

European Monetary Union and Fiscal Policy Sustainability

Focus on: Stability and Growth Pact

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Abstract

One of the most illustrating example in history of the EUROPEAN COMMUNITY are the growing interactions between sovereign countries -each retaining a large degree of fiscal autonomy- and the single monetary authority, which managing European monetary policy, since 1999. Additionally some regulations as the Stability and Growth Pact (SGP; 1997) introduce new conflicts and pushes so 'sustainable policy' to one of the mainstays in the European framework. Now sustainable policies are common in nearly all policy fields in Europe. But what is the real meaning of sustainable (fiscal) policy? The first sections of my paper try to answer this. Afterwards in the tradition of Barro/Gordon, I explore the role of monetary-fiscal policy interaction from a public finance perspective. My paper draws on this literature to investigate sustainable fiscal policy in EMU and analysis what are the influences of the current SGP. The new modelling focus is now the effect of 'sustainability' in fiscal policy. I think this is an interesting research object for the future of 'European policy modelling'. The existing literature in that field is very rare and unapplicable for policy-makers. More realistic modelling is necessary to take sustainable policy targets into consideration. A final section of this paper try to establish a simple stylized model for policy-makers, which analysis interactions between sustainable variables and other related targets. The novel part in that section is to find an answer to: How should the European fiscal framework reformed in future especially the SGP? So the paper concludes with a short reform discussion about the Stability and Growth Pact and an own proposal for an alternative to an 'independent' Ecofin-council. New findings in that research show us how we can solve the interaction between the 'European' and 'National' interests efficient.

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1 Introduction

The most illustrating example of interaction conflicts in the EUROPEAN COMMUNITY is seen in history of European monetary integration. In the background of environmental research a new term gets more and more important: 'SUSTAINABILITY' (Neher, [43]). Additionally sustainable policy is also in Europe one of the mainstays. Nearly all policy areas use now this term for instance in the common provisions "... to achieve balanced and sustainable development" (Art. 2, ECT) or in fiscal policy "... sustainable growth" and "...sustainable fiscal policy" (SGP, [27]). So sustainability haven been subjects of lively public and academic debates (Bohn 1995 and Pasinetti 2000). A wonderful by-product for the economic profession has been the emergence of a new research topic (Dixit [23]; Wacker [47]).

In the tradition of resource economics (Kennedy 1986 [38]; Stocky/Lucas 1993 [45]) and recent papers in related fields from Wilcox (1989), Bohn (1995, 1998), Gong et al. (2001) and Alfora/Kanczuk (2003), I try to define what is meant by 'sustainable' fiscal policy (debt and deficit policy) in the European framework. The second step in the paper is in reference along the growing literature about fiscal-monetary interaction in a monetary union e.g. Dixit (2001, [26]), Dixit/Lambertini (2001, [23], [24], [25]) and Beetsma/Bovenberg (1999, 2003, [5], [7]), to explore the role of 'sustainable' monetary-fiscal policy interaction from a public finance perspective. My paper draws on this literature to investigate what are the influences of the growing number in 'sustainable' policies in the EMU and what are the consequences especially for the current reform discussion about the SGP (cf. Beetsam/Uhlig [6]; Beetsma/Jensen [8]). Finally, I will establish a 'stylized' new modelling approach to analyze distinguishing sustainable policy fields. The aim is to find an answer to the following question: Which constellation imply a stronger 'sustainable' policy trading like fiscal policy within the SGP than in other policy fields for example in employment- or social policy?

I think the supranational monetary policy on the one hand and the dezentral fiscal policy on the other hand and its connection link the Stability and Growth Pact is an interesting research object by the future of 'European policy

modelling'. To make the existing literature in this field more realistic it is necessary to take into consideration the aim of a 'Sustainable' fiscal policy. I try to explain more precisely what is meant by sustainable public finance and how sustainability relates to the optimality of fiscal policies in a broader sense. The new findings in that paper show us how we can solve the interaction conflicts between the 'European'- and 'National' interests effectively [30].

The remainder of this paper is structured as follows. Section 2 explains and motivates the expression 'sustainability' and its function in fiscal policy. In section 3, I present a model close to the paper from Beetsma and Uhlig (1999) and Beetsma and Jensen (2003) and analyze the implication of fiscal policy sustainability. Section 4 show the new insights from this modelling approach. The knowledge that policy-makers need a simple screening device to evaluate sustainable policy in the European framework, will be analyzed in a new stylized model approach, which I present in section 5. Section 6, summarize the current reform discussion about the SGP and connect it with the theoretical findings and an own reform proposal for the SGP. Finally, Section 7 concludes the main body of the paper. All technicalities and proofs are relegated to an Appendix.

2 Motivation of Sustainable modelling

In the European Community Treaty provisions appears the expression 'sustainable' 6 times. First, you find 'sustainable' ideas in art. 2 ECT, which announces the main targets of the European union: 'The Community shall have as its task, by establishing a common market and an economic and monetary union and by implementing common policies or activities referred to in Articles 3 and 4, to promote throughout the Community a harmonious, balanced and *sustainable* development of economic activities, a high level of employment and of social protection, equality between men and women, *sustainable* and non-inflationary growth, a high degree of competitiveness and convergence of economic performance, a high level of protection and improvement of the quality of the environment, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States.' Also in art. 4 ECT and art. 6 ECT 'sustainability' plays an important role. In art. 4 Abs. 3:

'These activities of the Member States and the Community shall entail compliance with the following guiding principles: stable prices, *sound public finances* and monetary conditions and a *sustainable* balance of payments.' and art. 6: 'Environmental protection requirements must be integrated into the definition and implementation of the Community policies and activities referred to in Article 3, in particular with a view to promoting *sustainable* development.' Under Titel VII 'Economic and Monetary policy' art. 121 ECT contains the well-known convergence criteria but through the implementation of the SGP these points are always relevant. The text mention: '*A high degree of sustainable convergence by reference to the fulfilment by each Member State of the following criteria*':

- the *sustainability* of the government financial position; this will be apparent from having achieved a government budgetary position without a deficit that is excessive as determined in accordance with Article 104(6) ECT.

This treaty provisions show us the primary focus of sustainability in fiscal policy in Europe. Additionally I analyze regulations, protocols and all related documents to fiscal and economic policy from the European Commission and found that the expression 'sustainable or sustainability' appears more than 30 times. This is in my view an indicator that the term sustainability became in fiscal policy an very important guideline but also in other related policy fields in Europe.

Since the implementation of the Stability and Growth Pact in 1997, there are many discussions about the fiscal framework in Europe. The critics to the Stability Pact have even enforced in spring 2002 after failing to send the 'blue letter' to Germany and not strengthening the 'excessive deficit procedure' by the Ecofin council meeting in November 2003, against Germany. Some people would like a stronger Stability Pact with an independent council (Wyplosz, 2002) and other only modest modifications on the current structure to give the member countries more flexibility in fiscal policy (De Grauwe, 2003). To understand the current reform discussions about the SGP a few better you must recognize and consider the discussion about 'sustainable' fiscal policy in more detail. The reason for that is a curial preference to sustainable policy in the treaty provisions seen in the economic and fiscal framework and in the Stability and Growth

Pact. Europe will achieve a sustainable growth path and the national debt should decrease sustainably. All around in Europe the expression is used. But the economic meaning in the different fields is often not declared and seems nearly vague. In a recent work Fatás et al. (2003,[31]) conclude: *'(...) EMU should implement appropriate institutions at the national level that enable them to fulfil their obligation for maintaining sustainable public finance. There is, however, no explanation of what this obligation means in practice.'* and also the EU-Commission said on 11 November 2002: *'All countries must agree that sustainability is a core objective.'* But *'A clear definition of how sustainability should be measured is not included'* in the European fiscal framework. This clearly pre-embryonic stage of discussion about 'Sustainability' in the European fiscal framework is now ready to focus on in more detail.

2.1 Definition Approaches

The art of designing a fiscal framework for EMU is in finding an appropriate translation of the long-run concern for sustainability to the short-run behaviour of the government and an effective enforcement mechanism. A first approach to define the concept of 'sustainability' in the European framework began in 1998. Pasinetti (2000,[44]) define sustainable policy as: a deficit/GDP ratio that entails a decreasing (or at worst a constant) debt/GDP ratio, which means a decreasing (or at most a constant) tax burden, on account of the debt, on tax-payers. Conversely, he defined as non-sustainable those deficit/GDP ratios that entail an increasing debt/GDP ratio, which means that-if corrected-they would require an additional tax burden on the citizen. This definition have been criticized by Harck [33]. Harck asked the question: 'Is the definition by Pasinetti acceptable in the sense of being a useful screening device?' The main conclusion from Harck's critic was that a non-increasing debt ratio is neither a necessary nor a sufficient condition for sustainability in any reasonable sense of the world. It is not clear to make sense to define sustainability in isolation from the question of the existence and the level of a finite terminal debt ratio. Therefore Pasinetti distinguish two possible directions of 'sustainability' definitions. The definition differences, according to weather the initial debt position of the country concerned is above or below the externally given optimum level. That imply:

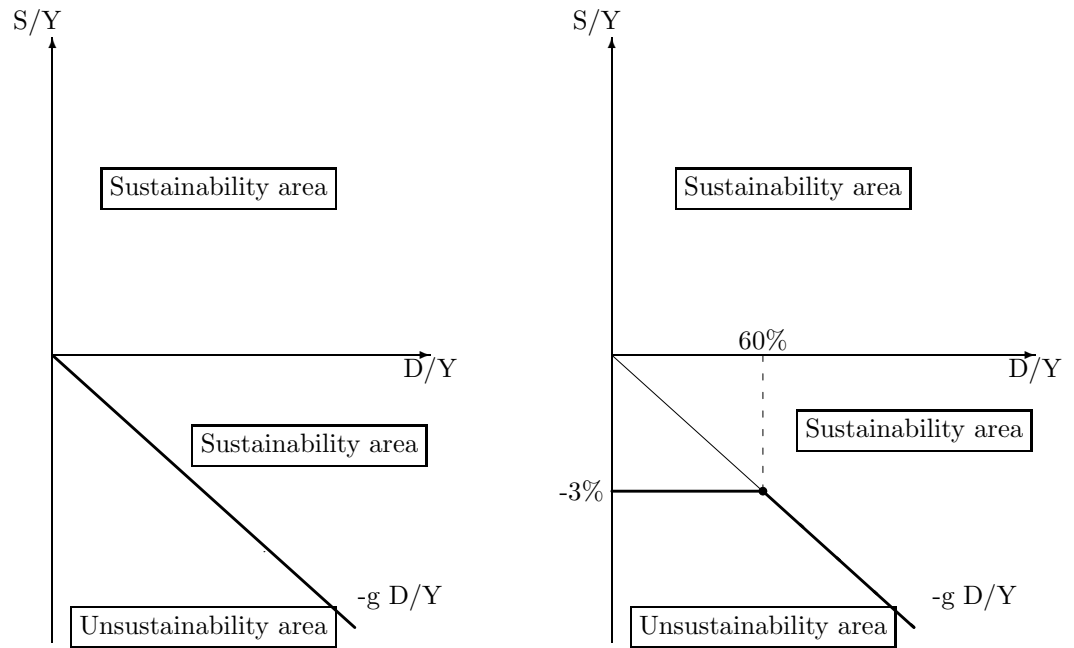


Figure 1: Two different definitions of Sustainability

- (a) Those countries where $\frac{D}{Y} > 60\%$, the strong inequality holds

$$\frac{S}{Y} > -g \frac{D}{Y}$$

where D represents debt, S is deficit and Y is the abbreviation for GDP. This definition would indeed a necessary and sufficient condition to put the country concerned on a persistent converging path towards a point below the externally fixed threshold of debt/GDP ratio to 60%.

- (b) Those countries where $\frac{D}{Y} \leq 60\%$, the added triangular area (see figure 1, right) would allow some temporary increase in debt/GDP ratio, so that temporary the following condition holds

$$\frac{S}{Y} \geq -g60\%.$$

The purpose of the simple definition of sustainability was indeed to provide a quick and simple screening device for policy-makers. But this is not without

dangerous, which I will show in my model and definition approach in the next subsection. The main problem with the definition here mentions also De Grauwe (2002). A sustainable fiscal policy like that in the SGP imply a zero debt position in the long-run. Pasinetti admit this constellation as a fascinating scenario, by far more interesting than any arbitrary levels of debt and deficit ceilings. Certainly there aren't any economic theory for debt and deficit thresholds but there are really good arguments for a certain amount of debt (De Grauwe, 2003, p.217).

In a press release of the European Commission (2004,[29]), I found a wider view of the 'sustainability' definition: '...the Commission has proposed that the most heavily indebted countries should be monitored more closely, coupled perhaps with more flexible application of the stability and growth pact in the case of countries achieving substantial progress in the areas of deficit and public debt.' This view relax the sustainable idea, because more shock and case to case contingent reactions imply more free-riding (Beetsam/Jensen, 2003) and undermine crucially the credibility of the commitments in the Stability and Growth Pact.

