Risk Sharing and Moral Hazard with a Stability Pact*

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Abstract

We show how a stability pact based on deficit sanctions eliminates the exacerbation of debt accumulation that may arise from monetary unification. Moreover, by making sanctions contingent upon the economic situation of countries, the stability pact provides for risk sharing. Differences in initial debt levels, however, reduce the scope for unanimous support for a pact. We introduce also endogenous "fiscal discipline" whose unobservability leads to moral hazard in its provision. If countries are ex ante identical, it is nevertheless optimal to make sanctions at least to some extent contingent on countries' economic situation. However, with cross-country differences in the costs of providing discipline, some countries may oppose such contingency.

Keywords: Stability pact; monetary union; public debt; risk sharing; fiscal discipline.

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1. Introduction

The "Stability and Growth Pact" (SGP), which was concluded at the Amsterdam Summit in June 1997, is intended to strengthen the Excessive Deficit Procedure for countries participating in the European Monetary Union (EMU). In particular, the SGP makes more precise the time schedule for the Procedure as well as the sanctions that will be imposed on countries that violate the Deficit Criterion. Under the SGP, countries that run an excessive deficit (i.e., a deficit in excess of the reference value of 3 percent of GDP), first have to make a non-interest bearing deposit. The deposit will be turned into a fine if the country persists in running excessive deficits. The smallest fine is 0.2 percent of GDP and it increases by 0.1 percent for each percentage point by which the deficit exceeds the reference value. The sanctions will be waived only under very special circumstances. This is the case if real GDP has fallen by 2 percent in a year. In the case of a fall of GDP by between 0.75 percent and 2 percent, the government has to argue that the violation of the Excessive Deficit Criterion was due to factors beyond its own control.[1]

Budgetary restrictions of the type advocated by the SGP have been criticised for, at best, being unnecessary and, at worst, being counterproductive (see Buiter et al., 1993). Some commentators argue that they are unnecessary, because capital markets can do the job of disciplining governments equally well by raising the premium on the interest to be paid on the government debt. There is indeed some evidence for the U.S. states that the risk premium on state debt is increasing in the amount of debt outstanding (see Bayoumi et al., 1995). However, whether this incentive is strong enough to deter governments, and especially myopic governments, from overborrowing is an empirical matter.[2] Restrictions are thought to be counterproductive because they tend to be particularly severe on countries whose economies are in recession. Such countries tend to run a relatively high deficit, and imposing sanctions on them for doing so would aggravate their situation.

This counterproductivity is hinted at in Beetsma and Uhlig (1999), who analyse a formal, but highly stylised, model of the SGP. In this paper, we extend this analysis into a variety of directions, paying particular attention to how to overcome the possible counterproductivity of a stability pact (a pact that may otherwise be necessary as capital markets cannot prevent overborrowing in our setup). As in Beetsma and Uhlig (1999),

[1] The Excessive Deficit Procedure and the SGP are described in more detail in, for example, Artis and Winkler (1998), Buti and Sapir (1998), Eichengreen and Wyplosz (1998) and Gros and Thygesen (1998).

[2] One may note that historical evidence on an early episode of European monetary cooperation — the gold standard up until World War I — suggests that the market-based penalty on interest rates paid by highly-indebted countries was too low: "*...it cannot be relied upon exclusively to provide borrowers with appropriate incentives*" (Flandreau et al., 1998, p. 148).

governments face re-election uncertainty and as a consequence they issue too much debt. This is because any resources left for the future may be spent by another government on public goods that are not valued by the current government. The resulting debt (or deficit) "bias" is to some extent kept in check because higher debt causes higher future inflation. However, in a monetary union the inflationary effects of a unilateral increase in public debt are only partly internalised, which exacerbates the debt bias. An appropriate stability pact can correct this additional debt bias.

In contrast to Beetsma and Uhlig (1999), in this paper the sanctions for running a too loose budgetary policy are made dependent upon the current economic situation of a country. This helps to overcome the problem that a stability pact aggravates the situation of a country that is already in a precarious situation because it has been hit by a bad economic shock. Specifically, this is achieved by making the reference deficit levels, above which countries pay a fine, *contingent* on the economic situation. Moreover, this contingency applies not just in very special circumstances as would be the case with the actual SGP.[3] We then show that by selecting the appropriate extent to which sanctions are shock contingent, a stability pact can actually provide for perfect risk sharing of idiosyncratic economic shocks, while still deterring governments from issuing too much debt on average.

If all countries are (ex ante) identical, then their governments unanimously agree on a pact: they sign a pact that corrects the additional debt bias arising from monetary unification and that simultaneously provides for perfect risk sharing. When countries have different initial debt positions, there may be disagreement about the preferred pact. Quite paradoxically, countries with high initial debt will be more in favour of sanctions than low-debt countries. The reason is that the former group of countries is forced to run lower deficits anyway, because of the intertemporal government budget constraint.

If the economic situation of a country is also affected by the "discipline" exerted by its government, and in such a way that discipline and exogenous economic shocks are not separately observable, then contingent sanctions may lead to moral hazard. "Discipline" is a catch-all term that, for example, includes a stricter monitoring of the handing out of benefits and structural reform of the economy (deregulation, etcetera).[4] If such discipline is politically costly (e.g. because it may lead to public opposition), governments will have an incentive not to exert sufficient discipline because they know that they will, at least

[3]That these circumstances would indeed be very special is supported by the findings of Eichengreen and Wyplosz (1998). They report that for the group of OECD countries during the period 1955-96, only in *seven* instances did a country experience a fall in GDP so large that sanctions would automatically be waived.

[4]Hence, in this paper, more discipline is *not* synonymous with lower deficits (or debt), although, ceteris paribus, it will be easier to keep deficits low if discipline is high.

partly, be compensated for a bad economic situation by net transfers from abroad.[5] Hence, in raising the degree of contingency of the sanctions to the observed economic situation a trade-off is made between increased moral hazard and enhanced risk sharing.[6]

With unobservable discipline, we show that if all countries are ex ante identical, it is optimal to make sanctions at least to some extent contingent on the observed economic situation. If countries are ex ante different, then those that have the strongest proclivity towards discipline suffer most from the spillovers caused by moral hazard in other countries and they may therefore refuse to sign a stability pact with sanctions contingent on the countries' economic situations. This may explain why, in practice, the sanctions imposed under the SGP are supposed to be lifted only in very special circumstances.

The literature on the SGP, and budgetary rules in general, is growing rapidly. Agell et al. (1996) also analyse a model, different from ours, in which membership of EMU may lead to an increase in fiscal deficits. This leads them to argue in favour of restricting fiscal policy. Milesi-Ferretti (1998) analyses restrictions on deficits in a model in which governments have the possibility to hide part of their spending ("creative accounting"). Restrictions on deficits should then be even tighter in order to offset part of the effects of creative accounting. Other related work is by Chari and Kehoe (1997) who explore the need for debt restrictions in a two-country model of monetary union. Giovannetti et al. (1997) extend their model by allowing for differences in initial debt levels and, therefore, differences in the most preferred monetary policy across countries. Our model differs in a number of important respects from the models employed by Chari and Kehoe (1997) and Giovannetti et al. (1997). First, in contrast to these models, the debt (or deficit) bias in our model arises from a political distortion. Second, as in Beetsma and Uhlig (1999), the budgetary rules in our model take the form of graduated punishments rather than rigid targets or ceilings on the public debt. Finally, we allow also for stochastic shocks and for endogenous discipline to influence the effects of the shocks.

The remainder of this paper is structured as follows. Section 2 presents the basic model. In Section 3 we demonstrate how a well-designed stability pact in which sanctions are contingent on shocks can provide for risk sharing, while still being able to reduce the debt bias. Section 4 introduces unobservable discipline into the model. This unobservability gives rise to moral hazard in exerting discipline, which renders a pact with sanctions

[5] The potential for moral hazard in redistributive schemes in general has, of course, been recognised for a long time; see, e.g., van der Ploeg (1991) and Wyplosz (1991) in relation to European monetary unification. To the best of our knowledge, however, our paper is the first formal analysis of the issue in the context of a monetary union with a stability pact

[6] See Persson and Tabellini (1996) for a similar trade-off in a model with local and federal fiscal authorities, and in which insurance provided by the latter leads to "risky" actions by the former.

contingent on the observed economic situation of a country less attractive. Section 5 concludes the main body of the paper.

2. The basic model

There are two periods, 1 and 2, and $n \geq 1$ countries. National monetary policymaking corresponds to the special case of $n = 1$, while monetary union corresponds to $n > 1$. Unless explicitly stated otherwise, in the sequel we assume that $n > 1$. Under a union, monetary policy is centralised, while fiscal policy is conducted at the national level. Countries are assumed to be identical both in their economic and political structure and in their preferences. Each country has two political parties, F and G.

We follow Alesina and Tabellini (1990) in assuming that the two parties differ in terms of their preferences for the composition of public spending. In particular, party F attaches utility only to the provision of a public good called F, while party G only cares about public good G. Qualitatively speaking, this polarisation of preferences will be without any consequence for our results. However, it will ease exposition. The utilities of the parties F and G in country i are given by, respectively,

$$U_{Fi}(.) = \mathrm{E}\left[u(f_{1i}) + u(f_{2i}) - \pi^2/(2\phi)\right], \qquad (1)$$

$$U_{Gi}(.) = \mathrm{E}\left[u(g_{1i}) + u(g_{2i}) - \pi^2/(2\phi)\right], \qquad (2)$$

where $f_{ti} \geq 0$ and $g_{ti} \geq 0$, respectively, are spending on public goods F and G in period t. Parties also care about inflation, π, both when they are in and out of office. Inflation is determined in the second period (see below). Parameter $\phi > 0$ is the (inverse of) the degree of inflation aversion. Furthermore, E[.] is the expectations operator conditional on the information available at the start of the game. Function u is twice continuously differentiable with $u' > 0$ and $u'' < 0$. For convenience, we assume that $u(0) = 0$. Note that we abstract from discounting; this is without any consequences for the results.

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

$$f_{1i} + g_{1i} = 1 + \epsilon_i + b_{1i} - b_{0i} - \psi\left(d_{1i} - \bar{d}_{1i}\right) + \tfrac{\psi}{n-1}\sum_{j=1, j\neq i}^{n}\left(d_{1j} - \bar{d}_{1j}\right), \qquad (3)$$

$$f_{2i} + g_{2i} = 1 - (1 + \pi^e - \pi)b_{1i} - \psi\left(d_{2i} - \bar{d}_{2i}\right) + \tfrac{\psi}{n-1}\sum_{j=1, j\neq i}^{n}\left(d_{2j} - \bar{d}_{2j}\right). \qquad (4)$$

In each period, governments receive an exogenous endowment of 1. First-period resources, however, are hit by ϵ_i which is a mean-zero shock with bounded support $[\epsilon_L, \epsilon^U]$, $\epsilon_L < 0 < \epsilon^U$, and variance σ^2.[7] Unless explicitly stated otherwise, the shocks are assumed to be uncorrelated, i.e., $\mathrm{E}[\epsilon_i \epsilon_j] = 0$, $\forall i, j : i \neq j$. The initial amount of debt in country i is given by b_{0i}, while b_{1i} is the amount of debt outstanding at the end of period 1. We assume that

$$b_{0i} \geq 0, \quad \forall i.$$

This is the most realistic case, especially when the model is discussed in the context of EMU. We exclude the possibility of debt default and assume that at the end of period 2 all debt is paid off, i.e., $b_{2i} = 0$. All debt is single-period, nominal government debt sold on the world capital market. We assume that the ex-ante real interest rate, which is exogenously determined on the world capital market, is zero. This is without any consequences for our results. Variable π^e is the subjective, in equilibrium rational, expectation that investors in government bonds form about the union-wide inflation rate. Hence, for investors to be willing to hold government bonds, the nominal interest rate must equal π^e. The ex-post real interest rate therefore follows as $\pi^e - \pi$.[8]

The next-to-last terms are graduated fines (or rewards) associated with government deficits, $d_{ti} \equiv b_{ti} - b_{t-1,i}$, reflecting the presence of some "Excessive Deficit Procedure" whenever $\psi > 0$. In this procedure, $\bar{d}_{ti}$ serves as a reference level for country i's deficit. If $d_{ti} > \bar{d}_{ti}$, government i pays a fine $\psi(d_{ti} - \bar{d}_{ti})$ in period t. On the other hand, if $d_{ti} < \bar{d}_{ti}$, government i receives a reward equal to $-\psi(d_{ti} - \bar{d}_{ti})$. Note that, in contrast to the actual SGP, the scheme is not discontinuous but involves a constant marginal cost of deficits at all deficit levels. More importantly, and also in contrast to the actual SGP, we assume that in period 1 the reference deficit level depends on the resource shock. However, in period 2, it is constant, because there is no shock in that period:

$$\bar{d}_{1i} = \bar{d} - \delta \epsilon_i \quad \text{and} \quad \bar{d}_{2i} = \bar{d}, \tag{5}$$

where δ is what we will term the *degree of shock contingency*.[9] If $\delta > 0$, then, in response

[7] Whenever relevant, the support of ϵ_i is implicitly assumed to be sufficiently restricted that public spending cannot be negative in equilibrium.

[8] Our aim is to study the behaviour of governments when a monetary union has already been formed and assess the effects of potential differences in countries' initial conditions when the union takes off. Initial debt levels are thus taken as given. In that case, introducing inflation in the first period also does not add much in terms of new insight. First-period inflation would affect the real return on initial debt (assuming that the initial debt is nominal). Implicitly, we then assume that the investors' expectation about first-period inflation was correct when the initial stock of public debt was issued. Therefore, the realised net return on initial debt is zero.

[9] Introducing a resource shock in the second period also, and making $\bar{d}_{2i}$ contingent on this shock would

to a bad shock, i.e. $\epsilon_i < 0$, the reference deficit level $\bar{d}_{1i}$ is raised, so that for a given deficit, d_{1i}, the government pays a lower fine (or receives a larger subsidy). This captures the idea that governments in severe fiscal distress should be punished less severely for running a given deficit. Vice versa, in response to a good shock, $\epsilon_i > 0$, the reference deficit level is lowered.

The final terms on the right-hand sides of (3) and (4) are the rebates to country i of the fines paid by the other union members. The sum of the fines and the rebates over all countries is zero in each period. Note that these rebates provide countries with low deficits with an interest in the ex-post enforcement of the pact on other countries. However, many doubt that the SGP will be strictly enforced in practice (e.g., see Buiter and Sibert, 1997). Nevertheless, in what follows, we assume that the sanctions implicit in (3)-(4) are fully credible. The fact that sanctions under this scheme are gradually increasing in the size of the deficit may lend it more credibility than the actual SGP, whose discontinuous nature could lead to loss of political prestige ("stigmatisation") of those countries that are subject to sanctions and therefore to stronger political pressures for not imposing them.

A Common Central Bank (CCB) sets monetary policy for the entire union. For simplicity, we assume that the CCB controls the inflation rate directly. Under "complete independence," its objective is to maximise $-\pi^2/(2\phi)$. This would reflect the spirit of the Maastricht Treaty, which stipulates that price stability be the overriding goal for the European Central Bank (ECB). However, many commentators doubt that in practice the ECB will be as independent as it is on paper.[10] Therefore, we consider the case in which the CCB is not completely independent. The aspect of independence that has received most attention in the Maastricht Treaty is that the ECB should be insulated from pressures to bail out countries in budgetary problems. Accordingly, in our model, the degree of independence of the CCB is determined by the extent to which the CCB is able to ignore the governments' budgetary positions.[11] More specifically, the CCB attaches a relative weight $0 \leq \lambda \leq 1$ to its objective under complete independence and a relative weight $1 - \lambda$ to the average amount of resources available to the governments in period 2 (i.e., when inflation is decided). The CCB's objective function is then given by

not add much insight to the analysis. For simplicity, we therefore allow for first-period shocks only.

[10] See, for example, The Economist, January 25, 1997, mentioning "overt French efforts to set up a political council to track, or guide, the supposedly independent European (Central) bank" (p. 25).

[11] As will be clear below, our model is thus in concert with Eichengreen and Wyplosz (1998) who in relation to monetary unification in Europe state: "*The most compelling argument for the Stability Pact is as extra protection for the ECB from pressure for an inflationary debt bailout*" (p. 71).

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

$$= -\frac{\pi^2}{2\alpha} + 1 - (1+\pi^e-\pi)\,\tilde{b}_1, \tag{6}$$

where $\alpha \equiv (1-\lambda)\phi/\lambda \geq 0$, and where tildes above variables denote cross-country averages. For example, $\tilde{b}_1 \equiv \frac{1}{n}\sum_{j=1}^{n} b_{1j}$. Therefore, $\lambda = 1$ or, equivalently, $\alpha = 0$ corresponds to an extremely independent CCB which is able to commit to zero inflation, while $\lambda < 1$ or $\alpha > 0$ corresponds to a CCB which to some extent is vulnerable to political pressures from the governments of the member countries.

3. Debt policy and risk sharing through a stability pact

The timing in the model is as follows. Without any loss of generality, it is assumed that party F is in power in period 1 in each country. First, a stability pact is signed. Then, the shocks ϵ_i, $\forall i$, occur. After this, each government issues debt, b_{1i}, $\forall i$, taking as given the amounts of debt issued by the other governments, and inflation expectations are determined. At the same time, first-period fines are paid and redistributed, and first-period public spending takes place.[12] The second period starts with the election of the new government. In each country the incumbent government is assumed to be re-elected with probability $0 \leq p < 1$. Finally, the CCB selects the inflation rate, second-period fines are paid and redistributed, and second-period public spending takes place.

