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ENFORCEMENT AND PROCEDURAL FLEXIBILITY

by Roel M. W. J. Beetsma
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by Roel M.W.J. Beetsma [2]

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Abstract

The paper proposes a theoretical analysis illustrating some key policy trade-offs involved in the implementation of a rules-based fiscal framework reminiscent of the Stability and Growth Pact (SGP). The analysis offers some insights on the current debate about the SGP. Specifically, greater "procedural" flexibility in the implementation of existing rules may improve welfare, thus increasing the Pact's political acceptability. Here, procedural flexibility designates the enforcer's room to apply well-informed judgment on the basis of underlying policies and to set a consolidation path that does not discourage high-quality policy measures. Yet budgetary opaqueness may hinder the qualitative assessment of fiscal policy, possibly destroying the case for flexibility. Also, improved budget monitoring and greater transparency increase the benefits from greater procedural flexibility. Overall, we establish that a fiscal pact based on a simple deficit rule with conditional procedural flexibility can simultaneously contain excessive deficits, lower unproductive spending and increase high-quality outlays.

Keywords: Fiscal rules, Stability and Growth Pact, procedural flexibility, deficits, structural reforms.

JEL classification: E62, H6.

Non-technical summary

Practically since its inception, the Stability and Growth Pact (SGP) has been under fierce criticism. In November 2003, the problems with the SGP culminated in the failure of its enforcement on France and Germany, two repeated violators of the deficit criterion. Though sharing the view that rules are necessary to constrain fiscal profligacy, many have blamed the SGP's basic design, while others believe its weakness is in its implementation, indicating that its constraining elements (in particular the sanctions) cannot be enforced. Experts have put forward a large number of proposals to reform the SGP. These vary from making the maximum allowable deficit dependent on the debt level to setting up independent fiscal boards that each year impose a new deficit limit on individual countries. Many of these proposals would require a rewriting of the SGP's Regulations or even of the Treaty on the European Union. These options have been explicitly rejected by the Ministers of Economics and Finance, who have also endorsed the European Commission's call to enhance the economic rationale underlying the implementation of the SGP.

Against this background, the current paper explores some key policy trade-offs in the implementation of a uniform fiscal framework in a monetary union with decentralized fiscal policies. The analysis highlights two key requirements for a successful fiscal framework in EMU, namely the need for simple and transparent rules and the need to improve the quality of the economic principles underlying their implementation.

We cast our analysis in the context of a two-period model of fiscal policy, with a partisan government selecting the deficit along with the provision of public goods and "high-quality" outlays. The latter are defined as measures that boost economic activity in the longer run. This could be public investment or - the interpretation we prefer - short-term budgetary outlays associated with structural reforms, such as reforms of the labor market. Electoral uncertainty induces the government to run excessive deficits, while implementing too little reform, given that reform only pays off in the longer run. The deficit bias provides a rationale for a discipline-enhancing fiscal framework (a "fiscal pact"). We assume that the pact is enforced by an independent agency, which has the flexibility to shape the enforcement of the basic rules to the particular circumstances of a case ("procedural flexibility"), exerting expert judgment independently from policy-makers. Our setup distinguishes such procedural flexibility explicitly from the strictness of enforcement. We focus on the way the fiscal framework affects the policy-makers' incentives. While enforcement through some sanction mechanism is intended to curb the deficit bias, procedural flexibility should preserve the government's incentive to implement structural reforms.

In the basic setup, which assumes a transparent budget, a flexible implementation of the fiscal pact generally increases its positive welfare effects. However, greater procedural flexibility, while improving the quality of fiscal policy, comes at the cost of weakening the disciplining role of fiscal pacts. Therefore, countries faced with a large deficit bias need stricter enforcement and less flexibility while, all else being equal, those with greater needs of reforms, should be treated with more flexibility. In the euro area, the continued reluctance to carry out structural reforms, and the persistent difficulty to exert fiscal restraint suggest that amendments to the Stability and Growth Pact should aim at strengthening the enforcement of fiscal discipline while paying greater attention to the underlying causes of excessive deficits. However, if the tightness of enforcement is given and the only possible amendments concern the pact's procedural flexibility, then increasing the latter boosts welfare only if the marginal income gains expected from high-quality spending are high enough. Finally, if neither flexibility nor enforcement can be effectively amended, the enforcer can always increase the desirability of the existing rules by setting a minimum threshold for high-quality outlays below which it will never apply any procedural flexibility. Such an arrangement extracts more reform at relatively low cost in terms of fiscal discipline.

The next step in our analysis is to relax the assumption of transparent budgets and examine the implications of budgetary opaqueness for the feasibility and desirability of procedural flexibility. To this end, we expand the model to allow for a third expenditure item, namely unproductive spending. Such spending benefits policy-makers only, but not society at large. For example, the government may extend favors to its own constituency or create jobs with minimal productivity. We assume that the pact's enforcer cannot distinguish such programs from reform-related expenditure, implying that it is unaware of the underlying "quality" of the deficit. In this case, unconditional flexibility makes the fiscal pact counter-productive. However, procedural flexibility can raise welfare under budgetary opaqueness if the enforcer shows only a limited tolerance for the lack of transparency by imposing a ceiling on the overspending up to which it stands ready to waive sanctions. In that case, we establish that a fiscal pact based on a straightforward deficit rule with procedural flexibility restricted to relatively small fiscal slippages can simultaneously contain excessive deficits, lower unproductive spending and increase high-quality outlays.

To put our analysis further into perspective, some observations are warranted. First, while our analysis suggests that procedural flexibility based on an independent and non-politicized judgment might well strengthen the SGP, flexibility should not be confused with a loosening of enforcement. On the contrary, enforcement should be strengthened to ensure that governments actually expect to pay some price for unwarranted profligacy. In such a scenario, the application of the corrective dimension of the pact would probably be limited to truly unacceptable fiscal behaviors so that violators find themselves isolated and unable to form coalitions inside the Council to block enforcement. Second, as budgetary opaqueness provides opportunities to abuse procedural flexibility, the latter should be exerted with caution, in practice excluding large fiscal slippages. Improving transparency and budgetary surveillance is thus an important step to secure the benefits from an increase in procedural flexibility. In fact, a practical implication of the model is that, when pondering the option of granting a sanction waiver, the enforcer should only consider those structural reforms with the most easily traceable budgetary impact. Third, to preserve focus and clear intuitions, our discussion of the implementation of fiscal rules neglects some potentially serious operational obstacles associated with a flexible implementation of a fiscal pact. Limited information on the precise extent of a reform package, or on its future pay-offs makes it difficult to assess the desirable degree of flexibility the enforcer should have in authorizing deviations from the letter of the rule. Further, limited budgetary transparency prevents an even-handed application of the rules. Finally, the model also abstracts from the politics of implementation, and simply emphasizes the well-known virtue of a non-politicized implementation of rules supposed to correct the effects of political bias. Exploring implementation mechanisms that are robust to these important constraints will be an important issue for further research.

1 Introduction

Because they regulate the actions of sovereign States, international treaties and pacts often suffer from a fundamental implementation problem owing in large part to the absence of an effective, legitimate and independent enforcer. In theory, sheer good faith (enshrined in the "pacta sunt servanda"[1] principle) is the cornerstone of treaty-based international law. In practice, even though the supranational status of Community law and institutions (including a judiciary) partly alleviates the enforcement problem, sovereign States abide by treaties as long as they perceive it in their interest to do so.

With this in mind, we analyze some key policy trade-offs involved in the implementation of a uniform fiscal framework in a monetary union with decentralized fiscal policies. The analysis sheds light on ways to prevent the "procedural impasse" that followed the ECOFIN's failure in November 2003 to apply the Pact for two serial offenders (France and Germany) faced with the prospect of enhanced budgetary surveillance, detailed recommendations for policy changes, and even pecuniary sanctions.

The failure to enforce the Pact's most stringent provisions points to two possible interpretations that have shaped the policy debate so far.[2] The first interpretation emphasizes a fundamental lack of enforceability rooted mainly in the fact that the "*responsibility for making the Member States observe budgetary discipline lies essentially with the Council*" (European Court of Justice, 2004), that is with (some weighted average of) the Member States themselves. The second interpretation stresses procedural issues, suggesting that the current procedure pays excessive attention to the letter of the regulation (that is an arbitrary numerical ceiling on the nominal deficit) and neglects its spirit, which is to avoid that unwarranted fiscal expansions reduce the benefits of a union-wide commitment to financial stability. Hence, the failure to recognize that some fiscal expansions are actually warranted[3] made the Pact's implementation procedure excessively rigid, leading a number of member states to worry that the fiscal framework might too easily conflict with their interest. This might explain why the Commission's recommendation to proceed with the most stringent provisions of the Pact against France and Germany did not win the required majority in the Council, effectively freezing the procedure for these countries.[4]

Our paper proposes a simple theoretical analysis articulating two key requirements for a successful fiscal framework in EMU, namely the need to keep the rules simple and transparent and the need to improve the quality of the economic principles underlying their implementation. As most of the related literature, the model focuses on the way

[1] "Treaties must be respected."

[2] The European Commission (2004) discusses in great detail the operational aspects of the Stability and Growth Pact brought to the fore by the November 2003 events, including a number of proposals to reform the implementation of the Pact.

[3] To many observers, fiscal behavior in France and Germany hardly qualified as a deliberate burst of laxity in view of the protracted slowdown affecting these economies.

[4] The November 2003 Council's conclusions explicitly putting the excessive deficit procedure in abeyance were annulled by the European Court of Justice in a ruling of July 13, 2004. At the time of writing (November 2004), the procedure remains on hold.

the fiscal framework affects policymakers' incentives. Such a setting inevitably blurs the concrete distinction between the straightforward implementation of very complicated rules and a flexible enforcement of simple rules. In practice, the former requires a large set of elaborate contingency plans attached to the core rules whereas the latter supposes that an independent agency has the flexibility to shape the enforcement of the basic rules to the particular circumstances of a case, exerting expert judgment independently from policymakers. While we recognize that our results could be interpreted in the first model of implementation (complicated contingency plans),[5] we adopt the language associated with the second model (expert judgement embedded in the enforcement procedure).

The presumption that a more flexible implementation procedure of simple deficit rules is the only practical way to strengthen the economic principles underlying the fiscal framework leads us to explicitly distinguish the strictness of enforcement from what we term procedural flexibility, that is the enforcer's room for manoeuvre to account for case-specific circumstances. We also examine how the lack of budgetary transparency undermines the flexible implementation of simple rules as misreporting and creative accounting are facilitated.

The basic theoretical benchmark is a two-period model of fiscal policy in which a partisan government chooses the deficit along with two expenditure items: the provision of public goods, and "high-quality" outlays (defined as measures boosting economic activity in period two). The latter could be interpreted as productive public investment or, as in Beetsma and Debrun (2004), short-term (period-one) budgetary costs proportional to the ambition of a structural reforms agenda, which is also the interpretation retained in the present analysis.[6] In equilibrium, the government has a tendency to run excessive deficits—providing a rationale for a stability pact—while spending too little on high-quality items. These inefficiencies stem from exogenous electoral uncertainty driving the policymaker's subjective discount rate above Society's level. We introduce a discipline-enhancing fiscal framework (that we call "fiscal pact"), assuming that a non-politicized supranational authority (SNA) is entrusted with the power to impose "sanctions" in case the actual deficit exceeds a predetermined threshold.[7] That fiscal pact reduces the deficit bias as intended but also lowers the quality of fiscal policy.

[5] Others have already explored the design of fiscal rules when the quality of fiscal policy matters (e.g. Peletier, Dur, and Swank, 1999, Castellani and Debrun, 2001, or Blanchard and Giavazzi, 2003). These studies indeed end up advocating more sophisticated rules, such as caps on expenditure adjusted for high-quality items.

[6] There is growing literature analyzing the linkages between macroeconomic and structural policies. On the impact of the monetary regime on the incentives to implement structural reforms, key contributions include Sibert (1999), Sibert and Sutherland (2000) and Calmfors (2001), whereas the fiscal-structural nexus is analyzed in Hughes-Hallett and Jensen (2001), Grüner (2002), Hughes-Hallett, Jensen and Richter (2004), Debrun and Annett (2004), and IMF (2004).

[7] In this stylized model, "sanctions" encompass both hard and soft dimensions of enforcement, that is pecuniary sanctions and enhanced surveillance typically associated with the corrective arm of the Stability and Growth Pact, and the peer pressure mechanism and early warnings operating under the preventive arm of the Pact.

Whereas the basic features of the pact are given — it is a deficit rule reducing the policymaker's utility in case of excessive deficit — , we parametrize both the strictness of enforcement (that is, the policymaker's marginal disutility of excessive deficits) and the extent to which sanctions can be "waived" to account for the overall quality of fiscal policy, reflecting a certain degree of "procedural flexibility". With enforcement and procedural flexibility clearly distinct, we can characterize welfare-maximizing combinations.

We proceed in three steps providing specific analytical insights on desirable adjustments of the Stability and Growth Pact (SGP). First, we characterize the socially-optimal fiscal pact, assuming the SNA can perfectly monitor the quality of fiscal policy. In a second step, we assume a suboptimal fiscal framework is in place and can be amended only in part. This allows us to devise a number of partial but welfare-improving fixes to the fiscal framework. Finally, we examine the implications of budgetary opaqueness for the feasibility and desirability of procedural flexibility. For that purpose, we expand the model to allow for a third expenditure item, namely unproductive spending (defined as socially useless programs benefitting policymakers only). The assumption that the SNA cannot distinguish unproductive programs from reform-related expenditure means that the SNA is unaware of the underlying quality of the deficit despite having full knowledge of the deficit and of the resources spent on the provision of public goods.

Our analysis points to the following key conclusions:

1. With transparent budgets, a flexible implementation of fiscal pacts generally increases their positive welfare effects. Yet greater procedural flexibility, while improving the quality of fiscal policy, weakens the disciplining role of fiscal pacts. As a consequence, countries faced with a large deficit bias need stricter enforcement and less flexibility while, all else being equal, those with greater needs of reforms should be treated more flexibly. In the euro area, the continued reluctance to carry out structural reforms, and the persistent difficulty to exert fiscal restraint suggest that amendments to the Stability and Growth Pact should aim at *strengthening the enforcement of fiscal discipline while paying greater attention to the underlying causes of excessive deficits*.

2. Still assuming transparent budgets, if the only possible reform of a suboptimal pact concerns its enforcement mechanism, tighter enforcement is beneficial only if either procedural flexibility or the overall quality of fiscal policy is sufficiently high to start with. Similarly, if the only possible reform concerns procedural flexibility, increasing flexibility is welfare improving only if the marginal income gains expected from high-quality spending are high enough. Finally, if neither flexibility nor enforcement can be effectively reformed, the SNA can always increase the desirability of the existing rules by setting a minimum threshold for high-quality outlays below which it will never apply any procedural flexibility.

3. If budgetary opaqueness hinders the SNA's inquiry about the quality of fiscal policy, *unconditional* flexibility makes the fiscal pact counter-productive. However,

procedural flexibility can maximize welfare under budgetary opaqueness if the SNA shows only a limited tolerance for the lack of transparency by imposing a ceiling on the overspending up to which it stands ready to waive sanctions. In that case, we establish that *a fiscal pact based on a straightforward deficit rule with procedural flexibility restricted to relatively small fiscal slippages can simultaneously contain excessive deficits, lower unproductive spending and increase high-quality outlays.*

The remainder of this paper is organized as follows. Section 2 presents the basic model, while Section 3 introduces a fiscal pact as a disciplining mechanism and derives the socially-optimal combination of enforcement and procedural flexibility. Section 4 studies the welfare effects associated with partial reforms of a given stability pact. In Section 5, we turn to the case of budgetary opaqueness. Finally, Section 6 summarizes the results and draws policy implications. Key derivations and proofs are presented in the Appendix.

2 The model

Our theoretical benchmark is a simple dynamic framework of a monetary union sharing many key features with Beetsma and Debrun (2004). Each country is a small open economy where both governments and households can freely borrow or lend in the international capital market at a given real interest rate, which, for convenience, is set at zero. Assuming away cross-country spillovers, the formal analysis of the pact is carried out on a single country, independently of other member states policy choices. The model has two periods, denoted by subscripts 1 and 2.

The utility function of a representative private agent (social utility) is separable across time and types of goods (public and private) so that we write:

$$V^S = \mathrm{E}_0 \left[u(c_1) + v(q_1) + u(c_2) + v(q_2) \right],$$

where c_t denotes private consumption in period t, q_t represents the consumption of a public good in period t, and $u(.)$ and $v(.)$ are the corresponding utility functions. $\mathrm{E}_0[.]$ denotes expectations taken at the start of the game. These functions have usual properties, namely $u' > 0$, $u'' < 0$, $v' > 0$ and $v'' < 0$. In addition, we assume $v(0) = 0$. For convenience, the social discount factor is set equal to unity. The agent's budget constraints in periods 1 and 2 are

$$\begin{aligned} c_1 &= (1-\theta) y_1 - I\gamma + \eta\gamma + l, \\ c_2 &= (1-\theta) y_2 - l, \end{aligned}$$

where y_1 and y_2 represent personal income in period 1 and 2, θ is a flat income tax rate, γ measures the amount of structural reforms (or, more generally of any public policy measure that carries a direct short-term cost for the population but delivers future benefits), I is the marginal cost of structural reforms (in terms of foregone private consumption) felt by individuals in period 1,[8] η is the marginal transfer received from the government in case reforms are carried out and l designates the net liabilities of the private sector at the end of period 1. In this model, the amount $\eta\gamma$ thus captures high-quality government spending. To focus on the design and implementation of fiscal pacts, the model sticks to the representative agent's fiction, thereby ignoring the distributive implications of fiscal and structural policies. Hence, in period 1, each individual is affected in the same way by reforms and needs to receive the same compensation in order to support reforms.