Buiter and Grafe (2003,[15]) define sustainability of a government fiscal programme as the absence of default risk. They mention also that 'one can weaken this to the requirement that default risk be below some threshold level' (cf. Besancenot et al., 2004, [9]). The idea of the fiscal constraints like the SGP and the Maastricht Treaty are externally imposed constraints aimed at preventing each individual member country from following an unsustainable, explosive path of public debt and deficits. In this view Buiter and Grafe shown that the 'excessive' debt is a more broadly based concept than 'unsustainable' debt. The reason for that is: 'Debt and deficit can be excessive, that is, imposed greater costs than benefits, without creating a serious risk of sovereign debt default.' However, debt sustainability is a more long-run perspective and so it is a necessary condition for debt not to be excessive in that view. But the definition here is very vague and impossible for an easy application through policy-makers. How can in reality default risk measured in states?

In the next subsection, I try to systematic the definition debate. Sustainable policy is borne in resource economics and environmental economics. So I borrow from the analysis in that fields and define 'sustainability' in tradition of that literature. To understand this in more detail I construct now a simple intertem-

poral 'Debt consolidation model'. In that model I will explain my view of the term 'Sustainable fiscal policy or debt policy'. Later I use this sustainability definition and implement that in a model, which analysis the European fiscal framework especially the Stability and Growth Pact.

2.2 Sustainable model approach

Government deficits have become a focus of professional interest and political debate all around the world (cf. Wilcox 1989 [48] and Bohn 1995 [12]). Particularly since the implementation of the SGP in the European monetary union and the significant raises of budget deficits in Germany, French and Portugal in 2003 and actually in UK and Italy in 2004, increases concerns about the long-run sustainability of fiscal policy in Europe. A first attempt to analyze 'Sustainability of Government Budget Deficits' makes Wilcox (1989). Apart of the approach by Diamond (1965, [22]), in that it was sustainable to borrow money, and pay the interest by borrowing more, Wilcox search an other way. In those economies, which are in literature labelled 'dynamical inefficient', an increase in current debt has no implications for future surpluses. So governments in dynamically efficient economies, face a present-value constraint, because it states that the current market value of the debt equals the discounted sum of expected future surpluses. The empirical results from Wilcox and related papers as Hamilton and Flavin (1986, [32]) show on the basis of U.S. date an ambivalent result about the sustainability of fiscal policy. They found that the U.S. fiscal policy is not sustainable. Going out, Bohn (1995) critics the older approaches and establish an explicit 'stochastic general equilibrium model'. He studied first the theoretical foundations of sustainability and through that he found new ways for a sustainable empirical test. A quantitative analysis on the basis of the theoretical foundation confirms the finding that U.S. fiscal policy is sustainable (Bohn, 1998). The central result of Bohn (1995, [11]) was that the government has to satisfy an intertemporal budget constraint and an associated transversality condition regardless of the level of the safe interest rate. All policies that satisfy both conditions would be called sustainable. Very close to this literature, I will first present a 'definition model', which conjuncture sustainable policy and consolidation effort to define 'Sustainability' in the '*European Framework*' under the SGP more appropriate.

In the following, I assume that the debt level is similar to a (natural) stock variable² which is treated sustainable (cf. logistic growth law). The intuition behind this assumption is clear. Excessive debt is dangerous because of default risk but also to low debt imply disadvantages. A strong consolidation in the debt stock imply to give up necessary infrastructure investments. That imply higher long-run costs in the future. Additionally you can compare a low debt stock similar with a too low fish stock. On the one hand is the result malnutrition on the other chronic underfinancing. A similar analogy is found if the debt stock is to high.³ This interpretation is certainly unfamiliar but it is also very tricky to find new insights about sustainable policy treatment. Additionally empirical findings in Bohn (1998, [13]) allow the following model approach. One question is: How depends consolidation and sustainable resource management in policy? All existing models cannot answer this. In a later model approach (cf. section 5) I try to approximate to that question a few more. In the following, I indicate the debt stock with the variable 'd(t)' and the 'harvest-rate' (= consolidation variable) 'u(t)'. The debt stock is interpreted (as explained above) as a utility variable from real debt 'b(t)'. The aim is to find the optimal consolidation path and so the equilibrium levels for debt and their corresponding consolidation effort.

Now we are ready to define the problem formally:

$$\max_u \int_0^{\infty} \ln[u(t)] e^{-\delta t} dt \quad (1)$$

$$s.t. \quad \dot{d} = r * d \left(1 - \frac{d}{k}\right) - u \quad r > 0, k > 0 \quad (2)$$

$$d_{t=0} = d_0 \quad (3)$$

The parameter 'r' can interpreted as debt growth, 'k' represent the whole financial budget revenues (on GDP) and 'δ' is a discount rate. Additionally I assume that $r > \delta > 0$ which is normal for that problems. The functional form of the budget constraint (2) is typical in resource economics.⁴ Moreover I transfer

²Cf. in environmental economics for example fishes.

³The utility of the debt stock decreases after a maximum because the costs of excessive debts are higher than there benefits.

⁴ $F(d) = rd \left(1 - \frac{d}{k}\right)$.

the 'Maximum Sustainable Yield' (MSY) concept here for debt $d^* < d_{MSY} = k/2$. To solve this problem I use a 'Hamilton function'. From optimal control theory -a first-order necessary condition- is known as the *maximum principle* or *pontryagin principle*. Denoted by \tilde{H} , the Hamiltonian is defined as

$$\tilde{H} = \ln[u] + \lambda(t) \left[rd \left(1 - \frac{d}{k} \right) - u \right] \quad (4)$$

For the problem (1-3) and with the Hamiltonian defined⁵ in (4) the maximum principle conditions are

$$\frac{\partial \tilde{H}}{\partial u} = \frac{1}{u} - \lambda = 0 \quad (5)$$

$$\dot{\lambda} - \delta\lambda = -\frac{\partial \tilde{H}}{\partial d} = -\lambda r \left[1 - \frac{2d}{k} \right] \quad (6)$$

$$\dot{d} = \frac{\partial \tilde{H}}{\partial \lambda} = rd \left(1 - \frac{d}{k} \right) - u. \quad (7)$$

After some trivial transformation it results the following difference equation system:

$$\dot{d} = rd \left(1 - \frac{d}{k} \right) - u \quad (8)$$

$$\dot{u} = -u \left(\delta - r \left[1 - \frac{2d}{k} \right] \right). \quad (9)$$

The solution of this differential equation system result in the optimal debt path d^* and the optimal consolidation path u^* . The results are

$$d^* = \frac{k(r - \delta)}{2r} \quad (10)$$

$$u^* = \frac{k}{2}(r^2 - \delta^2). \quad (11)$$

⁵ $\tilde{H} = He^{rt}$.

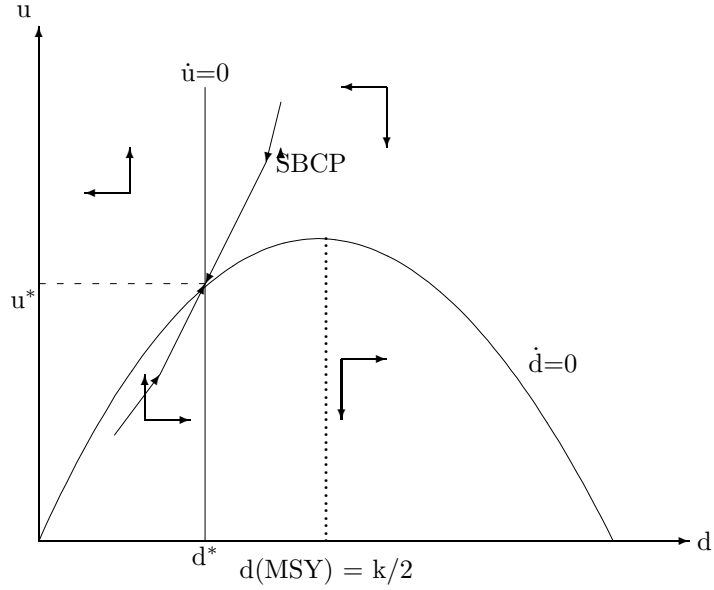


Figure 2: Path diagram

Because of the transversality condition (TC) $\lim_{t \rightarrow \infty} \lambda(t) \rightarrow 0$, I can prove that the path is stable with an unique equilibrium.⁶ The most important results and concluding definitions for sustainable policies are relegated to the next subsection.

2.3 Model results and their implications

A first non-unexpected finding is that the analysis above provides a warning that popular fiscal 'indicators' like deficit or debt-GDP ratios in the Stability and Growth Pact provide very little information about sustainability. This fact is also mentioned in the current reform discussion about the SGP by De Grauwe (2003).

The results from this simple model is

Result (i):

- (a) *The optimal debt level is positiv and smaller than the 'maximum sustainable yield' utility debt $0 < d^* < d_{MSY}$.*

⁶ $\tilde{H} = He^{rt} \Rightarrow H = e^{-rt} \ln(u) + \lambda[rd(1 - \frac{d}{k}) - u] \rightarrow 0$, because of the TC.

(b) *The optimal consolidation rate is positive $u^* > 0$.*

(c) *There is one stable path for convergence in the equilibrium (d^*, u^*) .*

The implications from these results is that a sustainable debt policy or consolidation policy correspond with a positive equilibrium debt ratio. In comparison to the existing aim in the SGP, that result show us: a zero debt level is not an 'inner' equilibrium. Only a rim debt level $d = 0$ could be possible but with an inefficient high consolidation level $u \gg 0$, which is certainly not achievable.

So theses results imply that a 'sustainable' fiscal policy (particularly debt policy) is consistent in my view with the following three propositions.

Proposition 1: *Sustainable fiscal policy or debt policy is a stable conjuncture among optimal consolidation and the corresponding debt level.*

Additionally a sustainable debt policy is smaller than the maximum sustainable yield amount but greater than zero. This generate the following second proposition,

Proposition 2: *Sustainable debt policy isn't excessive ($d^* < d_{MSY}$).*

The definition here seems different to Buiter and Grafe (2003) but the general idea is the same. Because the sustainable equilibrium debt level in this approach is equivalent to 'the absence of default risk'. Moreover 'Figure 1' shows that sustainable debt policy is also attainable with higher ('excessive') debt. That imply finally the third proposition,

Proposition 3: *Higher debt level ($d > d^*$) is sustainable if the consolidation level is also higher ($u > u^*$) and both variables convergence onto the stable path into the equilibrium (SBCP).*

That results could also interpreted for sustainable deficit levels. But the difficulty in both cases lays in a closer operationalization of the 'maximum sustainable yield' levels. This approach is no answer for an optimal debt or deficit threshold like that in the SGP. But it show us the direction of convergence for long-run target values in fiscal policy. All debt or deficit levels that are on the 'Sustainable-Balance-Consolidation-Path' (SBCP) are labelled as sustainable fiscal policies.

A short summary of this preliminary sections to defining sustainability in the European framework more appropriate results in the following definition:

Definition 1: *Sustainable policy is each combination of the managed resource and their corresponding consolidation effort, which position is on the 'Sustainable-Balance-Consolidation-Path (SBCP) and comprised Proposition 1,2, and 3.*

This definition includes the definition of Bohn (1998), which defines sustainable as a point on the Balance-Growth-Path (BGP) and in line with the transversality condition. Moreover it is also very similar to the definition in the European framework by Pasinetti (2000) and Buiters/Grafe (2003). But it is in my view a clearer description and better tractable definition for an analytical analysis.

The next section uses now the new sustainability concept in a model which analysis in detail the interdependence in the European framework especially the deficit thresholds and sanction fees within the well-known Stability and Growth Pact.

3 The basic model

Closest in spirit of the following model is Beetsma and Jensen (2003, [8]) and Beetsma and Uhlig (1999, [6]), which analysis contingent deficit sanctions and moral hazard with a stability pact. Other related work is Chari and Kehoe (1997, [17]) and Giovannetti et al. (1998), who explore the need for debt restrictions in multi-country models of a monetary union. Besancenot et al. (2004) analyzes the default on sustainable public debt. In their model they find out that the maximum debt level that investors are willing to hold may be much lower than the commonly used sustainable level.

The model consists of two periods, 1 and 2, and $n > 1$ countries that participate in a monetary union. Monetary policy is conducted at the supranational level, while fiscal policy remains decentral in the national sovereignty responsibility. Countries are assumed to be identical both in their economic and political structure. Moreover each country has two political parties, F and G, of which one of them forms the government in period 1. At the beginning of period 2,

the incumbent government is assumed to be re-elected with probability $0 \leq p < 1$. Without any loss of generality I assume that party F is in power in period 1 in each country.⁷ Close to Alesina and Tabellini (1990, [1]) I assume that the two parties differ in terms of their preferences for the composition of public spending. Both parties F and G attaches only to the provision of their own public good called f and g . The incumbent party will not spend anything on the other party's preferred good. Now the expected utility of parties F and G in country i are given by, respectively,

$$U_{Fi} = E[u(f_{i1}) + pu(f_{2i}) - \frac{\pi^2}{2\phi}], \quad (12)$$

$$U_{Gi} = E[pu(g_{2i}) - \frac{\pi^2}{2\phi}], \quad (13)$$

where $f_{ti} \geq 0$ and $g_{ti} \geq 0$, respectively, are spending on public goods F and G in period t . Function u is twice continuously differentiable with $u' > 0$, $u'' < 0$ and $u(0) = 0$. $E[\cdot]$ is the expectation operator conditional on the information available at the start of the game. Both parties are care about inflation π . The inflation rate is determined in the last second period. Parameter $\phi > 0$ is the inverse of the degree of inflation aversion. Similar to Beetsma and Jensen, I abstract from discounting because this does not affect my results.