The equilibrium of the model is found by backwards induction. The CCB takes the expected inflation rate and the average amount of debt issued in period 1 as given and maximises (6) over π. This yields

$$\pi = \alpha\tilde{b}_1. \tag{7}$$

Hence, inflation is proportional to the average debt level in the union. Because inflation expectations — and thus the nominal interest rate — are given, then, as long as there are political pressures on the CCB (i.e., $\alpha > 0$), a higher average union debt level provides a stronger incentive for the CCB to raise the inflation rate, so as to reduce real debt-servicing costs.

Now, consider the decision problem of the first-period government, which thus is formed by party F. Because debt is selected after the shocks have materialised, but before the

[12] Whether we formulate the governments' decision problem in terms of choosing debts or deficits is irrelevant. For convenience, we stick to the former. However, whether the formulation of the *sanctions* is in terms of debts or deficits is *not* irrelevant.

uncertainty about the identity of the second-period government is resolved, the first-period government maximises:

$$u(f_{1i}) + pu(f_{2i}^r) - \pi^2/(2\phi), \tag{8}$$

where f_{1i} is the right-hand side of (3), while f_{2i}^r is defined as spending on good F if party F is re-elected. It is given by the right-hand side of (4) with the rational-expectations requirement $\pi^e = \pi$ substituted.[13] This objective function takes into account that, in any given period, all public spending will fall on the public good preferred by the party that happens to be in office in that period.

Substituting (5) and $d_{ti} \equiv b_{ti} - b_{t-1,i}$ $(t = 1, 2)$ into (3) and (4), with $\pi^e = \pi$ substituted, and rewriting yields,

$$\begin{aligned} f_{1i} &= 1 + \tilde{\epsilon} + \tilde{b}_1 - \tilde{b}_0 + \left(\tfrac{n}{n-1}\psi - 1\right)\left[\left(\tilde{b}_1 - b_{1i}\right) - \left(\tilde{b}_0 - b_{0i}\right)\right] \\ &\quad + \left(\tfrac{n}{n-1}\psi\delta - 1\right)\left(\tilde{\epsilon} - \epsilon_i\right), \qquad (9) \\ f_{2i}^r &= 1 - \tilde{b}_1 + \left(1 - \tfrac{n}{n-1}\psi\right)\left(\tilde{b}_1 - b_{1i}\right). \qquad (10) \end{aligned}$$

In the sequel, we consider only punishment schemes that imply that the effect of an increase in individual debt beyond the average debt level does not lead to a reduction in first-period spending. That is, we restrict attention to

$$0 \leq \psi \leq \tfrac{n-1}{n}. \tag{11}$$

We exclude negative values of δ, because they imply, for a given deficit, a further tightening of the sanctions in response to a bad shock. In reality, this would surely be politically unacceptable. Also, we assume that, irrespective of the value of ψ admitted by (11), the indirect effect on public spending of a change in the reference deficit level in response to a bad shock does not outweigh the direct effect of the shock. Hence, we impose the following restriction on δ:

$$0 \leq \delta \leq 1. \tag{12}$$

Now, substitute (7), (9) and (10) into (1). Each government then maximises (8) with respect to b_{1i}, taking as given all other countries' debt levels. We assume (implicitly) that the function u and the model parameters are such that governments do not have an incentive to issue more debt than they can possibly repay at the end of period 2.

[13] When they select the amount of debt they want to issue, first-period governments take into account that, in equilibrium, inflation expectations are rational and, hence, that they adjust with the amount of debt that is issued.

For example, in the absence of deficit sanctions, initial debt and stochastic shocks, a sufficient condition for this is that $u'(2) < pu'(0)$. The (necessary and sufficient) first-order conditions can then be written as

$$u'(f_{1i})(1-\psi) = pu'(f_{2i}^r)(1-\psi) + \alpha^2 \tilde{b}_1/(\phi n), \quad \forall i, \tag{13}$$

with f_{1i} and f_{2i}^r given by, respectively, (9) and (10). Condition (13) has a natural interpretation. Governments select first-period debt so as to equate the marginal gain of additional first-period public spending [the left-hand side of (13)] with the associated expected marginal cost in the second period [the right-hand side of (13)]. This marginal cost is the sum of the expected loss in terms of lower second-period public consumption and the loss from higher future inflation.

Each first-order condition (13) implicitly characterises the optimal choice of b_{1i} as a function of b_{0i}, the average debt level in the union, the *common shock component*, $\tilde{\epsilon}$, and the country's *idiosyncratic shock component*, $\tilde{\epsilon} - \epsilon_i$. Combined, these reaction functions characterise the equilibrium first-period average debt level, which inserted back into each reaction function allows us to characterise the governments' Nash equilibrium choices of b_{1i}, $\forall i$.

In the following sub-sections we examine in more detail the main features of the equilibrium implied by (13) so as to highlight the potential inefficiencies that may be corrected by an appropriate stability pact. However, first we state two lemmata that are useful for the ensuing analysis:

Lemma 1. *Suppose that an equilibrium exists. If $\psi < \frac{n-1}{n}$, the equilibrium is unique. If $\psi = \frac{n-1}{n}$ and $\epsilon_i = \tilde{\epsilon}$, $\forall i$, an infinity of equilibria exist, but public spending levels in both periods, the average debt level and, hence, expected first-period governments' utilities are the same across all these equilibria and across all countries.*
Proof. *See Appendix A.*

Lemma 2. *Let $b_{0i} = \tilde{b}_0$, $\forall i$, and $\epsilon_i = \tilde{\epsilon}$, $\forall i$. Suppose that an equilibrium exists. If $\psi < \frac{n-1}{n}$, the equilibrium is symmetric, i.e., $b_{1i} = \tilde{b}_1$, $\forall i$.*
Proof. *By Lemma 1 the equilibrium is unique. Guess that the equilibrium is symmetric and substitute $b_{1i} = \tilde{b}_1$ into (13), $\forall i$. For all i, this reduces to the same condition, which can be solved for $\tilde{b}_1$.* ■

3.1. Identical initial debt levels and identical shocks

First, we consider the situation in which countries have identical initial debt levels, i.e., $b_{0i} = \tilde{b}_0, \forall i$, and are hit by a common shock, i.e., $\epsilon_i = \tilde{\epsilon}$, $\forall i$. For the remainder of this subsection, it will prove useful first to determine the solution that would be chosen by a (constrained) planner who takes the perspective of some first-period government and chooses the optimal $b_{1i} = \tilde{b}_1, \forall i$ (we only need to consider symmetric equilibria – see below). This provides a benchmark for the case in which the governments are involved in a Nash game, subject to a stability pact, when selecting debt. A stability pact will be optimal from the perspective of a first-period government if it implies the planner's choice of $\tilde{b}_1$ for any given realisation of $\tilde{\epsilon}$.

Substituting (9), (10) and (7) into (1) and assuming that $b_{1i} = \tilde{b}_1, \forall i$, one obtains a first-period government's utility as a function of $\tilde{b}_1$:

$$u\left(1 + \tilde{\epsilon} + \tilde{b}_1 - \tilde{b}_0\right) + pu\left(1 - \tilde{b}_1\right) - \left(\alpha \tilde{b}_1\right)^2 / (2\phi). \tag{14}$$

This expression is a strictly concave function of $\tilde{b}_1$. Hence, each first-period government would prefer the debt level $\tilde{b}_1 = \tilde{b}_1^*$ that solves

$$u'\left(1 + \tilde{\epsilon} + \tilde{b}_1 - \tilde{b}_0\right) = pu'\left(1 - \tilde{b}_1\right) + \alpha^2 \tilde{b}_1 / \phi. \tag{15}$$

Now return to the Nash game in which the governments select their debt in a decentralised fashion. Lemmata 1 and 2 imply that if initial debt levels and shocks are the same across countries, then $b_{1i} = \tilde{b}_1, \forall i$, and $f_{1i} = 1 + \tilde{\epsilon} + \tilde{b}_1 - \tilde{b}_0$ and $f_{2i}^r = 1 - \tilde{b}_1$, $\forall i$. Hence, a first-period government's utility is given by (14). Therefore, a stability pact that implies $\tilde{b}_1 = \tilde{b}_1^*$ will be optimal from the perspective of each of the individual first-period governments.

We shall now characterise the Nash equilibrium debt policies (which may, of course, be suboptimal) for a given stability pact. Assuming that an equilibrium exists, we study the effects on debt of varying the model's parameters. The results are obtained by implicit differentiation of (13) around a symmetric equilibrium. We defer the proofs to Appendix E (available upon request) and focus on the intuition here. First, we examine the case without shocks. Then, we consider shocks that are the same across countries.

In the absence of shocks, one has:

Result (i): Let $\epsilon_i = 0, \forall i$, and $b_{0i} = \tilde{b}_0, \forall i$. In addition, assume that $\psi = 0$. Then,

(a) If $\tilde{b}_0 = 0$ and $p \to 1$, then $b_{1i} = 0$, $\forall i$.

(b) A fall in p implies a higher b_{1i}, $\forall i$. If $\alpha > 0$, $\partial b_{1i}/\partial n > 0$, $\forall i$.

If the incumbent government is certain about re-election ($p \rightarrow 1$), then, in the absence of shocks and initial debt, it has no incentive to issue debt and available resources are equally balanced across the two periods.

However, the more interesting case is when there is uncertainty about re-election. This uncertainty increases the likelihood that future resources will be spent by the other party on the good that the incumbent attaches no utility to. In a sense, the incumbent's "effective" discount factor is reduced by the uncertainty about the election outcome. This leads to an increase in first-period public spending and debt. This "political distortion" provides the rationale for the stability pact in the model: the increase in debt as a result of governments not being sure about re-election is *exacerbated* in a monetary union with a CCB that is only partially independent (i.e., $\alpha > 0$). This follows by *Part (b)*, which states that debt accumulation is *increasing* in the number of union participants. The reason is that a larger union reduces the effect of an individual country's debt policy on the common, union-wide inflation rate. Hence, the incentive to restrain debt accumulation for the purpose of keeping future inflation low is weaker in a larger union (see also Beetsma and Bovenberg, 1999, and Beetsma and Uhlig, 1999).[14] Average debt accumulation and inflation therefore increase with the size of the union. This is the result of a typical non-cooperative inefficiency,[15] as each individual government ignores the negative international externalities from its own actions. The inefficiency can be observed immediately by comparing (13) and (15) and concluding that the value of $b_{1i} = \tilde{b}_1$ that solves (13) is strictly larger (if $n > 1$) than the one that solves (15).

As *Result (i)* demonstrates, incomplete CCB independence implies more debt accumulation under a union (i.e., $n > 1$) than with national monetary policymaking (i.e., $n = 1$). Therefore, we turn to the question whether the introduction of deficit sanctions may reduce average debt. One has:

Result (ii): Let $\epsilon_i = 0, \forall i$, and $b_{0i} = \tilde{b}_0, \forall i$. Then, $\partial b_{1i}/\partial \psi < 0$, unless $\alpha = 0$, in which case $\partial b_{1i}/\partial \psi = 0$.

It is instructive to assume first that $\alpha = 0$. That is, the CCB is completely independent. An increase in ψ has two intertemporal effects. On the one hand, it raises the fine associated

[14] Calmfors (1998) investigates a mechanism similar to this one in the context of labour market reform. As is the case with a debt reduction here, the benefit of an individual country's labour market reform in terms of lower inflation is smaller inside than outside a monetary union. Therefore, labour market reform will be smaller in a monetary union. See also Sibert and Sutherland (1999).

[15] To fix terminology, when mentioning "inefficiencies" we take the perspective of a first-period government, rather than society at large.

with running a deficit in the first period. Hence, first-period government spending becomes more expensive relative to second-period government spending, which induces governments to reduce debt accumulation. On the other hand, for a given amount of end-of-period 2 debt (in this case: zero), an increase in first-period debt reduces the second-period deficit by the same magnitude and thus leads to a reward in the second period. A higher ψ raises this reward and therefore stimulates debt accumulation to an extent that exactly offsets the effect of the first-period deficit punishment. In other words, the intertemporal trade-off between consumption in periods 1 and 2 is left unaltered by ψ. Hence, if, in practice, the ECB turns out to be as independent as the Maastricht Treaty envisages, then the deficit sanctions prescribed by the SGP will be redundant. Even though debt or deficits may be too high from a social perspective because of political distortions, the SGP cannot correct this.

Now, let us turn to the probably more realistic case in which the CCB is not completely independent (i.e., $\alpha > 0$). While an increase in ψ reduces the first-period utility gain and the second-period utility loss from an additional unit of debt to the same extent, it does not affect the additional loss in terms of future inflation that is associated with public debt. By having $\alpha > 0$, the net future cost of an additional unit of debt is increased. To again equate the current gain from an additional unit of debt with its future cost, debt needs to be reduced.

That sanctions for excessive deficits do not alter the intertemporal trade-off between public consumption in periods 1 and 2 is important for our ensuing results. It implies — as we will show below — that a stability pact can be designed exclusively for the purpose of correcting the international inefficiency (from the perspective of first-period governments) arising from each government not fully internalising the effect of its debt on the union-wide inflation rate, without distorting the governments' intertemporal allocation of public spending.[16]

This particular aspect appears to be an argument in favour of sanctions based on excessive deficits rather than on excessive debts. With sanctions based on excessive debt in both periods, a given amount of debt accumulation would yield less first-period consumption of public goods than without a pact. However, as the debt increase is carried over into the next period, there will be an additional cost in terms of next period's consumption of

[16] Intertemporal consumption smoothing implies that in a model with more than two periods, an increase in first-period debt leads to an increase in second-period debt as well (whereas in this model the effect on second-period debt is zero). Hence, the increase in the first-period deficit exceeds the reduction in the second-period deficit. Then, to leave the intertemporal trade-off of public consumption unchanged, additional corrective measures (e.g., a real interest rate subsidy) may be needed, because the second-period reward on additional first-period debt may be insufficient to restore the original intertemporal trade-off.

public goods. Although average debt accumulation would fall, such a scheme would clearly distort the intertemporal trade-off of public consumption by reducing the current marginal gain from issuing debt, while at the same time enhancing its future marginal cost.

Now, we reintroduce common shocks and establish the following result:

Result (iii): Let $b_{0i} = \tilde{b}_0$ and $\epsilon_i = \tilde{\epsilon}, \forall i$. Then,

(a) $\partial \tilde{b}_1 / \partial \tilde{\epsilon} < 0$.

(b) If u is quadratic,[17] $\partial \tilde{b}_1 / \partial \tilde{\epsilon}$ decreases with n and increases with ψ.

The effect of $\tilde{\epsilon}$ on $\tilde{b}_1$ is the result of standard intertemporal consumption smoothing: a bad shock ($\tilde{\epsilon} < 0$) creates a need for (additional) borrowing. More interesting, however, is the effect of an increase in the union size on the response to a given shock $\tilde{\epsilon}$, cf. *Part (b)*. This effect is analogous to our earlier *Result (i)(b)* that, in the absence of shocks, debt increases in n. The response of $\tilde{b}_1$ to $\tilde{\epsilon}$ is to some extent moderated, because, through its effect on debt, $\tilde{\epsilon}$ leads to welfare-costly movements in the future common inflation rate. However, in a larger union, each government internalises this cost only to a lesser extent. Therefore, the response of $\tilde{b}_1$ to $\tilde{\epsilon}$ will be more active in a larger union and, hence, the variance of inflation will be higher, the larger is n. Again, this represents a non-cooperative inefficiency as each government ignores the potentially negative international externalities of its own actions. *Part (b)* of *Result (iii)* also says that these externalities may be mitigated by raising ψ. A more severe shock (i.e., a fall in $\tilde{\epsilon} < 0$) would call for an increase in $\tilde{b}_1$. A higher ψ raises the cost of increasing debt at the individual level (note that each individual government ignores that the other governments are in the same position and would also like to raise their debt, in which case the fines would cancel). Hence, an increase in ψ implies a more "conservative" response to the common shock, $\tilde{\epsilon}$.

3.2. Identical initial debt levels and idiosyncratic shocks

We now relax the assumption that countries are hit by identical shocks. First, note that with common shocks only, the shock-contingency parameter δ does not affect the outcome for debt. This can be seen immediately, because in that case δ cancels from the first-period government budget constraint, (9). However, with differences in shocks across countries, δ *does* have an effect on debt accumulation. In particular, we will see that δ affects the response of a government's debt choice to the idiosyncratic shock component $\tilde{\epsilon} - \epsilon_i$.

[17] Function u being quadratic is a sufficient condition, but not a necessary one. By continuity, the result also holds if u''' is sufficiently close to zero.

The following result is concerned with the effect of a mean-preserving spread in the idiosyncratic shocks on the cross-sectional spread in debt positions and how this spread is affected by the stability pact parameters:

Result (iv): Let $0 \leq \psi < \frac{n-1}{n}$. Let $b_{0i} = \tilde{b}_0, \forall i$, and suppose that, initially, $\epsilon_i = \tilde{\epsilon}, \forall i$. Now, consider a marginal increase $\mathrm{d}(\tilde{\epsilon} - \epsilon_i)$, while $\mathrm{d}(\tilde{\epsilon} - \epsilon_j) = -\frac{1}{n-1}\mathrm{d}(\tilde{\epsilon} - \epsilon_i), \forall j \neq i$. This way $\tilde{\epsilon}$ is kept constant. Then,

(a) $b_{1i} - \tilde{b}_1$ is increasing in $\tilde{\epsilon} - \epsilon_i$.

(b) If u is quadratic, $\partial(b_{1i} - \tilde{b}_1)/\partial(\epsilon_i - \tilde{\epsilon})$ is increasing in ψ.

(c) If u is quadratic, $\partial(b_{1i} - \tilde{b}_1)/\partial(\epsilon_i - \tilde{\epsilon})$ is decreasing in δ.

