20, corresponding to the quarters from 1993:1 to 1997:4 - five years that are common to the estimation period of all stochastic equations and, further, that avoid the structural break induced by German reunification. Fiscal variables are not shocked[7], as that would blur the contrast between policy regimes and add noise to the simulation outcomes.

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4 As well as, in the case of Germany, a miscellaneous expenditure category (GMEXP): though countries in Europe are modelled in the same way, the German federal structure requires that we add GMEXP to capture net transfers to lower levels of government and the social security scheme.

5 Except in countries like Italy and Belgium, where the existence of a large proportion of short-term public debt is taken into account.

6 Variable GIP also influences net property income paid abroad, and thus the current account and asset stocks as well.

7 Formally, no residuals of equations defining fiscal variables are bootstrapped. The only exception is variable GIP, whose equation is the same in both regimes.

The mechanics of the simulation procedure are as follows. One starts by applying a set of shocks to the first period of the simulation horizon (1999:1, in this paper), and solves the model forward[8]. One then moves to the following quarter (1999:2), draws a new vector of disturbances, and solves forward again. This second model solution, however, will only determine the values of variables from 1999:2 onwards: 1999:1 is already history, and thus no longer subject to change. We proceed in this way until 2005:4; the ensuing set of 28 simulations (as the period considered comprises 28 quarters) is called a *trial*.

Results in section 5 are presented for a total of 200 trials per policy regime. Though this may seem a low figure, Barrell *et al.* (2000a) show that statistics of macroeconomic variability similar to ours (root-mean-squared deviations; see section 5.2) initially change as the number of replications grows, but settle down after roughly 100 trials: therefore, 200 trials are enough for a reliable assessment of each policy regime. As a further step to control for simulation error, we have seeded our shocks identically across regimes.

3. The Two Policy Regimes: Formalizing Automatic Stabilizers

In modelling fiscal automatic stabilization we have followed the OECD both in defining which revenue and expenditure items are assumed to depend on the cycle, and in quantifying such dependence. According to this approach, which has become standard among international organizations that periodically compute cyclically-adjusted budget balances, tax revenues (divided into several categories) respond to the economy's cyclical position, whereas public expenditure does not - except for unemployment benefits. Further, each cycle-dependent budget item displays a given, constant elasticity with respect to (*w.r.t.*) the output gap, reflecting the characteristics of the respective national tax system[9].

As we are interested in quantifying the impact of automatic stabilizers on macroeconomic volatility, two policy regimes are simulated: one where taxes and unemployment transfers are determined according to the abovementioned elasticities, the other where the cyclical response of those budget items is exactly cancelled out by (pro-cyclical) discretionary measures of identical magnitude. This will mean that in the latter regime tax and spending plans are set at their structural trajectory levels, and there are no fiscal feedback mechanisms operating to stabilise the economy. It is the purpose of this section to present how both regimes have been formalized in NiGEM.

However, alternative approaches to automatic stabilizers exist, and in particular the 'OECD view' of how the cycle affects the budget has come under attack in a number of recent studies. Hence, before turning to the issue of regime specification, we summarize and discuss such approaches and criticisms, and argue that, although a 'pure automatic

[8] The whole model is solved simultaneously using a version of the Fair-Taylor algorithm (Fair and Taylor, 1983), with terminal conditions on expected variables specified as constant rates of growth. This forward solution, yielding model-consistent expectations, must go far enough into the future to ensure that solution values do not depend on the terminal date: in this paper, we have always solved to 2017:1.

[9] See Giorno *et al.* (1995, pp. 203-208) for a summary of how such elasticities have been estimated.

stabilizers' regime is unlikely to be observed in practice, its analysis and simulation, improving on previous studies, can provide valuable insights.

Some studies have addressed the link between government size and output volatility. A recent example is Fatás and Mihov (1999), who report robust evidence that volatility tends to fall when size increases, reflecting automatic stabilization mechanisms associated with the latter. Although we do find that government size (or, more specifically, the size of cyclically-sensitive budget items) is an important determinant of the degree of automatic stabilization, it turns out that other factors play an important role as well. Further, while Fatás and Mihov rely on cross-sectional data (for either OECD members or US states), our approach allows us to compare the effectiveness of stabilizers in different individual countries.

Another strand of literature criticizes 'OECD-style' automatic stabilizers, the main objection being that they do not provide a good characterization of fiscal policy over the cycle. Melitz (1997) finds evidence of contemporaneous pro-cyclical behaviour of government spending in a sample of 19 OECD countries. A study by the European Commission (1997) reports that EU countries have on average engaged in pro-cyclical discretionary policy both in periods of moderately positive output gaps and in periods of strong recessions[10]. In the light of these papers, it then seems to be the case that, besides the cyclical variation of revenues and transfers that 'automatically' follows from the design of tax and unemployment insurance systems, other forces of a systematic or 'quasi-automatic' nature are also at play - for instance, a more lenient control of expenditure when cyclical upswings make revenues more abundant (Melitz, 1997).

Two other papers provide additional support to this criticism. Using data for U.S. states, Alesina and Bayoumi (1996) find that a lower cyclical variability of the budget balance (generally associated with tighter fiscal rules) does not translate into increased state output volatility - and thus budgets over the cycle probably reflect not only 'conventional' automatic stabilizers (which tend to smooth output) but also politically-induced distortions (which may be destabilizing). Brandner *et al.* (1998) perform a univariate trend-cycle decomposition of several revenue and expenditure categories for EU countries, and conclude that the cyclical components of current expenditures are generally more volatile than those of current revenues.

A second objection to the conventional view of automatic stabilizers concerns the assumption of time-invariant output gap elasticities (e.g. Url, 1997; Brandner *et al.*, 1998). This criticism is related to the fact that, in a medium term perspective, the degree of automatic stabilization becomes endogenous, as the tax system is subject to reform. If strong anti-deficit rules are in force, it is unlikely that a tax code giving rise to marked revenue fluctuations is left unrevised for long - in line with Bayoumi and Eichengreen (1995) or Alesina and Bayoumi (1996), who provide evidence that U.S. states with tighter 'balanced budget rules' tend to have budgets which are less reactive to the cycle.

While accepting that the above objections make valid points, we contend that it remains of interest to assess, in the light of the existing elasticity estimates and abstracting from political biases, how effectively European tax and transfer systems perform at smoothing output fluctuations. First, even if such systems proved incompatible with

[10] Buti *et al.* (1998) argue that this has been especially the case for high-debt countries.

SGP rules, and a reform of taxation and unemployment benefits ensued (the elasticity endogeneity argument), any accompanying increase in output volatility would be a loss in itself, whose quantification provides one possible rationale for our approach.

Furthermore, and despite widespread awareness of the existence of political distortions impinging on fiscal policy, the conventional view of automatic stabilizers continues to be found in recent studies on European fiscal policy: for instance, Buti *et al*. (1998) and the IMF (1998) aim at determining structural balances that would allow (conventionally-defined) budgetary stabilizers to operate without giving rise to excessive deficits.

Finally, existing studies estimating the effectiveness of automatic stabilizers in terms of output smoothing (e.g. OECD (1993), Bayoumi and Eichengreen (1995), European Commission (1997), Allsopp *et al.* (1997)) present important shortcomings. They are based on a very limited number of deterministic simulations, mainly consisting of demand shocks, which both excludes many other sources of uncertainty (unlike in stochastic simulations) and may bias the results towards large stabilization gains (as argued below in section 5). Only some studies have dealt with the several Euroland countries in a comparable way, and none has taken into account the new reality of a single monetary policy[11]. The macroeconometric models employed have sometimes been of a backward-looking nature, thus limiting the scope for consideration of the implications of government solvency or of the effects of actions on exchange rates and asset prices in a rational expectations world. And the regime where automatic stabilizers are prevented from operating (which serves as a term of comparison) has not always been accurately defined: for instance, in the OECD (1993) and the European Commission (1997) studies taxation is changed so as to keep the budget balance at a constant level, but such constancy should actually be ensured on both the expenditure and the revenue sides[12]. It is our goal to overcome these deficiencies.

An attractive feature of the conventional view of automatic stabilizers is that it can be expressed as a set of ‘simple rules’ for the relevant budget instruments - thus making it possible to perform a formal analysis of the ensuing policy regime in the dynamic, rational expectations framework of NiGEM. Deriving such ‘simple rules’[13] is what we now turn to.

3.1. The Automatic Stabilizers Regime

As mentioned before, we have decided to follow the OECD (cf. Giorno *et al.*, 1995 and OECD, 1998) as regards both the definition of which budget items are sensitive to the cycle and the elasticities that characterize such sensitivity. This ensures that our results are comparable to previous research by other authors (discussed above). For a given item with (nominal) value T, the OECD determines the corresponding structural (or cyclically adjusted) amount by the formula

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[11] The OECD (1993), for instance, makes an *ad-hoc* assumption of constant interest rates.

[12] As acknowledged by the European Commission itself (1997, n. 22, p. 101). In turn, Bayoumi and Eichengreen (1995) show that results are sensitive to which budget item adjusts to keep the fiscal balance fixed.

[13] Political factors would be much harder to formalize in this framework. Notice that our simple rules, as most such rules in the literature, are however baseline-dependent and non-operational (as knowledge of the contemporary output gap is required) - see e.g. McCallum (1993).

$$T^a = T\left(\frac{Y^*}{Y}\right)^{\alpha} \qquad (1)$$

where Y^* represents potential output, Y actual output and α is thus an elasticity with respect to the output gap. The OECD cyclically adjusts five budget categories: personal income tax, social security contributions, indirect taxes, corporate taxes and current primary expenditure. The elasticity applied to the latter is typically small, reflecting the circumstance that unemployment benefits are the only expenditure item assumed to vary automatically with the cycle. A summary of OECD elasticities[14] is presented in annex 1.