The budget constraints of the government in country i , $\forall i$, in periods 1 and 2 are,

$$f_{1i} + g_{1i} = 1 + \epsilon_i + b_{1i} - \psi(d_{1i} - \bar{d}_{1i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{1j} - \bar{d}_{1j}), \quad (14)$$

$$f_{2i} + g_{2i} = 1 - (1 + \pi^e - \pi)b_{1i} - \psi(d_{2i} - \bar{d}_{2i}) + \frac{\psi}{n-1} \sum_{j=1, j}^n (d_{2j} - \bar{d}_{2j}). \quad (15)$$

The governments endowment is exogenous and equal '1' in each period. First-period variables are hit by ϵ_i , a shock with $E[\epsilon] = 0$ and bounded support $[\epsilon_L, \epsilon^U]$, $\epsilon_L < 0 < \epsilon^U$, and variance σ_ϵ^2 with ϵ_i iid. $\forall i$. Debt at the end of period t is denoted

⁷Cf. Beetsma and Jensen (2003) mention that the result would be unchanged if in some countries party F and in other countries party G is in power, as long as the re-election probability of the incumbent government remains the same across countries.

by b_{it} . I assume that countries start with zero initial debt and that all debt is paid off at the end of the second period (i.e. $b_{0i} = b_{2i} = 0, \forall i$). Beetsma and Jensen (1999) relaxed the zero-initial debt assumption in their model and show that the main results are unaffected. The debt in period one, is in nominal government debt and sold on the world capital market (cf. Calvo and Guidotti, 1993). Close to Beetsma and Jensen (2003), I assume that the ex-ante real interest rate is zero, which is exogenously determined on the world capital market. But this does not affect my results. The variable π^e is the rational inflation expectation. Additionally the risk-neutral investors are willing to hold government bonds and the ex post real interest rate is $\pi^e - \pi$. The government deficit is defined as $d_{it} := b_{it} - b_{i,t-1}$. If the current deficit level d_{it} is higher than the allowed threshold of \bar{d}_{it} , imply a "Excessive Deficit Procedure" whenever $\psi > 0$. In that situation (period t) a breaching government i pay the fine $\psi(d_{ti} - \bar{d}_{ti})$, but in the revers constellation it becomes a reward. In line with Beetsma and Jensen (2003) I assume first of all in contrast of the actual SGP, that the period 1 deficit level depends on the resource of shock. But later I extend this assumption in a more realistic way.

$$\bar{d}_{1i} = \bar{d} - \delta\epsilon_i \quad \text{and} \quad \bar{d}_{2i} = \bar{d}, \quad (16)$$

where δ is what the authors term the 'degree of state contingency'. If $\delta > 0$, and a bad shock occur imply a raise in the reference deficit level like the 'exceptional options' in the SGP if the shock is sufficiently large.

The last terms in the equations (14) and (15) are the rebates to country i of the fines paid by the union members; close to the mechanism in the current SGP. Apart from the current reform discussion about the SGP that model implicit assumes total credible sanctions.

The Common Central Bank (CCB) sets monetary policy for the whole monetary union with primary aim 'price stability'. Equivalent to the assumptions above and the formal Treaty provisions (art. 105 ECT) I assume that the CCB is not completely independent. This assumption is controversial but many papers show that free-riding, moral hazard and bail-out problems are harder in a monetary union and influence so the independence of the CCB. The CCB attaches a weight $0 \leq \lambda \leq 1$ to the inflation objective of maximizing $-\pi^2/(2\phi)$ and a weight

$(1 - \lambda)$ to the objective of maximizing the average amount of resources available to the governments in period 2. The function is

$$U_{CCB} = \lambda \left(-\frac{\pi^2}{2\phi} \right) + (1-\lambda) \frac{1}{n} \sum_{i=1}^n \left[1 - (1 + \pi^e - \pi) b_{1i} - \psi (d_{2i} - \bar{d}_{2i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{2j} - \bar{d}_{2j}) \right] \quad (17)$$

After some transformations and calculations the function can be minimized to (cf. Appendix B)⁸

$$U_{CCB} = -\frac{\pi^2}{2\alpha} + 1 - (1 + \pi^e - \pi) \tilde{b}_1, \quad \alpha := \frac{(1-\lambda)\phi}{\lambda} \geq 0. \quad (18)$$

Before I presenting my model extensions to analyze 'sustainability in debt policy' I need some basic results from the model (Beetsma and Jensen, 2003) presented above.

The optimal inflation rate is calculated from maximizing (18) over π . This yields:

$$\pi = \alpha \tilde{b}_1. \quad (19)$$

The entire solution of the basic model can be summarized in a result (cf. Beetsma and Jensen, p. 195) as:

Result (ii). Let $\epsilon_i = \tilde{\epsilon}, \forall i$. One has:

- (a) Suppose that $p < 1$. First, if $\psi = 0, \tilde{\epsilon} = 0$ and $p \rightarrow 1$, then $\tilde{b}_1 = 0$. Second, a fall in p implies a higher \tilde{b}_1 . Finally, if $\alpha > 0$, $\partial \tilde{b}_1 / \partial n > 0$ and $\partial \tilde{b}_1 / \partial \alpha < 0$.
- (b) $\partial \tilde{b}_1 / \partial \psi < 0$, unless $\alpha = 0$, in which case $\partial \tilde{b}_1 / \partial \psi = 0$
- (c) $\partial \tilde{b}_1 / \partial \epsilon < 0$. Moreover, if u is quadratic and $\alpha > 0$, $\partial \tilde{b}_1 / \partial \tilde{\epsilon}$ decreases with n and increases with ψ .

The result above imply in easy words: (a) If the re-election probability p decrease then the optimal debt level in period 1, is higher. Behind that result is a kind of debt-bias for the incumbent party. Moreover an increasing number of monetary union member countries imply an increase of the optimal debt level, because of more free-riding incentives. Finally, higher weight to the inflation objective imply a decrease in the debt level. (b) The sanction mechanism ψ

⁸Cf. Beetsma and Uhlig (1999).

discipline the debt variable. (c) The debt increase in response to shocks if the monetary union is larger because each government internalizes the costs only to a lesser extent.

Finally I will mention here one important proposition which characterized an optimal pact. In my later work I reference to that Proposition (cf. Beetsma and Jensen, 2003, p. 198).

Proposition 4. *The first-period governments all prefer the pact characterized by $(\psi, \delta) = (\frac{n-1}{n}; 1)$.*

The intuition behind this proposition is that an optimal pact solve two roles simultaneously. First it fully internalize the consequences of individual debt policies for the common inflation rate. Second the reference deficit level to the shocks, is fully effective to eliminate country specific movements in public spending.

Now I am ready to discuss the model extension to analyze sustainable debt policy in that framework.

4 Modelling 'Sustainable debt consolidation'

The new research focus is to analyze similar to the model in section 2 the problem of 'Sustainable' policy but in a model which describes a monetary union. From Treaty provisions (art. 2 ECT) and the Stability and Growth Pact regulations [27] it is clear that 'sustainable' debt consolidation is an important issue.

I will take the notation from section 3 and extending now the basic model. Variable e_i is now the debt stock consolidation effort of country i. The motion of the debt stock ' $s(e_i)$ ' depends now directly from the consolidation effort ' e_i '. Thus the government i's expected utility is now given by:

$$U_{Fi} = E[-s_i(e_i) + u(f_{1i}) + pf_{(2i)} - \pi^2/(2\phi)], \quad \forall i, \quad (20)$$

where $s_i(e_i) = (1/2)(e_i - \frac{k}{2})^2$ represents the costs of 'sustainable' consolidation within the European fiscal framework, especially the 'Stability and Growth Pact'. The function above is crucial because it defines the 'maximum sustainable yield' value by ' $k/2$ '. Moreover the costs for the member states increase if consolidation is too high because of giving up long-run structural reforms and

distribute the costs of such projects about generations. But also too low consolidation imply higher costs because from section 2 you know that this correspond with an 'excessive deficit'. Apart from other functional forms the interpretation of the following budget constraint is very similar to equation (14):

$$f_{1i} + g_{1i} = 1 + \epsilon_i + e_i + b_{1i} - \psi(d_{1i} - \bar{d}_{1i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{1j} - \bar{d}_{1j}). \quad (21)$$

where now,

$$\bar{d}_{it} = \bar{d} - \delta(\epsilon_i + e_i), \quad \text{and} \quad \bar{d}_{2i} = \bar{d}. \quad (22)$$

Besides of the definition above I need additionally one assumption which induce the trade-off among sustainability consolidation to deficit and debt levels. In the following I define the deficit as (notice, $d_{i1} > 0$):

$$d_{it} := b_{it} - b_{i,t-1} + \left(\frac{k}{2} - e_i\right).^9 \quad (23)$$

The last term consists of the MSY optimum of consolidation minus the actual consolidation variable. That imply that very low consolidation below the MSY amount increase deficit and long-run debt. The MSY optimum $e_i = k/2$ imply then now affect of debt and deficit. But very high consolidation about the MSY value lower the current deficit but imply costs through the $s(e_i)$ sustainability function in the expected utility function U_i . Two important questions arise now: First, what is the optimal consolidation effort and so the debt level? Second, what happens with the social utility value if the MSY value 'k' changes (can also interpreted as in section 2 like thresholds in the SGP)? This could be analyzed after the model solution.

Using (14) and (15), the first- and second-period spending on good F can now be written as (for details see appendix C):

$$f_{1i} = 1 + \tilde{\epsilon} + e_i + 2\tilde{e} + \tilde{b} + \left(\frac{n}{n-1}\psi - 1\right)[(\tilde{b} - b_{i,1}) + (\tilde{e} - e_i)] + \\ + \left(\frac{n}{n-1}\psi\delta - 1\right)[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)] \quad (24)$$

⁹Notice that I assume also that $d_2 = -b_{i1}$.

$$f_{2i} = 1 - \tilde{b}_1 - \left(1 - \frac{n}{n-1}\psi\right)[(\tilde{b}_1 - b_{i,1})]. \quad (25)$$

From the few new assumptions above the model framework and thus these two time-constraints are crucially 'different' to the model from Beetsma and Jensen (2003).

Model solution:

The optimal behavior of the government of country i , in terms of the choice of effort and debt issuance, are characterized by the following necessary and sufficient first-order conditions:

$$\begin{aligned} \frac{\partial U_F}{\partial e_i} = 0 &\iff s'(e_i) = E[u'(f_{1i})[1 + \psi(1 - \delta)]] \\ &\iff s'(e_i) = [1 + \psi(1 - \delta)]E[u'(f_{1i})] \quad \forall i \end{aligned} \quad (26)$$

$$\begin{aligned} \frac{\partial U_F}{\partial b_i} = 0 &\iff 0 = E[u'(f_{1i})[1 - \psi] + pE[u'(f_{2i})][-(1 - \psi)] - E[\frac{\alpha^2}{\phi}\tilde{b}_1]] \\ &\iff E[u'(f_{1i})[1 - \psi] = pE[u'(f_{2i})](1 - \psi) + E[\frac{\alpha^2}{\phi}\tilde{b}_1], \quad \forall i \end{aligned} \quad (27)$$

While condition (27) correspond to that in the basic model, condition (26) which guides the optimal consolidation effort level, already hints the new effect. It equates the government's marginal cost of consolidation through effort to the expected marginal gain from period one and two (in terms a lower debt level close to the equilibrium MSY values). The stronger is the response of the reference debt level ($\delta \uparrow$) to the observed state of the economy and the weaker is the 'excessive deficit procedure' ($\psi \downarrow$)¹⁰, the smaller is this expected marginal gain. These reactions are crucial new findings for 'sustainable debt policy' within the Stability and Growth Pact'.¹¹ An interesting finding is that through consolidation the marginal gain of the RHS increase by ψ in comparison to a situation without

¹⁰and the re-election probability ($p \downarrow$) in a more general framework see appendix B.

¹¹This result show that the re-election probability is very important. A reform proposal which define a debt level per law for all different Government is from that perspective desirable (De Grauwe, 2003) but it is not really implementable because a new government implement their own consolidation level.

consolidation. An increase in the 'excessive deficit procedure' thus increase the marginal gains from consolidation. This finding imply for sustainability in public debt policy that a stronger stability pact can improve the marginal gains, *ceteris paribus*.