Part (a) of the result is again explained by the need for consumption smoothing: a relatively low realisation of ϵ_i (i.e., $\epsilon_i < \tilde{\epsilon}$) leads government i to issue a higher-than-average amount of debt.

The main difference with the case of identical shocks is the way in which debt policy is affected by the stability pact parameters. Consider first an increase in ψ. As stated by *Part (b)*, this may lead to a *stronger* response of debt to shocks. The intuition is the following. Suppose that country i is hit by a relatively bad shock (i.e., $\epsilon_i < \tilde{\epsilon}$). Hence, its government issues a larger than average amount of debt (i.e., $b_{1i} > \tilde{b}_1$). This results in a net fine in the first period and a net reward in the second period. However, the first-period fine reduces first-period resources further, while the second-period reward raises second-period resources. This induces the government to issue even more debt in the first period.[18] As mentioned in the Introduction, this corresponds to what has been an important source of criticism on the SGP: punishing excessive deficits may lead to a further deterioration of the budgetary position of a government which is already in a relatively weak financial position and, hence, exacerbate the deficit. This way, a stability pact may be counterproductive.

Part (c) implies that this potential counterproductivity of a pact in terms of exacerbating cross-country differences in debt (and deficits) can be reduced by making sanctions contingent on the shocks. The intuition is as follows. If $\epsilon_i < 0$, an increase in δ raises the reference deficit level and thus reduces the fine for running a given excessive deficit. The *net* fine falls and, hence, through this channel first-period resources rise if $\tilde{\epsilon} - \epsilon_i > 0$. Hence, the need to issue debt in the first period is reduced. This effect of an increase in δ can be seen from equation (9). Hence, by introducing deficit sanctions that are contingent

[18] This exacerbation of debt accumulation caused by the loss of resources resulting from the sanctions, is absent when shocks happen to be equal across countries. The reason is that in that case this direct loss of resources is exactly offset by the rebates of the other countries' fines.

on the exogenous shocks, a stability pact can accomplish a reduction in expected debt accumulation (see *Result (ii)*) without being counterproductive in the sense described above. Actually, because the reference deficit level is adjusted for the economic shocks that hit countries, a stability pact can provide for risk sharing among the union participants, as we will see below.

Having explored the qualitative effects of a stability pact on equilibrium debt accumulation, we turn to the question what pact will be selected when the initial debt levels are identical. Assuming that it is the first-period governments who bargain over a stability pact, we take their perspective when discussing the choice of the pact.

Because initial debt levels are equal across countries, all countries are ex ante identical at the moment that the pact is signed. Hence, all governments agree on the same, optimal pact:

Proposition 1. *Suppose that the initial debt levels are identical, i.e.,* $b_{0i} = \tilde{b}_0, \forall i$.

(a) The first-period governments unanimously agree on the pact characterised by $(\psi, \delta) = (\frac{n-1}{n}, 1)$.

(b) This pact improves strictly upon monetary unification without a pact (i.e., $\psi = 0$*).*

Proof. *(a) To see that the proposed pact is optimal from the first-period governments' perspective, first substitute* $\delta = \frac{n-1}{n}/\psi$ *into (9). For any given, non-zero value of* ψ *this eliminates the term involving* $\tilde{\epsilon} - \epsilon_i$*, which is uncorrelated with* $\tilde{\epsilon}$*. Hence, an optimal pact requires that* $\delta = \frac{n-1}{n}/\psi$*. Then, substituting* $\psi = \frac{n-1}{n}$ *(which implies* $\delta = 1$*) into (9) and (10) and substituting the spending levels into (13), we see that this condition becomes identical to (15). (b) From the first-order conditions (13) it follows that setting* $\psi = 0$ *leads to a level of debt* $\tilde{b}_1$ *that differs from the one that solves (15). Combined with the strict concavity of* u*, it follows that expected utility (at the moment the pact is signed) will be strictly lower for all governments.* ■

From Proposition 1 it should be clear that the stability pact can be designed to fulfill two major roles. The first role, which we explored earlier in this section is that, when shocks are equal across countries, an appropriate choice of ψ (i.e., $\psi = \frac{n-1}{n}$), eliminates the international inefficiencies (from the perspective of first-period governments) that arise in a monetary union from the governments' failure to fully internalise the consequences of their individual debt policies both for the level and the volatility of the common inflation rate.[19]

The second role of the pact is that through the appropriate choice of the adjustment of the reference deficit levels to the shocks, country-specific movements in public spending are completely eliminated. In other words, implicitly, through the adjustment of the reference deficit levels, the pact can provide for perfect cross-country risk sharing. To see the intuition for this result, remember that an increase in δ implies a reduction in the net fine that follows a relatively bad shock (i.e., $\epsilon_i < \tilde{\epsilon}$). By making δ large enough, this reduction can offset the direct effect of a relatively bad shock on government i's first period resources. As a result, both first- and second-period public spending will be equal across countries.

3.3. Differences in the initial debt levels

Proposition 1 provides an optimistic view on the scope for designing a stability pact that leaves all governments better off. However, this result hinges crucially on the assumption that countries are ex ante identical. We will now relax this assumption and allow for differences in initial debt. A priori, one may then expect governments to differ in their predisposition towards a stability pact. Below, we will show that this is indeed the case. Because public debt levels differ substantially across Europe, this may help to explain why not all the EMU participants have been equally enthusiastic about the idea of a stability pact.

In the next proposition we show that if the variance of the idiosyncratic shocks that hit the first-period government budget constraints is sufficiently small (so that potential risk sharing through a pact yields only minor gains) and if the CCB's degree of independence is sufficiently high (so that the exacerbation of debt accumulation from monetary unification is sufficiently small and the correction of this exacerbation yields only a minor gain), some governments may oppose signing a stability pact. More precisely,

Proposition 2. *Suppose that initial debt levels differ, i.e.,* $b_{0i} \neq \tilde{b}_0$*, for some* i*. Let* $\alpha \to 0$ *and* $\sigma^2 \to 0$*. Then, at least one of the governments is strictly worse off by signing a pact with* $\psi > 0$*.*

Proof. *Under the stated assumptions, the indirect utility of the first-period governments*

[19] Note that because the optimal pact calls for a constant marginal penalty on deficits, the scheme is somewhat related to the linear inflation contracts that feature in the literature on central bank independence (Walsh, 1995). Indeed, Persson and Tabellini (1995) examine how such contracts may induce cooperative behaviour in international settings.

as a function of the stability pact parameters can be written as:

$$V_{Fi}(\psi,\delta) \equiv E_\epsilon \left[u(f_{1i}) + pu(f_{2i}) \right], \quad \forall i,$$

where $E_\epsilon[.]$ *denotes the expectations operator with respect to the shocks* $(\epsilon_1, ..., \epsilon_n)$ *and where* f_{1i} *and* f_{2i}^r *are given by (9), with* $\epsilon_i = \tilde{\epsilon} = 0$, *and (10), respectively, and where the* b_{1i} *are implicitly given by (13). If* $\alpha \to 0$, *this reduces to* $u'(f_{1i}) = pu'(f_{2i}^r)$. *We then find*

$$\begin{aligned} \frac{\partial V_{Fi}(\psi,\delta)}{\partial \psi} &= E_\epsilon \left[\tfrac{n}{n-1}\psi \left(u'(f_{1i}) - pu'(f_{2i}^r)\right) \frac{\partial \tilde{b}_1}{\partial \psi} + \left(1 - \tfrac{n}{n-1}\psi\right) \left(u'(f_{1i}) - pu'(f_{2i}^r)\right) \frac{\partial b_{1i}}{\partial \psi} \right. \\ & \left. + \tfrac{n}{n-1} \left(u'(f_{1i}) - pu'(f_{2i}^r)\right) \left(\tilde{b}_1 - b_{1i}\right) - \tfrac{n}{n-1} u'(f_{1i}) \left(\tilde{b}_0 - b_{0i}\right) \right], \end{aligned}$$

which, by use of $u'(f_{1i}) = pu'(f_{2i}^r)$, *reduces to*

$$\frac{\partial V_{Fi}(\psi,\delta)}{\partial \psi} = -\tfrac{n}{n-1} \left(\tilde{b}_0 - b_{0i}\right) E_\epsilon \left[u'(f_{1i})\right], \quad \forall i.$$

Hence, $\partial V_{Fi}(\psi,\delta)/\partial\psi < (>)\ 0$ *if* $b_{0i} < (>)\ \tilde{b}_0$. *It then follows that if* b_{0i} *strictly differs from* $\tilde{b}_0$, *for some* i, *at least one of the governments is strictly worse off by a marginal increase in* ψ *starting at* $\psi = 0$. ■

By continuity, the result of Proposition 2 also holds if α and σ^2 are positive, but are sufficiently small. The proposition states that countries with initial debt levels below the union average may be worse off signing a pact that punishes excessive deficits, i.e., $\psi > 0$, whereas countries with higher-than-average initial debt levels will be made better off by the pact. Such a conflict of interest may seriously complicate or even prevent the adoption of a stability pact for countries forming a monetary union.

At first glance, the result that countries with higher-than-average debt are relatively better off under a pact may seem counterintuitive, as common wisdom probably suggests that it is in particular relatively "poor" countries (i.e., the countries with higher-than-average initial debt) that would oppose a scheme promoting fiscal restraint. However, one may think of the "poorer" countries as having used up most of their room for fiscal manoeuvre. Hence, they are forced to run a lower deficit level (note that we have explicitly excluded debt default) and, thus, suffer less from a scheme that imposes fines on excessive deficits. Indeed, Appendix B shows formally that, if $b_{0i} > b_{0j}$ (and $\psi \neq \frac{n-1}{n}$), then government i runs a lower deficit than government j in equilibrium. However, it is conceivable that had we focussed on a stability pact with debt-based sanctions, it would be the relatively "poor" countries (i.e., those with high initial debt) that would oppose the pact (as they would have relatively high debt levels in the future even though they would be running relatively low deficits).

That relatively highly-indebted countries would be more in favour of sanctions (assuming sanctions are based on excessive deficits) than countries with low initial debt, is not as unrealistic as it may seem to be. Such a pact might be favoured by the government of a highly-indebted country as a way of tying its hands to a stringent budgetary policy. Such an external commitment mechanism would be particularly useful if there is a lot of public opposition to budget cuts.

Nevertheless, the result on whether ex-ante different countries would be in favour of deficit-based sanctions or not, relies to some extent on the assumption that the shocks hitting the various union participants are identically distributed. Had we allowed for different means of the shocks, for example by letting the probability of being hit by an adverse shock to be increasing in the initial debt level (say, because high initial debt is the result of an economic or political structure that is conducive to debt accumulation), this could make countries with high initial debts reluctant to signing a pact, as they know they will be likely to run a large deficit — and pay a net fine — in period 1.

In any case, the combination of Propositions 1 and 2 suggests that the likelihood that all countries would agree on a stability pact is greater the larger is $\alpha > 0$ (because the gain from the pact in terms of offsetting the exacerbation of the political distortion in debt accumulation is larger) and the larger is $\sigma^2 > 0$ (because the benefit of a pact in terms of risk sharing will increase if sanctions are made shock-contingent).

4. Moral hazard and discipline

As mentioned in Section 2, in practice, whenever the Excessive Deficit Criterium will be violated, the sanctions imposed under the SGP take into account only in a very rough and imprecise way the exogenous shocks that hit a country. Probably, the best explanation for why the contingencies of the sanctions are not more detailed is that the exogenous shocks that impinge on the European economies are very hard to observe or to verify. The relevant data for assessing a country's economic situation (for example, unemployment data) are usually provided by its own authorities, who have an interest in the potential lifting of sanctions. This makes these statistics prone to manipulation. In addition, even if the statistics reflect the current state-of-affairs accurately, it is often difficult to tell to what extent an unfavourable economic situation is caused by laxity on the side of the authorities and to what extent it is caused by truly exogenous circumstances.

We will try to capture these notions by extending the basic model. We assume that, after the exogenous shock ϵ_i has materialised, the government of country i has the possibility to take certain measures that reduce the impact of the shock. We lump these measures together under the term *discipline*, which we denote by e_i. Enhanced discipline mitigates the effects of a bad shock (see below). Examples of more discipline are enhancing the efficiency of the public institutions, stricter monitoring of the handout of benefits, structural economic reform (for example, labour market reform and deregulation) and reductions in perks and privileges for the governing party's constituency or for special interest groups.

Exerting discipline often involves taking unpopular measures and may therefore lead to a reduction in the political support of a government that imposes them. We capture these political costs by assuming that government i's utility is now given by:

$$U_{Fi}\left(.\right) = \mathrm{E}\left[-v_i(e_i) + u(f_{1i}) + pu(f_{2i}) - \pi^2/(2\phi)\right], \tag{16}$$

where $v_i'' > 0$ and $v_i'(e_i) = 0$ for some $e_i = \kappa_i$. Hence, κ_i is government i's preferred amount of discipline. For example, a lower κ_i may correspond to a larger share of population living on benefits or a country with stronger special interest groups. Ceteris paribus, the government would be less inclined to implement a given amount of discipline.

By exerting discipline (i.e., $e_i > 0$) the direct effects of a bad shock (i.e., $\epsilon_i < 0$) can be mitigated. The simplest way of modelling this is to have discipline enter the first-period government budget constraint linearly. To focus on the extension at hand, from now on we assume that initial debt levels are zero for all countries, i.e., $b_{0i} = 0, \forall i$. As a result, (3) is replaced with

$$f_{1i} + g_{1i} = 1 + \epsilon_i + e_i + b_{1i} - \psi\left(d_{1i} - \bar{d}_{1i}\right) + \tfrac{\psi}{n-1}\sum_{j=1, j\neq i}^{n}\left(d_{1j} - \bar{d}_{1j}\right), \tag{17}$$

where, now,

$$\bar{d}_{1i} = \bar{d} - \delta\left(\epsilon_i + e_i\right) \quad \text{and} \quad \bar{d}_{2i} = \bar{d}. \tag{18}$$

This way of modelling discipline follows Illing (1995) and is in accordance with recent literature on special interest politics (see, e.g., Persson and Tabellini, 1999, and Persson et al., 1999). For example, one may alternatively interpret $-e_i$ as the rent the government extracts from the budget. Then, a low value of κ_i comprises not only a self-interested government, but also a political system for which rent-extraction, all things equal, is easy. In our terminology, however, a low value of κ_i will characterise a relatively "undisciplined-type" government, while a high value of κ_i characterises a relatively "disciplined-type" government.

We assume that ϵ_i and e_i are separately observable to government i, while the other governments only observe $\epsilon_i + e_i$. An example of $\epsilon_i + e_i < 0$ would be an increase in spending on unemployment benefits (which leaves fewer resources for spending on the public goods F or G). Although the increase in the number of individuals receiving benefits may be observable, it would be hard to infer which part of this increase is due to a truly exogenous bad shock (e.g., a change in world market prices for the country's exports) and which part is due to laxity on the side of the government (e.g., not implementing a sufficiently rigorous labour market reform).

Because ϵ_i and e_i are only observable as a sum, the reference deficit level can no longer be directly adjusted for the country-specific shock, but is made contingent on $\epsilon_i + e_i$, as reflected in (18). In practice, this would correspond to adjusting the severity of the sanctions under the SGP to observed unemployment or output growth, for example. As we will see, adjusting the reference deficit level as in (18) will lead to moral hazard.

An alternative to having $\bar{d}_{1i}$ contingent on $\epsilon_i + e_i$, would be to make $\bar{d}_{1i}$ contingent on an estimate $\hat{\epsilon}_i$ of ϵ_i that is formed with the help of the observation of $\epsilon_i + e_i$. The authority at the federal level that might be responsible for the execution of the pact would be faced with a signal-extraction problem.[20] Instead of assuming that this signal-extraction problem is solved at the federal level, we stick with the current formulation, which, for the following reasons, we believe would be more realistic. First, existing arrangements in Europe that transfer resources across borders (for example, the so-called Structural Funds) are based on observable statistics like output and unemployment, however sensitive these statistics may be to bad policies. Second, any pass from the observed $\epsilon_i + e_i$ to an estimate $\hat{\epsilon}_i$ is likely to lead to disagreement among countries about the methods that are used to translate $\epsilon_i + e_i$ into $\hat{\epsilon}_i$. Such disagreement would reduce the feasibility of the mechanism.

Below we will see that the realisations of public spending depend on the idiosyncratic shock components, $\tilde{\epsilon} - \epsilon_i$. This suggests that as another alternative to making $\bar{d}_{1i}$ contingent on $\epsilon_i + e_i$, one could make $\bar{d}_{1i}$ contingent on f_{1i}, or a combination of $\epsilon_i + e_i$ and f_{1i}, and avoid the moral hazard problem. This is not true, however. In fact, Appendix F (available upon request) shows that such a scheme (if linear) turns out to be exactly same as the scheme imbedded in (17).

[20]A very similar signal-extraction problem is present in Beetsma and Bovenberg (1998), in which having cross-country transfers based on $\epsilon_i + e_i$ yields exactly the same outcomes as solving the signal-extraction problem and having these transfers based on $\hat{\epsilon}_i$.

Before continuing, note that first-period public spending on good F is now given as:

$$f_{1i} = 1 + \tilde{\epsilon} + \tilde{e} + \tilde{b}_1 + \left(\tfrac{n}{n-1}\psi - 1\right)\left(\tilde{b}_1 - b_{1i}\right) + \left(\tfrac{n}{n-1}\psi\delta - 1\right)\left[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)\right], \quad (19)$$

while second-period public spending from the first-period government's perspective, if it is re-elected, is still given by (10). As before, inflation will be given by (7).