In an important way, however, our approach is the inverse of the OECD's. While the latter computes the *structural* values of budget items for given *actual* amounts, we aim at obtaining *actual* taxes and expenditure that, although varying across stochastic trials, correspond to a given unchanged *structural* stance - and thus reflect the operation of automatic stabilizers in the wake of a variety of shocks and in the absence of discretionary fiscal policy measures.

A second, related point is also worth emphasizing: we assume a constant structural stance across replications, but not along time. Since the essence of stochastic simulation is a comparison of outcomes that, for the same time period, result from different vectors of stochastic disturbances, the structural stance of fiscal policy is kept unchanged across trials for every given quarter of the simulation horizon. However, such stance need not be the same in, say, 1999:1 and 2002:4 - indeed, constancy along time would be contradictory with the goal of further fiscal consolidation to which Member States claim in their Stability Programmes to be committed (and which NiGEM's baseline largely encapsulates).

In the light of the preceding paragraphs, the automatic stabilizers policy regime is implemented in two steps. First, and prior to any stochastic trials, for each budget item and each quarter of the model solution horizon (1999:1 - 2017:1) we apply equation (1) to derive the structural values on baseline. Notice that the baseline output gap is not necessarily zero (especially in the initial years of the forecast), thus creating the need for cyclical adjustment. Rewriting the equation for clarity (with superscript *b* for baseline):

$$T_t^{a,b} = T_t^b\left(\frac{Y_t^{b,*}}{Y_t^b}\right)^{\alpha},\ t = 1999{:}1,\ldots,2017{:}1 \qquad (2)$$

Second, when performing stochastic simulations the actual values of budget items are obtained from:

$$T_t = T_t^a\left(\frac{Y_t^*}{Y_t}\right)^{-\alpha},\ T_t^a = \frac{P_t Y_t^*}{P_t^b Y_t^{b,*}} T_t^{a,b},\ t = 1999{:}1,\ldots,2017{:}1 \qquad (3)$$

The adjusted value T^a requires a word of explanation. We define a constant structural stance across replications by keeping the *ratio* of cyclically adjusted budget items to (nominal) potential output unchanged, rather than by simply fixing the value of adjusted items (in which case we would have T^a=$T^{a,b}$). We thus control for deviations from

[14] Also used, sometimes with slight modifications, by the European Commission (1995) and the IMF (1995).

baseline as regards the GDP deflator, *P*, and the economy's productive potential: in a situation where stochastic developments have made both *P* and Y^* bigger than on baseline, it would be hard to claim that keeping *nominal* adjusted budget categories unchanged would correspond to a constant structural stance.

Equations (2) and (3) should be regarded as a stylised representation of the policy regime, as three additional factors have yet to be taken into account. First, the tax and expenditure categories used by the OECD do not exactly coincide with NiGEM's, and hence some corrections are needed as regards the composition and/or magnitude of certain budget items. Second, corporate taxes are in some countries collected with a significant lag, thus requiring the use of past output gaps when performing cyclical adjustments. Last but not least, the unconstrained operation of automatic stabilizers does not ensure government solvency, implying that a forward-looking model like NiGEM might simply not have a saddlepath if an equation like (3) described the behaviour of all budget categories at all times. We present our solutions to these three problems by considering each of NiGEM's budget items in turn.

As seen in Section 2, the budget balance of a generic Euroland country is given by:

BUD = TAX + MTAX + CTAX - TRAN - GIP - GC*CED - GI*P

TAX includes both personal income tax and social security contributions, two items for which the OCDE has estimated separate elasticities. Furthermore, one generally finds some discrepancy between the sum of the OECD variables[15] for those two items and the values for TAX. By calibrating on the basis of the recent past the ratios of cyclically adjusted OECD income tax and social security contributions to NiGEM's TAX values - ratios γ_P and γ_S, respectively - we show in annex 1 that the counterpart of equation (2) becomes:

$$TAX_t^{a,b} = TAX_t^b \left[\gamma_P \left(\frac{Y_t^{b,*}}{Y_t^b} \right)^{-\alpha_P} + \gamma_S \left(\frac{Y_t^{b,*}}{Y_t^b} \right)^{-\alpha_S} + (1 - \gamma_P - \gamma_S) \right]^{-1}, t = 1999:1,...,2017:1 \qquad (4)$$

It is arguable that the loss from not disaggregating variable TAX into income tax and social security is minimal. Apart from the stability of parameters γ_P and γ_S during the simulation period, all one needs to assume for such disaggregation to become redundant is that the cyclical variation of income tax and of social security contributions affects the economy in the same way - a plausible assumption, as the two apparent impacts (via budget balance and via disposable income) exactly coincide for both revenue items.

To address the solvency issue, we determine TAX according to the operation of automatic stabilizers only during the period under stochastic simulation (i.e., 1999:1 to 2005:4), and revert to the standard NiGEM fiscal closure rule afterwards. We hence assume that automatic stabilizers are left unconstrained in the short to medium run, but any persistent deficit increases that might ensue will trigger tax rises in the medium to long run - which is realized by private agents and thus immediately reflected in forward-looking variables[16]. Formally, the counterpart of equation (3) reads:

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[15] See OECD (1998) and annex 1.

[16] As in rest of the analysis, we assume perfect commitment. However, Sims (1993) points out that large fiscal contractions in the future face a credibility problem, especially if monetary accommodation is

$$TAX_t = \begin{cases} \frac{P_t Y_t^*}{P_t^b Y_t^{b,*}} TAX_t^{a,b} \left[\gamma_P \left(\frac{Y_t^*}{Y_t} \right)^{-\alpha_P} + \gamma_S \left(\frac{Y_t^*}{Y_t} \right)^{-\alpha_S} + (1 - \gamma_P - \gamma_S) \right], t = 1999:1,...,2005:4 \\ PI_t \frac{TAX_{t-1}}{PI_{t-1}} + 0.2 \left(BUD_{t-1}^* - BUD_{t-1} \right), t > 2005:4 \end{cases} \quad (5)$$

where PI denotes personal income and BUD* is the budget balance target (which results from multiplying the baseline balance-to-GDP ratio by nominal GDP).

MTAX comes close to the OECD variable for indirect taxes, any gap between the two being handled in the same way as the wedge between TAX and the sum of OECD personal income tax and social security contributions. No other complications arise.

CTAX exactly coincides with OECD corporate taxes, the only correction needed regarding therefore the collection lags. We follow the OECD's method of adjustment: for each country a parameter λ gives the fraction of revenue collected in a given period that corresponds to corporate income earned in the same period (1-λ denoting the fraction of revenue derived from income earned before - in the previous year, for the OECD, which we proxy by a lag of four quarters). The counterparts of (2) and (3) become, respectively:

$$CTAX_t^{a,b} = CTAX_t^b \left[\lambda \left(\frac{Y_t^{b,*}}{Y_t^b} \right)^{\alpha_C} + (1-\lambda) \left(\frac{Y_{t-4}^{b,*}}{Y_{t-4}^b} \right)^{\alpha_C} \right], \ t = 1999:1, \ldots, 2017:1$$

$$CTAX_t = \frac{P_t Y_t^*}{P_t^b Y_t^{b,*}} CTAX_t^{a,b} \left[\lambda \left(\frac{Y_t^*}{Y_t} \right)^{\alpha_C} + (1-\lambda) \left(\frac{Y_{t-4}^*}{Y_{t-4}} \right)^{\alpha_C} \right]^{-1}, \ t = 1999:1, \ldots, 2017:1$$

Among the four NiGEM expenditure categories, only TRAN, which includes unemployment benefits, is assumed to be cyclically sensitive. NiGEM's standard treatment of GIP has not been modified (see section 2), whereas public consumption (GC) and public investment (GI) are modelled as independent of the cycle: versions of (2) and (3) with $\alpha = 0$ hence apply.

To model TRAN, we start by making use of the OECD elasticity for current primary expenditure. The closest NiGEM counterpart of this magnitude is given by the sum of GC (in nominal terms, i.e., multiplied by the consumption deflator) and TRAN: the ensuing aggregate is thus handled along the lines of equations (2) and (3), with a correction for statistical discrepancies similar to those performed for TAX and MTAX. By subtracting nominal GC (obtained as indicated in the previous paragraph) one derives the value of transfers[17].

perceived as an alternative. We might therefore include solid European Central Bank credentials as an underlying assumption of our regime characterization.

[17] Germany has another current expenditure category, GMEXP (recall n. 4), assumed independent of the cycle. Hence, NiGEM's counterpart of German current primary expenditure also includes GMEXP, which is then subtracted to obtain the value of transfers (see annex 1).

The overall magnitude of built-in stabilizers varies from country to country, reflecting differences in both the size of the several budget items as a percentage of GDP and in their elasticities *w.r.t.* the output gap. The standard summary measure in this area – the response of the whole budget balance, in p.p. of GDP, to a 1 p.p. change in the output gap – is presented for each country in annex 1. We have also supplemented it with a related indicator which only considers those budget items feeding into disposable income (the main transmission channel of automatic stabilizers). There is significant cross-country variation, especially as regards the second indicator – an important factor behind simulation outcomes, as discussed in section 5.