First-period income is given, while second-period income depends on the amount of structural reforms implemented in the first period. More reforms (for example, in the labor market) ensure that, after some adjustment period during which resources are reallocated, the economy operates more efficiently and generates higher income. Accordingly, we have:

$$y_1 = y, \quad y_2 = \Gamma(\gamma)\, y,$$

where y is exogenous (constant) and where $\Gamma' > 0$ and $\Gamma'' < 0$. Also, $\Gamma' \to \infty$ as $\gamma \to 0$ and $\Gamma' \to 0$ as $\gamma \to \infty$. The properties of Γ exclude counterproductive reforms (future income unambiguously increases when reforms are undertaken), and guarantee interior solutions. The assumed decreasing returns of reforms reflect inevitable limits to the ability of tax and regulatory instruments to improve the functioning of markets and deliver higher income. Also, we assume that the benefits from reforms materialize in the longer run whereas the costs are felt immediately. This fairly typical time path reflects the economy's adjustment to the new structural conditions, as resources are shifted across sectors, possibly entailing transitory unemployment (see IMF, 2004, for a survey of the relevant literature as well as new evidence for industrial countries).

The rationale for a stability pact arises from a political deficit bias reminiscent of Alesina and Tabellini (1990). Accordingly, there are two political parties, F and G. Nature draws the incumbent in period 1 but an election, whose outcome is uncertain, takes place at the end of period 1. The policymaker in office decides on the provision of a standard public good to the population. While private individuals are indifferent about the political color of the provider, politicians value the public good only to the extent that they provide it themselves. Assuming that each party shares the preferences of the representative individual in private consumption matters, the utility of party Q is:

$$V^Q = \mathrm{E}_0 \left[u(c_1) + v(q_1) + u(c_2) + v(q_2) + z(h) - kw(b) \right], \quad k \geq 0,$$

[8] As discussed in Blanchard (2004) and Beetsma and Debrun (2004), these costs include among other things the loss of rents, typically because reforms enhance competition in goods and labor markets—thereby eroding wage premia—, salary losses due to temporary unemployment accompanying the induced reallocation of resources across sectors, and the temporarily higher unemployment associated with relaxing firing restrictions (IMF, 2004). See Beetsma and Debrun (2004) for specific examples of such costs in the case of labor and product market reforms. Of course, the argument is also valid for other fiscal policy measures, including the nuisance from the development of large public infrastructures, such as airports. We summarize all these costs as foregone private consumption.

where q_t $(q_t = f_t, g_t)$ is the amount of public good provided by party Q $(Q = F, G)$ in period t.[9] At the beginning of the game (denoted by a subscript 0), expectations are calculated over the stochastic processes governing uncertainty about the outcome of elections and the quality of fiscal expenditure (in the case of budgetary opaqueness introduced later in the analysis). In office, politicians also derive some utility $z(h) > 0$ from pork-barrel spending $h > 0$, which we assume completely useless for the population at large. Initially, the amount of pork-barrel spending is assumed to be zero, with $z(0) = 0$. Later, in Section 5, h will be chosen optimally, making use of the assumption that $z' > 0$, and $z'' < 0$.

The policymaker's utility is also affected by an external discipline-enhancing mechanism (a "fiscal pact") administered by a *nonpoliticized supranational authority* (SNA). The pact reduces government's utility by $kw(b)$, where b is the fiscal deficit, $w' \geq 0$, and k captures the strictness of enforcement as perceived by the government (including the probability of non-enforcement thanks to successful political pressures on the SNA or the importance given to external commitments in domestic policy debates). This disciplinary mechanism is defined in broad terms, encompassing any mechanism through which the fiscal framework is likely to affect policymakers' behavior. For instance, to refer to the specifics of the SGP, k covers the corrective arm of the Pact, which includes financial sanctions and enhanced monitoring, but also some soft enforcement aspects related to the preventive arm, which includes peer pressure and early warnings (see European Commission, 2004, and Schuknecht, 2004, who discusses the role of soft enforcement in encouraging fiscal discipline). To ease the discussion, we will nevertheless refer to the term "sanctions" to designate the pact-related disutility.

Without loss of generality, we assume that party F is in office during the first period and is re-elected for a second (and last) term with an *exogenous* probability $p < 1$. Electoral uncertainty — related to the occurrence of scandals or random voters' turnout affecting both parties asymmetrically — raises government's effective discount rate above the socially optimal value. Although policy actions involving intertemporal trade-offs (such as structural and fiscal policies) should in principle affect re-election chances, the present analysis economizes on the details of the political set-up to bring out the key intuitions as clearly as possible, leaving for future research the analysis of a richer set of political incentives on these trade-offs.

The first- and second-period per-capita government budget constraints are written as:

$$f_1 + g_1 + h = \theta y - \eta\gamma + b, \tag{1}$$

$$f_2 + g_2 = \theta\Gamma(\gamma)\, y - b. \tag{2}$$

The first term on the right-hand sides represents tax revenues. Spending on public goods and pork-barrel programs are on the left-hand sides. In the absence of output shocks, there

[9] Formally, the model would be identical if we assumed two types of public good, one exclusively valued by party F and the other exclusively valued by party G, as long as the public goods are perfectly substitutable in individuals' utility.

is no automatic stabilizer and both items are entirely under the government's control. In the first period, the government can issue debt, b, which is repaid in the second period. Due to the absence of inherited liabilities, b is also the deficit in period 1. As indicated above, the term $\eta\gamma$ symbolizes the total public resources absorbed by the implementation of pro-growth structural reforms γ, including compensatory transfers extended to ensure the political acceptability of reforms. Even if the short-run costs of reform were affecting only a fraction of the population, the government might find it politically easier to provide net transfers in order to prevent the spillovers of social unrest to undermine the broader support for the reform program. Under perfect budgetary transparency, the marginal budgetary cost of reforms (η) is common knowledge, while budgetary opaqueness (see Section 5) introduces uncertainty about the true value of η.

Regarding the *implementation* of the stability pact, procedural flexibility is modeled as sanctions waivers conditional upon the quality of fiscal policy—specifically on the "amount" of structural reforms γ. This echoes the European Commission's recent call to "*introduce more economic rationale in the implementation of the stability and growth pact.*"[10] In fact, the Council's conclusions putting the Pact in abeyance for Germany was partly motivated by the Commission's own acknowledgement that the country had undertaken significant structural reforms that "*would boost potential growth and reduce the deficit in the medium to long term.*"

3 Optimal Pact under Budgetary Transparency and No Pork-Barrel

In this section, an analytically tractable solution to our model is found under the assumptions of a constant and perfectly observable η (full budgetary transparency) and of no pork-barrel spending ($h = 0$). This is an interesting benchmark for two reasons. First, full transparency implies the absence of any obstacle to procedural flexibility as the SNA can easily monitor the budget and observe the link between an excessive deficit and reform-related spending. Second, these assumptions yield a complete characterization of the optimal fiscal pact, and in particular of the equilibrium relationship between the strictness of enforcement and procedural flexibility.

To keep the algebra manageable (and also because in practice only simple procedures might be implementable), we assume a linear sanction scheme:[11]

[10] See "Commission calls for stronger economic and budgetary coordination", press communique IP/04/1062, September 3, 2004.

[11] If $b < \delta\eta\gamma$ and sanctions are pecuniary, the government would actually receive a transfer. Under our assumptions, it is unclear who would finance such tranfers (see, however, Beetsma and Debrun, 2004). Since the discussion of that particular case has no practical bearing, we simply assume that the re-election probability p is low enough to entail excessive deficits such that $b > \delta\eta\gamma$. More generally, we will always seek to restrict the formal analysis to constellations of parameters that turn out to be meaningful in terms of the actual policy debate.

$$w(b) = b - \delta\eta\gamma, \quad 0 \leq \delta \leq 1. \tag{3}$$

In (3), procedural flexibility amounts to adjusting the deficit by a fraction δ of $\eta\gamma$, the total public resources absorbed by structural reforms (or, more generally, high quality measures). A higher δ implies greater procedural flexibility. The sanction scheme (3) also allows to clearly separate enforcement k from flexibility.

This highly stylized treatment of the fiscal framework calls for caution when mapping the model's results into specific reform proposals of the actual SGP. The model can only illustrate some first-order principles underlying welfare-improving fiscal pacts and multiple reform proposals may be consistent with those principles. As clarified in the Introduction, we view δ as the extent to which our independent enforcer would be able to calibrate "sanctions" to the specifics of an excessive deficit case. An alternative interpretation of δ, that is an extension of the rules-based approach allowing for particular corrections to the actual deficit, is admittedly impractical and prone to an even greater amount of creative accounting (see e.g. von Hagen and Wolff, 2004).

The timing is as follows. First, the government implements a structural reform of size γ and simultaneously selects the deficit. Then, the private agent sets l, taking as given the government's policies. Third, elections take place (beginning of period 2) and, finally, all debts (private and public) are paid off.

The model is solved backwards to ensure time-consistency. Given the assumed zero discount rate, the representative consumer chooses l such that consumption is constant over time:

$$c_1 = c_2 = \tfrac{1}{2}\left[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta - I)\,\gamma\right]. \tag{4}$$

At the initial stage of the game, the government chooses (γ, b) maximizing its expected utility. Indeed, as the tax rate θ is given, and $g_1 = 0$ (recall that party F is in power in period 1), the optimal amount of public goods provided in period 1 (f_1) is derived from the budget constraint. Taking the budget constraints (1) and (2) into account, the government maximizes

$$2u_1 + v_1 + pv_2 + z(h) - k(b - \delta\eta\gamma), \tag{5}$$

where $u_1 \equiv u\left(\tfrac{1}{2}\left[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta - I)\,\gamma\right]\right)$, $v_1 \equiv v(\theta y - (h + \eta\gamma) + b)$ and $v_2 \equiv v(\theta\Gamma(\gamma)\,y - b)$ and $h = 0$ by assumption. The first-order conditions for b and γ are written as:[12]

$$\begin{aligned} v_1' &= pv_2' + k, & (6)\\ Hu_1' - \eta v_1' + p\theta y\Gamma' v_2' + \delta\eta k &= 0, & (7)\end{aligned}$$

[12]The strict concavity of the objective function ensures that the second-order conditions hold.

where

$$H(\gamma) \equiv (1-\theta)\, y\Gamma' + \eta - I.$$

Condition (6) simply equates the marginal utility of first-period deficits (reflecting increased public good provision) with its marginal cost, that is the discounted value of foregone public good provision in period 2,[13] to which we add the perceived marginal cost of deficits related to the enforcement of the fiscal pact. Similarly, condition (7) ensures that optimal reforms strike a balance between the marginal utility derived from private-good consumption (which may be negative or positive), the marginal cost of lower first-period public good provision, the expected marginal utility of increased public good provision in the second period, and the marginal utility derived by the government from a flexible implementation of the fiscal pact. Differentiating (6), we easily establish that $\partial b/\partial p = v_2' B_1 < 0$ and $\partial b/\partial \gamma = B_2 > 0$, where:

$$B_1 \equiv \frac{1}{v_1'' + p v_2''} < 0, \quad B_2 \equiv \frac{\eta v_1'' + p\theta y \Gamma' v_2''}{v_1'' + p v_2''} > 0. \tag{8}$$

Lemma 1 *All else being equal, as far as the optimal choice of the deficit is concerned, more structural reforms increase the deficit, while a higher re-election probability reduces it.*

The underlying intuition is straightforward. All else being equal, more structural reforms γ subtract resources from the provision of public goods in period 1 to increase resources available in the second period. The government finds it optimal to offset the intertemporal effect of reforms through a larger deficit, restoring its preferred time profile of public good provision. Another interpretation is that a higher deficit acts like a tax on the future benefits of reforms, whose proceeds can then be used to compensate short-term losses by households; that is, a higher deficit allows spreading the net benefits of reforms over time.

Greater re-election chances raise the government's expected utility from providing public goods in period 2, and correspondingly reduce its relative impatience to spend in period 1. As the wedge between the government's effective discount rate and Society's is reduced, the bias towards deficits becomes smaller.

3.1 Comparison with a Social Planner

To formally assess the impact of the political distortion ($p < 1$) on the representative consumer's utility (or social welfare), we first compare the solution under a partisan government with that under a social planner. By definition, the latter faces no distortion ($p = 1$) and, therefore, no legal restraint on fiscal discretion ($k = 0$). Appendix A formally establishes the following proposition:

[13] Recall that, as the real interest rate is assumed to be zero, the government's effective discount factor is equal to the probability of re-election.

Proposition 2 *Assume that there is no stability pact* ($k = 0$) *and that more ambitious structural reforms boost second-period government's revenues by a sufficiently large amount* ($\theta y \Gamma' > \eta$)*. Then, (a) for a given amount of reforms, the deficit is larger under a partisan government than under a planner, while, allowing for reforms to adjust endogenously, this holds if the present value of the net benefit to the government's revenues is not too large* ($\theta y \Gamma' - \eta$ *is not too large), and (b) reforms are less ambitious under a partisan government than under a planner.*

As suggested in the interpretation of Lemma 1, the risk of not being re-elected implies that, in equilibrium, a partisan government simultaneously exhibits a bias towards an excessive deficit and a bias towards status quo in structural reforms. This characterization of the fiscal-structural policy mix captures fairly well the situation in many euro area members states. It also underscores the challenge to simultaneously undertake fiscal adjustment and structural reforms (Debrun and Annett, 2004).

Notice that the condition $\theta y \Gamma' > \eta$ underpinning these results simply states that as re-election chances increase from $p < 1$ to $p = 1$, a policymaker will only undertake additional reforms perceived as "productive", in the sense of increasing total budgetary resources over the two periods, and thereby the opportunity to provide more public goods. In cases where the boost to second-period resources is sufficiently large, the incentive for reform is strong enough to push the optimal deficit under the planner above the preferred deficit of a partisan government (recall Lemma 1).

3.2 Effects of the Fiscal Pact on Deficits and Reforms

We now examine the effects of the fiscal pact's key parameters on deficits and reforms. To find out the effect of *stricter enforcement* on the deficit, we differentiate b with respect to k and obtain $db/dk = B_1 + B_2 \left(d\gamma/dk \right)$. As $B_1 < 0$, and holding reforms constant, stricter enforcement reduces the deficit because the marginal disutility of issuing debt is higher. To account for the indirect deficit effect of enforcement through the induced adjustment in structural reforms, we totally differentiate (7) with respect to k and, after some rearrangements, obtain $d\gamma/dk = \delta A_1 + A_2 \left(db/dk \right)$, where

$$
\begin{aligned}
A_1 &\equiv -\eta/K > 0, \quad A_2 \equiv \left(\eta v_1'' + p\theta y \Gamma' v_2'' \right)/K > 0, \\
K &\equiv (1-\theta)\, y u_1' \Gamma'' + \tfrac{1}{2} H^2 u_1'' + \eta^2 v_1'' + p \left(\theta y \Gamma' \right)^2 v_2'' + p\theta y v_2' \Gamma'' < 0.
\end{aligned}
$$

We observe that, in the absence of any procedural flexibility ($\delta = 0$), enforcing the pact's sanctions scheme only affects reforms through the deficit. Therefore, if a stricter enforcement of the pact triggers a fiscal contraction ($db/dk < 0$), structural reforms are also reduced ($d\gamma/dk < 0$), aggravating the status quo bias as the government spreads over all spending items the cuts imposed by the additional constraint on period 1 resources.

Procedural flexibility under the form of targeted sanction waivers mitigates the adverse effect of stricter enforcement on reforms ($\delta A_1 > 0$).

Combining the total derivatives of (6) and (7), and solving yields:

$$db/dk = (\delta A_1 B_2 + B_1) / (1 - A_2 B_2), \quad d\gamma/dk = (\delta A_1 + A_2 B_1) / (1 - A_2 B_2).$$

In Appendix B, we show that $A_2 B_2 < 1$, so that the following proposition holds:

Proposition 3 *For a given $\delta \geq 0$ but sufficiently small, stricter enforcement of the pact (a higher k) reduces both the deficit and structural reforms.*

Proposition 3 indicates that in cases where procedural flexibility remains limited, tightening the pact's enforcement reduces the deficit bias at the cost of a greater status quo bias in reforms. Indeed, punishing deficits with little attention to their underlying quality discourages the government to spend on measures designed to secure the necessary support for reforms. Yet increasing procedural flexibility conditionally on reform efforts is not necessarily a panacea. The reason is that granting more generous waivers in proportion of reforms (i.e. increasing δ) weakens the disciplinary effect of strict enforcement, as illustrated by the fact that the term $\delta A_1 B_2 / (1 - A_2 B_2)$ in the solution for db/dk is positive.

To evaluate the impact of greater procedural flexibility in equilibrium, we totally differentiate (6) and (7) with respect to δ and solve the resulting equations to find:

$$db/d\delta = k A_1 B_2 / (1 - A_2 B_2) > 0, \quad d\gamma/d\delta = k A_1 / (1 - A_2 B_2) > 0.$$

Proposition 4 follows:

Proposition 4 *Assuming the pact is effectively enforced (i.e. $k > 0$), greater procedural flexibility (i.e., a higher δ) increases structural reforms at the cost of a larger deficit.*

This again indicates that the government wishes to offset the impact of reforms on the intertemporal profile of expenditures and revenues by spreading the budgetary costs and benefits of reforms over time. More generally, we find that there are limits to procedural flexibility if the pact is to remain an effective disciplinary device.