For an explicit and closed-form model solution I assume a linear-quadratic specification of u (Cf. Beetsma and Jensen, 2003):

$$u(f_{ti}) = -\frac{(\xi - 1)}{2}(f_{i1})^2 + \xi f_{ti}, \quad \xi > 1 \quad \text{and} \quad 0 \leq f_{it} < \frac{\xi}{\xi - 1}. \quad (28)$$

This is very convenient for explaining the intuition behind the new results. To see how to solve the (Bayesian) Nash equilibrium in this case look in the Appendix C. With the functional specification above the consolidation effort and public debt levels can be expressed as:

$$b_{1i} = B - B_\epsilon \epsilon_i \quad (29)$$

$$e_i = D - D_\epsilon \epsilon_i. \quad (30)$$

where $D, B_\epsilon, D_\epsilon > 0$. The explicit expressions for B, D, B_ϵ and D_ϵ are contained in Appendix C. I limit the attention to cases in which $E[\tilde{b}_1] = B > 0$.

As before seen, there is an active role for a stability pact. A growing size of the union (' n ' increases) implies an increase in the average expected debt level.

Result (iii). Let $\psi > 0$. Then,

(a) $\frac{\partial D_\epsilon}{\partial \delta} < 0$ and $\frac{\partial B_\epsilon}{\partial \delta} < 0$.

(b) $\frac{\partial D}{\partial k} > 0$ and $\frac{\partial B}{\partial k} < 0$.

Part (a) implies that an increase in the reference deficit level of country i and thus a smaller sanction fine if bad shocks occur, decreases debt and also the consolidation effort. Therefore, the incentive to exert more consolidation effort is weakened. Contrary imply an increase in debt also symmetrical an increase in the consolidation effort (also seen in my model in section 2) to achieve sustainable public finance.¹²

¹²These results are also in line with Beetsma and Jensen (2003).

The results in part (b) focus more on 'sustainable' policy implications. An increase of the MSY value k (also interpreted as an increase of the excessive deficit threshold in the view of sustainability) imply a higher 'D' and thus a higher consolidation effort. The intuition behind this result is that a lower threshold in the long-run don't changes the initial defined debt equilibrium. Therefore to achieve that level imply despite the lack of deficit ceilings a higher consolidation effort to receive the equilibrium debt level. Apart from the reaction to consolidation effort the debt level decreases because: On the one hand lower deficit ceilings imply lower excessive debt in the future and on the other hand the higher consolidation effort accelerate the decrease in B and thus the debt value.

Are relaxed deficit thresholds compatible with 'Sustainability'?

Proposition 5. *In the situation of sustainable consolidation about the equilibrium level and equal with the 'maximum sustainable yield' value, utility is increasing after relaxing the sustainable deficit thresholds; $\partial V_{Fi}(\psi, \delta)/\partial k > 0$.*

Proof. See Appendix C. \square

Hence, this proposition states that gains of a normal 'sustainable consolidation' equilibrium in that debt policy is below the 'MSY' level by lowering the 'excessive deficit procedure' is in sign unknown. One can say it depends from re-election probability and debt amount in period one. A low re-election probability and low debt imply rather a negative influence to the parties utility. Interesting is that the gains from relaxing the sustainable threshold arise only if countries consolidate today more as necessary. Empirically is seen that after 1999 nearly all participating countries in the EMU reduce their consolidation policy (Fatás et al., 2003, [31]). Thus it is possible to assume that all countries have more disadvantages and losses after relaxing the sustainable thresholds in the SGP.

5 Understanding the relation between sustainability and consolidation policy

The view that policy-making should be based on simple behavioural rules is not new, although its normative and empirical relevance have not been established until recently. But rules are better than discretion is by now a widely accepted theoretical principle. The normative relevance of following rules rather than discretion was originally established by Kydland and Perscott (1977, [39]). The most famous rule in monetary policy is the Taylor rule (1993), which is very simple and better than some complex rules in theoretical models. Empirical work confirm that finding (Clarida, Gali and Gertler, [18],[19],[20]). The focus of the discussion in literature has almost exclusively been on monetary policy with scant attention to fiscal policy (Ballabriga and Martinez-Mongay, 2003, [4]). The only one exception is Bohn (1995,1998) and some Working Papers by Taylor (2000, [46]), but both for the United States.

In this section I will establish a new model approach, which provides a quick and simple screening device for policy-makers. Certainly the model is very stylized, but in the complex world like the EU with high uncertainties and stochastic shocks a clear 'decision-heuristic' for policy-makers is more important than a complex model with low relevance in the real world. The idea is modelling a simple rule for fiscal policy analogous to the monetary policy 'Taylor-rule'.

Assume that the policy-maker have two targets 'x' and 'y' that are either complement or conflict structured. Both targets are expected parameters. The interdependence of the targets is indicated by ' ζ '. Without loss of generality I label 'x' the sustainable target for example debt policy. The other variable could interpreted as political ambitious of consolidation effort or output stabilization or reputation for re-election and so on. The functional structure is in its simplest form: $y = |\zeta|x + z$, where z is a stochastic shock with mean-zero (i.i.d.) and variance σ_z^2 . The functional form for example between debt 'x' and deficit 'y' is empirical confirmed by Bohn (1998).¹³ Recent work by Ballabriga and Martinez-Mongay (2003) confirm the empirical findings also for Europe. You

¹³Bohn, showed that there exists an estimated positive response of primary surpluses to the debt-GDP ratio. He interpreted this estimation as a new test for the sustainability of fiscal policy.

can also invoke a theoretical argument that can justify the specification above (Barro, 1978). Apart from the tax smoothing argument Barro/Leeper ([40],[41]) and Adnés, Ballabriga and Vallés (2000, 2002; [2],[3]) shown in a different theoretical framework, which they calibrate that the above rule is a helpful good approximation. Thus each politician try to minimize a general loss function subject to the given interdependence constraints. I implement that in a more general framework to analyze sustainable policy and extend the approach in line with Dixit/Lambertini to examine an interaction structure that is everywhere existent in the EMU. In recent work Ballabriga and Martinez-Mongay (2003, p. 250) conclude that such modelling is: *'(...) plausible because it provides a formal stylized way of explaining fiscal behaviour by focusing on two key dimensions of government concern, and it is therefore relevant for actual policy choices, namely, government solvency and output stabilization.'* Starting from this point I model the problem similar to the empirical findings and tractable for a theoretical analysis.

The loss function is

$$\mathcal{L} = \frac{1}{2} \left[(x - x^*)^2 + a(y - y^*)^2 \right], \quad (31)$$

where x^*, y^* are the intended target values of sustainability and the other aim. The parameter 'a' indicates a weight for the relativ importance of both targets with $a \in (0, 1)$. With that functional form I assume that all amounts of x and y that are more close around the targets are preferred by the policy-maker.

The general problem is now formulated as:

$$\int \mathcal{L} = \frac{1}{2} \int \left[(x - x^*)^2 + a(\alpha + |\zeta|x + z - y^*)^2 \right] \quad (32)$$

The optimal sustainable level ' $x^{opt.}$ ' is yield after derivation of (32):

$$x^{opt.} = [1 + a|\zeta|^2]^{-1}(x^* + a|\zeta|y^*) \quad (33)$$

This solution is really not very new but going out from here, I can propose a new finding in the background of the sustainability debate discussed above and during the current reform discussion about the Stability and Growth Pact.

Proposition 6: *The sustainable managed variable decreases if the interdependence between the two targets become stronger ($|\zeta| > 1$).*

Proof: Simple derivation of the optimal variable ' $x^{opt.}$ ' yields:

$$\frac{\partial x^{opt.}}{\partial \zeta} = -a \frac{(|\zeta| - 1)y^* + 2|\zeta|x^*}{(1 + a|\zeta|^2)^2} < 0 \quad \forall \quad |\zeta| > 1 \quad (34)$$

The intuition behind this result is that a strong interdependence between for example the debt level and the other aims like output stabilization imply that the optimal sustainable debt level will be relaxed in that framework. But with the existence of the monetary union and thus the centralization of the monetary policy to the supranational level two important changes are induced: First, the fiscal-monetary interaction in Europe is increased because of free-riding and moreover there are emerging problems with idiosyncratic and asymmetric shocks. Second, there is a mechanism which additionally ensure the interdependence in fiscal-monetary, namely the SGP. The result from Proposition 6 is now: Since 1999, and the implementation of the monetary union the *necessity in the participating* countries for sustainable targets decrease in Europe because of stronger interdependence in comparison to the corresponding national levels. That result is a new argument for sustainable deficit and debt thresholds like that in the SGP. The thresholds in the SGP are calculated as a kind of national average values for debt and deficit, which are from the national perspective too strong in the new environment like that since 1999; but from an European view and the knowledge about the increasing interactions they are to loose. The intuition behind this finding is certainly a 'pooling' argument for the national countries which fail to internalize the externalities in the other participating countries. So I can conclude that the Stability and Growth Pact or better some disciplining thresholds which helps to treat fiscal policy more sustainable, are necessary but in a wider perspective as before in the national framework. Along with some arguments mentioned by De Grauwe (2002) in the reform discussion about the current Stability Pact, this finding here confirms that a border target set and monitoring horizon is desirable. But on the other hand I can show that a clear disciplining device for the fiscal policy is also desirable. The result is also true in a more complex framework of interaction between a supranational and national

institution.

Apart from the findings above there are a few studies about fiscal policy which conclude: In order to prevent government debt from increasing in the long run, fiscal policy should be tightened. Even in the medium term with a following demographic wind, current fiscal policy is hardly sustainable. Such demographic arguments are here disregarded. But Proposition 6 is also applicable for those arguments. The increasing relations between the sustainable debt target and the other targets -Proposition 6- imply that a stronger sustainable target is necessary in Europe. This fact was confirmed through many empirical and theoretical work. So the relation that was found in Proposition 6 seems very robust and general. Additionally it is very simple in their application for policy-makers.

5.1 Reputation Game

The positive issue of how policymakers choose sustainable debt policy remains unexplored in the current literature. I provide on basis to the simple stylized model above a formalization of signaling effects. Thus I build up a reputation game between two governments which differ in their ability to sustainable debt consolidation (spending cuts). In that model I examine separating equilibria and pooling equilibria.

The governments objective is to reach a sustainable debt level x^* that stabilize the debt-to-GDP ratio. I use the following loss function similar to Drazen and Masso (1994)¹⁴

$$L = p\Lambda + \frac{1}{2}(T)^2 \quad (35)$$

where p denotes the probability that the sustainable stabilization fails, and Λ is the fixed cost of failure. The government chooses first taxes T to achieve their consolidation target value. The cost of taxation is standard, while the cost of a failed consolidation reflects either the reputational and political costs of missing the announced budget target or the higher inflation which may result if the stabilization fails.¹⁵

¹⁴Cf. Dornbusch, 1991.

¹⁵Cf. my stylized model approach in section 5.

The sequence of events is as follows. At the beginning of period 0 the government issue debt and decide about the relative amounts of one- and two-period consolidation. At the end of period 1 the government chooses taxes to meet the announced budget target. However, whether or not the target will be met remain uncertain, since it depends of a shock, Z , which hits the budget after taxes have been set. The success of consolidation depends on the realization of Z . The probability that the consolidation fails is

$$p = \text{prob}[Z > T - G - X], \quad (36)$$

where G denotes government spending and X the consolidation effort which depends on the revenue and output in each period. The distribution of the shock Z is triangular with mean zero, $E_1 Z = 0$, and a support ranging between $-a$ and a . With this assumption I capture the fact that shocks of larger size are less likely to occur. Equation (36) shows on the RHS the distribution of Z , since I focus on a government which expects to succeed, in the sense of that in chooses a level of taxes T , for which the expected budget is larger than the announced target; i.e. $T-G-X>0$.

The consolidation effort is equal to

$$X = (1 - \psi)Y + (\psi)[E_0[Y] + p\Gamma^S] \quad (37)$$

where ψ is the share of consolidation in period two, Y is the output and $E_0 Y$ respectively the expected output (similar to budget growth revenue) and p is the probability to breach the deficit threshold from the Stability and Growth Pact Γ^S . Additionally I assume that output Y depends of fiscal policy stabilization. The government can be two types -tough or weak- depend on the level of spending in period 1. A tough government has a level of spending, G^L , lower than the level of spending, G^H , of a weak government. This result in

$$Y = Y(G^i) + \mu \quad i = H, L, \quad (38)$$

where $Y(G) \geq 0$ and an independent shock μ , distributed on the compact support $[\mu^l; \mu^h]$, with mean $E_0 \mu$ and variance $E_0 \mu^2 = \sigma^2$.