3.2. The Regime Without Automatic Stabilizers

Assessing the economic impact of budgetary stabilizers requires the definition of an alternative regime where fiscal policy is independent of the cycle. Previous studies have addressed this issue by making some *ad-hoc* assumption about which budget category changes to ensure a constant balance (see above), which inevitably entails a certain degree of arbitrariness. In this paper we assume instead that the *actual* values of each budget item are set equal to their *structural* counterparts[18] – defined, as before, as a constant share of nominal potential output. Hence, no reaction to the output gap takes place, and across replications fiscal policy is characterised by a constant ratio of the primary balance to nominal potential output. In operational terms, we use the same equations as before, but now with all elasticities (α) set to zero.

This policy regime admits two interpretations: a comprehensive reform of taxes and transfers that completely eliminates their dependence on cyclical conditions, or, perhaps more realistically, a systematic adoption of policy measures that, for each and every budget item, exactly cancel out the effects of the existing stabilizers.

3.3. Other Features of the Experimental Design

One of the main motivations for this paper is to assess whether the operation of automatic stabilizers is compatible with SGP compliance. We have therefore inserted into both NiGEM versions used for the two policy regimes a formalization of the excessive deficit procedure (EDP), closely following the letter of SGP provisions. Countries move along a succession of stages (e.g. declaration of an excessive deficit, EDP held in abeyance, issue of a notice, or imposition of a deposit) according to specific timings and to economic criteria, which have in most cases a *forward-looking* nature (e.g. whether the model-consistent forecast of the deficit/GDP ratio in the year after an excessive deficit is declared is already below 3 per cent, so that a notice can be avoided). Details of our formalization can be found in Dury and Pina (2000)[19].

The answer to the question of compatibility between SGP rules and unrestrained budgetary stabilizers clearly depends on the base scenario assumed for the trajectories of

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[18] With the exception of interest payments, which continue to be defined as in NiGEM's standard versions.

[19] The only difference lies in the fact that in the present paper, unlike in Dury and Pina (2000), deposits and fines have a 'virtual' nature (i.e., their imposition is recorded but the respective amounts do not feed into national debt stocks), since the regimes under simulation do not purport to represent actual fiscal policy under SGP rules.

deficit ratios over the period under simulation (1999:1 – 2005:4), or, more generally, on the model's baseline (the trajectory forecast for the economy in the absence of shocks). To limit the arbitrariness involved in this choice, an effort has been made to bring NiGEM's April 1999 baseline closer to the deficit targets set out in the several countries' Stability Programmes, as the latter provide a natural benchmark for fiscal policy in the coming years. Table A.2 (in annex 2) summarizes our assumptions: the average gap between baseline and Stability Programmes deficit ratios is as small as 0.04 percentage points of GDP; remaining deviations are often associated to differences in GDP growth and, more generally, result from the fact that a baseline cannot perfectly replicate the different Stability Programmes, as the latter were neither prepared simultaneously nor do they share a common underlying macroeconometric model.

Finally, our assessment of automatic stabilizers in the ten Euroland countries is conditioned on constant reaction functions for the remaining policy actors of the world economy. We consider an explicit EMU environment where the European Central Bank (ECB) targets a nominal aggregate, in line with the "prominent role" money has in its strategy (ECB, 1999). Since the ECB has made it clear that deviations from the announced reference value of 4.5% annual growth of the M3 aggregate will not automatically induce interest rate changes, nominal GDP targeting, rather than strict money targeting, has been modelled – nominal output being strongly correlated with money in the long run, but much less vulnerable to short-run volatility. Formally, the benchmark policy rule of the ECB is given by

$$i_t = i_t^b + \gamma \log\left(\frac{P_t . Y_t}{P_t^b . Y_t^b} \right) \tag{6}$$

where *i* is the 3-month nominal interest rate, and target values for nominal output correspond to Euroland baseline values[20]. Though different monetary rules - e.g. inflation targeting - could be simulated[21], the point of doing so would only be to check whether comparisons *between the two fiscal regimes* (i.e., the impact of automatic stabilizers) are sensitive to alternative ways of conducting the common monetary policy. We find it unlikely that such alternative rules can be an important determinant of the effectiveness of stabilizers at smoothing output, since the main driving forces of our results (cf. section 5.2) are not related to monetary policy – at least provided the monetary union context is modelled. Monetary policy could affect the probability of SGP violations – and this issue is addressed in a separate paper (Dury and Pina, 2000).

The major economies outside the Euro zone - the US, the UK, Japan and Canada – also have constant reaction functions in both policy regimes: interest rates respond to nominal GDP and inflation, while fiscal closure rules ensure solvency (as in the second branch of eq. (5)).

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[20] The parameter γ is set equal to 32.9, which is the inverse of the long run (semi)elasticity of Euroland money demand *w.r.t.* the interest rate.

[21] For a discussion of alternative monetary rules in NiGEM, see Barrell *et al.* (2000b).

4. Determining Potential Output

While the output gap elasticities of the several budget items broadly constitute a ‘consensus area’ among the several international institutions that routinely adjust budget balances (with OECD elasticity estimates playing a prominent role), there is a variety of methods to compute the output gap itself, with sometimes significantly different results (Barrell and Sefton (1995) provide a survey). Such methods fall into two main categories: time-series approaches and production function-based approaches.

Time-series methods vary widely in sophistication. While Barrell and Sefton (1995) or Url (1997) provide different examples of multivariate trend-cycle decompositions, the most widely used filters (e.g. Hodrick-Prescott, or the split time-trend method) remain those univariate. Their main shortcoming is the ‘end-point bias’: for instance, the Hodrick-Prescott filter used by the European Commission (1995) tends to follow the actual GDP time series more closely at the end of the sample than elsewhere. Alleviating this problem by extending the series into the near future implies, in turn, that current output gap estimates become strongly dependent on future output forecasts.

Both the OECD (Giorno *et al.*, 1995) and the IMF (De Masi, 1997) mainly follow a production function-based methodology. Although more strongly grounded in economic theory, and capable of taking into account a wider range of considerations, the use of a production function is much more demanding as regards the necessary information, some of which is either hard to measure (e.g. the capital stock) or actually unobservable (such as the natural rate of unemployment). Restrictive assumptions as regards some important parameters (e.g. the widespread use of a Cobb-Douglas specification, which imposes a unit elasticity of substitution) or the need for judgemental corrections in the light of country-specific information may also be viewed as disadvantages.

In this paper we estimate potential output by means of a production function. Rather than taking sides on the controversy about how to best compute output gaps (which is not the thrust of our analysis anyway), the main motivation for our choice has been one of consistency with the macroeconometric model used throughout. As will become clear below, standard versions of NiGEM already contain most of the building blocks needed for potential output estimation - e.g. factor demands, hours and wage equations. It therefore makes sense to extend the supply side of the model in order to obtain a formal measure of the output gap.

The analytical setup

For each Euroland country standard NiGEM versions have an underlying CES production function[22] with constant returns to scale, which one can write as:

[22] We use the term ‘underlying’ since these production functions, although not directly used for actual output determination, constitute the theoretical background for the specification of the factor demand equations and, in the case of the major economies, provide a measure of capacity utilisation, which then feeds into the price system. This capacity utilisation variable differs from our retained output gap measure insofar as the latter uses equilibrium, rather than actual, labour input.

$$Y_t = \gamma\left[\delta\left(K_t\right)^{-\rho} + \left(1-\delta\right)\left(L_t e^{\eta t}\right)^{-\rho}\right]^{-1/\rho}$$

In the equation above, output is a function of the capital stock *K* and of the labour input *L*, measured in employee hours[23]. Labour-augmenting technical progress takes place at rate η, while the elasticity of substitution σ equals $1/(1+\rho)$.

Our measure of potential output follows from this production function when *L* is taken at its equilibrium, rather than actual, level. Equilibrium labour input is defined as the product of equilibrium employment (obtained in turn by subtracting natural unemployment from the labour force) and equilibrium hours. Formally, representing by *LF* the total labour force, by *NAIRU* the natural unemployment rate and by *H* (quarterly) hours per worker, and denoting by an asterisk potential or equilibrium values:

$$Y_t^* = \gamma\left[\delta\left(K_t\right)^{-\rho} + \left(1-\delta\right)\left(LF_t\left(1 - NAIRU_t\right)H_t^* e^{\eta t}\right)^{-\rho}\right]^{-1/\rho} \qquad (7)$$

The remainder of this section discusses the several steps involved in the implementation of eq. (7), as well as the ensuing results. We then present (i) how NAIRU estimates have been obtained, (ii) the computation of equilibrium hours, (iii) the calibration of the production functions and (iv) the adjustments made to accommodate the special circumstances of some countries (e.g. the gradual catching up of East German productivity or the Irish very strong growth performance).

Estimating the NAIRU

We estimate the natural rate of unemployment within a stylised version of the bargaining framework of Layard *et al.* (1991, Chap. 2). Firms are assumed to have the 'right to manage', determining employment according to their labour demand curves. Therefore bargaining only takes place over wages, the outcome reflecting the relative strength of unions *versus* employers. The NAIRU is an equilibrium concept corresponding to the rate of unemployment that would prevail were the endogenous wage and price variables at their equilibrium levels (Barrell *et al.*, 1993). Endogeneity, however, clearly depends on the time frame of the analysis: as will become more clear below, a medium-term horizon is considered.