The first-order conditions for the government of country i are now given by:

$$\begin{aligned} \mathrm{E}_i\left[u'(f_{1i})\right](1-\psi) &= \mathrm{E}_i\left[pu'(f_{2i})\right](1-\psi) + \mathrm{E}_i\left[\alpha^2\tilde{b}_1/(\phi n)\right], \quad \forall i, & (20) \\ v_i'(e_i) &= \mathrm{E}_i\left[u'(f_{1i})\right](1-\psi\delta), \quad \forall i, & (21) \end{aligned}$$

where $\mathrm{E}_i[.]$ denotes the expectations operator with respect to all shocks ϵ_j, $j \neq i$.

4.1. Model solution and characterisation of the equilibrium

From now on, we adopt the following quadratic specifications for v and u:

$$\begin{aligned} v(e_i) &= (e_i - \kappa_i)^2/2, & (22) \\ u(f_{ti}) &= -(\xi - 1)(f_{ti})^2/2 + \xi f_{ti}, \text{ where } \xi > 1 \text{ and } 0 \leq f_{ti} < \xi/(\xi - 1). & (23) \end{aligned}$$

Moreover, we impose the normalisation that $\sum_{i=1}^{n}\kappa_i = 0$. A government with $\kappa_i > 0$ ($\kappa_i < 0$) will thus be a "disciplined" ("undisciplined") type. The quadratic specifications enable us to obtain closed-form solutions that can be easily analysed and that are convenient for explaining the intuition behind the results.

With functions v and u specified as in (22) and (23), respectively, government i's first-order conditions read as:

$$\begin{aligned} \mathrm{E}_i\left[-(\xi-1)f_{1i} + \xi\right](1-\psi) &= p\mathrm{E}_i\left[-(\xi-1)f_{2i} + \xi\right](1-\psi) + \left[\alpha^2/(\phi n)\right]\mathrm{E}_i\left[\tilde{b}_1\right], & (24) \\ e_i - \kappa_i &= \mathrm{E}_i\left[-(\xi-1)f_{1i} + \xi\right](1-\psi\delta). & (25) \end{aligned}$$

Appendix G (available upon request) shows how to solve for the (Bayesian) Nash equilibrium. The outcomes for public debt and discipline are given by, respectively:

$$\begin{aligned} b_{1i} &= A_1 + B_1\epsilon_i + C_1\kappa_i, & (26) \\ e_i &= A_2 + B_2\epsilon_i + C_2\kappa_i. & (27) \end{aligned}$$

where $B_1 < 0$, $B_2 < 0$, $C_1 \leq 0$ and $C_2 > 0$. The expressions for A_1, A_2, B_1, B_2, C_1 and

C_2 are contained in Appendix C. Combining (19), (10) and (C.1)-(C.6), one obtains:

$$f_{1i} = 1 + \tilde{\epsilon} + \tilde{e} + \tilde{b}_1 + K_1 (\epsilon_i - \tilde{\epsilon}) + L_1 \kappa_i, \quad (28)$$

$$f_{2i}^r = 1 - \tilde{b}_1 + K_2 (\epsilon_i - \tilde{\epsilon}) + L_2 \kappa_i. \quad (29)$$

where $K_1, K_2, L_1, L_2 \geq 0$. The expressions for K_1, K_2, L_1 and L_2 are also found in Appendix C.

Note from the expressions for A_1 and A_2 in Appendix C that $\mathrm{E}[\tilde{e}] > 0$, but that $\mathrm{E}[\tilde{b}_1]$ is no longer guaranteed to be positive. However, because these are the most interesting and empirically relevant ones, in the sequel we concentrate on cases in which $\mathrm{E}[\tilde{b}_1] > 0$.[21] The parameter restriction that this condition requires is strongest in the absence of a stability pact. Henceforth, we assume that

$$p\xi < 1,$$

which has an intuitive interpretation. It says that the utility function should be parameterised in such a way that the gains from public consumption (quantified by the parameters p and ξ) should not be too high relative to the costs of exerting discipline (note that, for convenience, the coefficient of the quadratic term in (22) has been set at unity). Otherwise, a government could rather easily free up resources for public consumption by exerting more discipline, thereby obliterating the need for debt finance.

The model puts some additional conditions on the parameters. First, it seems natural to impose that the marginal utility of public spending be positive for any level of debt that can be repaid under the intertemporal budget constraint. Hence, we assume that:

$$\xi < 2.$$

This is a necessary condition, although not necessarily a sufficient one. Second, as before, we assume implicitly that parameters are such that the first-order conditions (24) and (25) do not yield a debt level that is higher than can be repaid under the intertemporal budget constraint. For example, in the absence of shocks (i.e., $\epsilon_i = 0$, $\forall i$), the absence of differences in government discipline types (i.e., $\kappa_i = 0$, $\forall i$) and the absence of a stability pact (i.e., $\psi = \delta = 0$), this requires that $\xi(1 + \xi p) > 2$. In combination with the previous restrictions, this puts a lower bound on p. In more general cases, we thus assume that shock variances and differences in discipline types are sufficiently small that the intertemporal

[21] If, for example, equilibria were characterised by $\mathrm{E}[\tilde{b}_1] < 0$, it follows by (7) that the expected price level would be *falling* within the union. In terms of attaining the price-stability objective, it would thus be desirable to *encourage* debt accumulation. For our purposes this is not a very interesting case.

budget constraint not be violated.

The following result addresses the effect of the stability pact on the (expected) cross-country average of public debt and discipline (the proof of this result and the ensuing ones of this subsection are contained in Appendix H; available upon request):

Result (v):

(a) $\partial \mathrm{E}[\tilde{b}_1]/\partial\delta > 0$ and $\partial \mathrm{E}[\tilde{e}]/\partial\delta < 0$.

(b) *(b.1)* If $\delta = \alpha = 0$, $\partial \mathrm{E}[\tilde{b}_1]/\partial\psi = \partial \mathrm{E}[\tilde{e}]/\partial\psi = 0$.

(b.2) If $\alpha = 0$ and $\delta > 0$, $\partial \mathrm{E}[\tilde{b}_1]/\partial\psi > 0$ and $\partial \mathrm{E}[\tilde{e}]/\partial\psi < 0$.

(b.3) If $\delta = 0$ and $\alpha > 0$, $\partial \mathrm{E}[\tilde{b}_1]/\partial\psi < 0$ and $\partial \mathrm{E}[\tilde{e}]/\partial\psi > 0$.

Part (a) of *Result (v)* illustrates the moral hazard problem associated with a pact in which sanctions are made contingent on the observable quantity $e_i + \epsilon_i$. In expected terms, the average degree of discipline in the union decreases if the degree of contingency δ of the reference deficit level to changes in $e_i + \epsilon_i$ is raised. The moral hazard problem arises because a unilateral reduction in discipline raises the expected net transfer of resources from the other countries.[22] For a given reduction in discipline, the rise in the expected net transfer is increasing in δ. In other words, a higher δ weakens the incentive to exert discipline. To rebalance resources over time, (expected) average debt has to increase.

As regards to the effect of a change in the marginal deficit punishment ψ, remember from the previous section that if $\alpha = 0$, there is no international inefficiency to be corrected and, hence, $\mathrm{E}[\tilde{b}_1]$ and $\mathrm{E}[\tilde{e}]$ are unaffected by ψ if $\delta = 0$. If, in addition, $\delta > 0$, there is only the moral hazard effect from having contingent sanctions and, hence, $\partial \mathrm{E}[\tilde{e}]/\partial\psi < 0$ and $\partial \mathrm{E}[\tilde{b}_1]/\partial\psi > 0$. In other words, if $\alpha = 0$, that is, if the CCB is *completely* independent, a stability pact with contingent sanctions establishes exactly the opposite of what it is supposed to do! With $\alpha > 0$ and $\delta = 0$, an increase in the marginal debt punishment forces (expected) average debt down. This corresponds to *Result (ii)* in Section 3 for the version of the model without endogenous discipline. Moreover, by making it more costly to shift resources from the future to the present (through a higher ψ), the incentive to exert discipline is strengthened.

We turn now to the question how the degree of contingency of the sanctions to the observed economic situation affects the responses of debt and discipline to the shocks:

Result (vi):

[22] We say "expected" because, when choosing discipline, a government only observes its own shock, but not the shocks that hit the other countries.

(a) $\partial B_1/\partial\delta > 0$.

(b) $\partial B_2/\partial\delta > 0$.

First, consider *Part (b)* of *Result (vi)* which is slightly less complicated than Part *(a)*. Basically, the result shows that the moral hazard problem that we established in *Result (v)* for the case of (expected) average discipline also carries over to the response of discipline to idiosyncratic shocks. Suppose that country i is hit by a relatively bad shock ($\epsilon_i < 0$). Its government reacts with an increase in discipline (because $B_2 < 0$). A higher δ reduces the expected net increase in resources from a given increase in discipline and, hence, the response of discipline to shocks will become less active.

The effect of δ on the response of public debt (*Part (a)* of *Result (vi)*) to idiosyncratic shocks is slightly more complicated, because it is the result of two effects that work in opposite directions. Again, suppose that country i is hit by a bad shock ($\epsilon_i < 0$). Discipline is raised, but this increase is moderated by the higher degree of contingency δ, cf. *Part (b)*. This requires a further increase in country i's public debt. Apparently, however, this effect is dominated by the increase in the expected net transfer from the other countries in the system, which calls for a reduction in debt.

We investigate now how the degree of contingency of the sanctions on the observed economic situation affects the systematic differences in debt accumulation and discipline resulting from differences in government types across countries, κ_i.

Result (vii): Let $\psi < \frac{n-1}{n}$ and $\delta < 1$. Then,

(a) $\partial C_1/\partial\delta > 0$.

(b) $\partial C_2/\partial\delta > 0$.

Interestingly, as *Part (b)* makes clear, differences in discipline, resulting from differences government types, κ_i, are exacerbated by increases in δ. In other words, the countries that have the least disciplined governments, become even relatively less disciplined if the degree of contingency of the sanctions on the observed economic situation increases. In contrast to differences in discipline, differences in debt accumulation become smaller as δ increases. Again, this is the result of two factors that work in opposite directions: on the one hand, because differences in discipline increase if δ rises, public consumption smoothing over time implies larger cross-country differences in debt accumulation. On the other hand, an increase in δ raises the expected net transfer from disciplined-type to undisciplined-type governments. Apparently, the latter effect dominates the former.

The following result deals with how relative spending levels vary with δ. One has

Result (viii): Let $\psi < \frac{n-1}{n}$ and $\delta < 1$. Then,

(a) $\partial L_1 / \partial \delta < 0$.

(b) $\partial L_2 / \partial \delta < 0$.

In other words, although a country with a disciplined-type government has relatively more to spend on public consumption in both periods ($L_1 > 0$ and $L_2 > 0$), the difference in spending between countries with disciplined-type and undisciplined-type governments becomes smaller as δ increases. This reflects the increase in net transfers from countries with disciplined-type governments to countries with undisciplined-type governments. In the extreme case of $\psi = \frac{n-1}{n}$ and $\delta = 1$, one has:

Result (ix): Let $\psi = \frac{n-1}{n}$ and $\delta = 1$. Then,

(a) $K_1 = K_2 = 0$.

(b) $L_1 = L_2 = 0$.

Part (b) of *Result (ix)* confirms our earlier finding for the simplified model without discipline, that through an appropriate design of the stability pact, it can provide for perfect cross-country risk-sharing. In addition, for the same combination of parameters, net transfer flows completely offset differences in spending resulting from differences in discipline types.

4.2. Are contingent sanctions Pareto improving?

In contrast to the version of the model without endogenous discipline, an increase in the degree of risk sharing through a higher δ [see *Result (ix)(a)*] may be bought at the cost of potentially higher losses from moral hazard [see *Result (v)(a)*]. Indeed, one can show that when countries are ex ante identical, i.e., when $\kappa_i = 0$, $\forall i$, the optimal pact is no longer given by $(\psi, \delta) = \left(\frac{n-1}{n}, 1\right)$. In particular, Appendix I (available upon request) shows that, at this point, a government's expected utility is strictly decreasing in δ.[23]

To get a handle on the question as to whether making sanctions contingent on the observed economic situation is desirable at all, we evaluate whether, for given $0 < \psi \leq \frac{n-1}{n}$, a marginal increase in δ starting at zero produces a first-order gain in government i's utility. That is, for given $0 < \psi \leq \frac{n-1}{n}$, we evaluate $\partial V_{Fi}(\psi, \delta) / \partial \delta|_{\delta=0}$, where

$$V_{Fi}(\psi, \delta) \equiv \mathrm{E}_\epsilon \left[-(e_i - \kappa_i)^2 / 2 + u(f_{1i}) + pu(f_{2i}) - \left(\alpha \tilde{b}_1\right)^2 / (2\phi) \right],$$

[23]With differences in the κ_i, this is the case for $\kappa_i \geq 0$. Hence, for these governments, the pact characterised by $(\psi, \delta) = \left(\frac{n-1}{n}, 1\right)$ is suboptimal.

is government i 's indirect utility as a function of the stability pact parameters (f_{1i} and f_{2i} are understood to be evaluated in equilibrium) and where u is defined by (23). Differentiating this expression with respect to δ and evaluating at $\delta = 0$ yields:

$$\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} = \mathrm{E}_\epsilon\left[-\left(e_i - \kappa_i\right)\frac{\partial e_i}{\partial \delta} + u'(f_{1i})\frac{\partial f_{1i}}{\partial \delta} + pu'(f_{2i})\frac{\partial f_{2i}}{\partial \delta} - \frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial \tilde{b}_1}{\partial \delta}\right], \tag{30}$$

where the right-hand side of (30) is understood to be evaluated at $\delta = 0$ and where, using (19) and (10), respectively,

$$\left.\frac{\partial f_{1i}}{\partial \delta}\right|_{\delta=0} = \tfrac{n}{n-1}\psi\frac{\partial \tilde{b}_1}{\partial \delta} + \left(1 - \tfrac{n}{n-1}\psi\right)\frac{\partial b_{1i}}{\partial \delta} + \frac{\partial e_i}{\partial \delta} + \tfrac{n}{n-1}\psi\left[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)\right],$$

$$\left.\frac{\partial f_{2i}}{\partial \delta}\right|_{\delta=0} = -\tfrac{n}{n-1}\psi\frac{\partial \tilde{b}_1}{\partial \delta} + \left(1 - \tfrac{n}{n-1}\psi\right)\frac{\partial b_{1i}}{\partial \delta}.$$

Substitute these expressions into (30), which can then be written as:

$$\begin{aligned}\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} &= \mathrm{E}_\epsilon\left[\left[u'(f_{1i}) - pu'(f_{2i})\right]\tfrac{n}{n-1}\psi\frac{\partial \tilde{b}_1}{\partial \delta} - \frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial \tilde{b}_1}{\partial \delta}\right] \\ &\quad + \mathrm{E}_\epsilon\left[\left[u'(f_{1i}) - pu'(f_{2i})\right]\left(1 - \tfrac{n}{n-1}\psi\right)\frac{\partial b_{1i}}{\partial \delta}\right] \\ &\quad + \mathrm{E}_\epsilon\left\{u'(f_{1i})\left[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)\right]\right\}\tfrac{n}{n-1}\psi, \end{aligned} \tag{31}$$

where the right-hand side of (31) is evaluated at $\delta = 0$, and where we have made use of (25), evaluated at $\delta = 0$, and the law of iterated projections, $\mathrm{E}_\epsilon\left[\mathrm{E}_i\left[x\right]\right] = \mathrm{E}_\epsilon\left[x\right]$.

First, consider the special case in which the CCB is completely independent, i.e., $\alpha = 0$. By (20), the first two terms on the right-hand side of (31) drop out. Invoking the outcomes obtained under our utility specification (23), some algebra then yields:

$$\begin{aligned}\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} &= \tfrac{n}{n-1}\psi\mathrm{E}_\epsilon\left[u'(f_{1i})\left[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)\right]\right] \\ &= \tfrac{n}{n-1}\psi\left[(1 + B_2)(\xi - 1)K_1\mathrm{E}_\epsilon\left[\tilde{\epsilon} - \epsilon_i\right]^2 - C_2 L_1\kappa_i^2 - C_2\frac{2p}{1 + p\xi}\kappa_i\right], \end{aligned} \tag{32}$$

where B_2, C_2 and K_1 are evaluated at $\alpha = 0$. It is easy to see from (C.4) that $1 + B_2 > 0$. This expression then leads us to the following proposition:

Proposition 3. *Suppose that the CCB is completely independent (i.e., $\alpha = 0$), that $0 < \psi \leq \frac{n-1}{n}$ is given and that the shocks are uncorrelated. If $\kappa_i = \tilde{\kappa} = 0$, all first-period governments are better off by having at least some degree of contingency of the sanctions* *on the observed economic situation (i.e., δ is marginally increased at $\delta = 0$). If $\kappa_i \neq \tilde{\kappa}$, the benefit of making sanctions contingent is smaller for a disciplined-type government than for an undisciplined-type government such that $\kappa_j = -\kappa_i < 0$.*

Hence, disciplined-type governments tend to be less in favour of making sanctions contingent upon the observed economic situation. In fact, if the shock variance is sufficiently small (and, hence, the benefit from cross-country risk-sharing through the stability pact is sufficiently small), then such governments would veto a pact with contingent sanctions. The reason is that, by exerting less discipline, undisciplined-type governments effectively receive a transfer financed by the disciplined-type governments. Such differences in "intrinsic" discipline among countries may explain why the SGP adopted at the Amsterdam Summit in 1997 adjusts sanctions only in exceptional cases for countries' observed economic situation.