Substitution $X + G - T$ into the value of p , and replacing p in equation

(35), I obtain the loss that the government expects after observing X , but before knowing the realization of Z :

$$L = \frac{\Lambda}{2a^2}[a + G + X - T]^2 + \frac{1}{2}(T)^2. \quad (39)$$

Then, the optimal value of taxes is equal to $T^* = \zeta[a + G + X]$ where $\zeta = \Lambda/(a^2 + \Lambda)$. All technicalities are relegated to Appendix F. Substituting T^* into equation (39), and taking expectations conditional on the information at time 0, yields the value of the expected loss after some transformations as

$$E_0L^* = E_0\left(\frac{\zeta}{2}\right)[a + G + X]^2 = E_0\left(\frac{\zeta}{2}\right)[a + G + ((1 - \psi)Y + (\psi)[E_0[Y] + p\Gamma^S])]^2 \quad (40)$$

The loss function (40) is minimized choosing $\psi = 1$, or respectively setting $x^* = -a - G$. The last solution imply that sustainable debt policy is $x^* < 0$ and depends from government spending and shocks 'a'. Higher government spending imply also relativ higher sustainable targets as defined in section 2. The explicit solution for $\psi = 1$ imply that the government insulates the budget from budget shocks and thus eliminate all the uncertainty regarding the cost of consolidation. This policy is optimal because it rules out that the stabilization may fail as a result of a negative shock to the budget. Intuitively, a government which expects to succeed will not take the whole consolidation effort in period 1 because there are also budget risks in the meantime. Thus the government decide to consolidate optimally in period 2.

Consider now a class of separating equilibrium where believes have the following form: for consolidation levels shorter than ψ^S , the other governments expect to be tough. If the consolidation take first place in period 2, the government is identified as weak (W) because their consolidation effort X is longer and slower than in the case of a tough (T) government. This imply the following two conditions:

The weak government compare

$$E_0L^W(W, \psi = 1) \leq E_0L^W(T, \psi \leq \psi^S), \quad (41)$$

that inequality holds for

$$\psi \leq \psi^S = \frac{\sigma^2 + \lambda\alpha - \sqrt{\lambda^2\alpha^2 + \sigma^2\lambda(2\alpha - \lambda)}}{\sigma^2 + \alpha^2}, \quad (42)$$

where $\alpha := a + G^H + Y(G^H)$, $\lambda := Y(G^H) - Y(G^L)$ and it is the solution of the square equation of the expected loss of the weak government under full information. The intuition for this result is as follows. A short and thus fast consolidation carries no benefit for a weak government, except for allowing to distinguish itself as tough. Since by mimicking a tough government, consolidation payments are saved merely for two-period consolidation. Such gain disappears if the weak consolidate faster. In contrast the consolidation risk increase in the short-term, because of shocks which can arise after the consolidation imply that the weak reveals itself by choosing $0 < \psi^S < 1$. It is also worth to mention that the consolidation speed increase with the variance of output shocks σ^2 , and decreases with the difference, λ , between the efforts of fiscal policy stabilization.

A separating equilibrium of the tough government thus exists if and only if the tough government is willing to slow the consolidation down to ψ^S . This happens if,

$$E_0L^T(T, \psi^S) \leq E_0L^T(W, \psi^S < \bar{\psi} \leq 1), \quad (43)$$

and the incentive compatibility constraint is satisfied if

$$(1 - \lambda)^2\sigma^2 \leq (1 - \bar{\psi}d)^2\sigma^2 + \bar{\psi}^2\lambda^2 + 2\bar{m}\beta^2, \quad (44)$$

where $\beta := a + G^L + Y(G^L)$. The necessary condition for equation (44) depends also crucially of σ^2 and λ . If the shock σ^2 is too large then the tough government would prefer not to reveal its type. When such a separating equilibrium does not exist, pooling equilibrium may exist, where both governments choose the same consolidation speed and amount.

In a pooling equilibrium both governments choose the same consolidation, i.e. the forward output rate, is equal to

$$E_0Y = [Y(G^L) + (1 - q)\lambda] \quad (45)$$

where q , the probability that the government is tough, depends on the beliefs of the other governments in the monetary union. Since the tough government

chooses ψ^P , the consolidation speed which minimizes its expected loss, a pooling equilibrium exists if and only if ψ^P satisfied the incentive compatibility constraint of the weak government, $E_0L^W(Pool, \psi^S) \leq E_0L^W(W, \psi = 1)$. This requires

$$\psi^P = \frac{\sigma^2 - (1 - q)\lambda\beta}{\sigma^2 + (1 - q)^2\lambda^2} \geq \psi^W := \frac{\sigma^2 + \lambda\alpha q - \sqrt{\lambda^2 q^2 \alpha^2 + \sigma^2 \lambda q (2\alpha - \lambda q)}}{\sigma^2 + \lambda^2 q^2}. \quad (46)$$

Condition (46) shows that for a pooling equilibrium to exist the initial reputation, q , must be sufficiently high. Intuitively, a better reputation in fiscal policy imply a lower risk to breach the SGP, lower interest rate risk premium and thus making the tough government willing to choose instead of a high speed consolidation a slower speed to consolidate the budget ψ^P .

Summing up the following results: First, if a pooling equilibrium exists, the corresponding consolidation amount and speed ψ^P is slower than the separating equilibrium speed ψ^S , which induces a weak government to reveal itself, because $\psi^W > \psi^S$. Second the consolidation speed increase with the variance of output shocks in period 1, σ^2 , and decrease with the difference, λ , between the fiscal stabilization efforts by the two governments. Thus the reputation game shows that if the variance σ^2 is relative low to λ the differences in fiscal stabilization (automatic stabilizers) a separating equilibrium is more likely. Instead, in a pooling equilibrium, is debt consolidation slower (longer) than in a separating equilibrium. In both constellations is the consolidation speed ψ faster with higher variances σ^2 and slower with λ . Now I summarize the results in the last proposition.

Proposition 7: *A monetary union with dezentral fiscal policy imply high differences in fiscal stabilization λ and because of the convergence criteria a lower σ^2 than in the nation states before the MU.¹⁶ Thus a monetary union with a dezentral fiscal framework imply more likely a separating equilibrium.*

This Proposition explains that in the European monetary union exists many different consolidation amounts and speeds. The consolidation effort (speed) depends on output shocks and the differences in governments spending. Countries

¹⁶De Grauwe (2003) confirm that assumption empirical.

as Germany which was indicated as tough in the preliminary phase of the EMU consolidate slower if output shocks are relatively stronger in comparison to the different amounts in fiscal stabilization in the other European countries. That fact is intuitively empirically correct in Europe. But a detailed empirical evaluation should be done in a next step to evaluate the scope of the simple stylized model approach.

6 Reforming the SGP and Sustainability

The fiscal monitoring framework in Europe is crucially based on four elements: The deficit threshold, the debt threshold, the fiscal surveillance like the stability programs and finally the 'Broad Economic Policy Guidelines.' According to article 104 ECT, 'Member States shall avoid excessive government deficits', with excessive deficits being defined as above 3% of GDP. The SGP concretise the deficit procedure and implement a sanction mechanism. If a country breach the threshold it may pay fines of between 0.2 and 0.5% of its GDP. However, a country will not be fined in case of 'exceptional circumstances', i.e. if the deficit is generated by an unusual event out of control of the national authorities, or if output has fallen by more than 2%. Additionally you can avoid any sanctions, if partner countries agree, in the event of a fall in GDP of between 0.75 and 2%. The Treaty and SGP maintain also that the debt to GDP ratios should be below a reference value of 60%. This criteria is relevant to assess fiscal sustainability (Mathieu and Sterdyniak, 2003,[42]). Additionally the Pact sets out a medium-term objective, which is to reach budgetary positions 'close-to-balance or in surplus' and to implement yearly stability programs. These programmes are then evaluated by the Commission and the EFC. After the detailed evaluation, the Commission addresses a recommendation to the Ecofin council. The procedure of the SGP attempts to discipline the national fiscal policy in favor to the common price stability. On the one hand works the SGP sometimes like a corset for the fiscal policy. On the other hand is the SGP needed to discipline the fiscal policy. The question is: What are the costs and benefits in each situation? Making the European monetary union and the currency 'EURO' a successful

project it is consensus around all participating countries that the price stability is primary. Concluding: The EMU need a disciplining mechanism like the SGP but also protect national freedom as much as possible ('Subsidiarity principle', art. 5 ECT) to react for example to idiosyncratic and asymmetric shocks. To do these splits an adequate mechanism is necessary. In the following section, I discuss shortly the reform ideas of the current SGP. These alternatives have the intention to cure all existing incentive problems of the current Stability Pact.

6.1 Current Reform Discussion

The need for reforming the SGP became more and more obvious in the year of 2002. A number of economists have made different and sometimes contradictory proposals. Thus there are many coordination mechanisms, which transform non-cooperative constellations into cooperative. The actual reforms can be categorized into: (a) Radical reforms like market mechanisms or centralization. (b) Modification reforms to a new target structure. (c) Modification reforms on the basis of the current Pact. Moreover there exist different advantages and disadvantages but for all distinguishing proposals some basic principles are necessary for a good interaction management. The question is, whether the mechanisms are also sufficient? This is in general certainly open. But it depends from the assumptions and the environment of the interaction structure. The radical reform proposals are connected with fundamental changes of the fiscal policy framework in Europe, for example 'Tradeable Deficit Permits' (Casella, 2001,[16]), 'Rating Agencies to evaluate national Debt' (Eichengreen, 2002,[28]) and all proposals to a closer fiscal policy centralization at the European level (Heise, 2002,[34]; Euromemorandum, 2003). The suggestions from Casella (2001) and Eichengreen (2002) are towards a market solution which works efficient and solve the interaction problem. The other direction solving the problem efficient is towards more centralization. But the knowledge that these radical reforms need either a majority around the European countries and/or a closer political union makes both directions in the near future probably unlikely. On the other hand a modification proposal is only a change in the current fiscal framework in Europe. The reform alternatives in that field are: First to define a new target structure which transform the only focus today (deficit target) to a more-dimensional view and

bring this together with a longer time horizon. The second group of reforms are close on the current Pact, but similar in the suggestions to define a new target structure they all plead for a non-partisan or independent agency (committee) establishment.

Starting from this systematisation you find out three theoretical solution mechanisms for 'supranational-national' interaction conflicts: (a) Market, (b) Hierarchy and (c) Coordination mechanisms. In spite of Eijffinger (2003) have told: 'In the end it will be more hierarchy in the Fiscal Framework', likely similar to monetary policy but with an other structure, I focus also on co-ordination mechanisms because I think that a political union is in the near future really unthinkable. But all people in Europe know that we need a better (more credible) Stability Pact as the current one to discipline national fiscal policy.

Table 1: A summary of some Reform proposals

	Radical proposals	Modification proposals
Bofinger		Inflation targeting
Buiter		Permanent Balance rule
Buti	Higher degree of fiscal integration	Redefining the medium budget target and i.c.
Casella	Tradeable deficit permits	
De Grauwe		Contingent debt and deficit targets
Eichengreen	Rating Agency	Deficit Index and i.c.
Eijffinger		Structural balance targets
Ohr/Schmidt		Fully independent council
von Hagen		Independent council (i.c.)
Wypoloz		Fully independent council

6.2 New Reform Proposal

When a father calls his baby ugly, people take notice and expect to find a seriously aesthetically challenged child. When the President of the European Commission calls the fiscal rules of the Stability and Growth Pact 'stupid' and 'rigid' it is clear that changes to the Pact are in the air (Buiter, 2003, [14]). In this sense I will establish here a 'New Reform' of the current Stability and Growth Pact. The reform suggestion consists of a detailed analysis of all existing reform proposals from European organizations or leading economists and the logic idea, which

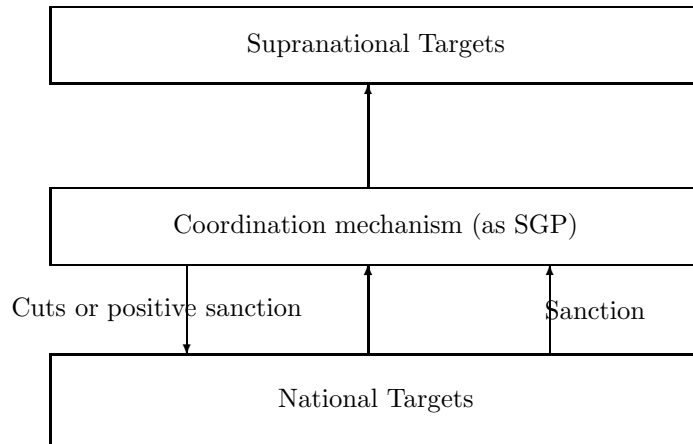


Figure 3: Incentive mechanism

I have found in the analysis above and another paper (Herzog, 2004,[36]). To explain the last in more detail look now to Figure 3.

The starting point is a clear 'supranational target', which have priority and consensus around all member countries. This is for example 'price stability' because all actors benefit from this public good. The conflicts coming-up because there are partial sovereignty rights in the hands of the member states which can contradict (pressure) the 'supranational-target'. The knowledge that there is no majority in the near future for radical reforms like more market or centralization imply to search an efficient 'co-ordination' mechanism as the SGP. The middle plain in figure 3 illustrate this. Conflict coordination imply always disciplining. The arrows left and right illustrate that issue. A negative disciplining mechanism like sanctions deteriorate and aggravate (Danger!) the supranational target in this constellation. On the other hand helps a positive incentive mechanism to protect (secure) the supranational target and disciplining simultaneously. Additionally, every disciplining task (consolidation) must correspond with equal rewards (Herzog, 2004,[37]). Thus means that every coordination or interaction mechanism in that constellation should support both disciplining and rewards for the loosen national sovereignty free room (cf. appendix G).