The adopted methodology rests on two relationships: a labour demand equation and a wage equation. NiGEM includes both for each of the Euroland countries. The former equation follows from the standard equality between the marginal product of labour (computed, naturally, according to the CES production function) and the markup-adjusted real hourly wage. Assuming that markups are stable, we disregard constant terms and write:

$$\ln(L_t) = \ln(Y_t) - \sigma \ln(W_t / P_t) + (\sigma - 1)\eta t \qquad (8)$$

where *W* is the nominal hourly wage rate. The wage equation models in a stylised way the determinants of the bargaining outcome by making wages dependent on the

[23] Both factor inputs refer to the whole economy, rather than to the private sector alone.

prevailing unemployment rate[24] (U), as well as on average labour productivity. Suppressing again intercept terms, it then holds that:

$$\ln(W_t \;/\; P_t) = \ln(Y_t \;/\; L_t) - \beta U_t \qquad (9)$$

An estimate of the NAIRU can now be obtained by solving eq. (8) for the (log) real wage, inserting the result into eq. (9) and solving the latter for the unemployment rate:

$$NAIRU_t = \frac{1}{\beta}\frac{\sigma - 1}{\sigma}\left[\ln\left(\frac{Y_t}{L_t}\right) - \eta t\right] \qquad (10)$$

Equations (8) and (9) express long-run equilibrium relationships, and appear as cointegrating vectors in NiGEM's error correction formulation for the labour demand and wage equations, respectively. A question which then naturally arises concerns how to treat the short-run dynamic terms (i.e., the difference terms) in those equations. Since we aim at estimating NAIRUs that correspond to a medium-term equilibrium, the difference terms have been set equal to the five-year centred moving average of the growth rates of the respective variables[25]. We thus obtain NAIRUs given by eq. (10)[26] plus intercept and average growth rates terms, expressing the level of unemployment compatible with the (medium-term) equilibrium real wage - derived from the labour demand equation.

Our estimates are summarized in Table 1, both for the recent past and for the years under stochastic simulation (1999-2005). The period starting in 1993 has not witnessed major structural changes, thus providing a basis to assess whether the methodology adopted yields reasonable results. The same period has also been used to calibrate some of the production function parameters (see below).

Determining equilibrium hours

NiGEM's equation for hours has been used along the lines described above: we have computed medium-term equilibrium hours as the value implied by the level terms of the respective equation when the difference terms are set equal to five-year centred moving averages of rates of growth. Omitting the intercept, the levels relationship present in the dynamic equation for hours reads

$$\ln(H_t) = -\beta \ln t,\ \beta > 0$$

thus expressing a gradual decline, at a decreasing rate, of the number of hours worked.

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[24] Clearly, many other factors influence the bargain - replacement ratios, the degree of unionisation or the existence and level of minimum wages, to name a few.

[25] For Spain and Austria seven-year centred moving averages were used instead. Notice that steady state rates of growth (those consistent with a balanced growth path) should have been used if we were interested in estimating long-term equilibrium unemployment rates.

[26] To minimize erratic movements in the NAIRU, the average labour productivity term in (10) is measured as an average over eight quarters.

Table 1 - NAIRU estimates *versus* actual unemployment rates (U)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GE	NAIRU	11.0	10.0	10.1	10.4	10.7	10.9	10.8	10.4	10.2	10.0	9.7	9.5	9.3
	U	9.1	9.6	9.5	10.5	11.5	11.0	10.7	10.5	10.2	9.8	9.6	9.5	9.3
FR	NAIRU	11.1	11.6	11.7	11.8	12.0	11.5	11.0	10.5	10.1	9.7	9.4	9.1	8.8
	U	11.7	12.2	11.6	12.3	12.5	11.8	11.1	10.6	10.3	9.9	9.6	9.2	9.0
IT	NAIRU	11.7	10.7	11.2	11.5	11.8	12.0	12.0	11.9	11.6	11.3	11.0	10.9	10.8
	U	10.4	11.5	12.0	12.0	12.2	12.2	11.9	11.8	11.5	11.2	11.1	11.0	10.9
SP	NAIRU	22.7	21.1	21.3	21.1	20.1	18.8	17.6	16.6	15.8	15.2	14.8	14.7	14.6
	U	22.9	24.1	22.9	22.2	20.8	18.8	17.0	15.5	14.7	14.8	15.0	15.0	14.8
NL	NAIRU	6.7	6.6	6.1	5.6	5.3	4.9	4.5	4.5	4.6	4.8	5.0	5.2	5.4
	U	6.6	7.1	6.9	6.3	5.2	4.0	3.9	4.3	4.6	4.9	5.2	5.3	5.4
BG	NAIRU	8.9	9.5	9.4	9.9	9.6	8.8	8.5	8.4	8.2	8.2	8.2	8.2	8.3
	U	8.9	10.0	9.9	9.7	9.3	8.8	8.7	8.4	8.3	8.3	8.3	8.3	8.3
PT	NAIRU	5.6	6.2	6.9	6.6	5.8	5.5	5.5	4.7	4.1	3.9	4.0	4.0	3.9
	U	5.7	7.0	7.3	7.3	6.8	4.9	4.8	4.6	4.4	4.2	4.1	4.0	3.9
OE	NAIRU	4.6	6.7	7.9	7.8	7.3	6.7	6.5	6.6	6.6	6.6	6.6	6.6	6.5
	U	6.8	6.5	6.6	7.0	7.1	7.2	7.1	6.8	6.6	6.6	6.7	6.6	6.5
IR	NAIRU	14.9	14.5	12.8	10.9	11.0	10.0	8.0	6.9	6.4	5.8	5.4	5.6	5.7
	U	15.6	14.3	12.3	11.6	10.1	8.9	8.2	6.3	5.9	5.8	5.8	5.8	5.8
FN	NAIRU	15.9	15.0	13.9	14.5	14.9	12.0	10.0	10.5	10.0	9.2	8.9	8.5	7.9
	U	17.6	17.5	16.2	15.3	13.1	11.8	10.2	10.1	10.0	9.6	9.2	8.7	8.1

Source for U: NiGEM's database, NiGEM's baseline for projection period.
GE = Germany, FR = France, IT = Italy, SP = Spain, NL = Netherlands, BG = Belgium, PT = Portugal, OE = Austria, IR = Ireland, FN = Finland.

Calibrating the production functions

The CES production function in equation (7) has four parameters to calibrate: γ, δ, η and ρ (or, equivalently, σ). Values for the elasticity of substitution σ and for the rate of exogenous technical progress η have already been derived: they follow from the cointegrating vector of the labour demand equation (see (8) above)[27]. Notice that this approach avoids one of the common shortcomings of output gap computations based on an aggregate production function - viz. the imposition of $\sigma = 1$ due to a Cobb-Douglas specification.

Parameter δ was calibrated by setting output elasticities *w.r.t.* each of the production factors equal to the respective shares in income. Some algebra shows that

$$\frac{1-\delta}{\delta} = \frac{W_t L_t \;/\; (P_t Y_t)}{1 - W_t L_t \;/\; (P_t Y_t)} \left(\frac{L_t e^{\eta t}}{K_t} \right)^{\rho}$$

from which one obtains δ.

[27] The elasticity of substitution can similarly be recovered from the long-run solution of the capital demand equation.

Finally, the scale parameter γ was found by setting, for each country, the ensuing average annual output gap over the 1993-1997 period equal to the homologous average computed on the basis of OECD (1998) output gap estimates.

Table 2 below contains our estimates. As an informal check for plausibility, it can be seen that in most cases the pattern of output gaps from 1993 to 1997 closely matches the OECD figures. During the period under simulation (1999-2005) NiGEM's baseline implies a gradual convergence to potential output, although the initial years still witness significant gaps for a number of countries.

Table 2 - Estimates of the output gap

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GE	NiGEM	-0.7	-0.6	-0.9	-1.6	-1.4	-0.7	-1.4	-0.9	-0.3	0.0	0.1	0.0	0.0
	OECD	-0.6	-0.3	-1.1	-1.6	-1.7	-1.4	-1.4	-1.2	-	-	-	-	-
FR	NiGEM	-2.2	-2.0	-2.4	-3.7	-2.5	-1.6	-1.1	-0.5	-0.2	-0.2	-0.1	-0.1	0.0
	OECD	-3.5	-2.4	-2.1	-2.5	-2.2	-1.2	-0.9	-0.4	-	-	-	-	-
IT	NiGEM	-2.1	-2.1	-1.2	-2.5	-3.0	-3.8	-3.4	-2.7	-1.5	-0.7	-0.4	-0.2	-0.1
	OECD	-2.6	-2.3	-1.1	-2.3	-2.6	-3.2	-3.2	-2.7	-	-	-	-	-
SP	NiGEM	-0.9	-2.1	-1.4	-1.9	-1.5	-0.9	-0.8	-0.1	0.0	0.1	-0.1	-0.2	0.0
	OECD	-1.3	-1.4	-1.3	-2.1	-1.7	-1.0	-0.8	-0.8	-	-	-	-	-
NL	NiGEM	-0.4	0.7	-0.6	-0.6	-0.6	0.7	0.4	0.2	0.1	0.0	0.1	0.0	0.0
	OECD	-1.2	-0.5	-0.6	0.1	0.7	1.4	1.0	0.4	-	-	-	-	-
BG	NiGEM	-3.5	-2.6	-2.5	-2.9	-2.0	-1.8	-1.2	-0.8	-0.4	0.0	0.2	0.1	0.0
	OECD	-3.1	-2.9	-2.4	-3.1	-2.1	-1.2	-1.0	-0.7	-	-	-	-	-
PT	NiGEM	-2.0	-2.3	-1.1	-0.7	-1.0	0.1	0.3	0.2	0.0	0.1	0.0	0.0	0.1
	OECD	-1.3	-1.8	-1.7	-1.5	-0.8	0.1	0.2	0.3	-	-	-	-	-
OE	NiGEM	-1.2	-1.5	-1.7	-1.5	-1.6	-1.3	-0.8	-0.4	0.0	0.0	-0.1	-0.1	0.0
	OECD	-1.8	-1.2	-1.2	-1.7	-1.5	-0.8	-0.7	-0.6	-	-	-	-	-
IR	NiGEM	-5.3	-4.1	-1.2	-2.1	0.5	1.7	1.2	0.7	0.6	0.3	-0.2	-0.1	0.0
	OECD	-6.0	-5.0	-1.1	-1.1	1.0	2.0	1.0	0.4	-	-	-	-	-
FN	NiGEM	-10.6	-8.1	-5.9	-3.8	0.3	1.3	0.8	1.0	0.5	0.2	0.1	-0.2	-0.1
	OECD	-10.9	-8.0	-4.9	-3.3	-1.0	1.3	0.8	0.3	-	-	-	-	-

Notes and sources: output gaps are defined as actual GDP minus potential GDP, as a percentage of the latter; OECD figures are taken from OECD (1998).