With these basic results in mind, we now characterize the optimal stability pact prevailing under full budget transparency and the absence of pork-barrel programs.

3.3 The Optimal Fiscal Pact

The optimal stability pact is described by the following proposition:

Proposition 5 *Under full budgetary transparency and in the absence of pork-barrel spending, there exists a combination of enforcement and procedural flexibility* $(k, \delta) = (k^s, \delta^s)$ *such that a partisan government is induced to select the socially-optimal mix of structural and fiscal policies. The pact delivering these outcomes is characterized by*

$$k^s = v'_{1s} - pv'_{2s}, \quad \delta^s = \frac{(\eta v'_{1s} - H_s u'_{1s} - p\theta y \Gamma'_s v'_{2s})}{\eta (v'_{1s} - pv'_{2s})},$$

A subscript "s" indicates that we evaluate the derivative functions at the socially-optimal combination (k^s, δ^s). The proof of the proposition is straightforward. Substitute $(k, \delta) = (k^s, \delta^s)$ into the government's first-order conditions (6) and (7), and confirm that $(b, \gamma) = (b^s, \gamma^s)$ is a solution of the resulting system of equations. Thanks to the strict concavity of the government's objective function, this is the unique solution for a policymaker subject to the pact (k^s, δ^s).

The intuition underlying the existence of such a pact is that we have two instruments (enforcement and procedural flexibility) to meet two objectives (reducing the deficit bias and promoting reforms). Due to the linearity of the government's first-order conditions in (k, δ), it is always possible to find a combination (k, δ) that delivers the social optimum.[14] Proposition 5 shows that if the political bias towards deficit is large—which occurs if p is small—, strict enforcement is desirable (k^s is large) whereas if the socially-optimal amount of reforms is large (that is if Γ'_s and H_s are low), procedural flexibility should be large as well.

In the euro area, the lack of progress in the Lisbon Agenda of structural reforms, and the persistent difficulty to exert fiscal restraint suggest that amendments to the Stability and Growth Pact should *strengthen the enforcement of fiscal discipline in the context of a procedure paying greater attention to the underlying causes of the excessive deficit.* Given the urgency of decisive reforms in a number of countries, *the optimal fiscal pact might thus resemble a combination of harsh sanctions for truly egregious fiscal behaviors.*

But how could such a pact emerge in reality? By definition, a "perfect", socially optimal pact could only emanate from a non-politicized institutions-building process (not modelled here) in which the distortions related to electoral uncertainty would have no place. A constitution designed by a non-political body and approved by referendum is one possible incarnation of such a process. However, even the non-politicized design of policy-making institutions is often constrained by history or pre-existing norms that are hard to change. This is why the next section examines the welfare effect of partially reforming an existing, suboptimal fiscal pact.

4 Limited Amendments to Suboptimal Fiscal Pacts

Since November 2003, a broad consensus on the need to amend the Stability and Growth Pact while preserving its essential features has emerged among policymakers and analysts.

[14] Appendix C provides an example with a numerical solution for (k^s, δ^s).

Yet, for obvious legal and practical reasons (such as the fact that some provisions of euro area's fiscal framework can only be modified by unanimous consent of all 25 Member States), it remains unclear how deeply the existing framework can be amended.[15] In a statement following their Scheveningen meeting in September 2004, the Ministers of Economy and Finance of the European Union confirmed that "*the Treaty should not be changed and that changes to the regulations should be minimized, if necessary at all*". In the context of our model, that situation suggests to study the conditions under which limited changes to a given fiscal pact would increase welfare. We start with the case of tightening enforcement while keeping procedural flexibility constant. We then look into the welfare impact of increasing procedural flexibility for given enforcement. Finally, taking procedural flexibility and enforcement as irrevocably fixed, we show that the SNA could increase welfare by implementing flexibility in a way that induces more reforms at a limited cost in terms of fiscal discipline.

In practice, the last two cases may be most relevant because, as already illustrated by the November 2002 Commission's recommendations, implementation procedures can be adjusted by a simple agreement between the Council and the Commission, without formally revising the Treaty (Article 104 relating to the Excessive Deficit Procedure) nor the Regulation (the Stability and Growth Pact itself). By contrast, the strictness of enforcement is essentially dictated by the formal relationship between the Commission and the Council and any change at that level would most probably require modifications in the legal framework. Yet it has been argued, most notably by the European Central Bank, that the SGP mainly suffers from a lack of enforcement and that procedural flexibility is sufficient. This is why the first sub-section formally investigates that possibility.

4.1 Enforcing a Pact with Given Procedural Flexibility

To assess the basic trade-off, we can compute the welfare effect of enforcing a sanction scheme $k(b-\delta\eta\gamma)$, starting from $k=0$ and taking procedural flexibility as given. Differentiating the social welfare function with respect to k, we evaluate the resulting expression at $k=0$. This yields (see Appendix D):

$$\begin{aligned}&(p-1)\,v_2'\left[\frac{db}{dk}-\theta y\Gamma'\frac{d\gamma}{dk}\right]=\\&\left[\frac{(p-1)\,v_2'}{1-A_2B_2}\right]\left[\frac{(1-\theta)\,yu_1'\Gamma''+\frac{1}{2}H^2u_1''+p\theta yv_2'\Gamma''+\eta\,(1-\delta)\,(\eta-\theta y\Gamma')\,v_1''}{K\,(v_1''+pv_2'')}\right].\end{aligned}\tag{9}$$

This expression can be positive or negative as it simply describes the trade-off involved by the decision to enforce sanctions against excessive deficits. On the one hand, as revealed in Proposition 3, punishing deficits is generally expected to reduce them ($db/dk<0$),

[15] See, for instance, Pisani-Ferry, 2002; Wyplosz, 2002; Buiter and Grafe, 2003; Calmfors and Corsetti, 2003; EEAG, 2003; Fatàs et al., 2004; and Eichengreen, 2004. Schuknecht (2004) is sceptical about the need for reform and views the SGP as having been effective so far, although not perfectly so.

which, given the deficit bias affecting partisan governments, improves welfare. On the other hand, the gains from lower deficits might be offset by a more severe bias against structural reforms ($d\gamma/dk < 0$), which would reduce welfare. From the second line of (9), we can read off the sign of the overall welfare effect. The first factor inside square brackets is unambiguously negative, while the denominator of the second factor inside square brackets is unambiguously positive. Hence, the overall welfare effect of enforcing sanctions against excessive deficits is determined by the numerator of that factor, leading to the following proposition:

Proposition 6 *Enforcing sanctions against excessive deficits always raises welfare if procedural flexibility is such that the SNA extends waivers for the full amount of high-quality spending $\eta\gamma$ (i.e. $\delta = 1$). For smaller degrees of procedural flexibility ($\delta < 1$), enforcing sanctions raises welfare only if the expected marginal income gain from reforms ($\Gamma' > 0$) is sufficiently small.*

The first part of the proposition establishes that procedural flexibility improves the terms of the trade-off between fiscal discipline and the status quo bias in reforms. Not surprisingly, if the SNA calibrates sanctions so as to practically exonerate governments from deficits caused by high-quality spending, then the marginal welfare effect of enforcing sanctions is always positive as the pact would never punish such spending.[16] Inevitably, when flexibility is limited, the trade-off between excessive deficits and the under-reform bias is less favorable and may even make enforcement counterproductive if the expected marginal effect of reforms on period-2 income is sufficiently large. Hence, in an environment where reforms are badly needed (that is when γ is low), rigid implementation procedures are more likely to make enforcement counterproductive.

4.2 Increasing Procedural Flexibility with Given Enforcement

Turning to changes in the implementation procedure, we investigate whether, for a given level of enforcement, greater procedural flexibility could increase welfare. The following proposition (demonstrated in Appendix E) answers that question.

Proposition 7 *Assume that more ambitious structural reforms increase second-period tax revenues by more than the first-period marginal cost ($\theta y \Gamma' > \eta$). Then, more flexibility (a higher δ) increases welfare.*

Hence, in the case where additional reforms are sufficiently "productive", the fact that raising δ encourages such reforms improves welfare, even though the deficit rises (recall Proposition 4). That result clearly hinges on the assumption of complete budgetary transparency as the SNA can precisely assess the policies underlying a given deficit and grant waivers accordingly. In Section 5, we show that budgetary opaqueness reduces the benefits from flexibility because it hinders the accuracy of SNA's assessment.

[16] In that case, using (1), sanctions are given by $k\,(f_1 + g_1 + h)$.

4.3 Flexibility for Ambitious Reforms Only

The extent to which the legal framework can be amended and the inevitable limits within which procedural flexibility can change point to a third practical option to adjust the implementation of the pact in a welfare improving way. In this subsection, we show that the SNA can enhance the positive impact of sanction waivers on reforms while remaining within the limits of existing procedural flexibility. This is done by restricting waivers to governments opting for sufficiently ambitious reform programs. Formally, that implies a more sophisticated sanction scheme for $b > 0$:

$$\begin{aligned} w(b) &= b, \quad \text{if } \gamma < \gamma^*, \\ w(b) &= b - \delta\eta\gamma, \quad \text{if } \gamma \geq \gamma^*, \end{aligned} \tag{10}$$

where $\gamma^* > 0$ is the minimum reform effort *below* which the SNA will *never* extend waivers. By putting an extra premium on ambitious reform agendas, the limitations to flexibility implied by (10) can strengthen the reform-enhancing role of a given amount of procedural flexibility while preserving the disciplinary effect of sanctions. In practice, the exclusive attention to ambitious reforms also seems natural in view of the difficulty (and the monitoring costs involved) to adjust sanctions for all reforms, including marginal ones.

Inevitably, the formal analysis of the policy game under (10) is slightly more complicated than before. As far as the optimal fiscal policy is concerned, the first-order condition for the deficit remains (6), irrespective of the extent of reforms. By contrast, finding the optimal structural policy first imposes to calculate two local optima corresponding to each of the two intervals $\gamma < \gamma^*$ and $\gamma \geq \gamma^*$, and then identify the global optimum. Maximizing $2u_1 + v_1 + pv_2 - kb$ over the interval $\gamma < \gamma^*$ yields either $\gamma = \gamma^*_- \equiv \sup[\gamma | \gamma < \gamma^*]$ or the value of γ solving (11):

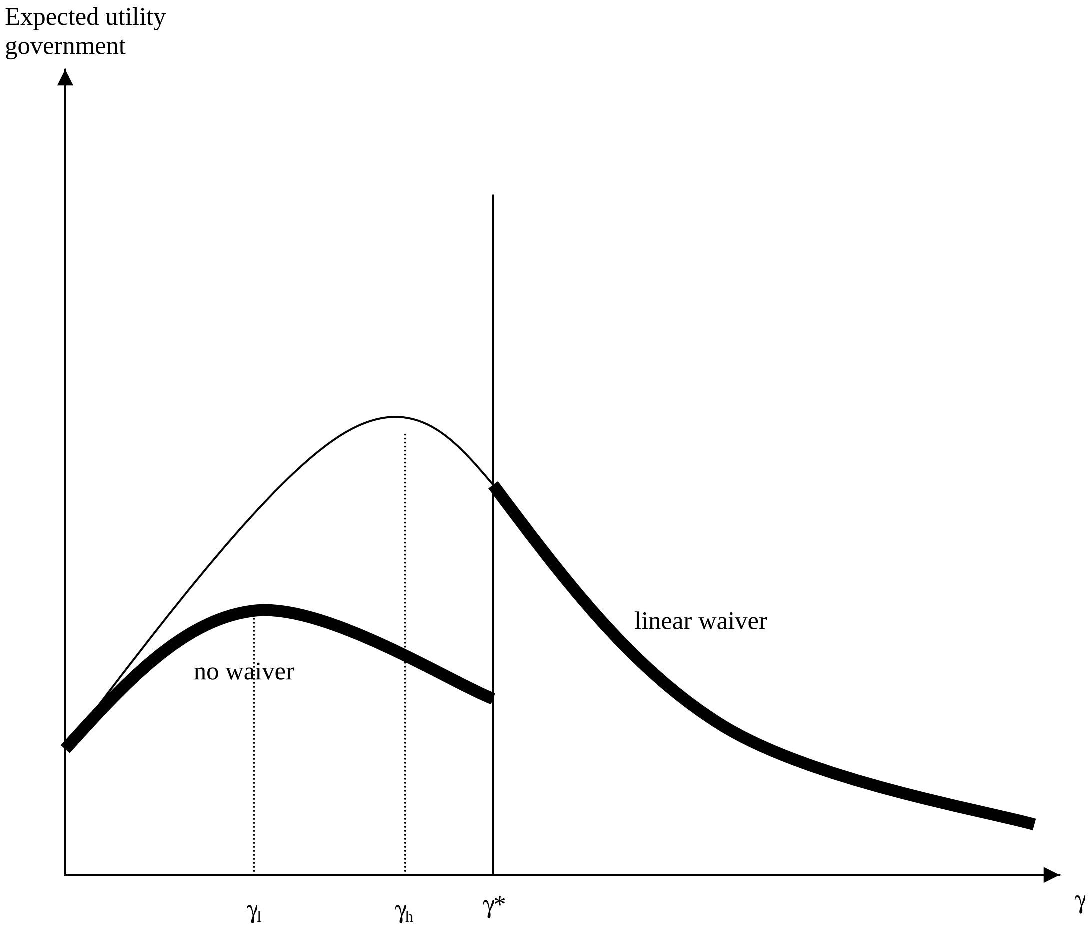
$$Hu_1' - \eta v_1' + p\theta y \Gamma' v_2' = 0 \quad \text{and} \quad \gamma < \gamma^*. \tag{11}$$

Denote the solution for γ to the first expression in (11) by γ_l. Maximizing $2u_1 + v_1 + pv_2 - k(b - \delta\eta\gamma)$ over the interval $\gamma \geq \gamma^*$ yields either the corner solution $\gamma = \gamma^*$ or the value of γ that solves the combination (7) *and* $\gamma > \gamma^*$. We denote the solution for γ to (7) by γ_h.

Figure 1 illustrates the government's expected utility without a possibility for a waiver ($\delta = 0$) and with a waiver (the linear sanction scheme). As the figure shows, an appropriate choice of $\gamma^* > \gamma_h$ induces the government to pick a more ambitious reform agenda than under the simple, linear scheme studied before. The following proposition, of which the proof is straightforward, formalizes this finding:

Proposition 8 *For given enforcement and procedural flexibility, the SNA can always devise a sanction scheme (10) in which the minimum level of reforms required to benefit*

Figure 1: sophisticated scheme enhances reform; optimum is γ*



from procedural flexibility is such that it encourages governments to choose more reforms than under the linear sanction scheme (3).

Having established that the SNA can provide incentives for additional structural reforms by amending the implementation procedure of the fiscal pact, it remains to check whether this improves social welfare. Indeed, as extra reforms exacerbate the deficit bias (see Lemma 1), the welfare effects are potentially ambiguous. In fact, the following Proposition establishes that these extra reforms do raise welfare:

Proposition 9 *Assume that more ambitious structural reforms increase second-period tax revenues by more than the first-period marginal cost ($\theta y \Gamma' > \eta$). For given enforcement, k, and procedural flexibility, δ, a sanction scheme restricting the benefits of procedural flexibility to governments having opted for sufficiently ambitious reforms ($\gamma \geq \gamma^*$), raises social welfare provided that the reform threshold γ^*, is set marginally above the optimal reform package γ_h governments would have adopted under a simple linear sanction scheme.*[17]

Proof. See Appendix G. ■

In the proof of this proposition, we consider γ^* as a choice variable set by the SNA and compute the marginal welfare effect (evaluated at $\gamma = \gamma_h$) of an increase in γ^*. As an intermediate step in the demonstration, we obtain an expression summarizing the trade-offs involved by choosing a more ambitious reform threshold:

$$(1-p)\, v_2' \theta y \Gamma' - (1-p)\, v_2' \frac{db}{d\gamma} + k \frac{db}{d\gamma} - k\delta\eta. \tag{12}$$

The first two terms in (12) capture the tension between fiscal and structural policies at the core of our model; that is, any reduction in the status quo bias against reforms comes at the cost of additional spending that ends up aggravating the deficit bias. Although enforcing sanctions against excessive deficits attenuates the fiscal slippage induced by extra reforms (third term in (12)), that disciplinary effect is undermined by the extent to which procedural flexibility waives sanctions in case of reforms (fourth term in (12)).

Appendix G also shows that (12) can be further worked out to yield:

$$(1-p)\, v_2' \left[\frac{(\theta y \Gamma' - \eta)\, v_1''}{v_1'' + p v_2''} \right] + k \left[\frac{\eta (1-\delta)\, v_1'' + p v_2'' (\theta y \Gamma' - \delta\eta)}{v_1'' + p v_2''} \right] > 0,$$

where all terms are again evaluated at $\gamma = \gamma_h$. That expression is positive if the marginal effect of reforms on period-2 fiscal revenues is sufficiently large, which is indeed the case under the now familiar condition that $\theta y \Gamma' > \eta$. Since both enforcement and procedural flexibility were held constant with respect to the linear sanction scheme, restricting the benefits of flexibility to ambitious reforms can always improve welfare. However, to preserve analytical tractability, the remainder of the analysis is conducted under the assumption of a simple linear punishment scheme.