Apart from the economically absolutely desirable changes of the target vari-

ables and their application period (De Grauwe, 2003,[21]; Bofinger, 2003,[10]) the decision procedure is certainly the most important one for the purpose of 'supranational targets' and sustainable fiscal policy. All other changes to a more-dimensional 'target set' are pointless, provided that there aren't guaranteed adequate penetration. Therefore, we need a more independent decision council to increase credibility and too enforce the importance of fiscal policy in Europe. To strengthen the European 'fiscal policy' and thus to generate an adequate opponent to monetary policy lies in the interest of the whole European society. So I suggest a 'negative escape clause'. This has the following function: If the 'supranational' targets are excessive breached by a member state then the Ecofin council will pass the decision competence to the independent council. The disciplining mechanism is as described above no more monetary, which would be aggravate the situation, rather a equivalent punishment in the same amount but in a positive manner like budget cuts.¹⁷

A more modest solution for independence in the decision process can achieved with a 'Vote- and Reputation function' (cf. Herzog 2004, [35]). The idea is the following: Sanction decisions in the Ecofin council should crucially depend on the number of votes from the countries with prudent and sustainable fiscal policy. So the number of votes should correspond with its reputation in fiscal policy. A country with a prudent and sustainable fiscal policy structure should get more votes than unsustainable and breaching countries. I construct a 'reputation index' which depends on inflation, debt and deficit (perhaps growth) and calculate the amount of votes for each country. A country with prudent fiscal policy means - low inflation, low debt and deficit- gets more votes than a country with bad fiscal policy. This mechanism induce tow advantages: First it avoids policy dealing about votes. Second it generates an intrinsically incentive through a market mechanism to more prudent and sustainable policy. Therefore, the Ecofin council and the national member states keeps her entire sovereignty, as long as they trade in compliance with the Pact thresholds. The cost of breaching the pact are also very high but without aggravation of the economic situation and with the advantage to make more credible and accountable decisions. This imply in that

¹⁷Moreover positive incentives (in my case, cuts) discipline fiscal policy more than monetary fees, because payments are arbitrary and recent empirical work confirms that supply-side consolidation (cuts) are stronger than demand-side effects like tax increases.

circumstances a more fitting opponent to the ECB and do not worsen national financial bankruptcy.

Since 10 years, monetary theory is analyzed in economic literature we have not learned to transfer it to other topics. Now we should transfer such results also to fiscal policy (cf. Wypolsz, 2003) in Europe.

7 Conclusion

I would like to conclude with some implications of my results for the design of institutions and mechanisms in the EMU and suggestions for future research.

A rethinking of the fiscal-monetary framework for the EMU is necessary and urgent. Revising the Stability and Growth Pact will not be easy, because we have a heterogenous target set of a 'magic Polyeder'. The analysis of 'Sustainability' in the European fiscal framework shows that this term seems very important in the environment where strong interdependence exists like the fiscal-monetary interaction framework, since 1999. This approach is certainly only a first step to an implementation theory that explains sufficient ingredients for efficient coordination mechanisms. For further success of the EMU and the 'Euro' it is necessary to find some other institutions and mechanisms than the SGP in the 'European economic union'.¹⁸ This seems an important topic for future research. Additionally the results and the development of public debt in reality (France, Germany, Portugal) show us, how urgent further research on this topic is.

The definition of fiscal architecture of EMU is still in progress. Many aspects and problems will be clarified merely as time goes by. Identifying key issues and relevant trade-offs is essential for designing appropriate policy responses at the EMU and at the national level. But after Februar 2002 the story of the early warning against Germany and after November 2003 the decision against imposing stronger sanctions; everybody knows someone goes wrong with the European fiscal framework especially with the SGP. Now it is time to look for an appropriate 'SUSTAINABLE' fiscal framework which cure the main problems and drawbacks particularly the current rules of the 'STABILITY AND GROWTH PACT'.

¹⁸The importance of good fiscal policy coordination in monetary unions is also obviously shown in historical monetary unions in Europe -Scandinavian and Latin coin unions- and current monetary unions in Africa.

8 Appendix

A Definition of Sustainability: Model Approach

Now we are ready to define the problem formally:

$$\max_u \int_0^{\infty} \ln[u(t)]e^{-\delta t} dt \quad (\text{A.1})$$

$$s.t. \quad \dot{d} = r * d \left(1 - \frac{d}{k}\right) - u \quad r > 0, k > 0 \quad (\text{A.2})$$

$$d_{t=0} = d_0 \quad (\text{A.3})$$

The parameter 'r' can interpreted as debt growth, 'k' represent the whole financial budget revenues (on GDP) and 'δ' is a discount rate. Additionally I assume that $r > \delta > 0$ which is normal for that problems. The functional form of the budget constraint (2) is the typical modelling approach in resource economics.¹⁹ Moreover I transfer the 'Maximum Sustainable Yield' (MSY) concept here for debt $d^* < d_{MSY} = k/2$. To solve this problem I use a 'Hamilton function'. From optimal control theory -a first-order necessary condition- is known as the *maximum principle* or *pontryagin principle*. Denoted by H, the Hamiltonian is defined as

$$\tilde{H} = \ln[u] + \lambda(t) \left[rd \left(1 - \frac{d}{k}\right) - u \right] \quad (\text{A.4})$$

For the problem 1 and with the Hamiltonian defined $\tilde{H} = He^{rt}$ in (4) the maximum principle conditions are

$$\frac{\partial \tilde{H}}{\partial u} = \frac{1}{u} - \lambda = 0 \quad (\text{A.5})$$

$$\dot{\lambda} - \delta\lambda = -\frac{\partial \tilde{H}}{\partial d} = -\lambda r \left[1 - \frac{2d}{k}\right] \quad (\text{A.6})$$

$$\dot{d} = \frac{\partial \tilde{H}}{\partial \lambda} = rd \left(1 - \frac{d}{k}\right) - u \quad (\text{A.7})$$

First, after the derivation of the first-order condition equation () yields:

$$\dot{\mu} = -\frac{1}{u^2}\dot{u}, \quad (\text{A.8})$$

this in connection with the second first-order condition is:

$$\dot{\mu} = \delta\mu - \mu r \left[1 - \frac{2d}{k}\right] = -\frac{1}{u^2}\dot{u}. \quad (\text{A.9})$$

Isolation \dot{u} yields the condition below.

¹⁹ $F(d) = rd \left(1 - \frac{d}{k}\right)$.

$$\dot{d} = rd\left(1 - \frac{d}{k}\right) - u \quad (\text{A.10})$$

$$\dot{u} = -u\left(\delta - r\left[1 - \frac{2d}{k}\right]\right) \quad (\text{A.11})$$

The solution of this differential equation system result in the optimal debt path d^* and the optimal consolidation path u^* . The results are ($\dot{u} = \dot{d} = 0$):

$$d^* = \frac{k(r - \delta)}{2r} \quad (\text{A.12})$$

$$u^* = \frac{k}{2}(r^2 - \delta^2) \quad (\text{A.13})$$

Because of the transversality condition (TC) $\lim_{t \rightarrow \infty} \lambda(t) \rightarrow 0$ I can proof that the path are stable with an unique equilibrium. Because: $\tilde{H} = He^{rt} \Rightarrow H = e^{-rt} \ln(u) + \lambda[rd(1 - \frac{d}{k}) - u] \rightarrow 0$, because of the TC.

B Derivation of the CCB function

The general CCB function is

$$U_{CCB} = \lambda\left(-\frac{\pi^2}{2\phi}\right) + (1 - \lambda)\frac{1}{n} \sum_{i=1}^n \left[1 - (1 + \pi^e - \pi)b_{1i} - \psi(d_{2i} - \bar{d}_{2i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{2j} - \bar{d}_{2j})\right] \quad (\text{B.1})$$

The following transformation yields,

$$U_{CCB} = (1 - \lambda)\left(\frac{-\pi^2}{2\phi\frac{(1-\lambda)}{\lambda}}\right) + \frac{1}{n} \sum_{i=1}^n \left[1 - (1 + \pi^e - \pi)b_{1i} - \psi(d_{2i} - \bar{d}_{2i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{2j} - \bar{d}_{2j})\right] \quad (\text{B.2})$$

Making the sum explicit and with $\alpha := \frac{\phi(1-\lambda)}{\lambda} \geq 0$ result in:

$$U_{CCB} = (1 - \lambda)\left(-\frac{\pi^2}{2\alpha}\right) + \left[1 - (1 + \pi^e - \pi)\tilde{b}_{1i}\right] + \frac{1}{n} \sum_{i=1}^n \left[-\psi(d_{2i} - \bar{d}_{2i}) + \frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{2j} - \bar{d}_{2j})\right] \quad (\text{B.3})$$

and then

$$U_{CCB} = (1 - \lambda)\left(-\frac{\pi^2}{2\alpha}\right) + \left[1 - (1 + \pi^e - \pi)\tilde{b}_{1i}\right] + \left(\left[-\psi(d_{2i}^a - \bar{d}_{2i}^a) - \frac{\psi}{n-1}(d_{2i}^a - \bar{d}_{2i}^a)\right] + \frac{1}{n} \sum_{i=1}^n \left[\frac{\psi}{n-1} \sum_{j=1, j \neq i}^n (d_{2j} - \bar{d}_{2j})\right]\right) \quad (\text{B.4})$$

and this yield

$$U_{CCB} = (1 - \lambda) \left(-\frac{\pi^2}{2\alpha} \right) + \left[1 - (1 + \pi^e - \pi) \tilde{b}_{1i} \right] + \left(\left[-\frac{n\psi}{n-1} (d_{2i}^a - \bar{d}_{2i}^a) \right] + \frac{1}{n} \sum_{i=1}^n \left[\frac{n\psi}{n-1} (d_{2j}^a - \bar{d}_{2j}^a) \right] \right) \quad (\text{B.5})$$

Now it is trivial to see that the last term is zero and only the first term stay. So it result the final form:

$$U_{CCB} = -\frac{\pi^2}{2\alpha} + 1 - (1 + \pi^e - \pi) \tilde{b}_1, \quad \alpha := \frac{(1-\lambda)\phi}{\lambda} \geq 0. (\text{B.6})$$

C Solution of the Nash equilibrium

Applying the specifications above the first-order conditions () and () become, respectively,

$$(e_i - \frac{k}{2}) = [1 + \psi(1 - \delta)](\xi - (\xi - 1)E[f_1 i]), \quad \forall i \quad (\text{C.1})$$

and

$$(1 - p)\xi - (\xi - 1)E[f_{i,t}] = -p(\xi - 1)E[f_{2,t}] + \underbrace{\mu}_{:= \frac{\alpha^2}{\phi n(1-\psi)}} E[\tilde{b}], \quad \forall i \quad (\text{C.2})$$

I consider a Bayesian Nash equilibrium in which each government's strategy will be a function of ϵ_i . In general is the solution also a function of its estimates about the other countries shocks and preferences, and estimates about other governments estimates about $\epsilon_j \forall j$. But to solve this n-player game in that general fashion would become intractable. So I following also the approach from 'Beetsma and Jensen (2003) that the governments strategy depends only on the realization of ϵ_i , but not on the other shocks.

Therefore I assume the following set of equilibrium strategies:

$$b_{1i} = B - B_\epsilon \epsilon_i \quad (\text{C.3})$$

$$e_i = D - D_\epsilon \epsilon_i. \quad (\text{C.4})$$

The equal set for the cross-country average debt and consolidation effort will be given by,

$$\tilde{b}_1 = B - B_\epsilon \tilde{\epsilon}_i \quad (\text{C.5})$$

$$\tilde{\epsilon}_i = D - D_\epsilon \tilde{\epsilon}_i. \quad (\text{C.6})$$

After subside the four strategies in the equation (24), the realizations of public consumption are:

$$\begin{aligned}
f_{1i} = & 1 + \tilde{\epsilon} + (D - D_\epsilon \epsilon_i) + 2(D - D_\epsilon \tilde{\epsilon}_i + (B - B_\epsilon \tilde{\epsilon}_i) \\
& + \left(\frac{n}{n-1} \psi - 1 \right) \left[[B_\epsilon \epsilon_i - B_\epsilon \tilde{\epsilon}] + [D_\epsilon \epsilon_i - D_\epsilon \tilde{\epsilon}] \right] \\
& + \left(\frac{n}{n-1} \psi \delta - 1 \right) \left[(\tilde{\epsilon} - \epsilon_i) + [D_\epsilon \epsilon_i - D_\epsilon \tilde{\epsilon}] \right] \quad (C.7)
\end{aligned}$$

Similar for f_{2i} yields:

$$f_{2i} = 1 - (B - B_\epsilon \tilde{\epsilon} - \left(1 - \frac{n}{n-1} \psi \right) (B_\epsilon \tilde{\epsilon} - B_\epsilon \epsilon_i)) \quad (C.8)$$