It is important to clarify that potential output does not remain constant across replications. Rather, it is recomputed according to equation (7) for each new set of shocks, and to the extent that the latter affect the values of variables such as the user cost of capital (which feeds into the demand for capital) or the average labour productivity (which influences the NAIRU), potential output will vary as well[28]. Our methodology therefore yields not only estimates of baseline potential output, but also a coherent framework to assess how disturbances impinge on the economy's equilibrium GDP.

[28] Although much less that actual GDP.

Some special cases

Minor adjustments to the general methodology presented above had to be made in the cases of Germany, Spain and Ireland. We now consider each of these countries in turn.

German unification induced a sudden drop in labour productivity (around 14%, when comparing in 1991 Germany as a whole with West German levels), followed by a gradual, non-linear catching up process of the former GDR (Barrell and te Velde, 2000). NiGEM's labour demand equation incorporates these developments by augmenting the technical progress time trend with a term capturing the above pattern of abrupt decrease followed by gradual recovery. Hence, for Germany, eq. (8) takes the form:

$$\ln(L_t) = \ln(Y_t) - \sigma \ln(W_t \,/\, P_t) + (\sigma - 1)\left\{\eta t - UNIF_t \left[0.14 \,/\, (1 + \varepsilon(t - t_0))\right]\right\}$$

where t_0 corresponds to the unification quarter (1990:4) and UNIF is an indicator variable equal to unity from 1991:1 onwards. Naturally, a similar adjustment takes place in the exponential technical progress term of the production function.

In the case of Spain the hypothesis of a unit elasticity of substitution could not be rejected, and therefore the general CES production function specializes into a Cobb-Douglas formulation[29]. An exponential neutral technical progress term has been calibrated on the basis of 1989-1997 data.

Ireland's recent years of very strong growth have led us to include neutral technical progress, besides the standard labour-augmenting term, in the CES production function. Calibrated for the 1987-1997 period, neutral technical progress is assumed to gradually fade away in the early years of the simulation period, reflecting the fact that the Irish economy has already essentially caught up to average European income per capita levels.

[29] Which implies that the Spanish NAIRU will not have any terms in the level of productivity - see eq. (10).

5. Empirical Results

In line with this paper's double motivation, we start by analysing how each policy regime fares in terms of compliance with SGP rules, and then turn to the implications of automatic stabilizers for macroeconomic variability. The regimes with and without built-in stabilizers are denoted below by regimes 1 and 2, respectively.

5.1. Automatic Stabilizers and SGP Discipline

The main conclusion to be drawn from Table 3 is that the unconstrained operation of automatic stabilizers is broadly compatible with a deficit ceiling of 3% of GDP. Under regime 1, among the ten countries comprised in our study, five (Italy, Belgium, Portugal, Ireland and Finland) never record an excessive deficit; four (Germany, France, the Netherlands and Spain) face probabilities of ever running an excessive deficit over the whole simulation period (1999-2005) which do not exceed 5%; and only one (Austria) finds that automatic stabilizers create a significant risk of SGP violations.

Table 3 – Probabilities (%) of events ever taking place over 1999-2005

		Exc. Def.	Notice	Deposit	Fine
GE	Reg. 1	5.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
FR	Reg. 1	2.5	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
IT	Reg. 1	0.0	0.0	0.0	0.0
	Reg. 2	2.5	0.0	0.0	0.0
NL	Reg. 1	0.5	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
BG	Reg. 1	0.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
SP	Reg. 1	2.5	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
PT	Reg. 1	0.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
OE	Reg. 1	27.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
IR	Reg. 1	0.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0
FN	Reg. 1	0.0	0.0	0.0	0.0
	Reg. 2	0.0	0.0	0.0	0.0

Non-zero entries shaded for readability.

Excessive deficits are not only rare but also short-lived. In an overwhelming majority of cases, countries manage to eliminate them in the same year they are declared (Table 4).

The remaining excessive deficits are corrected during the subsequent year, thus avoiding that the EDP ever reaches the stage where a notice is issued[30].

Table 4 - % of EDPs that finish in the initial year

	GE	FR	IT	NL	BG	SP	PT	OE	IR	FN
Reg. 1	90.0	100.0	-	100.0	-	80.0	-	94.4	-	-
Reg. 2	-	-	100.0	-	-	-	-	-	-	-

Such optimistic outlook is related to the assumed base scenario. Table A.3 (annex 2) presents the cyclically-adjusted baseline deficits and compares them with an example of the simple computations of 'safe' budgetary positions based on past output gaps mentioned in the introductory section. It can be seen that, with a few exceptions in initial years, baseline deficits are 'safe', often by a considerable margin.

If governments decide to block the operation of budget stabilizers (regime 2) compliance with SGP rules becomes virtually absolute: only Italy ever runs an excessive deficit.

The figures for Austria and (to a lesser extent) Italy, in regimes 1 and 2 respectively, illustrate the non-linear relation between baseline targets or deficit ratio volatilities, on the one hand, and the probability of excessive deficits, on the other – a consequence of the threshold nature of the latter. Austria has more frequent SGP violations not because its deficit ratio is particularly volatile (Table A.5, Annex 3), but rather because its assumed baseline deficits in initial years are somewhat higher than those of other countries: for a given volatility, a *modest* deterioration in baseline balances may translate into a *large* increase in the number of times the 3 per cent threshold is exceeded[31]. Likewise, a slightly higher deficit variability for Italy under regime 2 (cf. section 5.2) induces the occurrence of SGP breaches[32].

More detailed simulation results are provided by Table A.4 (in annex 3). Vulnerability to violations of the 3 per cent threshold tends to be highest in the initial years of the simulation horizon, where countries like Germany and Austria are still far away from a budgetary position close to balance (recall our baseline assumptions)[33]. Deficits in excess of 3 per cent of GDP are also more prevalent in times of recession (defined as an annual GDP fall of at least 0.75 per cent), which largely follows from the way regime 1 is defined; in both 1999 and 2000, however, Austria faces probabilities of breaking the deficit ceiling under no recession which are well above 5 per cent.

[30] More accurately, notices are non-existent not only because deficits are eventually corrected in time but also because, from the beginning to the termination of the EDP, they are always *expected* to be corrected in time (see Dury and Pina (2000) for details).

[31] As argued below, the relatively high Austrian figure for excessive deficits is also due to a lack of waivers (deficits over 3 per cent being regarded as exceptional and temporary).

[32] Which, unsurprisingly, take place in the year with the most vulnerable baseline deficit, 2000 (Tables A.2 and A.4), and are associated to deficit ratios only marginally above 3 per cent.

[33] There is a rough correspondence, but not a perfect matching, between the occurrence of SGP violations and the 'unsafe' character of some baseline deficits (Table A.3). Recall that the 'safe deficits' computations, though useful rules of thumb, are considerably exposed to the Lucas critique, and unable to yield quantified estimates of the probability of violations.

The two final columns of Table A.4 indicate that most deficits above the reference value of 3 per cent that take place under recessions are regarded as exceptional and temporary, thereby not giving rise to an EDP. An important exception, however, are the 1999 Austrian deficits, all of which are declared excessive: not only does the high (2.4 per cent) baseline deficit ratio for Austria in 2000 induce SGP violations in that same year, it also makes it less likely that any 1999 deficits are deemed temporary (i.e., expected to be corrected in the year after the end of the downturn).

5.2. Macroeconomic Volatility With and Without Automatic Stabilizers

Although all EMU members enjoy a more stable macroeconomic environment when built-in stabilizers are allowed to operate, the gains afforded by regime 1 display significant cross-country variation. This section aims at documenting and interpreting such variation, as well as comparing our results with those of previous studies.

Table 5 presents indices of macroeconomic variability with, relative to without, automatic stabilizers[34]. As regards GDP growth, stabilizations gains (in terms of reduced root-mean-squared deviation, RMSD) exceed 18 per cent in the case of Germany, and 13 per cent for Spain; Austria and Portugal come next (12 and 10 per cent, respectively), while the remaining six countries display variability reductions in the range of 5 to 7 per cent. These country rankings are broadly maintained when it comes to gains from reduced variability in consumption growth and in inflation, with differences scaled up (relative to the case of GDP growth) as regards the former variable, and down as regards the latter: not surprisingly, country dispersion is smallest for the variable where the relative influence of the common monetary policy (in contrast to the national fiscal policies) is strongest. While RMSDs average across time, Table A.6 (in annex 3) presents relative volatilities for each simulation year: no time pattern in stabilization gains is easily discernible.