[17] Appendix F shows that $Max\,[\gamma_l, \gamma_h] = \gamma_h$.

5 Budgetary Opaqueness

When procedural flexibility is based on the overall quality of fiscal policy, the lack of budget transparency is a potentially serious obstacle. Since only governments know the true fiscal implications of structural reforms and may not truthfully share that information with the SNA, our case for a "smart" implementation of simple rules may be weaker than in the case of perfect information. To put it bluntly, flexibility may create loopholes allowing policymakers to outsmart the enforcer. This could happen through creative accounting practices (Milesi-Ferretti, 2003; for suggestive Euro-area empirical evidence, see Von Hagen and Wolff, 2004), or more pragmatically, by overstating the budgetary impact of certain reforms. This section demonstrates that budgetary opaqueness does not negate the case for flexibility, but that it calls for greater caution in its execution. Incidentally, we also highlight a new channel through which budgetary transparency may entail welfare gains.

To enrich the formal analysis of budgetary opaqueness, we now assume that governments have private incentives to spend on socially-useless programs (pork-barrel spending). Examples of such programs include favors to the government's own constituency or the creation of jobs through infrastructure work with minimal social returns. Such programs may generate financial or other benefits (such as enhanced political support or better future job prospects) for members of the government.

That new political distortion (the other one being the effect of electoral uncertainty on governments' effective time preference) has first-order implications for the quality of a fiscal policy subject to simple deficit rules. Most importantly, it negates the trade-off between the deficit and the anti-reform bias, allowing us to establish that *simple deficit rules implemented with due regard for the quality of underlying policies can simultaneously reduce the deficit and increase high-quality outlays.*

5.1 Opaque Budgets and the Gains from Flexibility

To model the lack of budgetary transparency, we assume that the SNA cannot distinguish between pork-barrel programs h and high-quality spending $\eta\gamma$ because information about the true value of both h and η is known by the government only. However, the amount of reforms, γ, and the *total* amount not spent on public goods $h + \eta\gamma$ remains common knowledge. As we see from (1), the latter is compatible with the assumption that total spending on public goods, tax revenues and the deficit are perfectly observable. In practice, this may not be the case as misreporting or creative accounting practices make the true deficit imperfectly observable. The way we model opaqueness simply has the advantage of being directly related to one key objection to procedural flexibility, namely the difficulty to assess the quality of fiscal policy.

Under opaqueness, the budgetary impact of the two political distortions is blurred, complicating the SNA's task to extend waivers proportional to reform-related expenditures while punishing deficit-creating waste on pork-barrel programs. Yet, if $h + \eta\gamma$ appears large in relation to the observed reform agenda γ, the SNA would plausibly be more likely to conclude that the government has opted for large pork-barrel programs, while the opposite conclusion would be reached if $h + \eta\gamma$ is small in relation to γ. Barring any improvement in budget monitoring or transparency, we conjecture that it would be desirable for the SNA to exert flexibility only in cases where h is likely to be small, that is when the observed $h + \eta\gamma$ is sufficiently low in comparison to the amount of reforms. We thus assume a threshold value $\gamma\bar{s}$ for $h + \eta\gamma$ such that below $\gamma\bar{s}$, the SNA stands ready to show flexibility, while above $\gamma\bar{s}$, the sanction scheme will be fully enforced, excluding any waiver. The parameter $\bar{s}$ can thus be interpreted as the SNA's relative tolerance for opaqueness, or alternatively, its readiness to give governments the benefit of the doubt. Let us label the SNA's decision rule about waivers, the "restricted waiver policy" or RWP.

In this new game, the timing of events is as follows. First, γ, b and h are chosen. Then, η is observed by the government, which is followed by the representative consumer selecting her optimal profile of private consumption. Next, at the beginning of period 2, elections take place and, finally, all debts are paid off.

The government sets γ, b and h maximizing the following objective function:

$$\mathrm{E}\left\{2u_1 + v\left[\theta y - (h + \eta\gamma) + b\right] + pv\left[\theta\Gamma(\gamma)\, y - b\right] + z(h) - kw(b)\right\}.$$

To check the validity of our conjecture about the desirability of the RWP, we look at two alternatives, namely *never* extending waivers or *always* granting waivers, irrespective of the size of $h + \eta\gamma$. In the former case, governments expect the fiscal pact to inflict a disutility from deficit equivalent to

$$k\mathrm{E}\left[w(b)\right] = kb, \tag{13}$$

so that the set of first-order conditions for, b, γ and h are (41), (42) and (43) respectively,– see Appendix I. Instead, when waivers are always granted, then governments expect a pact-related disutility from deficits of

$$k\mathrm{E}\left[w(b)\right] = k\left[b - \delta\left(h + \bar{\eta}\gamma\right)\right], \tag{14}$$

and the first-order conditions become (41), (44) and (45) in Appendix I.

To keep the analysis of the RWP tractable, we assume that η is uniformly distributed over the interval $[\bar{\eta} - \sigma, \bar{\eta} + \sigma]$, where $\bar{\eta} \geq \sigma$. Hence, based on the SNA's decision rule under RWP, governments would then expect the disutility from the deficit to be (see Appendix I):

$$k\mathrm{E}\left[w(b)\right] = kb - \tfrac{1}{4}k\delta\gamma\left\{\left[2\left(h/\gamma + \bar{\eta}\right) - \sigma\right] + \left[\bar{s}^2 - \left(h/\gamma + \bar{\eta}\right)^2\right]/\sigma\right\}, \tag{15}$$

if

$$\bar{\eta} - \sigma < \bar{s} - h/\gamma < \bar{\eta} + \sigma, \tag{16}$$

with the second term on the right-hand side of (15) representing the expected waiver under RWP. It is easy to see from (15) that expected waivers are non-negative if (16) holds, and that they are strictly decreasing in $(h/\gamma + \bar{\eta})$, the size of non-transparent expenditure (including pork-barrel programs h) in relation to reforms.

Under (16), the first-order conditions for b, γ and h are (41) along with:[18]

$$\begin{aligned} \mathrm{E}\left\{Hu_1' - \eta v_1' + p\theta y \Gamma' v_2'\right\} &= -\tfrac{1}{4}k\delta\left\{\left[2\left(h/\gamma + \bar{\eta}\right) - \sigma\right] + \left[\bar{s}^2 - \left(h/\gamma + \bar{\eta}\right)^2/\sigma\right]\right\} \\ &\quad -\tfrac{1}{2}\left(k\delta h/\gamma\right)\left[\left(h/\gamma + \bar{\eta}\right)/\sigma - 1\right], \qquad (17) \\ z'(h) &= \tfrac{1}{2}k\delta\left[\left(h/\gamma + \bar{\eta}\right)/\sigma - 1\right] + \mathrm{E}\left[v_1'\right]. \qquad (18) \end{aligned}$$

As in previous sections, the basic principles underlying the effect of a fiscal pact's key features on equilibrium policies can be obtained by totally differentiating the first-order conditions. Focusing on the interesting case where (16) holds, we derive the following proposition (see Appendix I).

Proposition 10 *Holding constant γ and h, the response of the deficit to the introduction or adjustment of a pact is such that $\partial b/\partial k < 0$, $\partial b/\partial \delta = 0$, and $\partial b/\partial \bar{s} = 0$, while if b and h are frozen, the response of reforms can be described as $\partial\gamma/\partial k > 0$, $\partial\gamma/\partial\delta > 0$ and $\partial\gamma/\partial\bar{s} > 0$. Finally, with b and γ constant, the fiscal pact affects pork-barrel spending as follows: $\partial h/\partial k < 0$, $\partial h/\partial\delta < 0$ and $\partial h/\partial\bar{s} = 0$.*

The novelty is that the SNA's tolerance for opaqueness ($\bar{s}$) is now a parameter of the pact, along with the strictness of enforcement (k), and procedural flexibility (δ), and that it emerges as a complement of the latter in promoting structural reforms. Another novel element is the role played by the pact's parameters *through the expected sanctions for excessive deficit as calculated by governments*. This most notably affects the response of pork-barrel spending to greater procedural flexibility. Specifically, we see that, for given deficits and reforms, flexibility contributes to discourage unproductive outlays in spite of the fact it boosts the value of waivers associated with non-transparent expenditure in general. The reason is that any induced increase in pork-barrel spending would in fact augment the risk of that larger waiver being denied. Moreover, for a given risk of not receiving the waiver, greater flexibility increases the corresponding loss, encouraging governments to reallocate resources away from pork-barrel programs and into reform-enhancing expenditures — as such reallocation reduces that risk. A similar reasoning holds for tighter enforcement, k.

[18] If $\bar{s} - h/\gamma$ falls outside (16), the RWP unravels to one of the two alternatives, that is waivers are either always granted or always denied. The latter applies if $\bar{s} - h/\gamma \leq \bar{\eta} - \sigma$ and the relevant set of first-order conditions is (41)-(43) *and* this condition. The former applies if $\bar{s} - h/\gamma \geq \bar{\eta} + \sigma$ and the relevant set of first-order conditions is (41), (44) and (45) *and* this condition. The model thus admits the possibility of multiple equilibria.

Numerical solutions are now necessary to characterize possible equilibria in terms of the effects of the fiscal pact on public deficits, the structure of public expenditure, and social welfare. We assume that all utility functions are quadratic and given by:

$$u(x) = v(x) = \frac{1}{\omega} z(x) = -\tfrac{1}{2}(\xi - 1)x^2 + \xi x, \quad x < \xi/(\xi - 1), \tag{19}$$

where we impose $x < \xi/(\xi - 1)$ to keep marginal utilities strictly positive. The parameter ω stands for the relative attractiveness of pork-barrel spending for the incumbent government. Future income is linked to present reforms by a power function:

$$\Gamma(\gamma) = \gamma^q. \tag{20}$$

The baseline parameter combination is $\xi = 1.1$, $y = 5$, $p = \theta = 0.5$, $\omega = I = 1$, $\bar{\eta} = 0.75$, $\sigma = 0.5$ and $q = 0.25$. The value of y determines the size of the economy and can be chosen arbitrarily, while the value of ξ is such that marginal utilities are always positive. Given the highly stylized nature of the model, it is difficult to pin down "plausible" parameter values using hard data. We thus check the robustness of our results for a wide range of parameter combinations. Specifically, we have considered all parameter combinations formed by the Carthesian product of $p, \theta, \sigma \in \{0.25, 0.75\}$, $\omega \in \{0.75, 2\}$, $I \in \{0.5, 2\}$, $\bar{\eta} \in \{0.5, 1\}$ and $q \in \{0.1, 0.25, 0.5\}$. Hence, the tax rate θ and the re-election probability p vary over wide ranges that cover, respectively, the GDP-shares of the public sector in advanced economies and the chances that incumbent governments in democratic countries remain in office after elections. The support of the compensation cost distribution varies over a wide range relative to its mean. Finally, to provide some perspective on the budgetary and efficiency effects of reform, we notice that under the baseline reported in Table 1 below, second-period GDP exceeds first-period GDP by 8.5%, as a result of the reform,[19] while the net private contribution to the reform is about 7% of GDP.

We now proceed as follows. First, we look at the response of the deficit, reforms, pork-barrel spending, and social welfare to the introduction of a fiscal pact, excluding any procedural flexibility. Second, given a certain degree of enforcement, we look at the consequences of introducing procedural flexibility (that is we evaluate the impact of marginally increasing δ, starting at $\delta = 0$), assuming that the SNA grants waivers irrespective of $h + \eta\gamma$ (unrestricted procedural flexibility). Given combinations of (k, δ), the third and final step is to search for the optimal value of $\bar{s}$, that is the extent to which the SNA should give governments the benefit of the doubt regarding the true budgetary effect of reforms.

Table 1 summarizes the first step of our investigation where we consider the effects of introducing a stability pact with a rigid implementation procedure.[20] Unsurprisingly,

[19] This also seems reasonable in comparison to existing estimates of the benefits from structural reforms. For instance, the IMF (2003) estimates that if European labor and product markets were as competitive as in the U.S., European GDP would be 10 percent higher.

[20] That exercise thus yields the marginal effect on social utility of enforcing a stability pact starting at

enforcing a fiscal pact entails both a lower deficit and a reduction in pork-barrel spending, thereby partly alleviating the consequences of our two political distortions.[21] However, spending cuts also concern reform-facilitating items, and thus aggravate the anti-reform bias. The overall welfare effect is nevertheless positive:

Result 1 *For all parameter combinations considered here, the marginal welfare effect of enforcing a fiscal pact with no procedural flexibility* ($\delta = 0$) *is positive.*

Table 1: Marginal effects of enforcing a fiscal pact
(i.e., derivatives evaluated at $k = 0$)

case	$\frac{dV_S}{dk}$	$\frac{db}{dk}$	$\frac{d\gamma}{dk}$	$\frac{dh}{dk}$
baseline	+	−	−	−
$p = .25$	+	−	−	−
$p = .75$	+	−	−	−
$\theta = .25$	+	−	−	−
$\theta = .75$	+	−	−	−
$\sigma = .25$	+	−	−	−
$\sigma = .75$	+	−	−	−
$\bar{\eta} = .5$	+	−	−	−
$\bar{\eta} = 1$	+	−	−	−
$\omega = .75$	+	−	−	−
$\omega = 2$	+	−	−	−
$I = .5$	+	−	−	−
$I = 2$	+	−	−	−
$q = .1$	+	−	−	−
$q = .5$	+	−	−	−

Note: to focus on cases where h is positive, we do not report results for $\omega < 0.75$ (see Footnote 24 below). We always vary one parameter, while keeping the others at their baseline values.

We now examine whether procedural flexibility can reduce the collateral damage of the pact in terms of high-quality outlays if sanctions for excessive deficits are waived proportionally to spending unrelated to public good provision (that is, $h + \eta\gamma$). For that purpose, Table 2 presents the marginal effects of introducing procedural flexibility, taking enforcement k as given, and assuming that the SNA always grants waivers proportionally to $(h + \eta\gamma)$. Procedural flexibility loosens the disciplinary effect of the pact as the

$k = 0$ (no-enforcement), while keeping $\delta = 0$. The relevant system of first-order conditions is given by (41)-(43).

[21] As indicated earlier, one should bear in mind that none of the resulting solutions produces the socially-optimal allocation, because a fiscal pact with first-order effects on *intertemporal* choices cannot deal with the purely intratemporal distortion associated with pork-barrel spending.

deficit, and all expenditure items—including pork-barrel spending and reform-enhancing measures—increase. Regarding welfare, we find that:

Result 2 *For all parameter combinations considered here, the marginal welfare effect of introducing unrestricted procedural flexibility is negative.*

In other words, *introducing unrestricted procedural flexibility is never socially desirable.* This confirms our conjecture that *opaqueness should lead the SNA to opt for a restricted waiver policy (RWP) by which flexibility would be considered only in cases of limited fiscal slippages attributed to structural reforms (or other high-quality spending).*

Table 2: Marginal effects of introducing unrestricted procedural flexibility
(i.e., derivatives evaluated at $\delta = 0$)

case	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$
	$k = 0.1$				$k = .25$				$k = .5$			
baseline	−	+	+	+	−	+	+	+	−	+	+	+
$p = .25$	−	+	+	+	−	+	+	+	−	+	+	+
$p = .75$	−	+	+	+	−	+	+	+	−	+	+	+
$\theta = .25$	−	+	+	+	−	+	+	+	−	+	+	+
$\theta = .75$	−	+	+	+	−	+	+	+	−	+	+	+
$\sigma = .25$	−	+	+	+	−	+	+	+	−	+	+	+
$\sigma = .75$	−	+	+	+	−	+	+	+	−	+	+	+
$\bar{\eta} = .5$	−	+	+	+	−	+	+	+	−	+	+	+
$\bar{\eta} = 1$	−	+	+	+	−	+	+	+	−	+	+	+
$\omega = .75$	−	+	+	+	−	+	+	+	−	+	+	+
$\omega = 2$	−	+	+	+	−	+	+	+	−	+	+	+
$I = .5$	−	+	+	+	−	+	+	+	−	+	+	+
$I = 2$	−	+	+	+	−	+	+	+	−	+	+	+
$q = .1$	−	+	+	+	−	+	+	+	−	+	+	+
$q = .5$	−	+	+	+	−	+	+	+	−	+	+	+

Note: see Note to Table 1.

Table 3 looks into the effects of the RWP,[22] according to which flexibility will be denied if the sum of non-transparent spending items $h + \eta\gamma$ is deemed excessive by the SNA. In addition to k and δ, the relative weight attached to pork-barrel programs (ω) and the extent of budgetary opaqueness (σ) are allowed to take different values, while other parameters are kept equal to their baseline value.[23] We look at the equilibrium under

[22] This is done for a given k by changing δ while optimally adjusting $\bar{s}$.