Now turn to the case of $\alpha > 0$. The following proposition is proven in Appendix J (available upon request):

Proposition 4. *Suppose that shocks are uncorrelated. With neither $\alpha > 0$ nor $\sigma^2 > 0$ too large, with dispersion in discipline types (i.e., $\exists i : \kappa_i > 0$) and given $0 < \psi \leq \frac{n-1}{n}$, one or more countries oppose a marginal increase (starting at $\delta = 0$) in the degree of contingency of sanctions on the observed economic situation.*

This proposition says that if the potential benefits from risk sharing are sufficiently small (because σ^2 is sufficiently small), and governments differ in terms of their discipline types, there will always be a government that would want to veto a change in the stability pact that introduces some degree of contingency of the sanctions to countries' economic situations.

5. Conclusions

This paper has explored the scope for a stability pact that imposes sanctions on excessive deficits. If all countries are identical and the common central bank is not completely independent, they can all be better off under such a pact. The pact reduces the excessive deficit bias that arises from monetary unification and may provide for risk sharing if the reference deficit levels on which the sanctions are based are made contingent on the observed economic situation. Differences in initial debt reduce the chances of unanimous support for a pact. Moral hazard reduces the attractiveness of making sanctions contingent on the observed economic situation of countries. In particular, relatively disciplined governments may be worse off under such a pact. This may explain why the Stability and Growth Pact concluded at the Amsterdam summit in June 1997 allows for sanctions to be lifted only in rather extreme situations. Indeed, in practice the moral hazard when sanctions are contingent may be important because of the general lack of transparency in budgetary processes.

There is a variety of possible extensions of the analysis in this paper. One direction of further research would involve a more thorough analysis of the enforcement problems with the SGP and their effect on the fiscal policies of the participating countries. In fact, many economists have expressed their doubts about the enforceability of the SGP (see, e.g., Buiter and Sibert, 1997).

Appendix

A. Proof of Lemma 1

First, consider the case with $\psi \neq \frac{n-1}{n}$. Then, if an equilibrium exists, it is unique. Substitute (9) and (10) into (13), which yields a unique solution for b_{1i}, $\forall i$, as a function of $\tilde{b}_1$. Hence, if multiple equilibria exist, they should all be characterised by different values of $\tilde{b}_1$. Now, start from an equilibrium and consider the effect of a change in $\tilde{b}_1$. Treat $\tilde{b}_1$ and b_{1i} as two separate variables and totally differentiate (13). We then find:

$$\frac{\partial b_{1i}}{\partial \tilde{b}_1} = -\frac{\frac{n}{n-1}\psi\left[u''(f_{1i}) + pu''(f_{2i}^r)\right] - \alpha^2/\left[\phi n(1-\psi)\right]}{\left[1 - \frac{n}{n-1}\psi\right]\left[u''(f_{1i}) + pu''(f_{2i}^r)\right]}, \quad \forall i.$$

As $0 \leq \psi < \frac{n-1}{n}$, this expression is negative, so that an increase in $\tilde{b}_1$ leads to a fall in b_{1i} for all i and, therefore, to a fall in $\tilde{b}_1$: a contradiction. Hence, there exists no second combination b_{1i}, $\forall i$, which fulfills (13), $\forall i$.

In the special case of $\psi = \frac{n-1}{n}$ and common shocks only, $\epsilon_i = \tilde{\epsilon}$, $\forall i$, we find that by combining (9), (10) and (13):

$$u'\left(1 + \tilde{\epsilon} + \tilde{b}_1 - \tilde{b}_0\right) = pu'\left(1 - \tilde{b}_1\right) + \alpha^2 \tilde{b}_1/\phi, \quad \forall i.$$

Clearly, an infinite number of debt equilibria exist, all with the same average debt level, $\tilde{b}_1$. However, each of these equilibria leads to the same level of public spending in periods 1 and 2.

B. Countries with higher initial debt run lower deficits

We show that under the conditions of Proposition 2 countries with higher initial debt run lower deficits both in the first and in the second period. Actually, we can show this also while relaxing the assumption that $\alpha \to 0$. Assuming that $\sigma_\epsilon^2 \to 0$, the first-order condition for first-period debt can be written as [using (9), (10), (13) and the definition of the deficit]:

$$\begin{aligned} & u'\left\{1+\tilde{b}_1-\tilde{b}_0+\left(\tfrac{n}{n-1}\psi-1\right)\left[\tilde{b}_1-\tilde{b}_0-d_{1i}\right]\right\}(1-\psi) \\ = \;& pu'\left\{1-\tilde{b}_1+\left(1-\tfrac{n}{n-1}\psi\right)\left(\tilde{b}_1-d_{1i}-b_{0i}\right)\right\}(1-\psi)+\alpha^2\tilde{b}_1/(\phi n), \quad \forall i. \end{aligned} \tag{B.1}$$

Let $i \neq j$ and assume that $b_{0i} > b_{0j}$. We have to show that this implies that $d_{1i} < d_{1j}$. We do this by contradiction. Suppose first that $d_{1i} \geq d_{1j}$ and $0 \leq \psi < \frac{n-1}{n}$. Then, LHS$_i$(B.1)≤LHS$_j$(B.1) and, hence, RHS$_i$(B.1)≤RHS$_j$(B.1) (where LHS$_i$(B.1) and RHS$_i$(B.1), respectively, denote the left- and right-hand side of equation (B.1) for i). This implies $\tilde{b}_1-d_{1i}-b_{0i} \geq \tilde{b}_1-d_{1j}-b_{0j}$ and thus $b_{0j}-b_{0i} \geq d_{1i}-d_{1j}$: a contradiction.

C. Coefficients of outcomes in the model with endogenous discipline

The coefficients of the strategies in (26) and (27) are given by

$$A_1 = \frac{\xi-p-(\xi-1)(1+p(1-\psi\delta))}{(\xi-1)+[p(\xi-1)+\alpha^2/\phi n(1-\psi)][1+(\xi-1)(1-\psi\delta)]}, \tag{C.1}$$

$$A_2 = \frac{1-\psi\delta}{1+(\xi-1)(1-\psi\delta)}\left[1-(\xi-1)A_1\right], \tag{C.2}$$

$$B_1 = -\frac{(\xi-1)(1-\psi)(1-\psi\delta)}{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\alpha^2/(\phi n^2)\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]}<0, \tag{C.3}$$

$$B_2 = -1-\left[\frac{(\xi-1)(1-\psi)^2(1+p)+\alpha^2/\left(\phi n^2\right)}{(\xi-1)(1-\psi)(1-\psi\delta)}\right]B_1<0, \tag{C.4}$$

$$C_1 = -\frac{1-\frac{n}{n-1}\psi\delta}{\left(1-\frac{n}{n-1}\psi\right)\left\{1+p\left[1+(\xi-1)(1-\psi\delta)\left(1-\frac{n}{n-1}\psi\delta\right)\right]\right\}} \leq 0, \tag{C.5}$$

$$C_2 = -\frac{(1+p)\left(1-\frac{n}{n-1}\psi\right)}{1-\frac{n}{n-1}\psi\delta}C_1>0. \tag{C.6}$$

The coefficients of the outcomes in (28)-(29) are given by

$$\begin{aligned} K_1 &= \left(1-\tfrac{n}{n-1}\psi\right)B_1+\left(1-\tfrac{n}{n-1}\psi\delta\right)(1+B_2) \\ &= \frac{(\xi-1)(1-\psi)(1-\delta)\frac{1}{n-1}\psi+\left[(\xi-1)(1-\psi)^2p+\alpha^2/\left(\phi n^2\right)\right]\left(1-\frac{n}{n-1}\psi\delta\right)}{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\alpha^2/(\phi n^2)\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]} \geq 0, \end{aligned} \tag{C.7}$$

$$\begin{aligned} K_2 &= -\left(1-\tfrac{n}{n-1}\psi\right)B_1 \\ &= \frac{(\xi-1)(1-\psi)\left(1-\frac{n}{n-1}\psi\right)(1-\psi\delta)}{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\alpha^2/(\phi n^2)\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]} \geq 0, \end{aligned} \tag{C.8}$$

$$
\begin{aligned}
L_1 &= \left(1 - \tfrac{n}{n-1}\psi\right) C_1 + \left(1 - \tfrac{n}{n-1}\psi\delta\right) C_2 \\
&= \frac{p\left(1-\frac{n}{n-1}\psi\delta\right)}{1+p\left[1+(\xi-1)(1-\psi\delta)\left(1-\frac{n}{n-1}\psi\delta\right)\right]} \geq 0, \qquad \text{(C.9)} \\
L_2 &= \tfrac{1}{p} L_1 \geq 0. \qquad \text{(C.10)}
\end{aligned}
$$

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Risk sharing and Moral Hazard with a Stability Pact

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Technical Appendices

D. Derivation of U_{CCB}, equation (6)

The CCB attaches a relative weight $0 \leq \lambda \leq 1$ to its objective under complete independence and a relative weight $1-\lambda$ to the average amount of resources available to the governments in period 2 (i.e., when inflation is decided). Hence, the CCB's objective function is given by:

$$
\begin{aligned}
U_{CCB} &= \lambda \left(-\frac{\pi^2}{2\phi}\right) + (1-\lambda)\tfrac{1}{n}\sum_{i=1}^{n}\left[1-(1+\pi^e-\pi)b_{1i} - \psi\left(d_{2i}-\bar{d}_{2i}\right) + \tfrac{\psi}{n-1}\sum_{j=1,j\neq i}^{n}\left(d_{2j}-\bar{d}_{2j}\right)\right] \\
&= (1-\lambda) \\
&\quad \times \left\{-\frac{\pi^2}{2\phi(1-\lambda)/\lambda} + \tfrac{1}{n}\sum_{i=1}^{n}\left[1-(1+\pi^e-\pi)b_{1i} - \psi\left(d_{2i}-\bar{d}_{2i}\right) + \tfrac{\psi}{n-1}\sum_{j=1,j\neq i}^{n}\left(d_{2j}-\bar{d}_{2j}\right)\right]\right\} \\
&= (1-\lambda)\left[-\frac{\pi^2}{2\alpha} + 1 - (1+\pi^e-\pi)\tilde{b}_1\right],
\end{aligned}
$$

where $\alpha \equiv \phi(1-\lambda)/\lambda \geq 0$, and where we have used that the fines and the rebates cancel out in the aggregate. Ignoring the proportionality factor, $(1-\lambda)$, equation (6) follows.

E. Proofs of Results (i) - (iv)

E.1. Result (i)

(a) Use (9) and (10) to write the first-order conditions (13) in the absence of a pact and with $p \to 1$ as

$$u'(1+b_{1i}-b_{0i}) = u'(1-b_{1i}) + \alpha^2\tilde{b}_1/(\phi n), \quad \forall i.$$

If $b_{0i} = 0$, $\forall i$, it follows immediately that $b_{1i} = \tilde{b}_1 = 0$, $\forall i$.

(b) When $p < 1$, the first-order conditions are

$$u'\left(1 + b_{1i} - b_{0i}\right) = pu'\left(1 - b_{1i}\right) + \alpha^2 \tilde{b}_1 / \left(\phi n\right), \quad \forall i.$$

Our assumption that $b_{0i} = \tilde{b}_0 \geq 0$, $\forall i$, implies that $b_{1i} = \tilde{b}_1 > 0$, $\forall i$. Denote the solution for $\tilde{b}_1$ by $\tilde{b}_1^*$. Implicit differentiation yields

$$\frac{\partial \tilde{b}_1}{\partial p} = \frac{u'\left(\tilde{f}_2^*\right)}{\Omega - \alpha^2 / \left(\phi n\right)} < 0,$$

with $\Omega \equiv u''\left(\tilde{f}_1^*\right) + pu''\left(\tilde{f}_2^*\right) < 0$ and where $\tilde{f}_1^*$ and $\tilde{f}_2^*$ denote the solutions for public spending. Finally, we have

$$\frac{\partial \tilde{b}_1}{\partial n} = -\frac{\alpha^2 \tilde{b}_1^* / \left(\phi n^2\right)}{\Omega - \alpha^2 / \left(\phi n\right)},$$

which is positive for $\alpha > 0$.

E.2. Result (ii)

Remember that the assumption $b_{0i} = \tilde{b}_0 \geq 0$, $\forall i$, implies $b_{1i} = \tilde{b}_1 > 0$, $\forall i$ (cf. Lemma 2). Then, implicit differentiation of (13) yields

$$\frac{\partial \tilde{b}_1}{\partial \psi} = \frac{u'\left(\tilde{f}_1^*\right) - pu'\left(\tilde{f}_2^*\right)}{\Omega\left(1 - \psi\right) - \alpha^2 / \left(\phi n\right)}.$$

Using (13), we rewrite this as:

$$\frac{\partial \tilde{b}_1}{\partial \psi} = \frac{\alpha^2 \tilde{b}_1^* / \left[\phi n \left(1 - \psi\right)\right]}{\Omega\left(1 - \psi\right) - \alpha^2 / \left(\phi n\right)} < 0.$$

Clearly, for $\alpha = 0$, $\partial \tilde{b}_1 / \partial \psi = 0$.

E.3. Result (iii)

Remember that the assumption $b_{0i} = \tilde{b}_0$, $\forall i$, implies $b_{1i} = \tilde{b}_1$, $\forall i$.

(a) Implicit differentiation of (13) yields

$$\frac{\partial \tilde{b}_1}{\partial \tilde{\epsilon}} = -\frac{u''\left(\tilde{f}_1^*\right)\left(1 - \psi\right)}{\Omega\left(1 - \psi\right) - \alpha^2 / \left(\phi n\right)} < 0.$$

(b) Differentiation of the expression for $\partial \tilde{b}_1 / \partial \tilde{\epsilon}$ above and using $u''' = 0$, establishes

that $\partial\left(\partial\tilde{b}_1/\partial\tilde{\epsilon}\right)/\partial n < 0$ and $\partial\left(\partial\tilde{b}_1/\partial\tilde{\epsilon}\right)/\partial\psi > 0$.

E.4. Result (iv)

We vary $(\tilde{\epsilon} - \epsilon_i)$ while assuming that $\mathrm{d}(\tilde{\epsilon} - \epsilon_j) = -\frac{1}{n-1}\mathrm{d}(\tilde{\epsilon} - \epsilon_i)$, $\forall j \neq i$. This manipulation keeps $\tilde{\epsilon}$ unchanged. Furthermore, we assume that, initially, $\epsilon_i = \tilde{\epsilon}$.

(a) Total differentiation of country i's first-order condition, (13), yields

$$\mathrm{d}b_{1i} = \frac{u''\left(\tilde{f}_1^*\right)\left(\frac{n}{n-1}\psi\delta - 1\right)}{\left(\frac{n}{n-1}\psi - 1\right)\Omega}\mathrm{d}\left(\tilde{\epsilon} - \epsilon_i\right) + \frac{\frac{n}{n-1}\psi\Omega\left(1-\psi\right) - \alpha^2/\left(\phi n\right)}{\left(\frac{n}{n-1}\psi - 1\right)\Omega\left(1-\psi\right)}\mathrm{d}\tilde{b}_1, \tag{E.1}$$

which is evaluated around the initial, symmetric equilibrium. Similarly, total differentiation of countries j's, $\forall j \neq i$, first-order condition, while using $\mathrm{d}(\tilde{\epsilon} - \epsilon_j) = -\frac{1}{n-1}\mathrm{d}(\tilde{\epsilon} - \epsilon_i)$ and evaluating around the initial equilibrium, implies

$$\mathrm{d}b_{1j} = -\frac{1}{n-1}\frac{u''\left(\tilde{f}_1^*\right)\left(\frac{n}{n-1}\psi\delta - 1\right)}{\left(\frac{n}{n-1}\psi - 1\right)\Omega}\mathrm{d}\left(\tilde{\epsilon} - \epsilon_i\right) + \frac{\frac{n}{n-1}\psi\Omega\left(1-\psi\right) - \alpha^2/\left(\phi n\right)}{\left(\frac{n}{n-1}\psi - 1\right)\Omega\left(1-\psi\right)}\mathrm{d}\tilde{b}_1, \quad \forall j \neq i, \tag{E.2}$$

Note that $\mathrm{d}\tilde{b}_1 = \frac{1}{n}\mathrm{d}b_{1i} + \frac{1}{n}\sum_{j\neq i}\mathrm{d}b_{1j}$ and combine this with (E.1) and (E.2) to imply that $\mathrm{d}\tilde{b}_1 = 0$. Hence,

$$\frac{\partial\left(b_{1i} - \tilde{b}_1\right)}{\partial\left(\tilde{\epsilon} - \epsilon_i\right)} = \frac{u''\left(f_1^*\right)\left(\frac{n}{n-1}\psi\delta - 1\right)}{\left(\frac{n}{n-1}\psi - 1\right)\Omega} > 0,$$

when $0 \leq \psi < \frac{n-1}{n}$.

(b) Differentiation of the expression for $\partial\left(b_{1i} - \tilde{b}_1\right)/\partial\left(\tilde{\epsilon} - \epsilon_i\right)$ above, while using that $u''' = 0$ readily establishes that $\partial\left[\partial\left(b_{1i} - \tilde{b}_1\right)/\partial\left(\tilde{\epsilon} - \epsilon_i\right)\right]/\partial\psi > 0$ and
$\partial\left[\partial\left(b_{1i} - \tilde{b}_1\right)/\partial\left(\tilde{\epsilon} - \epsilon_i\right)\right]/\partial\delta < 0$.