More stable growth of output and prices ease the burden of monetary policy: it is noteworthy that also for short-term interest rates variability is reduced when automatic stabilizers are allowed to operate. The reverse naturally takes place as far as deficit ratios are concerned, since regime 1 entails a greater degree of fiscal activism[35].

[34] The underlying RMSD figures can be found in Table A.5 (annex 3).

[35] The huge country dispersion in the relative variability of the deficit ratio largely follows from the extremely low values of RMSD for some countries under regime 2 (Table A.5), and also from the fact that, due to a more volatile output, countries like Ireland make a more intensive use of their budget stabilizers than other economies. Italy is again an exception; its slightly reduced variability under regime 1 is explained by (i) the modest overall size of Italian built-in stabilizers, which implies a low volatility of the primary deficit, (ii) the greater stability of interest rates (and thus of interest payments) in regime 1, and (iii) a negative covariance between the primary deficit and interest payments (found for most countries).

Table 5 – Macroeconomic volatility: relative RMSDs under reg. 1 (reg. 2 = 100)

	Y growth	Inflation	C growth	Def/Y	i (short)	i (long)
Germany	81.6	85.9	61.7	530.7	-	-
France	93.4	90.9	84.5	308.1	-	-
Italy	95.1	91.3	88.5	95.5	-	-
Netherl.	94.2	91.4	72.3	870.7	-	-
Belgium	95.4	91.4	86.1	203.4	-	-
Spain	86.8	86.6	59.9	520.6	-	-
Portugal	90.1	93.7	84.6	163.1	-	-
Austria	88.1	90.2	72.4	642.6	-	-
Ireland	93.4	91.6	90.6	1060.8	-	-
Finland	93.0	91.8	82.4	106.7	-	-
Euroland	89.4	89.3	71.8	-	87.9	83.1

The first three columns refer to GDP growth, inflation measured by the consumers' expenditure deflator and private consumption growth, all in annual terms (4 quarters over previous 4 quarters); the fourth column concerns annual budget deficits as a percentage of GDP, whereas quarterly values of the short-run and long-run interest rates underlie the two final columns.

Root-mean-squared deviations (RMSDs) are summary statistics of the simulated volatility of a given variable x at different time horizons, defined as

$$RMSD(x) = \sqrt{\frac{1}{N}\sum_{t=1}^{N}\left\{\frac{1}{J}\sum_{j=1}^{J}\left(x_t^j - x_t^b\right)^2\right\}}$$

where N is the number of time periods, J is the number of trials and the superscript b denotes value on baseline. These statistics have been computed over the final quarters of 1999 to 2005 (i.e., in the equation above, t = 1999:4, 2000:4, …, 2005:4) in the case of GDP growth, inflation, consumption growth and deficits, and over all quarters from 1999:1 to 2005:4 in the case of interest rates.

This paper's results differ from previous analyses of the importance of automatic stabilizers in two main respects. First, our stabilization gains are smaller: while the OECD (1993), the European Commission (1997) or Allsopp *et al.* (1997) estimate that built-in stabilizers reduce the amplitude of output fluctuations in the major European economies by at least 25 per cent, we have arrived at figures in the range of only 5 to 18 per cent (11 per cent for Euroland as a whole)[36]. Second, our pattern of cross-country variation departs to some extent from the conventional wisdom whereby the economies which are either big or which have large automatic stabilizers reap the highest gains.

The multiplicity of forces at work in the world make it difficult to provide a detailed account of the effects behind simulation results. However, a plausible explanation for the fact that other studies find larger stabilization gains lies in the kind of disturbances considered. Automatic stabilizers feed into the economic system mainly through the channel of disposable income, and are therefore most suited to counteract demand disturbances, and in particular shocks to private consumption – precisely the kind of disturbance which previous analyses have almost exclusively focussed on. Stochastic simulations, instead, consider multiple sources of uncertainty, of which consumption shocks are no more than one example.

[36] Although results from deterministic and stochastic simulations are not exactly comparable, in both cases one is taking output variability without built-in stabilizers as a denominator or index base (as in Table 5).

As far as the pattern of cross-country variation is concerned, differences in the size of national automatic stabilizers undoubtedly play an important role. For instance, the striking contrast in the magnitude of Spanish and Italian stabilizers (cf. section 3.1 and annex 1) translates into much bigger gains from regime 1 for the Iberian country; and the relatively modest size of Portuguese built-in stabilizers limits the benefits reaped by this country, although it fares well by other criteria (see below). As argued in previous studies, openness – often inversely related to economic size – plays against the effectiveness of budgetary stabilizers, by the standard Keynesian argument that a greater proportion of a stimulus to aggregate demand is directed towards imports. Our results give some support to this view: the two biggest winners from regime 1, Germany and Spain, are more closed than smaller economies (see Table 6), and among the latter the less open countries (Portugal, Austria and Finland) obtain higher stabilization gains than the more open trio (Ireland, Belgium and the Netherlands).

Table 6 - Exports and Imports as a % of GDP (1993-1997)

	GE	FR	IT	NL	BG	SP	PT	OE	IR	FN
Exports	24.0	23.8	25.8	52.9	66.9	23.9	30.0	39.1	73.3	36.9
Imports	23.1	21.2	21.6	46.3	62.7	23.6	37.4	39.4	58.4	29.5

Source: European Commission (1998), *European Economy*, No. 66. Figures refer to trade in goods and services.

The two factors discussed in the previous paragraph, however, leave important features of cross-country variation unexplained, such as the modest stabilization gains derived by France, or the relatively high benefits reaped by Portugal. An additional factor that we find relevant for the effectiveness of automatic stabilizers, and which previous studies have overlooked, is the speed of transmission to private consumption of a stimulus to disposable income. As budgetary stabilizers operate through the latter variable, faster transmission will enhance shock smoothing under regime 1, whereas a slower response of consumption reduces the advantage of fiscal policy over endogenous stabilization mechanisms, such as wage and price adjustment. Table 7 shows consumption elasticities (both in the short and in the long run) with respect to real disposable income. The high short-run elasticities for EMU members like Ireland, Austria and Finland (closely followed by Germany, Spain and Portugal) contrast with the sluggishness of consumption in the Netherlands, Italy and France, thereby shedding some further light on why the latter countries derive modest benefits from the operation of automatic stabilizers.

Table 7 - Income elasticities of private consumption

	GE	FR	IT	NL	BG	SP	PT	OE	IR	FN
Short run	0.61	0.32	0.44	0.35	0.53	0.59	0.59	0.72	0.75	0.66
Long run	0.80	0.86	0.80	0.89	0.94	0.91	0.85	0.93	0.93	0.96

The short-run elasticity is defined as the cumulative percentage change in private consumption in the first 4 quarters following a 1 per cent impulse shock to real personal disposable income (RPDI). NiGEM models private consumption as a function of RPDI, real net financial wealth, nominal interest rates and inflation; consumption equations have an error correction form, with a data driven lag structure and long run elasticities on RPDI (reported in the table) and wealth summing to unity (restriction accepted by the data).

6. Concluding Remarks

We have performed a formal analysis of budgetary stabilizers in Euroland countries within the dynamic, rational-expectations framework of NiGEM. Two main issues have motivated our study: how effective such stabilizers are at smoothing output fluctuations, and whether their operation will conflict with SGP provisions.

Output growth volatility is decreased by less than commonly believed: around 11 per cent in EMU as a whole, rather than by a quarter to a third. Further, and contrary to previous studies, we find important exceptions to the standard conclusion that countries which benefit the most are those with less open economies and/or with bigger built-in stabilizers. While it is worth reasserting that stochastic simulation results do not lend themselves to the kind of detailed interpretation feasible in small analytical models (a price to be paid for taking on board a much wider set of economic interactions), plausible explanations for our findings are relatively straightforward. As stabilizers work through disposable income, they are most effective in the face of shocks to aggregate demand, and in particular to private consumption – prevalent in previous studies, but just one among several sources of macroeconomic uncertainty. And, in a world where wages and prices, though slowed down by pervasive short-run rigidities, eventually adjust to disturbances, the advantage of budgetary stabilizers largely depends on their speed of transmission – their effectiveness being thus enhanced by a fast response of consumption to disposable income.

Even when full operation of budgetary stabilizers is allowed, violations to SGP rules are relatively rare and short-lived – for instance, no EDP has ever reached the stage of a notice. Several facts and assumptions lie behind this result: (i) contrary to widespread concerns (e.g. Eichengreen, 1997), few countries entered EMU up against the 3 per cent ceiling; (ii) we have broadly assumed compliance with Stability Programmes; (iii) macroeconomic volatility in itself is somewhat reduced by automatic stabilizers; (iv) deficits beyond 3 per cent are generally associated with recessions, and some of them are therefore regarded as exceptional and temporary. Incidentally, the temporariness clause is most likely not to be verified if fiscal consolidation has a slow start – leaving initial years with high consecutive baseline deficits.

Our automatic stabilizers policy regime, although useful to address the issues at hand, is clearly an idealized representation of governments' behaviour. Apart from the simplifying features common to most analyses of policy rules in macroeconometric models - such as perfect credibility, baseline-dependence, or the absence of political distortions - we have assumed that no particular corrective action is taken when excessive deficits emerge. A more plausible assessment of the operation of the SGP in the near future, taking such corrective action into account, can be found in Dury and Pina (2000).

We have focussed attention on existing automatic stabilizers: those at national level. Fiscal federalism, however, boils down to built-in stabilizers as well – this time of a supranational nature – and hence constitutes an interesting related field of analysis.