[23] All the results hold for a much wider range of parameter combinations than those reported in Table 3. In particular, we investigated each combination (except those where $\sigma > \bar{\eta}$) formed by the Carthesian product of $p, \theta, \sigma \in \{0.25, 0.75\}$, $\omega \in \{0.75, 2\}$, $I \in \{0.5, 2\}$, $\bar{\eta} \in \{0.5, 1\}$, $q \in \{0.1, 0.25, 0.5\}$, $k \in \{0.1, 0.25\}$ and $\delta \in \{0.1, 0.25, 0.5, 1\}$.

condition (16), which is the solution to the system formed by (41), (17) and (18). Most solutions support the novel insights of Proposition 10 regarding the impact of procedural flexibility on the reallocation of public resources away from pork-barrel spending and in favor of reforms.[24] What is more, flexibility leads in most cases to a lower deficit. To summarize:

Result 3 *Under budgetary opaqueness, the restricted waiver policy allows procedural flexibility to improve the equilibrium structure of public expenditure, possibly destroying the trade-off between the deficit bias and reform-related expenditure.*

From the perspective of rational governments, greater flexibility under the RWP raises the cost of being denied a waiver—recall that a higher δ leads to more generous waivers. In response, they trim the deficit, and reduce the probability of having their request for waiver turned down — by increasing the funding for reforms, and reducing unproductive expenditure. Consequently, greater procedural flexibility can increase social welfare even though the SNA cannot appraise the exact budgetary costs of reforms!

Does the penchant for pork-barrel programs (ω) affect the results? The numerical solutions reported in Table 3 indicate that an increase in ω not only shifts resources in favor of these programs, but also aggravates the deficit bias as the policymaker optimally shifts part of the cost to period 2 as well. This has two conflicting effects on reforms; a direct — negative — crowding-out effect, and a positive effect reflecting governments' effort to limit the risk of no-access to waivers (recall that the latter increases with the size of non-transparent expenditure in relation to reforms). Interestingly, the second effect dominates in most cases.

Before concluding this analysis, we compare the RWP to its two alternatives, namely unrestricted waivers (that is, irrespective of the level of $h/\gamma + \eta$, so that the equilibrium is determined by (41), (44) and (45)) or total absence of waivers (that is $\delta = 0$; and the equilibrium is determined by (41)-(43)). The corresponding social welfare levels shown in Table 3 support our initial conjecture that the RWP dominates the alternatives:

Result 4 *Under budgetary opaqueness, procedural flexibility with restricted waivers is socially preferable to either the absence of procedural flexibility or unlimited flexibility (i.e. unrestricted waivers).*

[24] Pork-barrel spending is sometimes reported to be negative. This has no bearing on the formal validity of the model since the latter only hinges on all marginal utilities being always positive, which is indeed the case in all solutions presented here (for all possible realizations of η). The restriction $h \geq 0$ was introduced earlier for the sole purpose of straightforward interpretations.

Table 3: Comparing equilibria under RWP and its alternatives

(ω, k, δ)	V_S	b	γ	h	V_S^{NW}	V_S^{AW}	V_S	b	γ	h	V_S^{NW}	V_S^{AW}
		σ	=	0.25				σ	=	0.75		
$(.75, .1, .1)$	6.53	3.76	1.37	1.25	6.26	6.19	6.31	3.81	1.26	1.45	6.24	6.16
$(.75, .1, .25)$	6.82	3.59	1.42	0.97	6.26	6.08	6.41	3.77	1.28	1.36	6.24	6.04
$(.75, .1, .5)$	7.15	3.38	1.43	0.64	6.26	5.91	6.54	3.70	1.30	1.23	6.24	5.86
$(.75, .1, 1)$	7.54	3.11	1.39	0.25	6.26	5.58	6.73	3.59	1.33	1.04	6.24	5.51
$(.75, .25, .1)$	7.91	1.94	1.13	0.27	7.58	7.39	7.63	2.08	1.08	0.54	7.56	7.35
$(.75, .25, .25)$	8.15	1.83	1.22	0.01	7.58	7.11	7.71	2.02	1.08	0.45	7.56	7.07
$(.75, .25, .5)$	8.34	1.71	1.25	-0.19	7.58	6.70	7.80	1.96	1.08	0.36	7.56	6.63
$(.75, .25, 1)$	8.50	1.63	1.31	-0.38	7.58	6.05	7.90	1.89	1.08	0.25	7.56	5.90
$(1, .1, .1)$	4.70	4.96	1.51	2.92	4.31	4.24	4.42	4.99	1.29	3.18	4.28	4.21
$(1, .1, .25)$	5.10	4.82	1.70	2.52	4.31	4.14	4.58	4.94	1.38	3.02	4.28	4.11
$(1, .1, .5)$	5.59	4.59	1.84	2.05	4.31	3.98	4.79	4.87	1.48	2.81	4.28	3.94
$(1, .1, 1)$	6.27	4.19	1.89	1.40	4.31	3.69	5.11	4.74	1.61	2.50	4.28	3.63
$(1, .25, .1)$	6.33	3.15	1.36	1.85	5.59	5.42	5.84	3.32	1.16	2.31	5.57	5.39
$(1, .25, .25)$	6.93	2.80	1.44	1.25	5.59	5.16	6.11	3.20	1.25	2.04	5.57	5.12
$(1, .25, .5)$	7.50	2.38	1.38	0.68	5.59	4.78	6.43	3.04	1.32	1.73	5.57	4.72
$(1, .25, 1)$	8.01	1.92	1.20	0.16	5.59	4.17	6.83	2.80	1.37	1.33	5.57	4.05
$(2, .1, .1)$	0.49	7.43	1.91	6.25	0.21	0.17	0.32	7.28	1.44	6.47	0.19	0.14
$(2, .1, .25)$	0.67	7.54	2.44	5.92	0.21	0.10	0.43	7.34	1.69	6.32	0.19	0.07
$(2, .1, .5)$	0.88	7.60	3.01	5.51	0.21	-0.02	0.55	7.40	1.99	6.13	0.19	-0.05
$(2, .1, 1)$	1.23	7.59	3.69	4.89	0.21	-0.22	0.71	7.45	2.38	5.84	0.19	-0.26
$(2, .25, .1)$	1.94	6.07	2.15	5.48	1.35	1.22	1.62	5.93	1.50	5.88	1.33	1.20
$(2, .25, .25)$	2.33	6.09	2.82	4.89	1.35	1.04	1.83	5.99	1.88	5.61	1.33	1.01
$(2, .25, .5)$	2.85	5.96	3.40	4.19	1.35	0.78	2.05	6.00	2.25	5.29	1.33	0.73
$(2, .25, 1)$	3.79	5.53	3.83	3.17	1.35	0.33	2.36	5.97	2.70	4.82	1.33	0.26

Notes: Parameters other than ω, k, δ and σ are at their baseline values. Columns 2 - 5 and 8 - 11 characterize the equilibrium obtained from the set of first-order conditions (41), (17) - (18). V_S^{NW} is the social welfare level corresponding to the absence of flexibility ("Never Waiver"), that is the solution obtained with the set of first-order conditions (41) - (43). V_S^{AW} is the social welfare associated with the unrestricted waiver policy ("Always Waiver"), that is the solution obtained with the set of first-order conditions (41), (44) - (45). Finally, the negative utility levels reported in some instances reflect negative values for private consumption or second-period public spending. We do not discuss these economically meaningless cases.

5.2 The Benefits of Budgetary Transparency

Interestingly, our analysis illustrates a new channel through which transparency in public sector accounts might increase Society's welfare. In our simple model where exogeneous political distortions justify the introduction of a rules-based fiscal framework intended to discourage deficits, budgetary transparency raises social welfare because it allows a better[25] implementation of the rules-based framework.

To see this, we first assess the direct impact of a change in transparency (σ) on optimal policies. Under RWP and assuming that $\bar{\eta}-\sigma < \bar{s}-h/\gamma < \bar{\eta}+\sigma$, Appendix I demonstrates the following Proposition:

Proposition 11 *Holding constant the other two policy instruments in each case, the response of the policy mix to a change in budgetary transparency is such that* $\partial b/\partial\sigma = 0$, $\partial\gamma/\partial\sigma < 0$ *(if* $\bar{s} > \bar{\eta}$*) and* $\partial h/\partial\sigma > 0$.

In words, an increase in budgetary transparency (that is, a *smaller* σ) clarifies the distinction between reform-enhancing and unproductive spending, helping the SNA in deciding whether or not to show flexibility. The government thus faces greater incentives to shift resources away from pork-barrel programs and into reform-enhancing measures.

Turning to the complete, numerical solutions, Table 3 makes clear that for all parameter combinations under review, social welfare increases with transparency (decreases with σ).[26] This allows us to conclude that:

Result 5 *All else being equal, an increase in budgetary transparency raises social welfare.*

In the limit case of full transparency ($\sigma = 0$), waivers are made contingent on compensation spending only and $w(b)$ is given by (3).[27] Table 4 shows that in all cases under review, flexibility encourages additional reforms at the cost of higher deficits, in line with Proposition 4, demonstrated above in the case where $h = 0$. However, the effect on pork-barrel spending is ambiguous. On the one hand flexibility relaxes the incentive to reduce deficits, while on the other hand the cost associated with the enhanced reform incentives crowds out unproductive spending.

[25] That is an implementation more mindful of the rules' potentially adverse consequences on the quality of fiscal policy.

[26] We thus hold the other parameters constant and assume the SNA's tolerance for opaqueness, $\bar{s}^{opt}$, is optimally adjusted.

[27] Appendix H contains the derivations for this case.

Table 4: Marginal effects of introducing procedural flexibility
(evaluated at $\delta = 0$)

case	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$	$\frac{dV_S}{d\delta}$	$\frac{db}{d\delta}$	$\frac{d\gamma}{d\delta}$	$\frac{dh}{d\delta}$
	$k = 0.1$				$k = .25$				$k = .5$			
baseline	+	+	+	−	+	+	+	−	+	+	+	−
$p = .25$	−	+	+	−	+	+	+	−	+	+	+	−
$p = .75$	+	+	+	−	+	+	+	−	+	+	+	−
$\theta = .25$	−	+	+	−	+	+	+	−	+	+	+	−
$\theta = .75$	+	+	+	+	+	+	+	+	+	+	+	+
$\eta = .5$	+	+	+	+	+	+	+	+	+	+	+	+
$\eta = 1$	−	+	+	−	+	+	+	−	+	+	+	−
$\omega = .75$	−	+	+	−	+	+	+	−	+	+	+	−
$\omega = 2$	+	+	+	−	+	+	+	−	+	+	+	+
$I = .5$	−	+	+	−	+	+	+	−	+	+	+	−
$I = 2$	+	+	+	+	+	+	+	+	+	+	+	+
$q = .1$	+	+	+	−	+	+	+	−	+	+	+	−
$q = .5$	+	+	+	−	+	+	+	−	+	+	+	−

Note: see Note to Table 1.

Although flexibility does not necessarily entail net welfare gains — see in particular the second column of Table 4 — , this is more likely to be the case under stricter enforcement (that is if k is higher). *Hence, if a fiscal pact is characterized by low enforcement (i.e. a low k), introducing procedural flexibility is potentially harmful because the disciplinary effect of the arrangement may become too weak. By contrast, procedural flexibility helps make strict enforcement (i.e. a high k) more easily "acceptable" for the public (and indirectly, governments) as corresponding welfare levels increase for all parameter constellations considered here.*[28] This is in sharp contrast with the results obtained for the unrestricted waiver policy under imperfect information, where procedural flexibility never improves welfare.

6 Conclusion

Practically since its inception, the Stability and Growth Pact has been under fierce criticism. Some have argued that the Pact's basic design was fundamentally flawed, and consequently harmful for member states. Other critics focused on the Pact's implementation, indicating that its constraining elements (in particular the sanctions) could not be enforced. In the aftermath of the November 2003 events, reforming the SGP became inevitable and a large number of proposals have been put forward to "improve" the euro area's fiscal architecture. However, many of the proposed reforms are substantial, some requiring significant amendments to the Regulations supporting the SGP or even revisions to the Treaty establishing the European Union, all options now explicitly rejected by the

[28] We confirm this result also for the much wider range of parameter combinations reported in Footnote 23, except that we now set $\sigma = 0$ in the Carthesian product defining the parameter space.

Ministers of Economics and Finance, who also endorsed the European Commission's call to *enhance the economic rationale underlying the implementation of the Pact.*

The aim of this paper was to capture in a simple theoretical set-up some broad trade-offs pertaining to the current debate about feasible SGP reforms. We explored the conditions under which procedural flexibility—which a priori does not imply deep regulatory changes—could increase the effectiveness of the framework. Given the difficulties associated with self-enforcement, such effectiveness clearly depends on the perceived desirability of the pact by member states. With that in mind, we have shown that the flexible implementation of a simple, rules-based fiscal framework can increase the desirability of the arrangement for participating countries, thus containing the risk of enforcement deadlocks.

Overall, the model suggests that procedural flexibility based on an independent and non-politicized judgment might well strengthen the SGP. However, it also identifies two cardinal conditions for that to be the case. First, an increase in procedural flexibility should not be confused with a loosening of enforcement. On the contrary, enforcement should be strengthened to ensure that governments actually expect to pay some price for unwarranted profligacy. In such a scenario, the application of the corrective dimension of the pact would probably be limited to truly unacceptable fiscal behaviors so that violators find themselves isolated and unable to form coalitions inside the Council to block enforcement. Second, as budgetary opaqueness provides opportunities to abuse procedural flexibility, the latter should be exerted with caution, in practice excluding large fiscal slippages. Improving transparency and budgetary surveillance is thus an important step to secure the benefits from an increase in procedural flexibility. In fact, a practical implication of the model is that, when pondering the option of granting a waiver, the SNA should only consider those structural reforms with the most easily traceable budgetary impact.

Inevitably, a stylized model aimed at characterizing some first-order principles underlying the implementation of fiscal rules tends to neglect the operational obstacles associated with a flexible implementation of a fiscal pact. In particular, limited information on the concrete extent of a reform package, or on its future pay-offs makes it difficult to assess the desirable degree of flexibility the SNA should have in authorizing deviations from the letter of the rule. Our analysis can only suggest that great caution should be exerted. Another element not explicitly addressed here but that matters for the Pact's legitimacy, is that limited budgetary transparency prevents an even-handed application of the rules. Finally, the model also abstracts from the politics of implementation, and simply underscores the well-known virtue of a non-politicized implementation of rules supposed to correct the effects of political bias. Exploring implementation mechanisms that internalize these important constraints is an important topic for further research.

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Appendix

A Proof of Proposition 2

The first part of Part (a) follows immediately from Part (a) of Lemma 1. To prove the second part of Part (a), we differentiate (6) into (7), to give the system:

$$\begin{aligned} db/dp &= v_2' B_1 + B_2 d\gamma/dp, \\ d\gamma/dp &= -\left(\theta y \Gamma' v_2'/K\right) + A_2 db/dp, \end{aligned}$$

where B_1, B_2, A_2 and K are defined in the main text. Combining these two expressions, we derive:

$$\frac{db}{dp} = \left[\frac{1}{1-A_2B_2}\right]\left[\frac{v_2'}{v_1''+pv_2''}\right]\frac{(1-\theta)yu_1'\Gamma''+\frac{1}{2}H^2u_1''+p\theta yv_2'\Gamma''+\eta(\eta-\theta y\Gamma')v_1''}{K},$$

of which the first factor is positive (as shown in the next Appendix), the second factor is negative and the third factor is is positive if $\theta y\Gamma' - \eta > 0$ is not too large. Hence, if $\theta y\Gamma' - \eta > 0$ is not too large, $db/dp < 0$.

To prove part (b), we first substitute (6) into (7). We can rewrite the result as:

$$Hu_1' = \left(\eta - \theta y \Gamma'\right) pv_2' + \eta\left(1-\delta\right)k. \tag{21}$$

Set $k = 0$. Assume that $\theta y\Gamma' > \eta$. For given γ, the term on the left-hand side of (21) is the same both under a partisan government and a planner and, moreover, this term is decreasing in γ. Further, for any given γ, the right-hand side of (21) is smaller (more negative) under a planner ($p = 1$) than under a partisan government ($p < 1$). Hence, a solution for γ under a planner must exceed that under a partisan government.

B Proof that $A_2B_2 < 1$

We have that

$$A_2B_2 = \frac{\left(\eta v_1'' + p\theta y\Gamma' v_2''\right)^2}{K\left(v_1''+pv_2''\right)},$$

Hence,

$$\begin{aligned} K\left(v_1''+pv_2''\right) &> \\ \tfrac{1}{2}H^2u_1''\left(v_1''+pv_2''\right) + \left[\eta^2 v_1'' + p\left(\theta y\Gamma'\right)^2 v_2'' + p\theta y v_2'\Gamma''\right]\left(v_1''+pv_2''\right) &> \\ \left[\eta^2 v_1'' + p\left(\theta y\Gamma'\right)^2 v_2'' + p\theta y v_2'\Gamma''\right]\left(v_1''+pv_2''\right) &= \\ \eta^2\left(v_1''\right)^2 + p\left(\theta y\Gamma'\right)^2 v_1''v_2'' + p\theta y\Gamma'' v_2' v_1'' + p\eta^2 v_1''v_2'' + \left(p\theta y\Gamma' v_2''\right)^2 + p^2\theta y v_2'\Gamma'' v_2'' &= \end{aligned}$$

$$
\begin{aligned}
\left(\eta v_1'' + p\theta y\Gamma' v_2''\right)^2 - 2\eta p\theta y\Gamma' v_1'' v_2'' + p\left[\eta^2 + \left(\theta y \Gamma'\right)^2\right] v_1'' v_2'' + p\theta y \Gamma'' v_2' v_1'' + p^2\theta y v_2' \Gamma'' v_2'' &= \\
\left(\eta v_1'' + p\theta y\Gamma' v_2''\right)^2 + p\left(\eta - \theta y\Gamma'\right)^2 v_1'' v_2'' + p\theta y\Gamma'' v_2' v_1'' + p^2\theta y v_2' \Gamma'' v_2'' &>
\end{aligned}
$$

$$
\left(\eta v_1'' + p\theta y\Gamma' v_2''\right)^2,
$$

which completes the proof that $A_2 B_2 < 1$.