F. Schemes contingent on a linear combination of f_{1i} and $\epsilon_i + e_i$

In this appendix we show that sanction schemes (linearly) contingent on f_{1i}, or a combination of $\epsilon_i + e_i$ and f_{1i}, can be written as (17) or, equivalently, (19). Let

$$\begin{aligned} f_{1i} &= 1 + \epsilon_i + e_i + b_{1i} - \hat{\psi}\left[d_{1i} + \omega f_{1i} + \mu\left(\epsilon_i + e_i\right)\right] \\ &\quad + \frac{\hat{\psi}}{n-1}\sum_{j=1, j\neq i}^{n}\left[d_{1j} + \omega f_{1j} + \mu\left(\epsilon_j + e_j\right)\right], \end{aligned} \tag{F.1}$$

$$\iff \quad f_{1i} = 1 + \epsilon_i + e_i + b_{1i} - \hat{\psi}\left[d_{1i} + \mu\left(\epsilon_i + e_i\right)\right] - \hat{\psi}\omega f_{1i} + \frac{\hat{\psi}\omega}{n-1}\left(n\tilde{f}_1 - f_{1i}\right)$$

$$+\tfrac{\hat{\psi}n}{n-1}\left[\tilde{d}_1+\mu\left(\tilde{\epsilon}+\tilde{e}\right)\right]-\tfrac{\hat{\psi}}{n-1}\left[d_{1i}+\mu\left(\epsilon_i+e_i\right)\right],$$

$$\Longleftrightarrow\quad\left(1+\hat{\psi}\omega\right)f_{1i}=1+\epsilon_i+e_i+b_{1i}-\hat{\psi}\tfrac{n}{n-1}\left[d_{1i}+\mu\left(\epsilon_i+e_i\right)\right]$$
$$+\tfrac{\hat{\psi}\omega}{n-1}\left(n\tilde{f}_1-f_{1i}\right)+\tfrac{\hat{\psi}n}{n-1}\left[\tilde{d}_1+\mu\left(\tilde{\epsilon}+\tilde{e}\right)\right],$$

$$\Longleftrightarrow\quad\left(1+\hat{\psi}\omega\tfrac{n}{n-1}\right)f_{1i}=1+\epsilon_i+e_i+b_{1i}+\hat{\psi}\tfrac{n}{n-1}\left(\tilde{d}_1-d_{1i}\right)$$
$$+\hat{\psi}\tfrac{n}{n-1}\mu\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]+\tfrac{\hat{\psi}\omega n}{n-1}\tilde{f}_1.$$

Hence, $\tilde{f}_1=1+\tilde{\epsilon}+\tilde{e}+\tilde{b}_1$. Substitute this into the right-hand side of the previous equation and use that $d_{1i}=b_{1i}$ and $\tilde{d}_1=\tilde{b}_1$. This yields:

$$\begin{aligned}\left(1+\hat{\psi}\omega\tfrac{n}{n-1}\right)f_{1i}\;&=\;1+\epsilon_i+e_i+b_{1i}+\hat{\psi}\tfrac{n}{n-1}\left(\tilde{b}_1-b_{1i}\right)\\&\quad+\hat{\psi}\tfrac{n}{n-1}\mu\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]+\tfrac{\hat{\psi}\omega n}{n-1}\left(1+\tilde{\epsilon}+\tilde{e}+\tilde{b}_1\right),\end{aligned}$$

$$\Longleftrightarrow\quad\left(1+\hat{\psi}\omega\tfrac{n}{n-1}\right)f_{1i}=\left(1+\tilde{\epsilon}+\tilde{e}+\tilde{b}_1\right)\left(1+\hat{\psi}\omega\tfrac{n}{n-1}\right)+\hat{\psi}\tfrac{n}{n-1}\left(\tilde{b}_1-b_{1i}\right)$$
$$+\hat{\psi}\tfrac{n}{n-1}\mu\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]+\left(\epsilon_i-\tilde{\epsilon}\right)+\left(e_i-\tilde{e}\right)+\left(b_{1i}-\tilde{b}_1\right),$$

$$\Longleftrightarrow\quad f_{1i}=\left(1+\tilde{\epsilon}+\tilde{e}+\tilde{b}_1\right)+\tfrac{\hat{\psi}\frac{n}{n-1}-1}{1+\hat{\psi}\omega\frac{n}{n-1}}\left(\tilde{b}_1-b_{1i}\right)$$
$$+\tfrac{\hat{\psi}\frac{n}{n-1}\mu-1}{1+\hat{\psi}\omega\frac{n}{n-1}}\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right].$$

This is equivalent to (19) if (ψ,δ) are chosen such that:

$$\frac{\hat{\psi}\frac{n}{n-1}-1}{1+\hat{\psi}\omega\frac{n}{n-1}}=\psi\tfrac{n}{n-1}-1,$$

$$\frac{\hat{\psi}\frac{n}{n-1}\mu-1}{1+\hat{\psi}\omega\frac{n}{n-1}}=\psi\delta\tfrac{n}{n-1}-1.$$

The solution to this system is:

$$\psi=\frac{\hat{\psi}\left(1+\omega\right)}{1+\hat{\psi}\omega\frac{n}{n-1}},\qquad\delta=\frac{\omega+\mu}{1+\omega}.$$

Hence, by appropriately choosing (ψ, δ) for given $\left(\hat{\psi}, \omega, \mu\right)$, one can write (F.1) as (19) or, equivalently, (17).

G. Derivation of outcomes for b_{1i}, (26), and e_i, (27)

For convenience, we repeat the relevant budget constraints from the first-period government's perspective:

$$f_{1i} = 1 + \tilde{\epsilon} + \tilde{e} + \tilde{b}_1 + \left(\tfrac{n}{n-1}\psi - 1\right)\left(\tilde{b}_1 - b_{1i}\right) + \left(\tfrac{n}{n-1}\psi\delta - 1\right)\left[(\tilde{\epsilon} - \epsilon_i) + (\tilde{e} - e_i)\right], \quad \text{(G.1)}$$

$$f_{2i}^{\,r} = 1 - \tilde{b}_1 + \left(1 - \tfrac{n}{n-1}\psi\right)\left(\tilde{b}_1 - b_{1i}\right), \quad \text{(G.2)}$$

and the expression for inflation

$$\pi = \alpha\tilde{b}_1. \quad \text{(G.3)}$$

In period 1, each government selects debt and effort, knowing its own shock but not knowing the other countries' shocks. These choices are taken simultaneously, so we consider a "Cournotian game" for which we want to characterise the (Bayesian) Nash equilibrium. Note that the fact that the governments subsequently can observe the sum of e_i and ϵ_i in all countries is of no importance for the equilibrium outcomes: knowing that you get information about something later is of no use now (by the law of iterated projections).

Government i maximises

$$U_{Fi}(.) = \mathrm{E}_i\left[-v_i(e_i) + u(f_{1i}) + pu(f_{2i}) - \pi^2/(2\phi)\right].$$

over b_{1i} and e_i.

G.1. The equilibrium conditions for a (Bayesian) Nash equilibrium with quadratic utility

Consider first the choice of debt. Maximising $U_{Fi}(.)$ with respect to b_{1i} subject to (G.1), (G.2), and (G.3), taking as given b_{1j}, $\forall j$, $j \neq i$, as well as e_i, $\forall i$, yields the following first-order conditions:

$$\mathrm{E}_i\left[u'(f_{1i})\right](1-\psi) = \mathrm{E}_i\left[pu'(f_{2i}^r)\right](1-\psi) + \mathrm{E}_i\left[\alpha^2\tilde{b}_1/(\phi n)\right], \quad \forall i. \quad \text{(G.4)}$$

The choice of discipline is characterised by maximising $U_{Fi}(.)$ with respect to e_i subject to (19), (10), and (7), taking as given e_j, $\forall j$, $j \neq i$, as well as b_{1i}, $\forall i$. The necessary first-order conditions are given by

$$v_i'(e_i) = \mathrm{E}_i\left[u'(f_{1i})\right](1-\psi\delta), \quad \forall i. \tag{G.5}$$

Applying the specifications for u and v adopted in the text, the first-order conditions (G.4) and (G.5) become

$$\begin{aligned}
\mathrm{E}_i\left[\xi - (\xi-1) f_{1i}\right] &= p\mathrm{E}_i\left[\xi - (\xi-1) f_{2i}^r\right] + \left[\alpha^2/\left(\phi n(1-\psi)\right)\right]\mathrm{E}_i\left[\tilde{b}_1\right], \quad \forall i, \\
e_i - \kappa_i &= \mathrm{E}_i\left[\xi - (\xi-1) f_{1i}\right](1-\psi\delta), \quad \forall i.
\end{aligned}$$

Because u and v are quadratic, these conditions are not only necessary, but also sufficient.

Now use that $\lambda = \alpha^2/\left(\phi n(1-\psi)\right)$. Hence, these conditions become:

$$(1-p)\xi - (\xi-1)\mathrm{E}_i\left[f_{1i}\right] = -p(\xi-1)\mathrm{E}_i\left[f_{2i}^r\right] + \lambda\mathrm{E}_i\left[\tilde{b}_1\right], \quad \forall i, \tag{G.6}$$

$$e_i - \kappa_i = \xi(1-\psi\delta) - (\xi-1)(1-\psi\delta)\mathrm{E}_i\left[f_{1i}\right], \quad \forall i. \tag{G.7}$$

In the Bayesian Nash equilibrium we consider, each government i's strategy will be a function of ϵ_i and its estimates about other countries' shocks, and estimates about other governments' estimates about ϵ_j, $\forall j$, and so on. In a n-player game like this one, the algebra would become rather intractable. However, as we have assumed that the shocks have zero mean, taking this iterative process into account becomes particularly simple, because these estimates simply vanish. As a result, government i's strategy depends only on the realisation of ϵ_i, but not the other shocks.

Therefore, we conjecture the following set of equilibrium strategies:

$$b_{1i} = A_1 + B_1\epsilon_i + C_1\kappa_i, \tag{G.8}$$

$$e_i = A_2 + B_2\epsilon_i + C_2\kappa_i. \tag{G.9}$$

If this conjecture is correct, the realisations of average debt and discipline will be given by, respectively,

$$\tilde{b}_1 = A_1 + B_1\tilde{\epsilon}, \tag{G.10}$$

$$\tilde{e} = A_2 + B_2\tilde{\epsilon}, \tag{G.11}$$

where we have used that $\tilde{\kappa} = 0$.

Hence, the realisations of public consumption are given by

$$\begin{aligned} f_{1i} &= 1+\tilde{\epsilon}+A_2+B_2\tilde{\epsilon}+A_1+B_1\tilde{\epsilon}+\left(\tfrac{n}{n-1}\psi-1\right)(B_1\tilde{\epsilon}-B_1\epsilon_i-C_1\kappa_i) \\ &\quad +\left(\tfrac{n}{n-1}\psi\delta-1\right)\left[\tilde{\epsilon}-\epsilon_i+(B_2\tilde{\epsilon}-B_2\epsilon_i-C_2\kappa_i)\right]. \end{aligned} \tag{G.12}$$

$$f_{2i}^r = 1-[A_1+B_1\tilde{\epsilon}]+\left(1-\tfrac{n}{n-1}\psi\right)(B_1\tilde{\epsilon}-B_1\epsilon_i-C_1\kappa_i). \tag{G.13}$$

To verify the conjectured strategies and to solve for its coefficients, we need to compute the expectations of these expressions, conditional upon government i's information set. From (G.12) we find:

$$\begin{aligned} \mathrm{E}_i[f_{1i}] &= 1+\tilde{\epsilon}+A_2+B_2\frac{1}{n}\epsilon_i+A_1+B_1\frac{1}{n}\epsilon_i \\ &\quad +\left(\tfrac{n}{n-1}\psi-1\right)\left(B_1\frac{1}{n}\epsilon_i-C_1\kappa_i-B_1\epsilon_i\right) \\ &\quad +\left(\tfrac{n}{n-1}\psi\delta-1\right)\left[\frac{1}{n}\epsilon_i-\epsilon_i+B_2\frac{1}{n}\epsilon_i-C_2\kappa_i-B_2\epsilon_i\right] \end{aligned}$$

and thus

$$\begin{aligned} \mathrm{E}_i[f_{1i}] &= 1+A_1+A_2+\left(\frac{1+B_1+B_2}{n}\right)\epsilon_i-\left(\tfrac{n}{n-1}\psi-1\right)\left(C_1\kappa_i+B_1\frac{n-1}{n}\epsilon_i\right) \\ &\quad -\left(\tfrac{n}{n-1}\psi\delta-1\right)\left[\frac{n-1}{n}(1+B_2)\epsilon_i+C_2\kappa_i\right] \\ &= 1+A_1+A_2-\left(\tfrac{n}{n-1}\psi-1\right)C_1\kappa_i-\left(\tfrac{n}{n-1}\psi\delta-1\right)C_2\kappa_i \\ &\quad +\left[\frac{1+B_1+B_2}{n}-\left(\tfrac{n}{n-1}\psi-1\right)B_1\frac{n-1}{n}-\left(\tfrac{n}{n-1}\psi\delta-1\right)\frac{n-1}{n}(1+B_2)\right]\epsilon_i, \end{aligned}$$

and thus

$$\begin{aligned} \mathrm{E}_i\{f_{1i}\} &= 1+A_1+A_2-\left(\tfrac{n}{n-1}\psi-1\right)C_1\kappa_i-\left(\tfrac{n}{n-1}\psi\delta-1\right)C_2\kappa_i \\ &\quad +\left[(1+B_2)(1-\psi\delta)+B_1(1-\psi)\right]\epsilon_i. \end{aligned} \tag{G.14}$$

Similarly, we find the expected public consumption in period two by use of (G.13):

$$\begin{aligned} \mathrm{E}_i[f_{2i}^r] &= 1-\left[A_1+B_1\frac{1}{n}\epsilon_i\right] \\ &\quad +\left(1-\tfrac{n}{n-1}\psi\right)\left(B_1\frac{1}{n}\epsilon_i-C_1\kappa_i-B_1\epsilon_i\right) \end{aligned}$$

and thus

$$\mathrm{E}_i[f_{2i}^r] = 1-A_1-\left(1-\tfrac{n}{n-1}\psi\right)C_1\kappa_i-B_1(1-\psi)\epsilon_i. \tag{G.15}$$

Finally, we need to find government i's expectation of average debt. This follows by use of (G.10) as

$$\mathrm{E}_i\left[\tilde{b}_1\right] = A_1 + B_1 \frac{1}{n}\epsilon_i. \tag{G.16}$$

G.2. Verification of conjectures and solution

Insert the expressions for $\mathrm{E}_i[f_{1i}]$, $\mathrm{E}_i[f_{2i}^r]$ and $\mathrm{E}_i\left[\tilde{b}_1\right]$ into the first-order conditions. This yields [also using the conjecture for e_i, equation (G.9)]:

$$\begin{aligned} & (1-p)\,\xi - (\xi - 1)\left[1 + A_1 + A_2 - \left(\tfrac{n}{n-1}\psi - 1\right)C_1\kappa_i - \left(\tfrac{n}{n-1}\psi\delta - 1\right)C_2\kappa_i\right. \\ & \left. + \left[(1+B_2)(1-\psi\delta) + B_1(1-\psi)\right]\epsilon_i\right] \\ = \; & -p\,(\xi-1)\left[1 - A_1 - \left(1 - \tfrac{n}{n-1}\psi\right)C_1\kappa_i - B_1(1-\psi)\,\epsilon_i\right] \\ & + \lambda\left[A_1 + B_1\frac{1}{n}\epsilon_i\right], \end{aligned} \tag{G.17}$$

and

$$\begin{aligned} & A_2 + C_2\kappa_i + B_2\epsilon_i - \kappa_i \\ = \; & \xi(1-\psi\delta) - (\xi-1)(1-\psi\delta)\left[1 + A_1 + A_2 - \left(\tfrac{n}{n-1}\psi - 1\right)C_1\kappa_i - \left(\tfrac{n}{n-1}\psi\delta - 1\right)C_2\kappa_i\right. \\ & \left. + \left[(1+B_2)(1-\psi\delta) + B_1(1-\psi)\right]\epsilon_i\right]. \end{aligned} \tag{G.18}$$

G.2.1. Solution for shock coefficients

As (G.17) and (G.18) must hold for all values of ϵ_i, we have that the following must hold:

$$-(\xi-1)\left[(1+B_2)(1-\psi\delta) + B_1(1-\psi)\right] = p\,(\xi-1)\,B_1(1-\psi) + \lambda B_1\frac{1}{n}, \tag{G.19}$$

$$B_2 = -(\xi-1)(1-\psi\delta)\left[(1+B_2)(1-\psi\delta) + B_1(1-\psi)\right]. \tag{G.20}$$

These expressions uniquely identify coefficients B_1 and B_2. By inserting (G.20)'s implied value for $(1+B_2)(1-\psi\delta) + B_1(1-\psi)$ into (G.19), we get

$$\frac{B_2}{(1-\psi\delta)} = p\,(\xi-1)\,B_1(1-\psi) + \lambda B_1\frac{1}{n},$$

leading to a value of B_2, given B_1,

$$B_2 = B_1(1-\psi\delta)\left[p\,(\xi-1)(1-\psi) + \lambda\frac{1}{n}\right]. \tag{G.21}$$

Inserting this value back into (G.19) then gives

$$
\begin{aligned}
& -(\xi-1)\left[\left(1+B_1(1-\psi\delta)\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]\right)(1-\psi\delta)+B_1(1-\psi)\right] \\
= \; & B_1\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]
\end{aligned}
$$

We isolate B_1 on the left-hand-side to get:

$$
B_1\left[-\left[(\xi-1)(1-\psi\delta)^2+1\right]\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]-(\xi-1)(1-\psi)\right]=(\xi-1)(1-\psi\delta).
$$

Hence, the solution is

$$
B_1=-\frac{(\xi-1)(1-\psi\delta)}{\left[(\xi-1)(1-\psi\delta)^2+1\right]\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]+(\xi-1)(1-\psi)}<0. \quad \text{(G.22)}
$$