In the next step I calculate the expectations of (C.7) and (C.9). I need these expressions to solve the strategies above for its coefficients. From (C.7) follows:

$$\begin{aligned}
E[f_{1i}] = & 1 + \frac{1 - 2D_\epsilon - B_\epsilon}{n} \epsilon_i + D - D_\epsilon \epsilon_i + 2D + \left(\frac{n}{n-1} \psi - 1 \right) \left(\left[\frac{n-1}{n} \right] B_\epsilon \epsilon_i + \right. \\
& \left. \left[\frac{n-1}{n} \right] D_\epsilon \epsilon_i + \left(\frac{n}{n-1} \psi \delta - 1 \right) \left(\left[\frac{n-1}{n} \right] D_\epsilon \epsilon_i - \left[\frac{n-1}{n} \right] \epsilon_i \right) \right) \quad (C.9)
\end{aligned}$$

and thus after some calculation

$$E[f_{1i}] = 1 + 3D + B + [(1 - \psi \delta) - (1 - \psi) B_\epsilon - [2 - \psi(1 + \delta)] D_\epsilon] \epsilon_i. \quad (C.10)$$

Similarly, from equation (C.8) I calculate:

$$E[f_{2i}] = 1 - B + \frac{n-1}{n} \epsilon_i + \frac{1}{n} B_\epsilon \epsilon_i - \left(\frac{n}{n-1} \psi - 1 \right) \left(\frac{n-1}{n} B_\epsilon \epsilon_i + \frac{n-1}{n} D_\epsilon \epsilon_i \right) \quad (C.11)$$

and thus some calculation,

$$E[f_{2i}] = 1 - B + (1 - \psi) B_\epsilon \epsilon_i \quad (C.12)$$

Finally, I need the government's expectation of average debt. From (C.5) I find:

$$E[\tilde{b}] = B - B_\epsilon \frac{1}{n} \epsilon_i. \quad (C.13)$$

C.1 Explicit first-order conditions

Now insert the expressions for $E[f_{1i}]$, $E[f_{2i}]$ and $E[\tilde{b}]$ into the first-order conditions (C.1) and (C.2). This yields:

$$\begin{aligned}
(1-p)\xi - (\xi-1)\left(1 + 3D + B + [(1-\psi\delta) - (1-\psi)B_\epsilon - [2-\psi(1+\delta)]D_\epsilon]\epsilon_i\right) = \\
= -p(\xi-1)\left(1 - B + (1-\psi)B_\epsilon\right) + \mu\left(B - B_\epsilon\frac{1}{n}\epsilon_i\right) \quad (\text{C.14})
\end{aligned}$$

and

$$\begin{aligned}
D - D_\epsilon\epsilon_i - \frac{k}{2} = \xi[1 + \psi(1-\delta)] - [1 + \psi(1-\delta)](\xi-1)* \\
* \left(1 + 3D + B + [(1-\psi\delta) - (1-\psi)B_\epsilon - [2-\psi(1+\delta)]D_\epsilon]\epsilon_i\right) \quad (\text{C.15})
\end{aligned}$$

C.2 Step 1: Solution for shock coefficients

When (C.15) and (C.16) must hold of all values ϵ_i , we have that the following must hold:

$$-(\xi-1)\left((1-\psi\delta) - (1-\psi)B_\epsilon - [2-\psi(1+\delta)]D_\epsilon\right) = -p(\xi-1)[(1-\psi)B_\epsilon - \mu B_\epsilon\frac{1}{n}] \quad (\text{C.16})$$

$$D_\epsilon = [1 + \psi(1-\delta)](\xi-1)\left((1-\psi\delta) - (1-\psi)B_\epsilon - [2-\psi(1+\delta)]D_\epsilon\right) \quad (\text{C.17})$$

Now change (C.17) so that:

$$\frac{D_\epsilon}{(\xi-1)(1+\psi-\psi\delta)} = \left((1-\psi\delta) - (1-\psi)B_\epsilon - [2-\psi(1+\delta)]D_\epsilon\right) \quad (\text{C.18})$$

From substitution (C.18) in (C.16) results:

$$-\frac{D_\epsilon}{(1+\psi-\psi\delta)} = B_\epsilon[-p(\xi-1)(1-\psi) - \frac{\mu}{n}] \quad (\text{C.19})$$

$$D_\epsilon = B_\epsilon(1+\psi-\psi\delta)[p(\xi-1)(1-\psi) + \frac{\mu}{n}] \quad (\text{C.20})$$

Notice that up to now I define $\Theta := (1+\psi-\psi\delta)[p(\xi-1)(1-\psi) + \frac{\mu}{n}]$. This is only to simplify the following calculation. Next I substitute (C.19) back in (C.16). That yields,

$$-(\xi-1)(1-\psi\delta) + (\xi-1)(1-\psi)B_\epsilon + (\xi-1)[2-\psi(1+\delta)]\Theta B_\epsilon = -B_\epsilon[p(\xi-1)(1-\psi) + \frac{\mu}{n}], \quad (\text{C.21})$$

isolating this term to B_ϵ is:

$$B_\epsilon = \frac{(\xi-1)(1-\psi\delta)}{(\xi-1)(1-\psi) + (\xi-1)[2-\psi(1+\delta)]\Theta + [p(\xi-1)(1-\psi) + \frac{\mu}{n}]} > 0. \quad (\text{C.22})$$

Combined with (C.), I the recover the expression for D_ϵ :

$$D_\epsilon = \frac{(\xi-1)(1-\psi\delta) * (1+\psi-\psi\delta)[p(\xi-1)(1-\psi) + \frac{\mu}{n}]}{(\xi-1)(1-\psi) + (\xi-1)[2-\psi(1+\delta)]\Theta + [p(\xi-1)(1-\psi) + \frac{\mu}{n}]} > 0. \quad (\text{C.23})$$

C.3 Step 2: Solution for average consolidation and debt

Now with B_ϵ and D_ϵ given by (C.22) and (23), respectively, (C.15) and (C.17) reduce to

$$(1-p)\xi - (\xi-1)\left(1+3D+B\right) = -p(\xi-1)(1-B) + \mu B \quad (\text{C.24})$$

and

$$D - \frac{k}{2} = \xi[1 + \psi(1-\delta)] - [1 + \psi(1-\delta)](\xi-1) * \left(1+3D+B\right) \quad (\text{C.25})$$

From this two conditions above I compute the solution for B and D. Thus it follows from (C.24),

$$D\left[1+3(\xi-1)[1+\psi-\psi\delta]\right] = \frac{k}{2} + \xi[1+\psi-\psi\delta] - (\xi-1)[1+\psi-\psi\delta](1+B), \quad (\text{C.26})$$

isolating now this term to 'D' result in:

$$D = \frac{\frac{k}{2} + [1 + \psi - \psi\delta](1+B)}{1 + 3(\xi-1)[1 + \psi - \psi\delta]}. \quad (\text{C.27})$$

The sign from D depends crucial from the sign of 'B' which is no calculated. But before I define $X := 1 + 3(\xi-1)[1 + \psi - \psi\delta] > 0$ for simplifying the further calculation. From backward substitution of D from (C.27) into (C.24) identify 'B':

$$(1-p)\xi - (\xi-1)\left(1 + 3\frac{k}{2X} + 3\frac{[1 + \psi - \psi\delta]}{X}(1+B) + B\right) = -p(\xi-1) + B[p(\xi-1) + \mu]. \quad (\text{C.28})$$

Isolating the B part gives:

$$B\left[\mu + p(\xi-1) + (\xi-1) + 3(\xi-1)\frac{[1 + \psi - \psi\delta]}{X}\right] = (1-p)\xi - (\xi-1)\left(1 + 3\frac{1}{X}\left[\frac{k}{2} + [1 + \psi - \psi\delta]\right]\right) + p(\xi-1) \quad (\text{C.29})$$

and thereby

$$B = \frac{(1-p)\xi - (\xi-1)\left(1 + 3\frac{1}{X}\left[\frac{k}{2} + [1 + \psi - \psi\delta]\right]\right) + p(\xi-1)}{\left[\mu + p(\xi-1) + (\xi-1) + 3(\xi-1)\frac{[1 + \psi - \psi\delta]}{X}\right]} \quad (\text{C.30})$$

Inserting this value of B back into (C.27) then provides the solution for D:

$$D = \frac{\frac{k}{2} + [1 + \psi - \psi\delta]\left(1 + \frac{(1-p)\xi - (\xi-1)\left(1 + 3\frac{1}{X}\left[\frac{k}{2} + [1 + \psi - \psi\delta]\right]\right) + p(\xi-1)}{\left[\mu + p(\xi-1) + (\xi-1) + 3(\xi-1)\frac{[1 + \psi - \psi\delta]}{X}\right]}\right)}{1 + 3(\xi-1)[1 + \psi - \psi\delta]}. \quad (\text{C.31})$$

Finally using (C.), (C.), (C.) and (C.), I obtain

$$f_{i1} = 1 + \tilde{\epsilon} + e_i + 2\tilde{e} + \tilde{b} + \left(\frac{n}{n-1}\psi - 1\right)\left[B_\epsilon(\epsilon_i - \tilde{\epsilon}) + D_\epsilon(\epsilon_i - \tilde{\epsilon})\right] + \left(\frac{n}{n-1}\psi\delta - 1\right)\left[(D_\epsilon - 1)(\epsilon_i - \tilde{\epsilon})\right] \quad (\text{C.32})$$

$$f_{i1} = 1 + \tilde{\epsilon} + e_i + 2\tilde{e} + \tilde{b} + F_{1\epsilon}(\epsilon_i - \tilde{\epsilon}) \quad (\text{C.33})$$

with $F_{i\epsilon} = \left(\frac{n}{n-1}\psi - 1\right) \left[B_\epsilon + D_\epsilon\right] + \left(\frac{n}{n-1}\psi\delta - 1\right) \left[(D_\epsilon - 1)\right] \geq 0$ and similar for $'f'_{i2}$

$$f_{2i} = 1 - \tilde{b}_1 - \left(1 - \frac{n}{n-1}\psi\right) [-B_\epsilon(\epsilon_i - \tilde{\epsilon})] \quad (\text{C.34})$$

$$f_{2i} = 1 - \tilde{b}_1 + F_{2\epsilon}(\epsilon_i - \tilde{\epsilon}) \quad (\text{C.35})$$

with $F_{2\epsilon} = \left(1 - \frac{n}{n-1}\psi\right) [B_\epsilon]$. Notice that it is trivial seen, if $(\psi, \delta) = \left(\frac{n}{n-1}, 1\right)$, then $F_{1\epsilon} = F_{2\epsilon} = 0$.

C.4 Derivation of the results

(a) Simple derivation of $'B_\epsilon'$ and $'D'$ shows the result. First look at the term $'B_\epsilon'$:

$$B_\epsilon = \frac{(\xi - 1)(1 - \psi\delta)}{(\xi - 1)(1 - \psi) + (\xi - 1)[2 - \psi(1 + \delta)]\Theta + [p(\xi - 1)(1 - \psi) + \frac{\mu}{n}]} \quad (\text{C.36})$$

The sign of the derivation of $'B_\epsilon'$ depends only from the numerator because the denominator is always positive in a quadratic form. The symbol \times indicate that the right-hand side has the same sign as the left hand side. Thus I analyze now only the numerator of the derivation.:

$$\frac{\partial B_\epsilon}{\partial \delta} \times -\psi(\xi - 1)(\xi - 1)(1 - \psi) + (\xi - 1)[2 - \psi(1 + \delta)]\Theta + [p(\xi - 1)(1 - \psi) + \frac{\mu}{n}] - (\xi - 1)(1 - \psi\delta)(-\psi(\xi - 1))\Theta \quad (\text{C.37})$$

$$= \Theta(\xi - 1)(1 - \psi\delta) - [(\xi - 1)(1 - \psi) + (\xi - 1)[(1 - \psi\delta) + (1 - \psi)] + p(\xi - 1)(1 - \psi) + \frac{\mu}{n}] \quad (\text{C.38})$$

$$= (\Theta - 1)(\xi - 1)(1 - \psi\delta) - 2(\xi - 1)(1 - \psi) - p(\xi - 1)(1 - \psi) - \frac{\mu}{n} < 0 \quad (\text{C.39})$$

because we know that $1 > \Theta > 0$. Now the same procedure for $'D_\epsilon'$. From (C.) follows immediately,

$$\frac{\partial D_\epsilon}{\partial \delta} \times \frac{\partial B_\epsilon}{\partial \delta} \Theta + B_\epsilon(-\psi)[p(\xi - 1)(1 - \psi) + \frac{\mu}{n}] < 0 \quad (\text{C.40})$$

(b) In that result I find out what are the effect of a change by the 'MSY' values. Furthermore I take the derivative from 'D' (C.) and 'B' (C.) to 'k'. The results are:

$$\frac{\partial D}{\partial k} = \frac{\frac{1}{2}}{\left[(\xi - 1)(1 - \psi) + (\xi - 1)[2 - \psi(1 + \delta)]\Theta + [p(\xi - 1)(1 - \psi) + \frac{\mu}{n}]\right]^2} > 0 \quad (\text{C.41})$$

$$\frac{\partial B}{\partial k} = \frac{-3(\xi - 1)\frac{1}{2X} \left((\xi - 1)(1 - \psi) + (\xi - 1)[2 - \psi(1 + \delta)]\Theta + [p(\xi - 1)(1 - \psi) + \frac{\mu}{n}] \right)}{\left((\xi - 1)(1 - \psi) + (\xi - 1)[2 - \psi(1 + \delta)]\Theta + [p(\xi - 1)(1 - \psi) + \frac{\mu}{n}] \right)^2} < 0 \quad (\text{C.42})$$

D Proposition 6

Government *i*'s equilibrium expected utility as a function of the stability pact parameters is given by:

$$V_{Fi}(\psi, \delta) \equiv E \left[-\frac{1}{2}(e_i - k)^2 + u(f_{1i}) + pu(f_{2i}) - \frac{(\alpha \tilde{b}_1)^2}{2\psi} \right] \quad (\text{D.43})$$

where u is defined by (28) and f_{1i} , f_{2i} are understood to be evaluated for the equilibrium outcomes. Differentiating $V_{Fi}(\psi, \delta)$ with respect to 'k' yields:

$$\frac{\partial V_{Fi}(\psi, \delta)}{\partial \delta} = E \left[\frac{1}{2}(e_i - \frac{k}{2}) \frac{\partial D}{\partial k} + u'(f_{1i}) \left[3 \frac{\partial D}{\partial k} + \frac{\partial B}{\partial k} \right] + pu'(f_{2i}) \left[-\frac{\partial B}{\partial k} \right] - \frac{\alpha^2}{\phi} \tilde{b}_1 \frac{\partial B}{\partial k} \right] \quad (\text{D.44})$$

the sign is exact then negativ if we assume $e_i = \frac{k}{2}$. That imply that if the consolidation effort is equal the MSY level then a greater threshold value 'k' induce welfare gains. But I define a sustainable equilibrium so that $e_i < \frac{k}{2}$. In that condition is the sign indefinite (positive or negative). It depends crucial from 'p' the re-election probability and the debt stock 'b'.