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Annex 1

Here we provide details on the implementation of the automatic stabilizers regime. We start by indicating the OECD fiscal variables as they appear in the *Economic Outlook database inventory* (OECD, 1998). The OECD cyclically adjusts:

- direct taxes on households (variable TYH; subscript P below)
- social security contributions received by government (variable SSRG; subscript S)
- direct taxes on business (variable TYB; subscript C)
- indirect taxes (variable TIND; subscript I)
- gov't current disbursements excl. gross interest payments (var. YPGX; subscript E)

The correspondence between NiGEM and OECD fiscal variables is established along the following lines. Conceptually, TAX comprises TYH and SSRG; a residual component X, assumed independent of the cycle, is added to capture statistical discrepancies. Thus $TAX=TYH+SSRG+X$, $TAX^a=TYH^a+SSRG^a+X$, and we can write:

$$\frac{TAX_t}{TAX_t^a}=\gamma_P\frac{TYH_t}{TYH_t^a}+\gamma_S\frac{SSRG_t}{SSRG_t^a}+\left(1-\gamma_P-\gamma_S\right)$$

where

$$\gamma_P=\frac{TYH_t^a}{TAX_t^a},\gamma_S=\frac{SSRG_t^a}{TAX_t^a},1-\gamma_P-\gamma_S=\frac{X_t}{TAX_t^a},\frac{TYH_t}{TYH_t^a}=\left(\frac{Y_t^*}{Y_t}\right)^{-\alpha_P},\frac{SSRG_t}{SSRG_t^a}=\left(\frac{Y_t^*}{Y_t}\right)^{-\alpha_S}$$

Equation (4) of the main text easily follows. The share parameters γ_P and γ_S correspond to 1993-97 averages.

In a similar way, we decompose MTAX into TIND and a residual component, with share parameters γ_I and 1-γ_I, respectively; and likewise for the aggregate TRAN + GC*CED (denoted below by CPS, for simplicity), which is set equal to YPGX (share γ_E) plus a discrepancy term (share 1-γ_E). Bearing in mind our treatment of GC as a constant ratio to nominal potential output, simulation outcomes for TRAN are then given by:

$$TRAN_t=\frac{P_tY_t^*}{P_t^bY_t^{b,*}}CPS_t^{a,b}\left[\gamma_E\left(\frac{Y_t^*}{Y_t}\right)^{-\alpha_E}+\left(1-\gamma_E\right)\right]-\frac{P_tY_t^*}{P_t^bY_t^{b,*}}CED_t^b.GC_t^b$$

with

$$CPS_t^{a,b}=CPS_t^b\left[\gamma_E\left(\frac{Y_t^{b,*}}{Y_t^b}\right)^{-\alpha_E}+\left(1-\gamma_E\right)\right]^{-1}$$

In the case of Germany, CPS = TRAN + GC*CED + GMEXP and the above equation for TRAN has the extra term $-\frac{P_tY_t^*}{P_t^bY_t^{b,*}}GMEXP_t^b$.

The treatment of *MTAX* is straightforward, while that of *CTAX* has already been described in the main text. The following table summarizes the OECD's elasticities (α) and collection lag parameters (λ), as well as the share parameters (γ) referred to above and the summary measures of the built-in stabilizers' global size.

Table A.1 – Indicators characterising automatic stabilizers

	λ	α_P	α_S	α_C	α_I	α_E	γ_P	γ_S	γ_I	γ_E	**Size 1[d]**	**Size 2[e]**
GE	1	0.9	0.7	2.5	1	-0.2	0.34[a]	0.80	0.72	1.02[b]	0.49	0.30
FR	0.7	1.4	0.7	3.0	1	-0.1	0.25	0.70	0.95	1.05	0.52	0.30
IT	1	0.4	0.3	2.9	1	0	0.37	0.46	1.17	0.96	0.31	0.09
SP	1	1.9	1.1	2.1	1	-0.3	0.37	0.58	0.99	1.07	0.60	0.44
NL [c]	0.6	1.3	1.0	2.5	1	-0.2	0.30	0.55	0.96	0.96	0.63	0.41
BG	1	1.2	0.8	2.5	1	-0.1	0.41	0.42	1.44	1.03	0.55	0.34
PT	0	1.2	0.5	2.5	1	-0.2	0.37	0.63	0.63	0.89	0.42	0.21
OE	1	1.2	0.5	2.5	1	-0.1	0.44	0.56	1.05	1.05	0.48	0.27
IR	1	1.3	0.5	2.5	1	-0.2	0.71	0.29	0.98	1.11	0.47	0.24
FN	1	1.1	0.8	2.5	1	-0.1	0.52	0.48	0.69	1.01	0.53	0.34

[a] OECD variable is TYH + ZCS020

[b] OECD variable is YPGX + ZCS009

[c] OECD variable for corporate taxes is TYB + ZCS002, which differs from CTAX; we set the latter equal to TYB + ZCS002 (share γ_C) plus a residual (share 1-γ_C), with $\gamma_C = 1.04$.

[d] Budget balance change, in p.p. of GDP, due to a 1 p.p. increase in the output gap. Computed as a weighted average of the five OECD elasticities (switching the sign of α_E), using as weights the shares of the respective budget items in nominal potential output (1993-1997 averages).

[e] Computed along the lines of the indicator 'Size 1', but considering only $\alpha_P, \alpha_S, \alpha_E$.

Annex 2

Table A.2 - NiGEM's baseline *versus* the national Stability Programmes

Member State		surplus(+)/deficit(-) (% of GDP) 1999	2000	2001	2002	GDP growth (%) 1999	2000	2001	2002
Germany	Baseline	-2.3	-1.8	-1.6	-1.2	1.6	2.8	2.7	2.9
	S. Prog.	-2.0	-2.0	-1.5	-1.0	2.0	2.5	2.5	2.5
France	Baseline	-2.5	-1.7	-1.3	-1.2	2.3	2.6	2.5	2.7
	S. Prog. [(a)]	-2.3	-2.0	-1.6	-1.2	2.4	2.5	2.5	2.5
Italy	Baseline	-1.9	-2.3	-1.6	-	1.5	2.5	2.6	-
	S. Prog.	-2.0	-1.5	-1.0	-	2.5	2.8	2.9	-
Spain	Baseline	-1.5	-1.0	-0.2	0.0	3.1	3.7	2.8	2.3
	S. Prog.	-1.6	-1.0	-0.4	0.1	3.8	3.3	3.3	3.3
Netherl.	Baseline	-1.6	-1.3	-0.9	-0.7	2.0	2.5	2.5	2.6
	S. Prog. [(b)]	-1.3	-1.2	-1.1	-1.0	2.3	2.3	2.3	2.3
Belgium	Baseline	-0.9	-0.5	-0.6	-0.7	1.8	2.7	2.1	2.1
	S. Prog.	-1.3	-1.0	-0.7	-0.3	2.4	2.3	2.3	2.3
Portugal	Baseline	-2.0	-1.8	-1.2	-0.9	3.2	3.6	2.7	2.5
	S. Prog.	-2.0	-1.5	-1.2	-0.8	3.5	3.2	3.2	3.3
Austria	Baseline	-2.5	-2.4	-1.3	-1.0	2.1	2.5	2.0	1.9
	S. Prog.	-2.0	-1.7	-1.5	-1.4	2.8	2.6	2.1	2.2
Ireland	Baseline	2.3	2.3	2.2	-	8.0	7.4	7.6	-
	S. Prog.	1.7	1.4	1.6	-	6.7	6.4	5.8	-
Finland	Baseline	2.8	2.7	2.3	2.2	3.3	3.3	3.1	3.0
	S. Prog.	2.4	2.2	2.1	2.3	4.0	2.7	2.6	2.6

Sources: Stability Programmes and NiGEM

(a) Cautious macroeconomic scenario; in the favourable scenario, figures for the deficit ratio over the period 1999-2002 are -2.3, -1.7, -1.2 and -0.8, respectively, while projections for growth become 2.7 in 1999 and 3.0 in 2000-2002.

(b) Cautious macroeconomic scenario; figures for the 2002 budget ratio become -0.25 and 0.25 under the intermediate and favourable scenarios, respectively. The growth forecast of 2.3% is an average over 1999-2002. As the Programme does not contain deficit targets for the intermediate years (2000 and 2001), a linear interpolation was used.

Table A.3 – Structural surpluses(+)/deficits(-) on baseline (% of potential output)

	'safe def.'	1999	2000	2001	2002	2003	2004	2005
GE	-1.6	-1.6	-1.4	-1.4	-1.2	-0.9	-0.5	-0.3
FR	-1.5	-1.9	-1.5	-1.2	-1.1	-1.0	-0.9	-0.9
IT	-2.1	-0.8	-1.3	-1.1	-0.8	-1.1	-1.4	-1.3
SP	-1.2	-1.0	-0.9	-0.2	0.0	-0.3	-0.4	-0.5
NL	-1.9	-1.9	-1.5	-1.0	-0.7	-0.7	-0.6	-0.5
BG	-1.7	-0.2	0.0	-0.3	-0.7	-0.8	-0.8	-1.0
PT	-1.1	-2.1	-1.9	-1.3	-0.9	-0.9	-1.0	-1.1
OE	-2.1	-2.1	-2.2	-1.3	-1.0	-1.0	-1.0	-1.1
IR	-1.1	1.9	2.0	2.0	1.7	1.2	0.4	-0.4
FN	-0.1	2.4	2.2	2.1	2.1	1.4	0.8	0.4

Cyclically-adjusted balances on baseline are shown for the years under stochastic simulation (1999-2005). The column 'safe deficits' is based on OECD (1997), *Economic Outlook*, No. 62, December, p. 24, Table 13, and shows the structural balances needed to avoid exceeding the 3 per cent threshold for an output gap corresponding to the mean value of the maximum output gap recorded in recessions in the 1975-97 period.