Combined with (G.21), we then recover the expression for B_2:

$$
B_2=-\frac{(\xi-1)(1-\psi\delta)^2\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]}{\left[(\xi-1)(1-\psi\delta)^2+1\right]\left[p(\xi-1)(1-\psi)+\lambda\frac{1}{n}\right]+(\xi-1)(1-\psi)}<0. \quad \text{(G.23)}
$$

G.2.2. Solution for average effort and debt

Now, with B_1 and B_2 given by (G.22) and (G.23), respectively, (G.17) and (G.18) reduce to

$$
\begin{aligned}
& (1-p)\xi-(\xi-1)\left[1+A_1+A_2-\left(\tfrac{n}{n-1}\psi-1\right)C_1\kappa_i-\left(\tfrac{n}{n-1}\psi\delta-1\right)C_2\kappa_i\right] \\
= \; & -p(\xi-1)\left[1-A_1-\left(1-\tfrac{n}{n-1}\psi\right)C_1\kappa_i\right]+\lambda A_1, \qquad \text{(G.24)}
\end{aligned}
$$

and

$$
\begin{aligned}
& A_2+C_2\kappa_i-\kappa_i \\
= \; & \xi(1-\psi\delta) \\
& -(\xi-1)(1-\psi\delta)\left[1+A_1+A_2-\left(\tfrac{n}{n-1}\psi-1\right)C_1\kappa_i-\left(\tfrac{n}{n-1}\psi\delta-1\right)C_2\kappa_i\right].
\end{aligned}
$$

We now want to determine A_1, A_2, $C_1\kappa_i$ and $C_2\kappa_i$. For this purpose we sum all the left-hand and right-hand sides of these $2n$ equations (and divide the results by n). We thus have the following two conditions (as $\tilde{\kappa}=0$):

$$
(1-p)\xi-(\xi-1)(1+A_1+A_2)=-p(\xi-1)(1-A_1)+\lambda A_1, \qquad \text{(G.25)}
$$

and

$$A_2 = \xi\left(1-\psi\delta\right) - \left(\xi-1\right)\left(1-\psi\delta\right)\left(1+A_1+A_2\right). \tag{G.26}$$

These equations identify A_1 and A_2. From (G.26) we obtain the following solution for A_2:

$$A_2 = \frac{\xi\left(1-\psi\delta\right) - \left(\xi-1\right)\left(1-\psi\delta\right)\left(1+A_1\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}. \tag{G.27}$$

We then plug the solution for A_2 from (G.27) back into (G.25) so as to identify A_1:

$$\begin{aligned} & \left(1-p\right)\xi - \left(\xi-1\right)\left[1+A_1+\frac{\xi\left(1-\psi\delta\right) - \left(\xi-1\right)\left(1-\psi\delta\right)\left(1+A_1\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}\right] \\ = \; & -p\left(\xi-1\right)\left[1-A_1\right] + \lambda A_1. \end{aligned}$$

Isolating the A_1 part gives:

$$\begin{aligned} & \left[-\frac{\left(\xi-1\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)} - p\left(\xi-1\right) - \lambda\right] A_1 \\ = \; & -\left(1-p\right)\xi + \left(\xi-1\right)\left[1+\frac{\left(1-\psi\delta\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}\right] - p\left(\xi-1\right) \end{aligned}$$

$$\begin{aligned} \Leftrightarrow \; & \left[-\frac{\left(\xi-1\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)} - p\left(\xi-1\right) - \lambda\right] A_1 \\ = \; & p - \xi + \frac{\left(\xi-1\right)\left(1+\xi\left(1-\psi\delta\right)\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}. \end{aligned}$$

And thereby

$$\begin{aligned} A_1 &= \frac{p-\xi+\dfrac{\left(\xi-1\right)\left(1+\xi\left(1-\psi\delta\right)\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}}{-\dfrac{\left(\xi-1\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)} - p\left(\xi-1\right) - \lambda} \\ &= \frac{\left(\xi-p\right)\left(1+\left(\xi-1\right)\left(1-\psi\delta\right)\right) - \left(\xi-1\right)\left(1+\xi\left(1-\psi\delta\right)\right)}{\left(\xi-1\right)+\left(p\left(\xi-1\right)+\lambda\right)\left(1+\left(\xi-1\right)\left(1-\psi\delta\right)\right)} \\ &= \frac{\xi-p-\left(\xi-1\right)\left(1+p\left(1-\psi\delta\right)\right)}{\left(\xi-1\right)+\left(p\left(\xi-1\right)+\lambda\right)\left(1+\left(\xi-1\right)\left(1-\psi\delta\right)\right)}. \end{aligned} \tag{G.28}$$

Inserting this value of A_1 back into (G.27) then provides the solution for A_2:

$$A_2 = \frac{\left(1-\psi\delta\right)}{1+\left(\xi-1\right)\left(1-\psi\delta\right)}\left[1-\frac{\left(\xi-1\right)\left[\xi-p-\left(\xi-1\right)\left(1+p\left(1-\psi\delta\right)\right)\right]}{\left(\xi-1\right)+\left(p\left(\xi-1\right)+\lambda\right)\left(1+\left(\xi-1\right)\left(1-\psi\delta\right)\right)}\right]. \tag{G.29}$$

G.2.3. Solution for country-specific discipline and debt

Having derived these averages, we can now go back to each government i's optimality conditions and find the "idiosyncratic" components of the strategies. Let us repeat the conditions:

$$\begin{aligned} & (1-p)\,\xi - (\xi-1)\left[1 + A_1 + A_2 + C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right) + C_2\kappa_i\left(1-\psi\delta\tfrac{n}{n-1}\right)\right] \\ = & -p\,(\xi-1)\left[1 - A_1 - C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right)\right] + \lambda A_1, \end{aligned} \tag{G.30}$$

and

$$\begin{aligned} & A_2 + C_1\kappa_i - \kappa_i \\ = & \ \xi\,(1-\psi\delta) - (\xi-1)\,(1-\psi\delta)\left[1 + A_1 + A_2 + C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right) + C_2\kappa_i\left(1-\psi\delta\tfrac{n}{n-1}\right)\right]. \end{aligned} \tag{G.31}$$

From this system of equations we subtract (G.25)-(G.26), to yield:

$$-\,(\xi-1)\left[C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right) + C_2\kappa_i\left(1-\psi\delta\tfrac{n}{n-1}\right)\right] = p\,(\xi-1)\,C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right), \tag{G.32}$$

and

$$C_2\kappa_i - \kappa_i = -\,(\xi-1)\,(1-\psi\delta)\left[C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right) + C_2\kappa_i\left(1-\psi\delta\tfrac{n}{n-1}\right)\right]. \tag{G.33}$$

From (G.32) we then immediately find

$$(1+p)\,C_1\kappa_i\left(1-\psi\tfrac{n}{n-1}\right) = -C_2\kappa_i\left(1-\psi\delta\tfrac{n}{n-1}\right),$$

and thus

$$C_1\kappa_i = -\frac{1-\psi\delta\frac{n}{n-1}}{\left(1-\psi\frac{n}{n-1}\right)(1+p)}C_2\kappa_i. \tag{G.34}$$

This is then inserted back into (G.33) to solve for $C_2\kappa_i$:

$$C_2\kappa_i - \kappa_i = -\,(\xi-1)\,(1-\psi\delta)\,\frac{p}{1+p}\left(1-\psi\delta\tfrac{n}{n-1}\right)C_2\kappa_i,$$

and therefore

$$C_2\kappa_i\left[1 + \frac{(\xi-1)\,(1-\psi\delta)\,p\left(1-\psi\delta\frac{n}{n-1}\right)}{1+p}\right] = \kappa_i,$$

leading to

$$C_2 = \frac{1+p}{1+p+(\xi-1)(1-\psi\delta)\,p\left(1-\psi\delta\frac{n}{n-1}\right)}. \tag{G.35}$$

Inserted back into (G.34) we then solve for C_1:

$$C_1 = -\frac{1-\psi\delta\frac{n}{n-1}}{\left(1-\psi\frac{n}{n-1}\right)\left[1+p+(\xi-1)(1-\psi\delta)\,p\left(1-\psi\delta\frac{n}{n-1}\right)\right]}. \tag{G.36}$$

H. Proof of results (v) - (ix)

H.1. Result (v)

(a) One can rewrite

$$A_1 = (1-\psi)\frac{1-p\left[1+(\xi-1)(1-\psi\delta)\right]}{(1-\psi)(\xi-1)\{1+p\left[1+(\xi-1)(1-\psi\delta)\right]\}+(\alpha^2/\phi n)\left[1+(\xi-1)(1-\psi\delta)\right]}.$$

Hence,

$$\begin{aligned}
\frac{\partial A_1}{\partial\delta} &\propto p(\xi-1)\psi(1-\psi)(\xi-1)\{1+p\left[1+(\xi-1)(1-\psi\delta)\right]\} \\
&\quad +p(\xi-1)\psi\left(\alpha^2/\phi n\right)\left[1+(\xi-1)(1-\psi\delta)\right] \\
&\quad +\left[(1-\psi)(\xi-1)p(\xi-1)\psi+\left(\alpha^2/\phi n\right)(\xi-1)\psi\right]\{1-p\left[1+(\xi-1)(1-\psi\delta)\right]\} \\
&\propto p\left\{(1-\psi)(\xi-1)\{1+p\left[1+(\xi-1)(1-\psi\delta)\right]\}+\left(\alpha^2/\phi n\right)\left[1+(\xi-1)(1-\psi\delta)\right]\right\} \\
&\quad +\left[(1-\psi)(\xi-1)p+\left(\alpha^2/\phi n\right)\right]\{1-p\left[1+(\xi-1)(1-\psi\delta)\right]\} \\
&= p(1-\psi)(\xi-1)\{1+p\left[1+(\xi-1)(1-\psi\delta)\right]\} \\
&\quad +\left[(1-\psi)(\xi-1)p+\left(\alpha^2/\phi n\right)\right] \\
&\quad -(1-\psi)(\xi-1)p^2\left[1+(\xi-1)(1-\psi\delta)\right] \\
&= p(1-\psi)(\xi-1)+p^2(1-\psi)(\xi-1)\left[1+(\xi-1)(1-\psi\delta)\right] \\
&\quad +\left[(1-\psi)(\xi-1)p+\left(\alpha^2/\phi n\right)\right]-(1-\psi)(\xi-1)p^2\left[1+(\xi-1)(1-\psi\delta)\right] \\
&= p(1-\psi)(\xi-1)+(1-\psi)(\xi-1)p+\left(\alpha^2/\phi n\right) \\
&> 0.
\end{aligned}$$

where the symbol $\propto$ is used to indicate that the right-hand side has the same sign as the left-hand side. Further,

$$\frac{\partial A_2}{\partial\delta} = -\frac{\psi}{\left[1+(\xi-1)(1-\psi\delta)\right]^2}\left[1-(\xi-1)A_1\right]+\left[\frac{1-\psi\delta}{1+(\xi-1)(1-\psi\delta)}\right]\frac{\partial\left[1-(\xi-1)A_1\right]}{\partial\delta}.$$

Because $1-(\xi-1)A_1>0$ (this is easy to show), the first term on the right-hand side is negative. In addition, from the result that $\frac{\partial A_1}{\partial \delta}>0$ (and the restrictions imposed on the parameters), it follows that the second term on the right-hand side is also negative. Hence, $\frac{\partial A_2}{\partial \delta}<0$.

(b.1) Immediate, because neither A_1 nor A_2 depends on ψ.

(b.2) If $\delta>0$ and $\alpha=0$, we can write:

$$A_1=\frac{1-p\left[1+(\xi-1)(1-\psi\delta)\right]}{(\xi-1)\left\{1+p\left[1+(\xi-1)(1-\psi\delta)\right]\right\}}.$$

Hence, ψ enters A_1 and A_2 only through the combination $\psi\delta$. Hence, from *Result (v)(a)*, which holds in particular also if $\alpha=0$, the desired result follows immediately.

(b.3) If $\delta=0$ and $\alpha>0$, we can write:

$$A_1=\frac{1-p\xi}{(\xi-1)(1+p\xi)+\left[\alpha^2/\phi n(1-\psi)\right]\xi}.$$

Using that $p\xi<1$, the results follow immediately.

H.2. Result (vi)

(a) One can write B_1 as:

$$B_1=-(\xi-1)(1-\psi)\left(\frac{y}{\gamma_0+\gamma_1 y^2}\right),$$

where

$$\begin{aligned} y &\equiv (1-\psi\delta)>0,\\ \gamma_0 &\equiv (\xi-1)(1-\psi)^2(1+p)+\alpha^2/\phi n^2>0,\\ \gamma_1 &\equiv \left[(\xi-1)(1-\psi)^2 p+\alpha^2/\phi n^2\right](\xi-1)>0. \end{aligned}$$

Hence,

$$\frac{\partial B_1}{\partial y}=-(\xi-1)(1-\psi)\left[\frac{\gamma_0-\gamma_1 y^2}{\left(\gamma_0+\gamma_1 y^2\right)^2}\right].$$

Hence, $\frac{\partial B_1}{\partial \delta}>0$ is equivalent to $\gamma_0>\gamma_1 y^2$, which is equivalent to:

$$(\xi-1)(1-\psi)^2(1+p)+\alpha^2/\phi n^2>\left[(\xi-1)(1-\psi)^2 p+\alpha^2/\phi n^2\right](\xi-1)(1-\psi\delta)^2.$$

Given the parameter conditions that have been imposed, this condition is fulfilled.

(b) We can write:

$$B_2 = -\left(\frac{\gamma_1 y^2}{\gamma_0 + \gamma_1 y^2}\right),$$

An increase in δ reduces y and, hence, the result follows.

H.3. Result (vii)

(a) One has:

$$\begin{aligned}
\frac{\partial C_1}{\partial \delta} &\propto \tfrac{n}{n-1}\psi\left(1-\tfrac{n}{n-1}\psi\right)\left\{1+p\left[1-(1-\xi)(1-\psi\delta)\left(1-\tfrac{n}{n-1}\psi\delta\right)\right]\right\} \\
&\quad +\left(1-\tfrac{n}{n-1}\psi\right)p(\xi-1)\left[-(1-\psi\delta)\tfrac{n}{n-1}\psi-\left(1-\tfrac{n}{n-1}\psi\delta\right)\psi\right]\left(1-\tfrac{n}{n-1}\psi\delta\right) \\
&\propto \tfrac{n}{n-1}\left(1-\tfrac{n}{n-1}\psi\right)+\tfrac{n}{n-1}\left(1-\tfrac{n}{n-1}\psi\right)p\left[1+(\xi-1)(1-\psi\delta)\left(1-\tfrac{n}{n-1}\psi\delta\right)\right] \\
&\quad -p(\xi-1)\tfrac{n}{n-1}\left(1-\tfrac{n}{n-1}\psi\right)(1-\psi\delta)\left(1-\tfrac{n}{n-1}\psi\delta\right) \\
&\quad -p\left(1-\tfrac{n}{n-1}\psi\right)(\xi-1)\left(1-\tfrac{n}{n-1}\psi\delta\right)^2 \\
&= \tfrac{n}{n-1}\left(1-\tfrac{n}{n-1}\psi\right)(1+p)-\left(1-\tfrac{n}{n-1}\psi\right)(\xi-1)\left(1-\tfrac{n}{n-1}\psi\delta\right)^2 p \\
&= \left(1-\tfrac{n}{n-1}\psi\right)\left[\tfrac{n}{n-1}(1+p)-p(\xi-1)\left(1-\tfrac{n}{n-1}\psi\delta\right)^2\right] \\
&> 0.
\end{aligned}$$

(b) Immediate.

H.4. Result (viii)

(a) One has:

$$\begin{aligned}
\frac{\partial L_1}{\partial \delta} &\propto -\tfrac{n}{n-1}\psi\left\{1+p\left[1+(\xi-1)(1-\psi\delta)\left(1-\tfrac{n}{n-1}\psi\delta\right)\right]\right\} \\
&\quad +p(\xi-1)\left[(1-\psi\delta)\tfrac{n}{n-1}\psi+\left(1-\tfrac{n}{n-1}\psi\delta\right)\psi\right]\left(1-\tfrac{n}{n-1}\psi\delta\right) \\
&= -\tfrac{n}{n-1}\psi(1+p)-\tfrac{n}{n-1}\psi p(\xi-1)(1-\psi\delta)\left(1-\tfrac{n}{n-1}\psi\delta\right) \\
&\quad +p(\xi-1)(1-\psi\delta)\tfrac{n}{n-1}\psi\left(1-\tfrac{n}{n-1}\psi\delta\right)+p(\xi-1)\psi\left(1-\tfrac{n}{n-1}\psi\delta\right)^2 \\
&\propto -\tfrac{n}{n-1}(1+p)+p(\xi-1)\left(1-\tfrac{n}{n-1}\psi\delta\right)^2 \\
&= -\tfrac{1}{n-1}(1+p)-1+p\left[(\xi-1)\left(1-\tfrac{n}{n-1}\psi\delta\right)^2-1\right] \\
&< 0.
\end{aligned}$$

(b) Immediate, using *Result (viii)(a)*.

H.5. Result (ix)

(a) Immediate.

(b) Immediate.