C Example of an optimal pact

Assume that:

$$
u(x) = v(x) = -\tfrac{1}{2}(\xi - 1)x^2 + \xi x, \quad x < \xi / (\xi - 1).
$$

Hence, (6) becomes:[29]

$$
\begin{aligned}
-(\xi - 1)\left[\theta y - \eta\gamma + b\right] + \xi &= k + p(\xi - 1)\left[b - \theta\Gamma(\gamma) y\right] + p\xi \Leftrightarrow \\
b &= \frac{(1-p)\xi - k}{(1+p)(\xi - 1)} + \frac{\theta y\left[p\Gamma(\gamma) - 1\right] + (h + \eta\gamma)}{1+p}.
\end{aligned}
$$

By equating the outcome for the deficit under a partisan government with that under a planner ($p = 1$ and $k = 0$), we can solve for the value of k that reproduces the socially-optimal deficit level:

$$
k^s = \tfrac{1}{2}(1-p)\left\{2\xi + (\xi - 1)\left[(h + \eta\gamma^s) - (1 + \Gamma(\gamma^s))\theta y\right]\right\} > 0.
$$

We observe that a higher h or a higher γ^s requires a higher k^s, because the government wants to shift part of the increase in h or γ^s to the future by raising the deficit. A larger productivity gain for a given level of reform (a higher $\Gamma(\gamma^s)$ given γ^s) requires a fall in k^s, because it is socially optimal to bring some of the productivity gains to the first period.

Using (7), we can compute the optimal value δ^s for δ as:

$$
\delta^s = \left(\eta v_{1s}' - H u_{1s}' - p\theta y \Gamma_s' v_{2s}'\right) / \eta k^s,
$$

where the subscript "s" is used to indicate that we evaluate at $b = b^s$ and $\gamma = \gamma^s$.

Let us give a numerical example. Assume that $\xi = 1.1$, $y = 5$, $p = \theta = 0.5$, $\eta = 0.75$, $I = 1.0$, $h = 0$ and $\Gamma(\gamma) = \gamma^{0.25}$. Then we find that $b^s = 0.59$, $\gamma^s = 1.33$, $k^s = 0.45$ and $\delta^s = 0.67$.

[29] Here, we leave $h \geq 0$ free, rather than setting $h = 0$ as we did in the main text (for convenience). By leaving h free, we can see how it affects the optimal design (k^s, γ^s) of the stability pact.

D Derivation of (9)

Differentiate individuals' utility with respect to k, to give:

$$\begin{aligned}
&\frac{d\left[2u\left(c_1\right)+v\left(q_1\right)+v\left(q_2\right)\right]}{dk}\\
=\;& Hu_1'\tfrac{d\gamma}{dk}+v_1'\left[-\eta\tfrac{d\gamma}{dk}+\tfrac{db}{dk}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{dk}-\tfrac{db}{dk}\right]\\
=\;& \left[\left(\eta-\theta y\Gamma'\right)v_1'+\left(\theta y\Gamma'-\delta\eta\right)k\right]\tfrac{d\gamma}{dk}+v_1'\left[-\eta\tfrac{d\gamma}{dk}+\tfrac{db}{dk}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{dk}-\tfrac{db}{dk}\right]\\
=\;& \left(-\theta y\Gamma' v_1'+v_2'\theta y\Gamma'\right)\tfrac{d\gamma}{dk}+\left(v_1'-v_2'\right)\tfrac{db}{dk}+\left(\theta y\Gamma'-\delta\eta\right)k\tfrac{d\gamma}{dk}\\
=\;& \left(-\theta y\Gamma'\left(pv_2'+k\right)+v_2'\theta y\Gamma'\right)\tfrac{d\gamma}{dk}+\left[\left(p-1\right)v_2'+k\right]\tfrac{db}{dk}+\left(\theta y\Gamma'-\delta\eta\right)k\tfrac{d\gamma}{dk}\\
=\;& \left(p-1\right)v_2'\left[\tfrac{db}{dk}-\theta y\Gamma'\tfrac{d\gamma}{dk}\right]+k\left[\tfrac{db}{dk}-\delta\eta\tfrac{d\gamma}{dk}\right]
\end{aligned}$$

where the second equality makes use of (21) and (6) and the fourth equality makes use of (6). If $k=0$, the second term in the final line vanishes. The first term can be written as:

$$\left(p-1\right)v_2'\frac{B_1\left(1-\theta y\Gamma' A_2\right)+\delta A_1\left(B_2-\theta y\Gamma'\right)}{1-A_2B_2}.$$

We now need to work out the components $B_1\left(1-\theta y\Gamma' A_2\right)$ and $A_1\left(B_2-\theta y\Gamma'\right)$. We have:

$$\begin{aligned}
&B_1\left(1-\theta y\Gamma' A_2\right)\\
=\;& \frac{1}{v_1''+pv_2''}\left[1-\theta y\Gamma'\frac{\eta v_1''+p\theta y\Gamma' v_2''}{K}\right]\\
=\;& \tfrac{1}{v_1''+pv_2''}\tfrac{(1-\theta)yu_1'\Gamma''+\frac{1}{2}H^2u_1''+\eta^2v_1''+p(\theta y\Gamma')^2v_2''+p\theta y v_2'\Gamma''-\theta y\Gamma'\eta v_1''-p(\theta y\Gamma')^2v_2''}{K}\\
=\;& \frac{1}{v_1''+pv_2''}\frac{\left(1-\theta\right)yu_1'\Gamma''+p\theta y v_2'\Gamma''+\frac{1}{2}H^2u_1''+\eta\left(\eta-\theta y\Gamma'\right)v_1''}{K}.
\end{aligned}$$

Next,

$$\begin{aligned}
&\delta A_1\left(B_2-\theta y\Gamma'\right)\\
=\;& \frac{-\delta\eta}{K}\left[\frac{\eta v_1''+p\theta y\Gamma' v_2''-\theta y\Gamma'\left(v_1''+pv_2''\right)}{v_1''+pv_2''}\right]\\
=\;& \frac{-\delta\eta\left(\eta-\theta y\Gamma'\right)v_1''}{K\left[v_1''+pv_2''\right]}.
\end{aligned}$$

Hence,

$$\begin{aligned}
&\left(p-1\right)v_2'\frac{B_1\left(1-\theta y\Gamma' A_2\right)+\delta A_1\left(B_2-\theta y\Gamma'\right)}{1-A_2B_2}\\
=\;& \left[\tfrac{(p-1)v_2'}{1-A_2B_2}\right]\left[\tfrac{1}{v_1''+pv_2''}\right]\tfrac{(1-\theta)yu_1'\Gamma''+\frac{1}{2}H^2u_1''+\eta(\eta-\theta y\Gamma')v_1''+p\theta y v_2'\Gamma''-\delta\eta(\eta-\theta y\Gamma')v_1''}{K}\\
=\;& \left[\tfrac{(p-1)v_2'}{1-A_2B_2}\right]\left[\tfrac{1}{v_1''+pv_2''}\right]\tfrac{(1-\theta)yu_1'\Gamma''+\frac{1}{2}H^2u_1''+p\theta y v_2'\Gamma''+\eta(1-\delta)(\eta-\theta y\Gamma')v_1''}{K}.
\end{aligned}$$

E Proof of Proposition 7

Differentiate individuals' utility with respect to δ, to give:

$$
\begin{aligned}
& \frac{d\left[2u\left(c_1\right)+v\left(q_1\right)+v\left(q_2\right)\right]}{d\delta} \\
= \; & Hu_1'\tfrac{d\gamma}{d\delta}+v_1'\left[-\eta\tfrac{d\gamma}{d\delta}+\tfrac{db}{d\delta}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{d\delta}-\tfrac{db}{d\delta}\right] \\
= \; & \left[\left(\eta-\theta y\Gamma'\right)v_1'+\left(\theta y\Gamma'-\delta\eta\right)k\right]\tfrac{d\gamma}{d\delta}+v_1'\left[-\eta\tfrac{d\gamma}{d\delta}+\tfrac{db}{d\delta}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{d\delta}-\tfrac{db}{d\delta}\right] \\
= \; & \left[-\theta y\Gamma'v_1'+\left(\theta y\Gamma'-\delta\eta\right)k+\theta y\Gamma'v_2'\right]\tfrac{d\gamma}{d\delta}+\left(v_1'-v_2'\right)\tfrac{db}{d\delta} \\
= \; & \left[\theta y\Gamma'\left(v_2'-v_1'\right)+\left(\theta y\Gamma'-\delta\eta\right)k\right]\tfrac{d\gamma}{d\delta}+\left(v_1'-v_2'\right)\tfrac{db}{d\delta} \\
= \; & \left[\theta y\Gamma'\left(\left(1-p\right)v_2'-k\right)+\left(\theta y\Gamma'-\delta\eta\right)k\right]\tfrac{d\gamma}{d\delta}+\left[\left(p-1\right)v_2'+k\right]\tfrac{db}{d\delta} \\
= \; & \left(p-1\right)v_2'\left[\tfrac{db}{d\delta}-\theta y\Gamma'\tfrac{d\gamma}{d\delta}\right]+k\left[\tfrac{db}{d\delta}-\delta\eta\tfrac{d\gamma}{d\delta}\right].
\end{aligned}
$$

To evaluate this expression, we need to find the expressions for $\frac{db}{d\delta}$ and $\frac{d\gamma}{d\delta}$. We obtain these by differentiating (6) and (7), which yields, respectively:

$$
\begin{aligned}
\frac{db}{d\delta} &= B_2\frac{d\gamma}{d\delta}, && (22) \\
\frac{d\gamma}{d\delta} &= kA_1+A_2\frac{db}{d\delta}. && (23)
\end{aligned}
$$

Hence,

$$
\begin{aligned}
\left(p-1\right)v_2'\left[\tfrac{db}{d\delta}-\theta y\Gamma'\tfrac{d\gamma}{d\delta}\right] &= \left(p-1\right)v_2'\left[\frac{B_2-\theta y\Gamma'}{B_2}\right]\frac{db}{d\delta} \\
&= \left[\left(p-1\right)v_2'\right]\left[\tfrac{\left(\eta-\theta y\Gamma'\right)v_1''}{\eta v_1''+p\theta y\Gamma' v_2''}\right]\left[\tfrac{kA_1B_2}{1-A_2B_2}\right], && (24)
\end{aligned}
$$

and

$$
\begin{aligned}
k\left[\tfrac{db}{d\delta}-\delta\eta\tfrac{d\gamma}{d\delta}\right] &= \left[B_2-\delta\eta\right]\left[\tfrac{k^2A_1}{1-A_2B_2}\right] \\
&= \left[\tfrac{\eta v_1''\left(1-\delta\right)+pv_2''\left(\theta y\Gamma'-\delta\eta\right)}{v_1''+pv_2''}\right]\left[\tfrac{k^2A_1B_2}{1-A_2B_2}\right]. && (25)
\end{aligned}
$$

We showed earlier that $A_2B_2<1$. Recall our assumption that $\theta y\Gamma'>\eta$. Given that the first and second factor in square brackets in the second line of (24) are negative, (24) is positive. Further, given our assumption that $\delta\leq 1$, (25) is positive. Hence, the marginal welfare effect of introducing some relief is positive.

F Proof that $Max\left[\gamma_l,\gamma_h\right]=\gamma_h$

Note that when $\delta\downarrow 0$, (7) converges to (11) and γ_h coincides with γ_l. Differentiating (6) and (7) with respect to δ, we obtain (22) and (23), respectively. Combining the latter two expressions, we obtain

$$\frac{d\gamma}{d\delta}=\frac{kA_1}{1-A_2B_2}>0,$$

which completes the proof.

G Proof of Proposition 9

Social welfare as a function of γ^* is (note that if $\gamma=\gamma^*$, relief is given):

$$2u_1^*+v_1^*+v_2^*,$$

where a star superscript indicates that we evaluate expressions at $(\gamma,b)=(\gamma^*,b^*)$, where b^* is the value of b that solves (6) for $\gamma=\gamma^*$. All terms in the ensuing proof will be evaluated at $\gamma^*=\gamma^h$. Differentiate the above expression with respect to γ^*, to give:

$$\begin{aligned}
& Hu_1'+\left[-\eta+\frac{db}{d\gamma}\right]v_1'+\left[\theta y\Gamma'-\frac{db}{d\gamma}\right]v_2' \\
= \; & Hu_1'-\eta v_1'+\theta y\Gamma' v_2'+\left(v_1'-v_2'\right)\frac{db}{d\gamma} \\
= \; & Hu_1'-\eta v_1'+p\theta y\Gamma' v_2'+\delta\eta k+\left[v_1'-pv_2'-k\right]\frac{db}{d\gamma} \\
& +(1-p)\,\theta y\Gamma' v_2'-\delta\eta k+k\frac{db}{d\gamma}-(1-p)\,v_2'\frac{db}{d\gamma}.
\end{aligned}$$

Then, by (6) and (7), the preceding expression reduces to:

$$(1-p)\,v_2'\left(\theta y\Gamma'-\frac{db}{d\gamma}\right)+k\left(\frac{db}{d\gamma}-\delta\eta\right).$$

We have that:

$$\begin{aligned}
\theta y\Gamma'-\frac{db}{d\gamma} &= \frac{\theta y\Gamma'\left[v_1''+pv_2''\right]-\left[\eta v_1''+p\theta y\Gamma' v_2''\right]}{v_1''+pv_2''} \\
&= \frac{\left(\theta y\Gamma'-\eta\right)v_1''}{v_1''+pv_2''}>0,
\end{aligned}$$

because $\theta y\Gamma'-\eta>0$ by assumption and where the expression for $\frac{db}{d\gamma}$ follows by totally differentiating (6), and

$$\begin{aligned}
\frac{db}{d\gamma}-\delta\eta &= \frac{\left[\eta v_1''+p\theta y\Gamma' v_2''\right]-\delta\eta\left[v_1''+pv_2''\right]}{v_1''+pv_2''} \\
&= \frac{\eta\,(1-\delta)\,v_1''+pv_2''\left(\theta y\Gamma'-\delta\eta\right)}{v_1''+pv_2''}>0,
\end{aligned}$$

because $\delta\leq 1$ and $\theta y\Gamma'>\eta$.

H Pork-barrel with perfect transparency

With pork-barrel programs now a decision variable, maximizing (5) implies an additional first-order condition. The optimal fiscal-structural policy mix thus necessarily satisfies (6), (7), and

$$v_1' = z'. \tag{26}$$

H.1 Effects of changes in k

Totally differentiating the first-order conditions (6), (7) and (26) yields

$$\begin{aligned}
\frac{d\gamma}{dk} &= \delta A_1 + A_2\frac{db}{dk} + A_3\frac{dh}{dk}, && (27)\\
\frac{db}{dk} &= B_1 + B_2\frac{d\gamma}{dk} + B_3\frac{dh}{dk}, && (28)\\
\frac{dh}{dk} &= C_1\frac{db}{dk} + C_2\frac{d\gamma}{dk}, && (29)
\end{aligned}$$

where, in addition to the definitions already contained in the main text:

$$\begin{aligned}
A_3 &\equiv -\eta v_1''/K < 0,\\
B_3 &\equiv v_1''/\left(v_1'' + p v_2''\right) > 0,\\
C_1 &\equiv v_1''/\left(v_1'' + z''\right) > 0,\\
C_2 &\equiv -\eta v_1''/\left(v_1'' + z''\right) < 0.
\end{aligned}$$

The final outcomes are computed as follows. Upon substitution of (29) into (27) and (28), we obtain:

$$\begin{aligned}
\frac{d\gamma}{dk} &= \delta A_1 + A_2\frac{db}{dk} + A_3\left[C_1\frac{db}{dk} + C_2\frac{d\gamma}{dk}\right],\\
\frac{db}{dk} &= B_1 + B_2\frac{d\gamma}{dk} + B_3\left[C_1\frac{db}{dk} + C_2\frac{d\gamma}{dk}\right],
\end{aligned}$$

which is equivalent to

$$\begin{aligned}
\frac{d\gamma}{dk} &= \delta\tilde{A}_1 + \tilde{A}_2\frac{db}{dk}, && (30)\\
\frac{db}{dk} &= \tilde{B}_1 + \tilde{B}_2\frac{d\gamma}{dk}, && (31)
\end{aligned}$$

where

$$\tilde{A}_1 \equiv A_1/(1-A_3C_2),$$
$$\tilde{A}_2 \equiv (A_2+A_3C_1)/(1-A_3C_2),$$
$$\tilde{B}_1 \equiv B_1/(1-B_3C_1),$$
$$\tilde{B}_2 \equiv (B_2+B_3C_2)/(1-B_3C_1).$$

Solving further, we obtain the final solution as:

$$\frac{db}{dk} = \left(\tilde{B}_1+\delta\tilde{A}_1\tilde{B}_2\right)/\left(1-\tilde{A}_2\tilde{B}_2\right), \tag{32}$$
$$\frac{d\gamma}{dk} = \left(\delta\tilde{A}_1+\tilde{A}_2\tilde{B}_1\right)/\left(1-\tilde{A}_2\tilde{B}_2\right), \tag{33}$$
$$\frac{dh}{dk} = \left[\delta\tilde{A}_1\left(C_2+C_1\tilde{B}_2\right)+\tilde{B}_1\left(C_1+C_2\tilde{A}_2\right)\right]/\left(1-\tilde{A}_2\tilde{B}_2\right). \tag{34}$$

The marginal social welfare effect of an increase in k is:

$$\begin{aligned}
&\frac{d\left[2u\left(c_1\right)+v\left(q_1\right)+v\left(q_2\right)\right]}{dk} \\
=\ & Hu_1'\tfrac{d\gamma}{dk}+v_1'\left[-\left(\tfrac{dh}{dk}+\eta\tfrac{d\gamma}{dk}\right)+\tfrac{db}{dk}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{dk}-\tfrac{db}{dk}\right] \\
=\ & \left[\eta v_1'-p\theta y\Gamma' v_2'-\delta\eta k\right]\tfrac{d\gamma}{dk}+v_1'\left[-\left(\tfrac{dh}{dk}+\eta\tfrac{d\gamma}{dk}\right)+\tfrac{db}{dk}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{dk}-\tfrac{db}{dk}\right] \\
=\ & (p-1)\,v_2'\left[\tfrac{db}{dk}-\theta y\Gamma'\tfrac{d\gamma}{dk}\right]+k\left[\tfrac{db}{dk}-\delta\eta\tfrac{d\gamma}{dk}\right]-v_1'\tfrac{dh}{dk}.
\end{aligned}$$

We obtain an overall welfare evaluation by substituting into the final line of this expression the final solutions for $\frac{db}{dk}$, $\frac{d\gamma}{dk}$ and $\frac{dh}{dk}$ (from (32) - (34)).