E Extended solution of the Nash equilibrium

$$f_{1i} = 1 + \tilde{\epsilon} + e_i + 2\tilde{e} + \tilde{b} + \left(\frac{n}{n-1} \psi - 1 \right) [(\tilde{b} - b_{i,1}) + (\tilde{e} - e_i)] + \left(\frac{n}{n-1} \psi \delta - 1 \right) [(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)] \quad (\text{E.1})$$

$$f_{2i} = 1 + e_i - \tilde{e} - \tilde{b} - \left(\frac{n}{n-1} \psi - 1 \right) [(\tilde{b} - b_{i,1}) + (\tilde{e} - e_i)] \quad (\text{E.2})$$

From the few new assumptions above the model framework, these two time-constraints are very different to Beetsma and Jensen (2003).

E.1 Model solution

The optimal behavior of the government of country *i*, in terms of the choice of effort and debt issuance, is characterized by the following necessary and sufficient first-order conditions:

$$\begin{aligned} \frac{\partial U_F}{\partial e_i} = 0 &\iff s'(e_i) = E[u'(f_{1i})[1 + \psi(1 - \delta)] + pu'(f_{2i})[\psi]] \\ &\iff s'(e_i) = [1 + \psi(1 - \delta)]E[u'(f_{1i})] + p\psi E[u'(f_{2i})], \quad \forall i \end{aligned} \quad (\text{E.3})$$

$$\begin{aligned}\frac{\partial U_F}{\partial b_i} = 0 &\iff 0 = E[u'(f_{1i})[1 - \psi] + pE[u'(f_{2i})](-(1 - \psi))] - E\left[\frac{\alpha^2}{\phi}\tilde{b}_1\right] \\ &\iff E[u'(f_{1i})[1 - \psi] = pE[u'(f_{2i})](1 - \psi) + E\left[\frac{\alpha^2}{\phi}\tilde{b}_1\right], \quad \forall i\end{aligned}\quad (\text{E.4})$$

While condition (27) correspond to that in the basic model, condition (26) which guides the optimal consolidation effort level, already hints the new effect. It equates the government's marginal cost of consolidation through effort to the expected marginal gain from period one and two (in terms a lower debt level close to the equilibrium MSY values). The stronger is the response of the reference debt level ($\delta \uparrow$) to the observed state of the economy and the weaker is the 'excessive deficit procedure' ($\psi \downarrow$) and the re-election probability ($p \downarrow$), the smaller is this expected marginal gain. These reactions are crucial new findings for 'sustainable debt policy' within the Stability and Growth Pact'.²⁰

F Stylized policy-model with Sustainability

The governments objective is to reach a sustainable debt level x^* that stabilize the debt-to-GDP ratio. I use the following loss function similar to Drazen and Masso (1994)²¹

$$L = p\Lambda + \frac{1}{2}(T)^2 \quad (\text{F.1})$$

where p denotes the probability that the sustainable stabilization fails, and Λ is the fixed cost of failure. The probability that the consolidation fails is

$$p = \text{prob}[Z > T - G - X], \quad (\text{F.2})$$

where G denotes government spending and X the consolidation effort which depends on the revenue and output in each period. The distribution of the shock Z is triangular with mean zero, $E_1 Z = 0$, and a support ranging between $-a$ and a . The consolidation effort is equal to

$$X = (1 - \psi)Y + (\psi)[E_0[Y] + p\Gamma^S] \quad (\text{F.3})$$

where ψ is the share of consolidation in period two, Y is the output and $E_0 Y$ respectively the expected output and p is the probability to breach the deficit threshold from the Stability and Growth Pact Γ^S . A tough government has a level of spending, G^L , lower than the level of spending, G^H , of a weak government. This result in

$$Y = Y(G^i) + \mu \quad i = H, L, \quad (\text{F.4})$$

where $Y(G) \geq 0$ and an independent shock μ , distributed on the compact support $[\mu^l; \mu^h]$, with mean $E_0 \mu$ and variance $E_0 \mu^2 = \sigma^2$.

Substitution $X + G - T$ into the value of p , and replacing p in equation (F.1), I obtain the loss function:

²⁰Cf. This result show that the re-election probability is very important. A reform proposal which define a debt level per law for all different Government is from that perspective desirable but not real implementable because a new government implement their own consolidation level.

²¹cf. Dornbusch, 1991

$$L = \frac{\Lambda}{2a^2}[a + G + X - T]^2 + \frac{1}{2}(T)^2. \quad (\text{F.5})$$

Then, the optimal value of taxes is equal to $T^* = \zeta[a + G + X]$ where $\zeta = \Lambda/(a^2 + \Lambda)$. Substituting T^* into equation (39), yields

$$L = \frac{\Lambda^2}{2a^2} \left((1 - \zeta)(a + G + X) \right)^2 + \frac{1}{2}(\zeta[a + G + X])^2 \quad (\text{F.6})$$

$$L = \underbrace{\left[\frac{\Lambda}{a^2 + \Lambda^2} \right]}_{=:\zeta} * \left(\frac{a^2}{a^2 + \Lambda} \right) + \zeta^2 \left] \frac{1}{2}(a + G + X)^2 \quad (\text{F.7})$$

this is now

$$E_0 L^* = E_0 \left(\frac{\zeta}{2} \right) [a + G + X]^2 = E_0 \left(\frac{\zeta}{2} \right) [a + G + ((1 - \psi)Y + (\psi)[E_0[Y] + p\Gamma^S])]^2 \quad (\text{F.8})$$

The loss function (40) is minimized choosing $\psi = 1$, or respectively setting $x^* = -a - G$. The last solution imply that sustainable debt policy is $x^* < 0$ and depends from government spending and a shock.

Consider a class of *separating equilibrium*. The weak government compare

$$E_0 L^W(W, \psi = 1) \leq E_0 L^W(T, \psi \leq \psi^S), \quad (\text{F.9})$$

that inequality is equivalent to

$$E_0 [X - Y(G^H) + Y(G^H)]^2 \leq E_0 [X - \psi Y(G^H) + (1 - \psi)\mu + \psi Y(G^L)]^2 \quad (\text{F.10})$$

\iff

$$0 \leq \psi^2(\lambda^2 + \sigma^2) - 2(\alpha\lambda + \sigma^2)\psi + \sigma^2. \quad (\text{F.11})$$

The 'only' solution is now:

$$\psi \leq \psi^S = \frac{\sigma^2 + \lambda\alpha - \sqrt{\lambda^2\alpha^2 + \sigma^2\lambda(2\alpha - \lambda)}}{\sigma^2 + \alpha^2} \quad (\text{F.12})$$

where $\alpha := a + G^H + Y(G^H)$, $\lambda := Y(G^H) - Y(G^L)$. A separating equilibrium of the tough government thus exists if and only if the *though* government is willing to slow the consolidation down to ψ^S . This happens if,

$$E_0 L^T(T, \psi^S) \leq E_0 L^T(W, \psi^S < \bar{\psi} \leq 1), \quad (\text{F.13})$$

$$E_0 [a + G^L + (1 - \psi^S)Y + \psi^S E_0 Y]^2 \leq E_0 [z + \bar{\psi}\lambda + (1 - \bar{\psi})u]^2 \quad (\text{F.14})$$

$$E_0 [z + (1 - \psi^S)u]^2 \leq E_0 [z + \bar{\psi}\lambda + (1 - \bar{\psi})u]^2 \quad (\text{F.15})$$

and thus the incentive compatibility constraint is satisfied if

$$(1 - \lambda^S)^2 \sigma^2 \leq (1 - \bar{\psi})^2 \sigma^2 + \bar{\psi}^2 \lambda^2 + 2\bar{\psi}\beta\lambda, \quad (\text{F.16})$$

where $\beta := a + G^L + Y(G^L)$. The necessary condition for equation (44) depends also crucially of σ^2 and λ .

In a *pooling equilibrium* both governments choose the same consolidation, i.e. the forward output rate, is equal to

$$E_0 Y = [Y(G^L) + (1 - q)\lambda] \quad (\text{F.17})$$

where q , the probability that the government is tough, depends on the beliefs of the other governments in the monetary union. A pooling equilibrium exists if and only if ψ^P satisfied the incentive compatibility constraint of the weak government, $E_0 L^W(\text{Pool}, \psi^S) \leq E_0 L^W(W, \psi = 1)$. This requires

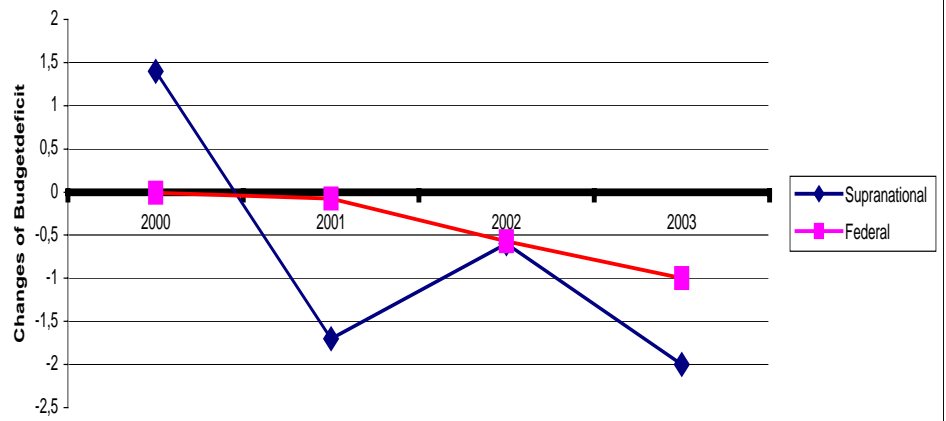
$$\psi^P = \frac{\sigma^2 - (1 - q)\lambda\beta}{\sigma^2 + (1 - q)^2 \lambda^2} \geq \psi^W := \frac{\sigma^2 + \lambda\alpha q - \sqrt{\lambda^2 q^2 \alpha^2 + \sigma^2 \lambda q (2\alpha - \lambda q)}}{\sigma^2 + \lambda^2 q^2}. \quad (\text{F.18})$$

Calculation is similar to the separating equilibrium.

G Comparing fiscal-monetary incentive schemas

An interesting finding is that since the convergence period 1994-1998 all countries in Europe consolidate the budget. After the 'Euro' introduction in 1999 nearly all countries pass the consolidation path from the convergence period. This is shown by the 'Supranational' curve of budget changes from 1999-2003. This diagram shows that fiscal discipline at the supranational level works not very well through the 'SGP'. The other curve presents the budget development of the federal regions in Germany. In these regions works a so-called 'National Stability Pact', with positive incentives as described above. A similar 'National Stability Pact' exists for example in Austria. The main differences between the both institutional coordination mechanisms are the incentive schemas. The 'National Stability Pact' works with positive incentives and the 'Supranational Pact' with negative sanctions. Two findings are now seen from the following figure: First: the 'National Pact' works not asymmetrical in good times as the SGP. Second: the 'National Pact' disciplining more in bad times, since 2001. These two effects are also important for a more efficient incentive mechanism like the SGP in Europe. Obviously, since 2001 works the national Pact better than the big brother on the supranational level, although Germany breaches the SGP three-times.

Aggregated Changes of the Budgetdeficit: A Comparison between 'Supranational-National' (EU-Germany)



Source: Eurostat and Destatis

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