I. Proof that for $\kappa_i \geq 0$ it is no longer optimal to have $(\psi, \delta) = (\frac{n-1}{n}, 1)$

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

$$V_{Fi}(\psi,\delta) \equiv \mathrm{E}_{\epsilon}\left[-\left(e_i-\kappa_i\right)^2/2+u\left(f_{1i}\right)+pu\left(f_{2i}\right)-\left(\alpha\tilde{b}_1\right)^2/\left(2\phi\right)\right],$$

where f_{1i} and f_{2i} are understood to be evaluated for the equilibrium outcomes. Differentiating this expression with respect to δ and evaluating at $\theta^* \equiv (\psi,\delta) = (\frac{n-1}{n}, 1)$ yields:

$$\left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\theta^*} = \mathrm{E}_{\epsilon|\theta^*}\left[-\left(e_i-\kappa_i\right)\frac{\partial e_i}{\partial\delta}+u'(f_{1i})\frac{\partial f_{1i}}{\partial\delta}+pu'(f_{2i})\frac{\partial f_{2i}}{\partial\delta}-\frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\right],$$

where the subscript "$|\ \theta^*$ " is used to indicate that the expectation on the right-hand side is evaluated at θ^* and where, using (19) and (10), respectively,

$$\left.\frac{\partial f_{1i}}{\partial\delta}\right|_{\theta^*} = \frac{\partial\tilde{e}}{\partial\delta}+\frac{\partial\tilde{b}_1}{\partial\delta}+\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right], \qquad \left.\frac{\partial f_{2i}}{\partial\delta}\right|_{\theta^*} = -\frac{\partial\tilde{b}_1}{\partial\delta}.$$

Hence,

$$\left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\theta^*} = \mathrm{E}_{\epsilon|\theta^*}\left[\begin{array}{c}-\left(e_i-\kappa_i\right)\frac{\partial e_i}{\partial\delta}+u'(f_{1i})\left[\frac{\partial\tilde{e}}{\partial\delta}+\frac{\partial\tilde{b}_1}{\partial\delta}+\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]\right]\\-pu'(f_{2i})\frac{\partial\tilde{b}_1}{\partial\delta}-\frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\end{array}\right].$$

Hence, using government i's first-order condition for e_i and the law of iterated expectations:

$$\left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\theta^*} = \mathrm{E}_{\epsilon|\theta^*}\left[\begin{array}{c}-u'(f_{1i})\left(1-\psi\delta\right)\frac{\partial e_i}{\partial\delta}+u'(f_{1i})\left[\frac{\partial\tilde{e}}{\partial\delta}+\frac{\partial\tilde{b}_1}{\partial\delta}+\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]\right]\\-pu'(f_{2i})\frac{\partial\tilde{b}_1}{\partial\delta}-\frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\end{array}\right].$$

Hence,

$$\begin{aligned}\left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\theta^*} &= \mathrm{E}_{\epsilon|\theta^*}\left[\left(\frac{n-1}{n}\right)u'(f_{1i})\frac{\partial e_i}{\partial\delta}+u'(f_{1i})\left(\frac{\partial\tilde{e}}{\partial\delta}-\frac{\partial e_i}{\partial\delta}\right)+u'(f_{1i})\left[\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]\right]\\&= \mathrm{E}_{\epsilon|\theta^*}\left\{u'(f_{1i})\left[\left(\frac{\partial\tilde{e}}{\partial\delta}-\frac{1}{n}\frac{\partial e_i}{\partial\delta}\right)+\left(\tilde{\epsilon}-\epsilon_i\right)+\left(\tilde{e}-e_i\right)\right]\right\},\end{aligned}$$

where we have used that $\mathrm{E}_{\epsilon|\theta^*}[u'(f_{1i})] = \mathrm{E}_{\epsilon|\theta^*}[pu'(f_{2i}) + \frac{\alpha^2}{\phi}\tilde{b}_1]$. Hence,

$$\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\theta^*} = \mathrm{E}_{\epsilon|\theta^*}\left\{u'(f_{1i})\left[\frac{\partial \tilde{e}}{\partial \delta} - \frac{1}{n}\frac{\partial e_i}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i) - C_2\kappa_i\right]\right\}.$$

Note that,

$$\frac{\partial \tilde{e}}{\partial \delta} - \frac{1}{n}\frac{\partial e_i}{\partial \delta} = \frac{n-1}{n}\frac{\partial A_2}{\partial \delta} + \left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta},$$

$$1 + B_2 = \frac{(\xi-1)(1+p) + \alpha^2/\phi}{(\xi-1) + [(\xi-1)p + \alpha^2/\phi][1 + (\xi-1)/n^2]} > 0,$$

$$C_2|_{\theta^*} = 1.$$

Hence,

$$\begin{aligned}
\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\theta^*} &= \mathrm{E}_{\epsilon|\theta^*}\left\{u'(f_{1i})\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} + \left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i) - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right]\right\} \\
&= \mathrm{E}_{\epsilon|\theta^*}\left\{\begin{array}{c}\left[1-(\xi-1)\left(\tilde{\epsilon} + \tilde{e} + \tilde{b}_1 + K_1(\epsilon_i - \tilde{\epsilon}) + L_1\kappa_i\right)\right] \\ \times\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} + \left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i) - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right]\end{array}\right\} \\
&= \mathrm{E}_{\epsilon|\theta^*}\left\{\begin{array}{c}\left[1-(\xi-1)\left(\tilde{\epsilon} + \tilde{e} + \tilde{b}_1\right)\right] \\ \times\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} + \left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i) - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right]\end{array}\right\},
\end{aligned}$$

where we have used that, at θ^*, $K_1 = L_1 = 0$. Hence,

$$\begin{aligned}
\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\theta^*} &= [1-(\xi-1)(A_1+A_2)]\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right] + \\
&\quad + \mathrm{E}_{\epsilon|\theta^*}\left\{\begin{array}{c}[1-(\xi-1)((A_1+A_2) + (1+B_1+B_2)\tilde{\epsilon})] \\ \times\left[\left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i)\right]\end{array}\right\} \\
&= [1-(\xi-1)(A_1+A_2)]\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right] \\
&\quad - (\xi-1)\,\mathrm{E}_{\epsilon|\theta^*}\left\{[(1+B_1+B_2)\tilde{\epsilon}]\left[\left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\frac{\partial B_2}{\partial \delta} + (1+B_2)(\tilde{\epsilon}-\epsilon_i)\right]\right\} \\
&= [1-(\xi-1)(A_1+A_2)]\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right] \\
&\quad - (\xi-1)(1+B_1+B_2)\frac{\partial B_2}{\partial \delta}\mathrm{E}_{\epsilon|\theta^*}\left[\tilde{\epsilon}\left(\tilde{\epsilon} - \frac{1}{n}\epsilon_i\right)\right] \\
&= [1-(\xi-1)(A_1+A_2)]\left[\frac{n-1}{n}\frac{\partial A_2}{\partial \delta} - \frac{1}{n}\kappa_i\frac{\partial C_2}{\partial \delta} - \kappa_i\right] \\
&\quad - (\xi-1)(1+B_1+B_2)\frac{1}{n}\left(\frac{n-1}{n}\right)\sigma^2\left(\frac{\partial B_2}{\partial \delta}\right).
\end{aligned}$$

Note that

$$1-(\xi-1)(A_1+A_2) = 1-(\xi-1)\left\{\left[\frac{1-\psi\delta}{1+(\xi-1)(1-\psi\delta)}\right][1-(\xi-1)A_1] + A_1\right\}$$

$$= \left[\frac{1}{1+(\xi-1)(1-\psi\delta)}\right]\left[1-(\xi-1)A_1\right],$$

where, working out,

$$\begin{aligned} 1-(\xi-1)A_1 &= \frac{(\xi-1)+[p(\xi-1)+\lambda][1+(\xi-1)(1-\psi\delta)]-(\xi-1)(\xi-p)+(\xi-1)^2[1+p(1-\psi\delta)]}{(\xi-1)+[p(\xi-1)+\lambda][1+(\xi-1)(1-\psi\delta)]} \\ &\geq \frac{(\xi-1)p+(\xi-1)(1-\xi)+(\xi-1)^2[1+p(1-\psi\delta)]}{(\xi-1)+[p(\xi-1)+\lambda][1+(\xi-1)(1-\psi\delta)]} > 0. \end{aligned}$$

Moreover,

$$\begin{aligned} 1+B_1+B_2 &= \frac{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\lambda\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]-\left[(\xi-1)(1-\psi)^2p+\lambda\right](\xi-1)(1-\psi\delta)^2-(\xi-1)(1-\psi)(1-\psi\delta)}{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\lambda\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]} \\ &= \frac{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\lambda\right]-(\xi-1)(1-\psi)(1-\psi\delta)}{(\xi-1)(1-\psi)^2+\left[(\xi-1)(1-\psi)^2p+\lambda\right]\left[1+(\xi-1)(1-\psi\delta)^2\right]} > 0. \end{aligned}$$

Further, remember that $\frac{\partial A_2}{\partial\delta}<0$, $\frac{\partial B_2}{\partial\delta}>0$ and $\frac{\partial C_2}{\partial\delta}>0$. Hence, $\left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\theta^*}<0$, if $\kappa_i\geq 0$.

J. Proof of Proposition 4

We take as the starting point expression (31), and work it out further:

$$\begin{aligned} \left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\delta=0} &= \mathrm{E}_\epsilon\left\{\left[u'(f_{1i})-pu'(f_{2i})\right]\frac{n}{n-1}\psi\frac{\partial\tilde{b}_1}{\partial\delta}-\frac{\alpha^2}{\phi}\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\right\} \\ &+\mathrm{E}_\epsilon\left\{\left[u'(f_{1i})-pu'(f_{2i})\right]\left(1-\frac{n}{n-1}\psi\right)\frac{\partial b_{1i}}{\partial\delta}\right\} \\ &+\mathrm{E}_\epsilon\left\{u'(f_{1i})\left[(\tilde{\epsilon}-\epsilon_i)+(\tilde{e}-e_i)\right]\right\}\frac{n}{n-1}\psi. \end{aligned} \tag{J.1}$$

Applying first-order condition (20) to the first two terms on the right-hand side of (J.1) this expression can be rewritten as:

$$\begin{aligned} \left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\delta=0} &= \mathrm{E}_\epsilon\left\{-\frac{\alpha^2}{\phi}\left[1-\frac{\psi}{(n-1)(1-\psi)}\right]\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\right\}+\mathrm{E}_\epsilon\left\{\left[\frac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)}\right]\tilde{b}_1\frac{\partial b_{1i}}{\partial\delta}\right\} \\ &+\mathrm{E}_\epsilon\left\{u'(f_{1i})\left[(\tilde{\epsilon}-\epsilon_i)+(\tilde{e}-e_i)\right]\right\}\frac{n}{n-1}\psi. \end{aligned}$$

Hence,

$$\begin{aligned} \left.\frac{\partial V_{Fi}(.)}{\partial\delta}\right|_{\delta=0} &= \mathrm{E}_\epsilon\left\{-\frac{\alpha^2}{\phi}\left[1-\frac{\psi}{(n-1)(1-\psi)}\right]\tilde{b}_1\frac{\partial\tilde{b}_1}{\partial\delta}\right\} \\ &+\left[\frac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)}\right]\mathrm{E}_\epsilon\left[(A_1+B_1\tilde{\epsilon})\left(\frac{\partial A_1}{\partial\delta}+\frac{\partial B_1}{\partial\delta}\epsilon_i+\frac{\partial C_1}{\partial\delta}\kappa_i\right)\right] \\ &+\mathrm{E}_\epsilon\left\{\left[1+(1-\xi)\left(\tilde{\epsilon}+\tilde{e}+\tilde{b}_1+K_1(\epsilon_i-\tilde{\epsilon})+L_1\kappa_i\right)\right]\left[(\tilde{\epsilon}-\epsilon_i)(1+B_2)-C_2\kappa_i\right]\right\}\frac{n}{n-1}\psi \end{aligned}$$

Hence,

$$\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} = \mathrm{E}_\epsilon \left\{ -\frac{\alpha^2}{\phi}\left[1-\tfrac{\psi}{(n-1)(1-\psi)}\right]\tilde{b}_1 \frac{\partial \tilde{b}_1}{\partial \delta} \right\}$$
$$+\left[\tfrac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)}\right]\mathrm{E}_\epsilon\left[A_1\left(\frac{\partial A_1}{\partial \delta}+\frac{\partial C_1}{\partial \delta}\kappa_i\right)+\frac{1}{n}C_1\frac{\partial C_1}{\partial \delta}\sigma^2\right]$$
$$+(\xi-1)(1+B_2)K_1\mathrm{E}_\epsilon\left[(\tilde{\epsilon}-\epsilon_i)^2\right]\tfrac{n}{n-1}\psi$$
$$-\left\{\left[1+(1-\xi)\mathrm{E}_\epsilon\left(\tilde{e}+\tilde{b}_1\right)+L_1\kappa_i\right]C_2\kappa_i\right\}\tfrac{n}{n-1}\psi.$$

Hence,

$$\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} = \mathrm{E}_\epsilon \left\{ -\frac{\alpha^2}{\phi}\left[1-\tfrac{\psi}{(n-1)(1-\psi)}\right]\tilde{b}_1 \frac{\partial \tilde{b}_1}{\partial \delta} \right\}$$
$$+\tfrac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)}\mathrm{E}_\epsilon\left[A_1\left(\frac{\partial A_1}{\partial \delta}+\frac{\partial C_1}{\partial \delta}\kappa_i\right)+\frac{1}{n}C_1\frac{\partial C_1}{\partial \delta}\sigma^2\right]$$
$$+(\xi-1)(1+B_2)K_1\mathrm{E}_\epsilon\left[(\tilde{\epsilon}-\epsilon_i)^2\right]\tfrac{n}{n-1}\psi$$
$$-\tfrac{n}{n-1}\psi C_2 L_1\kappa_i^2-\tfrac{n}{n-1}\psi C_2\kappa_i\left[1+(1-\xi)\mathrm{E}_\epsilon\left(\tilde{e}+\tilde{b}_1\right)\right].$$

Hence,

$$\left.\frac{\partial V_{Fi}(.)}{\partial \delta}\right|_{\delta=0} = \mathrm{E}_\epsilon \left\{ -\frac{\alpha^2}{\phi}\left[1-\tfrac{\psi}{(n-1)(1-\psi)}\right]\tilde{b}_1 \frac{\partial \tilde{b}_1}{\partial \delta} \right\}$$
$$+\tfrac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)}\mathrm{E}_\epsilon\left[A_1\left(\frac{\partial A_1}{\partial \delta}+\frac{\partial C_1}{\partial \delta}\kappa_i\right)+\frac{1}{n}C_1\frac{\partial C_1}{\partial \delta}\sigma^2\right]$$
$$+(\xi-1)(1+B_2)K_1\mathrm{E}_\epsilon\left[(\tilde{\epsilon}-\epsilon_i)^2\right]\tfrac{n}{n-1}\psi$$
$$-\tfrac{n}{n-1}\psi C_2 L_1\kappa_i^2-\tfrac{n}{n-1}\psi C_2\left[1+(1-\xi)\mathrm{E}_\epsilon\left(\tilde{e}+\tilde{b}_1\right)\right]\kappa_i. \quad \text{(J.2)}$$

Let us check the sign of this expression by investigating its right-hand side term by term:

1. The first term: $1-\frac{\psi}{(n-1)(1-\psi)} \geq 0$ if $\psi \leq \frac{n}{n-1}$. Moreover, $\mathrm{E}_\epsilon[\tilde{b}_1\frac{\partial \tilde{b}_1}{\partial \delta}] = \mathrm{E}_\epsilon[A_1\frac{\partial A_1}{\partial \delta} + B_1\frac{\partial B_1}{\partial \delta}\tilde{\epsilon}^2]$, where $A_1 > 0$, $\frac{\partial A_1}{\partial \delta} > 0$, $B_1 < 0$, and $\frac{\partial B_1}{\partial \delta} > 0$. Hence, the first term cannot be signed unambiguously, in general. However, for small enough σ^2 it is negative and it can be brought arbitrarily close to zero by making α small enough.

2. The second term: $\frac{\alpha^2\left(1-\frac{n}{n-1}\psi\right)}{\phi n(1-\psi)} \geq 0$ if $\psi \leq \frac{n}{n-1}$, $A_1 \geq 0$, $\frac{\partial A_1}{\partial \delta} > 0$, $\frac{\partial C_1}{\partial \delta} > 0$, $C_1\frac{\partial C_1}{\partial \delta} \leq 0$. This term cannot be unambiguously signed. However, it can be brought arbitrarily close to zero by making α small enough.

3. The third term: $\xi - 1 > 0$, $1 + B_2 > 0$, $K_1 > 0$, $\mathrm{E}_\epsilon\left[(\tilde{\epsilon}-\epsilon_i)^2\right] > 0$. Hence, the third

term is positive. However, it can be brought arbitrarily close to zero by making σ^2 small enough.

4. The fourth term: C_2 and L_1 are both positive and bounded away from zero as α and σ^2 are reduced to zero. If $\kappa_i > 0$ the fourth term is negative and bounded away from zero as α and σ^2 are reduced to zero.

5. The fifth term: define $z \equiv \frac{(\xi-p)-(\xi-1)(1+p)}{(\xi-1)+[p(\xi-1)+\lambda]\xi}$. Hence, we can write:

$$\begin{aligned} 1+(1-\xi)\,\mathrm{E}_\epsilon\left(\tilde{e}+\tilde{b}_1\right) &= 1+(1-\xi)\left\{z+\tfrac{1}{\xi}\left[1+(1-\xi)\,z\right]\right\} \\ &= \tfrac{1}{\xi}\left[1+(1-\xi)\,z\right] \\ &= \frac{1}{\xi}\left[\frac{(\xi-1)\,p\xi+\xi\left[p\,(\xi-1)+\lambda\right]}{(\xi-1)+\xi\left[p\,(\xi-1)+\lambda\right]}\right] \\ &> 0. \end{aligned}$$

   This term, as well as $C_2 > 0$ is bounded away from zero as α and σ^2 are reduced to zero. Hence, if $\kappa_i > 0$ the fifth term is negative.

Hence, if there exists an i such that $\kappa_i > 0$, then, if α and σ^2 are sufficiently small, expression (J.2) is negative for country i. Further, note that, if $\alpha = 0$, expression (J.2) reduces to equation (32) in the text.