H.2 Effects of changes in δ

Totally differentiating the system (6), (7) and (26) with respect to δ yields:

$$\frac{d\gamma}{d\delta} = kA_1+A_2\frac{db}{d\delta}+A_3\frac{dh}{d\delta}, \tag{35}$$
$$\frac{db}{d\delta} = B_2\frac{d\gamma}{d\delta}+B_3\frac{dh}{d\delta}, \tag{36}$$
$$\frac{dh}{d\delta} = C_1\frac{db}{d\delta}+C_2\frac{d\gamma}{d\delta}. \tag{37}$$

The solution is:

$$\frac{db}{d\delta} = k\tilde{A}_1\tilde{B}_2/\left(1-\tilde{A}_2\tilde{B}_2\right), \tag{38}$$
$$\frac{d\gamma}{d\delta} = k\tilde{A}_1/\left(1-\tilde{A}_2\tilde{B}_2\right), \tag{39}$$
$$\frac{dh}{d\delta} = \left[k\tilde{A}_1\left(C_2+C_1\tilde{B}_2\right)\right]/\left(1-\tilde{A}_2\tilde{B}_2\right). \tag{40}$$

The marginal social welfare effect of an increase in δ is:

$$\begin{aligned}
& \frac{d\left[2u\left(c_1\right)+v\left(q_1\right)+v\left(q_2\right)\right]}{d\delta} \\
= \; & Hu_1'\tfrac{d\gamma}{d\delta}+v_1'\left[-\left(\tfrac{dh}{d\delta}+\eta\tfrac{d\gamma}{d\delta}\right)+\tfrac{db}{d\delta}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{d\delta}-\tfrac{db}{d\delta}\right] \\
= \; & \left[\eta v_1'-p\theta y\Gamma' v_2'-\delta\eta k\right]\tfrac{d\gamma}{d\delta}+v_1'\left[-\left(\tfrac{dh}{d\delta}+\eta\tfrac{d\gamma}{d\delta}\right)+\tfrac{db}{d\delta}\right]+v_2'\left[\theta y\Gamma'\tfrac{d\gamma}{d\delta}-\tfrac{db}{d\delta}\right] \\
= \; & \left(p-1\right)v_2'\left[\tfrac{db}{d\delta}-\theta y\Gamma'\tfrac{d\gamma}{d\delta}\right]+k\left[\tfrac{db}{d\delta}-\delta\eta\tfrac{d\gamma}{d\delta}\right]-v_1'\tfrac{dh}{d\delta}.
\end{aligned}$$

The final step in computing the effect on social welfare is to substitute into the final line of this expression the final solutions for $\frac{db}{d\delta}$, $\frac{d\gamma}{d\delta}$ and $\frac{dh}{d\delta}$ (from (38) - (40)).

I Budgetary opaqueness

I.1 First-order conditions

In the case where relief is *never* granted ($\delta=0$), the first-order conditions for b, γ and h are, respectively:

$$\begin{aligned}
\mathrm{E}\left\{v'\left[\theta y-\left(h+\eta\gamma\right)+b\right]\right\} &= k+pv'\left[\theta\Gamma\left(\gamma\right)y-b\right], && (41)\\
\mathrm{E}\left[Hu_1'-\eta v_1'+p\theta y\Gamma' v_2'\right] &= 0, && (42)\\
z'\left(h\right) &= \mathrm{E}\left[v_1'\right]. && (43)
\end{aligned}$$

When relief is *always* granted, the first-order conditions for b, γ and h are, respectively, (41),

$$\begin{aligned}
\mathrm{E}\left[Hu_1'-\eta v_1'+p\theta y\Gamma' v_2'\right] &= -k\delta\bar{\eta}, && (44)\\
z'\left(h\right) &= -k\delta/\gamma+\mathrm{E}\left[v_1'\right]. && (45)
\end{aligned}$$

I.2 Derivation of (15)

For the case of $\bar{\eta}-\sigma<\bar{s}-h/\gamma<\bar{\eta}+\sigma$, we can write:

$$\begin{aligned}
k\mathrm{E}\left[w\left(b\right)\right] &= k\left\{\begin{array}{c}\mathrm{E}\left[b-\delta\left(h+\eta\gamma\right)|h/\gamma+\eta\leq\bar{s}\right]*\Pr\left[h/\gamma+\eta\leq\bar{s}\right]+\\ \mathrm{E}\left[b|h/\gamma+\eta>\bar{s}\right]*\Pr\left[h/\gamma+\eta>\bar{s}\right]\end{array}\right\}\\
&= k\left\{b-\delta\gamma\mathrm{E}\left[h/\gamma+\eta|h/\gamma+\eta\leq\bar{s}\right]*\Pr\left[h/\gamma+\eta\leq\bar{s}\right]\right\}.
\end{aligned}$$

We work out:

$$\begin{aligned}
\mathrm{E}\left[h/\gamma+\eta | h/\gamma+\eta\leq\bar{s}\right] &= \int_{\bar{\eta}-\sigma}^{\bar{s}-h/\gamma}\left(h/\gamma+\eta\right)\frac{\varphi\left(\eta\right)}{\Phi\left(\bar{s}-h/\gamma\right)}d\eta \\
&= \int_{\bar{\eta}-\sigma}^{\bar{s}-h/\gamma}\left(h/\gamma+\eta\right)\frac{1/\left(2\sigma\right)}{\left[\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)\right]/\left(2\sigma\right)}d\eta \\
&= \int_{\bar{\eta}-\sigma}^{\bar{s}-h/\gamma}\frac{h/\gamma+\eta}{\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)}d\eta \\
&= \left[\frac{\left(h/\gamma\right)\eta+\eta^2/2}{\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)}\right]_{\bar{\eta}-\sigma}^{\bar{s}-h/\gamma} \\
&= \frac{\left(h/\gamma\right)\left(\bar{s}-h/\gamma\right)+\frac{1}{2}\left(\bar{s}-h/\gamma\right)^2}{\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)}-\frac{\left(h/\gamma\right)\left(\bar{\eta}-\sigma\right)+\frac{1}{2}\left(\bar{\eta}-\sigma\right)^2}{\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)}
\end{aligned}$$

$$\begin{aligned}
&= \frac{h}{\gamma}+\frac{1}{2}\frac{\left[\left(\bar{s}+\sigma\right)-\left(h/\gamma+\bar{\eta}\right)\right]\left[\bar{s}-h/\gamma+\bar{\eta}-\sigma\right]}{\bar{s}+\sigma-\left(h/\gamma+\bar{\eta}\right)} \\
&= \frac{h}{\gamma}+\frac{1}{2}\left[\bar{s}-h/\gamma+\bar{\eta}-\sigma\right] \\
&= \frac{1}{2}\frac{h}{\gamma}+\frac{1}{2}\left[\bar{s}+\bar{\eta}-\sigma\right] \\
&= \frac{1}{2}\left[\left(\bar{s}-\sigma\right)+\left(h/\gamma+\bar{\eta}\right)\right].
\end{aligned}$$

Further:

$$\Pr\left(h/\gamma+\eta\leq\bar{s}\right)=\Pr\left(\eta\leq\bar{s}-h/\gamma\right)=\frac{\left(\bar{s}+\sigma\right)-\left(h/\gamma+\bar{\eta}\right)}{2\sigma}.$$

Hence,

$$\begin{aligned}
k\mathrm{E}\left[w\left(b\right)\right] &= kb-\tfrac{1}{2}k\delta\gamma\left[\left(\bar{s}-\sigma\right)+\left(h/\gamma+\bar{\eta}\right)\right]\left[\tfrac{\left(\bar{s}+\sigma\right)-\left(h/\gamma+\bar{\eta}\right)}{2\sigma}\right] \\
&= kb-\tfrac{1}{4}\tfrac{k\delta\gamma}{\sigma}\left[\left(\bar{s}-\sigma\right)+\left(h/\gamma+\bar{\eta}\right)\right]\left[\left(\bar{s}+\sigma\right)-\left(h/\gamma+\bar{\eta}\right)\right] \\
&= kb-\tfrac{1}{4}\tfrac{k\delta\gamma}{\sigma}\left[\left(\bar{s}-\sigma\right)\left(\bar{s}+\sigma\right)-\left(\bar{s}-\sigma\right)\left(h/\gamma+\bar{\eta}\right)+\left(\bar{s}+\sigma\right)\left(h/\gamma+\bar{\eta}\right)-\left(h/\gamma+\bar{\eta}\right)^2\right] \\
&= kb-\tfrac{1}{4}\tfrac{k\delta\gamma}{\sigma}\left[\bar{s}^2-\sigma^2+2\sigma\left(h/\gamma+\bar{\eta}\right)-\left(h/\gamma+\bar{\eta}\right)^2\right],
\end{aligned}$$

which is easily written as (15).

I.3 The effect of $(h/\gamma+\bar{\eta})$ on expected relief

We have:

$$\frac{\partial\left[\bar{s}^2-\sigma^2+2\sigma(h/\gamma+\bar{\eta})-(h/\gamma+\bar{\eta})^2\right]}{\partial(h/\gamma+\bar{\eta})}=2\sigma-2\left(h/\gamma+\bar{\eta}\right)\leq 0, \qquad (46)$$

because $\bar{\eta}\geq\sigma$ and $h\geq 0$. Moreover, we note that, when $h/\gamma+\bar{\eta}=\bar{s}+\sigma$, the term $\left[\bar{s}^2-\sigma^2+2\sigma\left(h/\gamma+\bar{\eta}\right)-\left(h/\gamma+\bar{\eta}\right)^2\right]$ reduces to zero. Because $\bar{s}>0$, a marginal reduction of $(h/\gamma+\bar{\eta})$ from the level $(\bar{s}+\sigma)$ implies that $h/\gamma+\bar{\eta}>\sigma$, so that the term

$\left[\bar{s}^2 - \sigma^2 + 2\sigma\left(h/\gamma + \bar{\eta}\right) - \left(h/\gamma + \bar{\eta}\right)^2\right]$ becomes positive. Hence, (46) is positive and decreasing in $(h/\gamma + \bar{\eta})$ for all $(h/\gamma + \bar{\eta})$ that fulfill $\bar{\eta} - \sigma < \bar{s} - h/\gamma < \bar{\eta} + \sigma$, which is equivalent to $\bar{s} - \sigma < h/\gamma + \bar{\eta} < \bar{s} + \sigma$.

I.4 The effect of σ on expected relief

We have:

$$\frac{\partial\left[\frac{k\delta\gamma}{4\sigma}\left[\bar{s}^2-\sigma^2+2\sigma(h/\gamma+\bar{\eta})-(h/\gamma+\bar{\eta})^2\right]\right]}{\partial\sigma} = -\tfrac{1}{4}k\delta\gamma\left[\frac{\left(\sigma^2+\bar{s}^2\right)-\left(h/\gamma+\bar{\eta}\right)^2}{\sigma^2}\right],$$

which can be positive or negative for values of $(h/\gamma + \bar{\eta})$ that fulfill $\bar{\eta}-\sigma < \bar{s}-h/\gamma < \bar{\eta}+\sigma$. If $h/\gamma + \bar{\eta} = \bar{s} + \sigma$, then this derivative is negative. If $\bar{s} > \bar{\eta}$ and h is not too large or γ is not too small, then this derivative is positive.

I.5 Proof of Proposition 10

Differentiating (41) with respect to k yields:

$$\mathrm{E}\left\{v_1''\left[-\tfrac{dh}{dk} - \eta\tfrac{d\gamma}{dk} + \tfrac{db}{dk}\right]\right\} - pv_2''\left[\theta y\Gamma'\tfrac{d\gamma}{dk} - \tfrac{db}{dk}\right] = 1,$$

which is rewritten as:

$$\tfrac{db}{dk} = \hat{B}_1 + \hat{B}_2\tfrac{d\gamma}{dk} + \hat{B}_3\tfrac{dh}{dk},$$

where

$$\hat{B}_1 \equiv \frac{1}{\mathrm{E}\left[v_1''+pv_2''\right]} < 0, \quad \hat{B}_2 \equiv \frac{\mathrm{E}\left[\eta v_1''+p\theta y\Gamma' v_2''\right]}{\mathrm{E}\left[v_1''+pv_2''\right]} > 0, \quad \hat{B}_3 \equiv \frac{\mathrm{E}\left[v_1''\right]}{\mathrm{E}\left[v_1''+pv_2''\right]} > 0.$$

Hence, the direct effect of k on b, captured by $\hat{B}_1$, is negative. We similarly find:

$$\begin{aligned}
\tfrac{db}{d\delta} &= \hat{B}_2\tfrac{d\gamma}{d\delta} + \hat{B}_3\tfrac{dh}{d\delta},\\
\tfrac{db}{d\bar{s}} &= \hat{B}_2\tfrac{d\gamma}{d\bar{s}} + \hat{B}_3\tfrac{dh}{d\bar{s}},\\
\tfrac{db}{d\sigma} &= \hat{B}_2\tfrac{d\gamma}{d\sigma} + \hat{B}_3\tfrac{dh}{d\sigma},
\end{aligned}$$

so that the direct effects of δ, $\bar{s}$ and σ on b are zero.

Differentiating (17) with respect to k yields:

$$\begin{aligned}
&\mathrm{E}\left\{\begin{array}{c}\left[(1-\theta)\,y\Gamma''u_1' + \tfrac{1}{2}H^2u_1''\right]\tfrac{d\gamma}{dk} - \eta v_1''\left[-\tfrac{dh}{dk} - \eta\tfrac{d\gamma}{dk} + \tfrac{db}{dk}\right]\\ +p\theta y\Gamma'' v_2'\tfrac{d\gamma}{dk} + p\theta y\Gamma' v_2''\left[\theta y\Gamma'\tfrac{d\gamma}{dk} - \tfrac{db}{dk}\right]\end{array}\right\}\\
= \;& -\tfrac{1}{4}\delta\left\{\left[2\left(h/\gamma+\bar{\eta}\right)-\sigma\right] + \left[\bar{s}^2 - \left(h/\gamma+\bar{\eta}\right)^2\right]/\sigma\right\}\\
& -\tfrac{1}{4}k\delta\left[\tfrac{2}{\gamma}\tfrac{dh}{dk} - \tfrac{2h}{\gamma^2}\tfrac{d\gamma}{dk} - \tfrac{2(h/\gamma+\bar{\eta})}{\sigma}\left[\tfrac{1}{\gamma}\tfrac{dh}{dk} - \tfrac{h}{\gamma^2}\tfrac{d\gamma}{dk}\right]\right]\\
& -\tfrac{1}{2}\left[\tfrac{\delta h}{\gamma} + \tfrac{k\delta}{\gamma}\tfrac{dh}{dk} - \tfrac{k\delta h}{\gamma^2}\tfrac{d\gamma}{dk}\right]\left[\tfrac{h/\gamma+\bar{\eta}}{\sigma} - 1\right] - \tfrac{1}{2}\tfrac{k\delta h}{\gamma}\left[\tfrac{1}{\gamma\sigma}\tfrac{dh}{dk} - \tfrac{h}{\gamma^2\sigma}\tfrac{d\gamma}{dk}\right] \Leftrightarrow
\end{aligned}$$

$$
\begin{aligned}
& \mathrm{E}\left\{\begin{array}{c}\left[\frac{1}{2}H^2u_1''+(1-\theta)\,y\Gamma''u_1'+\eta^2v_1''+p\theta y\Gamma''v_2'+p\left(\theta y\Gamma'\right)^2v_2''\right]\frac{d\gamma}{dk}\\ -\left[\eta v_1''+p\theta y\Gamma' v_2''\right]\frac{db}{dk}+\eta v_1''\frac{dh}{dk}\end{array}\right\}\\
= \; & -\tfrac{1}{4}\delta\left\{\left[2\left(h/\gamma+\bar\eta\right)-\sigma\right]+\left[\bar s^2-\left(h/\gamma+\bar\eta\right)^2\right]/\sigma\right\}\\
& -\frac{1}{2}\frac{k\delta}{\gamma}\left[1-\frac{h/\gamma+\bar\eta}{\sigma}\right]\left[\frac{dh}{dk}-\frac{h}{\gamma}\frac{d\gamma}{dk}\right]-\frac{1}{2}\frac{k\delta}{\gamma}\left[\frac{h/\gamma+\bar\eta}{\sigma}-1\right]\left[\frac{h}{k}+\frac{dh}{dk}-\frac{h}{\gamma}\frac{\gamma}{dk}\right]\\
& -\frac{1}{2}\left(\frac{k\delta}{\gamma}\right)\left(\frac{h}{\gamma\sigma}\right)\left[\frac{dh}{dk}-\frac{h}{\gamma}\frac{d\gamma}{dk}\right]\Leftrightarrow
\end{aligned}
$$