Annex 3

Table A.4 – Probabilities (%) of deficits and recessions: detailed simulation results

		P(def)		P(rec)		P(def|rec)		P(def|no rec)		P(ED)		P(waiv|def&rec)	
		reg. 1	reg. 2	reg. 1	reg. 2	reg. 1	reg. 2	reg. 1	reg. 2	reg. 1	reg. 2	reg. 1	reg. 2
GE	1999	8.5	0.0	5.0	6.5	100.0	0.0	3.7	0.0	3.5	0.0	100.0	-
	2000	2.0	0.0	5.5	8.5	9.1	0.0	1.6	0.0	1.0	0.0	100.0	-
	2001	0.5	0.0	8.0	14.0	0.0	0.0	0.5	0.0	0.5	0.0	-	-
	2002	0.5	0.0	9.5	12.5	5.3	0.0	0.0	0.0	0.0	0.0	100.0	-
	2003	0.5	0.0	7.5	11.5	6.7	0.0	0.0	0.0	0.0	0.0	100.0	-
	2004	0.0	0.0	7.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
FR	1999	2.5	0.0	0.0	0.0	-	-	2.5	0.0	2.5	0.0	-	-
	2000	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2001	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
IT	1999	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2000	0.0	2.5	0.0	0.5	-	0.0	0.0	2.5	0.0	2.5	-	-
	2001	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	0.0	0.5	-	0.0	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
NL	1999	0.5	0.0	0.0	0.0	-	-	0.5	0.0	0.5	0.0	-	-
	2000	0.5	0.0	1.5	2.5	33.3	0.0	0.0	0.0	0.0	0.0	100.0	-
	2001	0.0	0.0	4.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	3.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2003	1.5	0.0	4.0	4.0	37.5	0.0	0.0	0.0	0.0	0.0	100.0	-
	2004	0.0	0.0	0.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
BG	1999	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2000	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2001	0.5	0.0	3.0	2.0	16.7	0.0	0.0	0.0	0.0	0.0	100.0	-
	2002	0.5	0.0	2.5	3.0	20.0	0.0	0.0	0.0	0.0	0.0	100.0	-
	2003	0.0	0.0	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
SP	1999	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2000	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2001	0.0	0.0	4.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	10.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2003	2.5	0.0	9.5	17.0	10.5	0.0	1.7	0.0	2.0	0.0	50.0	-
	2004	1.5	0.0	5.5	9.5	9.1	0.0	1.1	0.0	0.5	0.0	100.0	-
PT	1999	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2000	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2001	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	0.0	0.5	-	0.0	0.0	0.0	0.0	0.0	-	-
OE	1999	19.5	0.0	2.5	2.5	100.0	0.0	17.4	0.0	19.5	0.0	0.0	-
	2000	11.0	0.0	4.5	8.5	44.4	0.0	9.4	0.0	7.5	0.0	100.0	-
	2001	0.0	0.0	11.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	11.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	8.0	11.5	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	8.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
IR	1999	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2000	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2001	0.0	0.0	0.5	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	0.0	0.5	-	0.0	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	2004	0.5	0.0	5.0	6.5	10.0	0.0	0.0	0.0	0.0	0.0	100.0	-
FN	1999	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2000	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2001	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2002	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2003	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-
	2004	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-

Table A.4 presents, for each country, year and regime, the estimated probabilities of the following events:

(i) budget deficits over 3% of GDP (‘def’);

(ii) recessions, defined as annual GDP falls of at least 0.75% (‘rec’);

(iii) deficits over 3% conditional on the occurrence of a recession (‘def|rec’);

(iv) deficits over 3% conditional on there being no recession ('def|no rec');
(v) excessive deficits, i.e., deficits over 3% which are not regarded as exceptional, temporary and close to the reference value ('ED');
(vi) deficits over 3% being 'waived' (i.e., not deemed excessive) conditional on the occurrence of a recession ('waiv|def&rec').

Results for (v) and (vi) refer to the year in which deficits actually take place – i.e., the year before they are either declared as excessive or waived. As a consequence, no probabilities are reported for 2005: decisions regarding those deficits would be taken only in 2006, already beyond the end of the period under stochastic simulation. For readability, all non-zero entries are shaded.

Table A.5 – Macroeconomic volatility: RMSDs

		Y growth	Inflation	C growth	Def/Y	i (short)	i (long)
Germany	Reg. 1	2.10	0.88	1.22	0.65	-	-
	Reg. 2	2.58	1.03	1.97	0.12	-	-
France	Reg. 1	1.05	0.57	0.67	0.45	-	-
	Reg. 2	1.12	0.62	0.80	0.15	-	-
Italy	Reg. 1	1.16	0.79	0.67	0.31	-	-
	Reg. 2	1.22	0.86	0.76	0.32	-	-
Netherl.	Reg. 1	1.66	0.57	0.39	0.70	-	-
	Reg. 2	1.76	0.62	0.54	0.08	-	-
Belgium	Reg. 1	1.39	0.60	1.56	0.58	-	-
	Reg. 2	1.45	0.65	1.81	0.29	-	-
Spain	Reg. 1	1.96	0.98	1.48	0.97	-	-
	Reg. 2	2.26	1.13	2.46	0.19	-	-
Portugal	Reg. 1	1.11	0.65	0.80	0.35	-	-
	Reg. 2	1.23	0.70	0.95	0.22	-	-
Austria	Reg. 1	1.92	0.88	1.08	0.58	-	-
	Reg. 2	2.18	0.98	1.49	0.09	-	-
Ireland	Reg. 1	2.33	0.97	2.35	0.54	-	-
	Reg. 2	2.50	1.06	2.60	0.05	-	-
Finland	Reg. 1	0.82	0.46	1.21	0.33	-	-
	Reg. 2	0.88	0.50	1.47	0.31	-	-
Euroland	Reg. 1	1.34	0.53	0.65	-	0.68	0.09
	Reg. 2	1.50	0.60	0.91	-	0.77	0.11

See Table 5 (in the main text) for details on definitions of variables and computation of RMSDs.

Table A.6 – Macroeconomic volatility: relative standard deviations under reg. 1 (reg. 2 = 100)

	1999	2000	2001	2002	2003	2004	2005
Germany							
Y growth	83.0	81.6	80.5	80.1	81.5	82.6	83.4
Inflation	92.4	84.8	84.3	84.0	85.1	84.7	89.0
C growth	61.3	58.2	58.3	60.9	63.7	64.2	65.7
France							
Y growth	94.6	93.5	95.5	92.2	94.0	93.6	91.0
Inflation	94.9	87.4	91.6	86.6	94.0	92.6	89.9
C growth	80.9	84.0	88.3	87.4	85.5	87.1	78.9
Italy							
Y growth	98.0	97.3	96.3	95.3	93.8	89.9	96.9
Inflation	93.4	98.5	88.7	88.2	95.9	90.2	89.6
C growth	94.0	83.4	88.9	93.8	87.8	87.4	88.5
Netherl.							
Y growth	89.4	92.2	93.8	93.4	96.6	97.1	95.5
Inflation	93.1	91.1	85.4	90.5	91.8	93.5	97.4
C growth	67.8	62.6	68.2	78.3	75.8	70.2	77.2
Belgium							
Y growth	93.6	98.5	95.2	92.2	91.2	101.2	94.7
Inflation	85.9	91.1	89.6	94.9	87.0	93.7	91.7
C growth	84.3	83.8	83.9	86.7	88.5	87.2	84.8
Spain							
Y growth	90.0	94.4	93.9	83.1	86.4	84.2	83.8
Inflation	102.9	101.1	92.3	85.2	85.4	84.0	80.0
C growth	72.4	65.9	62.9	64.0	56.1	57.5	59.3
Portugal							
Y growth	91.9	91.7	87.2	90.7	92.5	88.0	90.6
Inflation	99.4	96.0	88.9	115.9	105.7	69.7	90.9
C growth	83.7	82.8	84.4	84.5	84.8	84.5	87.0
Austria							
Y growth	91.4	89.0	86.9	86.2	88.7	89.6	86.2
Inflation	91.2	94.9	77.5	98.4	89.5	89.7	90.6
C growth	66.2	68.1	76.4	72.6	70.2	72.4	75.0
Ireland							
Y growth	91.4	91.9	95.9	92.1	89.5	95.9	94.6
Inflation	95.2	93.4	86.6	99.4	87.7	93.9	89.2
C growth	89.7	91.2	97.4	85.0	87.9	89.9	94.0
Finland							
Y growth	94.6	89.9	94.8	97.4	93.6	87.1	93.8
Inflation	99.4	96.5	94.4	89.5	95.6	96.5	82.3
C growth	93.3	81.5	82.4	84.5	81.3	81.7	79.1
Euroland							
Y growth	89.4	89.6	89.2	88.2	90.2	89.5	89.7
Inflation	86.6	91.4	87.8	87.1	90.1	88.1	90.4
C growth	68.2	68.1	69.6	71.8	72.8	75.0	73.7

'Y growth', 'Inflation' and 'C growth' are defined as in Table 5. Standard deviations are computed across replications using simulation means (rather than baseline values).