$$
\begin{aligned}
& \mathrm{E}\left\{\begin{array}{c}\left[\frac{1}{2}H^2u_1''+(1-\theta)\,y\Gamma''u_1'+\eta^2v_1''+p\theta y\Gamma''v_2'+p\left(\theta y\Gamma'\right)^2v_2''\right]\frac{d\gamma}{dk}\\ -\left[\eta v_1''+p\theta y\Gamma' v_2''\right]\frac{db}{dk}+\eta v_1''\frac{dh}{dk}\end{array}\right\}\\
= \; & -\tfrac{1}{4}\delta\left\{\left[2\left(h/\gamma+\bar\eta\right)-\sigma\right]+\left[\bar s^2-\left(h/\gamma+\bar\eta\right)^2\right]/\sigma\right\}\\
& -\frac{1}{2}\frac{h\delta}{\gamma}\left[\frac{h/\gamma+\bar\eta}{\sigma}-1\right]-\frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\frac{dh}{dk}+\frac{1}{2}\left(\frac{k\delta h^2}{\gamma^3\sigma}\right)\frac{d\gamma}{dk}\Leftrightarrow
\end{aligned}
$$

$$
\begin{aligned}
& \mathrm{E}\left\{\left[K-\frac{1}{2}\left(\frac{k\delta h^2}{\gamma^3\sigma}\right)\right]\frac{d\gamma}{dk}\right\}=\mathrm{E}\left\{\left[\eta v_1''+p\theta y\Gamma' v_2''\right]\frac{db}{dk}\right\}-\mathrm{E}\left[\eta v_1''\frac{dh}{dk}\right]\\
& -\tfrac{1}{4}\delta\left\{\left[2\left(h/\gamma+\bar\eta\right)-\sigma\right]+\left[\bar s^2-\left(h/\gamma+\bar\eta\right)^2\right]/\sigma\right\}\\
& -\frac{1}{2}\frac{h\delta}{\gamma}\left[\frac{h/\gamma+\bar\eta}{\sigma}-1\right]-\frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\frac{dh}{dk}\Leftrightarrow
\end{aligned}
$$

$$
\frac{d\gamma}{dk}=\delta\hat A_1+\hat A_2\frac{db}{dk}+\hat A_3\frac{dh}{dk},
$$

where

$$
\hat A_1=-\frac{\frac{1}{4}\left\{\left[2\left(\frac{h}{\gamma}+\bar\eta\right)-\sigma\right]+\left[\frac{\bar s^2-(h/\gamma+\bar\eta)^2}{\sigma}\right]\right\}+\frac{1}{2}\frac{h}{\gamma}\left[\frac{h/\gamma+\bar\eta}{\sigma}-1\right]}{\mathrm{E}\left[\hat K\right]}>0,
$$

$$
\hat A_2=\mathrm{E}\left[\eta v_1''+p\theta y\Gamma' v_2''\right]/\mathrm{E}\left[\hat K\right]>0,
$$

$$
\hat A_3=-\mathrm{E}\left[\frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)+\eta v_1''\right]/\mathrm{E}\left[\hat K\right].
$$

This shows that the direct effect of an increase in k on γ is positive.

In an analogous way, we find:

$$
\frac{d\gamma}{d\delta}=k\hat A_1+\hat A_2\frac{db}{d\delta}+\hat A_3\frac{dh}{d\delta},
$$

which shows that the direct effect of δ on γ is positive.

Next, differentiating (17) with respect to $\bar s$ yields:

$$
\begin{aligned}
& \mathrm{E}\left\{K\frac{d\gamma}{d\bar s}\right\}=\mathrm{E}\left\{\left[\eta v_1''+p\theta y\Gamma' v_2''\right]\frac{db}{d\bar s}\right\}-\mathrm{E}\left[\eta v_1''\frac{dh}{d\bar s}\right]\\
& -\frac{1}{4}k\delta\left\{\frac{2}{\gamma}\frac{dh}{d\bar s}-\frac{2h}{\gamma^2}\frac{d\gamma}{d\bar s}+\frac{2\bar s}{\sigma}-\frac{2(h/\gamma+\bar\eta)}{\sigma}\left[\frac{1}{\gamma}\frac{dh}{d\bar s}-\frac{h}{\gamma^2}\frac{d\gamma}{d\bar s}\right]\right\}\\
& -\frac{1}{2}\left[\frac{k\delta}{\gamma}\frac{dh}{d\bar s}-\frac{k\delta h}{\gamma^2}\frac{d\gamma}{d\bar s}\right]\left[\frac{h/\gamma+\bar\eta}{\sigma}-1\right]-\frac{1}{2}\left(\frac{k\delta h}{\gamma}\right)\left[\frac{1}{\gamma\sigma}\frac{dh}{d\bar s}-\frac{h}{\gamma^2\sigma}\frac{d\gamma}{d\bar s}\right]\Leftrightarrow
\end{aligned}
$$

$$\mathrm{E}\left\{K\frac{d\gamma}{d\bar{s}}\right\} = \mathrm{E}\left\{\left[\eta v_1'' + p\theta y\Gamma' v_2''\right]\frac{db}{d\bar{s}}\right\} - \mathrm{E}\left[\eta v_1''\frac{dh}{d\bar{s}}\right]$$
$$-\frac{1}{2}k\delta\left(\frac{\bar{s}}{\sigma}\right) - \frac{1}{2}\frac{k\delta}{\gamma}\left[\frac{dh}{d\bar{s}} - \frac{h}{\gamma}\frac{d\gamma}{d\bar{s}}\right]\left[1 - \frac{h/\gamma+\bar{\eta}}{\sigma}\right] -$$
$$\frac{1}{2}\frac{k\delta}{\gamma}\left[\frac{dh}{d\bar{s}} - \frac{h}{\gamma}\frac{d\gamma}{d\bar{s}}\right]\left[\frac{h/\gamma+\bar{\eta}}{\sigma} - 1\right] - \frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\left[\frac{dh}{d\bar{s}} - \frac{h}{\gamma}\frac{d\gamma}{d\bar{s}}\right] \Leftrightarrow$$

$$\mathrm{E}\left\{K\frac{d\gamma}{d\bar{s}}\right\} = \mathrm{E}\left\{\left[\eta v_1'' + p\theta y\Gamma' v_2''\right]\frac{db}{d\bar{s}}\right\} - \mathrm{E}\left[\eta v_1''\frac{dh}{d\bar{s}}\right]$$
$$-\frac{1}{2}k\delta\left(\frac{\bar{s}}{\sigma}\right) - \frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\frac{dh}{d\bar{s}} + \frac{1}{2}\left(\frac{k\delta h^2}{\gamma^3\sigma}\right)\frac{d\gamma}{d\bar{s}} \Leftrightarrow$$

$$\frac{d\gamma}{d\bar{s}} = -\frac{1}{2}k\delta\left(\frac{\bar{s}}{\sigma}\right)/\mathrm{E}\left[\hat{K}\right] + \hat{A}_2\frac{db}{d\bar{s}} + \hat{A}_3\frac{dh}{d\bar{s}},$$

which shows that the direct effect of $\bar{s}$ on γ is positive.

Next, differentiate (17) with respect to σ:

$$\mathrm{E}\left\{K\frac{d\gamma}{d\sigma}\right\} = \mathrm{E}\left\{\left[\eta v_1'' + p\theta y\Gamma' v_2''\right]\frac{db}{d\sigma}\right\} - \mathrm{E}\left[\eta v_1''\frac{dh}{d\sigma}\right] +$$
$$\frac{1}{4}k\delta\left[1 + \frac{\bar{s}^2-(h/\gamma+\bar{\eta})^2}{\sigma^2}\right] + \frac{1}{2}\left(\frac{k\delta h}{\gamma}\right)\left(\frac{h/\gamma+\bar{\eta}}{\sigma^2}\right) - \frac{1}{2}\frac{k\delta}{\gamma}\left[\frac{dh}{d\sigma} - \frac{h}{\gamma}\frac{d\gamma}{d\sigma}\right]\left[1 - \frac{h/\gamma+\bar{\eta}}{\sigma}\right]$$
$$-\frac{1}{2}\frac{k\delta}{\gamma}\left[\frac{dh}{d\sigma} - \frac{h}{\gamma}\frac{d\gamma}{d\sigma}\right]\left[\frac{h/\gamma+\bar{\eta}}{\sigma} - 1\right] - \frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\left[\frac{dh}{d\sigma} - \frac{h}{\gamma}\frac{d\gamma}{d\sigma}\right] \Leftrightarrow$$

$$\mathrm{E}\left\{K\frac{d\gamma}{d\sigma}\right\} = \mathrm{E}\left\{\left[\eta v_1'' + p\theta y\Gamma' v_2''\right]\frac{db}{d\sigma}\right\} - \mathrm{E}\left[\eta v_1''\frac{dh}{d\sigma}\right] +$$
$$\frac{1}{4}k\delta\left[1 + \frac{\bar{s}^2-(h/\gamma+\bar{\eta})^2}{\sigma^2}\right] + \frac{1}{2}\left(\frac{k\delta h}{\gamma}\right)\left(\frac{h/\gamma+\bar{\eta}}{\sigma^2}\right) - \frac{1}{2}\left(\frac{k\delta h}{\gamma^2\sigma}\right)\frac{dh}{d\sigma} + \frac{1}{2}\left(\frac{k\delta h^2}{\gamma^3\sigma}\right)\frac{d\gamma}{d\sigma} \Leftrightarrow$$

$$\begin{aligned}\frac{d\gamma}{d\sigma} &= \frac{1}{2}k\delta\frac{\frac{1}{2}\left[1 + \frac{\bar{s}^2-(h/\gamma+\bar{\eta})^2}{\sigma^2}\right] + \frac{h}{\gamma}\left[\frac{h/\gamma+\bar{\eta}}{\sigma^2}\right]}{\mathrm{E}\left[\hat{K}\right]} + \hat{A}_2\frac{db}{d\sigma} + \hat{A}_3\frac{dh}{d\sigma} \\ &= \frac{1}{4}\frac{k\delta}{\sigma^2}\left[\frac{\sigma^2 + \bar{s}^2 + (h/\gamma)^2 - \bar{\eta}^2}{\mathrm{E}\left[\hat{K}\right]}\right] + \hat{A}_2\frac{db}{d\sigma} + \hat{A}_3\frac{dh}{d\sigma},\end{aligned}$$

so that the direct effect of σ on γ is negative if $\bar{s} > \bar{\eta}$.

Differentiating (18) with respect to k yields:

$$z''\frac{dh}{dk} = \frac{1}{2}\delta\left[\frac{h/\gamma+\bar{\eta}}{\sigma} - 1\right] + \frac{1}{2}k\delta\left[\frac{1}{\gamma\sigma}\frac{dh}{dk} - \frac{h}{\gamma^2\sigma}\frac{d\gamma}{dk}\right] + \mathrm{E}\left\{v_1''\left[-\frac{dh}{dk} - \eta\frac{d\gamma}{dk} + \frac{db}{dk}\right]\right\} \Leftrightarrow$$

$$\frac{dh}{dk} = \delta\hat{C}_1 + \hat{C}_2\frac{d\gamma}{dk} + \hat{C}_3\frac{db}{dk},$$

where

$$\hat{C}_1 = \frac{\frac{1}{2}\left[\frac{h/\gamma+\bar{\eta}}{\sigma}-1\right]}{z''-\frac{1}{2}\left[\frac{k\delta}{\gamma\sigma}\right]+\mathrm{E}\left[v_1''\right]}<0, \quad \hat{C}_2=-\frac{\frac{1}{2}\left[\frac{k\delta h}{\gamma^2\sigma}\right]+\eta\mathrm{E}\left[v_1''\right]}{z''-\frac{1}{2}\left[\frac{k\delta}{\gamma\sigma}\right]+\mathrm{E}\left[v_1''\right]},$$
$$\hat{C}_3 = \frac{\mathrm{E}\left[v_1''\right]}{z''-\frac{1}{2}\left[\frac{k\delta}{\gamma\sigma}\right]+\mathrm{E}\left[v_1''\right]}>0.$$

Hence, the direct effect of k on h is negative.

Next, differentiating (18) with respect to δ, and following analogous steps yields:

$$\frac{dh}{d\delta}=k\hat{C}_1+\hat{C}_2\frac{d\gamma}{d\delta}+\hat{C}_3\frac{db}{d\delta},$$

which shows that the direct effect of δ on h is negative.

Further, differentiating (18) with respect to $\bar{s}$, and following analogous steps yields:

$$\frac{dh}{d\bar{s}}=\hat{C}_2\frac{d\gamma}{d\bar{s}}+\hat{C}_3\frac{db}{d\bar{s}},$$

so that the direct effect of $\bar{s}$ on h is zero.

Further, differentiating (18) with respect to σ:

$$z''\frac{dh}{d\sigma}=-\frac{1}{2}k\delta\left[\frac{h/\gamma+\bar{\eta}}{\sigma^2}\right]+\frac{1}{2}k\delta\left[\frac{1}{\gamma\sigma}\frac{dh}{d\sigma}-\frac{h}{\gamma^2\sigma}\frac{d\gamma}{d\sigma}\right]+\mathrm{E}\left\{v_1''\left[-\frac{dh}{d\sigma}-\eta\frac{d\gamma}{d\sigma}+\frac{db}{d\sigma}\right]\right\}\Leftrightarrow$$

$$\frac{dh}{d\sigma}=-\frac{\frac{1}{2}k\delta\left[\frac{h/\gamma+\bar{\eta}}{\sigma^2}\right]}{z''-\frac{1}{2}\left[\frac{k\delta}{\gamma\sigma}\right]+\mathrm{E}\left[v_1''\right]}+\hat{C}_2\frac{d\gamma}{d\sigma}+\hat{C}_3\frac{db}{d\sigma},$$

so that the direct effect of σ on h is positive.

I.6 Work out (41), (17) and (18)

We work out the first-order conditions (41), (17) and (18) under the assumption of quadratic utilities (19). Working out (41) yields:

$$\begin{aligned}\mathrm{E}\left\{-(\xi-1)\left[\theta y-(h+\eta\gamma)+b\right]+\xi\right\} &= k-p(\xi-1)\left[\theta\Gamma(\gamma)y-b\right]+p\xi\Leftrightarrow\\ -(\xi-1)\left[\theta y-(h+\bar{\eta}\gamma)+b\right]+\xi &= k+p(\xi-1)\left[b-\theta\Gamma(\gamma)y\right]+p\xi\Leftrightarrow\end{aligned}$$

$$b=\frac{(1-p)\xi-k}{(1+p)(\xi-1)}+\frac{\theta y\left[p\Gamma(\gamma)-1\right]+(h+\bar{\eta}\gamma)}{1+p}. \tag{47}$$

Working out (18) gives:

$$\omega\left[-(\xi-1)h+\xi\right] = \tfrac{1}{2}k\delta\left[(h/\gamma+\bar{\eta})/\sigma-1\right]+ -(\xi-1)\left[\theta y-(h+\bar{\eta}\gamma)+b\right]+\xi.$$

Hence,

$$h = D_1 + D_2 b,$$

where

$$D_1 \equiv \frac{\xi(\omega-1)+(\xi-1)(\theta y-\bar{\eta}\gamma)-\frac{k\delta}{2\sigma}(\bar{\eta}-\sigma)}{(\xi-1)(\omega+1)+\frac{1}{2}\frac{k\delta}{\sigma\gamma}}, \quad D_2 \equiv \frac{\xi-1}{(\xi-1)(\omega+1)+\frac{1}{2}\frac{k\delta}{\sigma\gamma}}.$$

Combining the expressions for b and h, we can solve these variables solely as functions of γ:

$$b = \frac{(1-p)\xi-k}{(\xi-1)[(1+p)-D_2]} + \frac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+D_1}{(1+p)-D_2},$$

$$h = D_1 + D_2\left\{\frac{(1-p)\xi-k}{(\xi-1)[(1+p)-D_2]} + \frac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+D_1}{(1+p)-D_2}\right\}.$$

Working out (17):

$$\begin{aligned}
& \mathrm{E}\left[(1-\theta)y\Gamma'+\eta-I\right]\left[-\tfrac{1}{2}(\xi-1)\left((1-\theta)(1+\Gamma(\gamma))y+(\eta-I)\gamma\right)+\xi\right] \\
& -\eta\left[-(\xi-1)(\theta y-(h+\eta\gamma)+b)+\xi\right]+p\theta y\Gamma'\left[-(\xi-1)(\theta\Gamma(\gamma)y-b)+\xi\right] \\
= & -\tfrac{1}{4}k\delta\left\{\left[2\left(\tfrac{h}{\gamma}+\bar{\eta}\right)-\sigma\right]+\left[\bar{s}^2-\left(\tfrac{h}{\gamma}+\bar{\eta}\right)^2\right]/\sigma\right\}-\tfrac{k\delta h}{2\gamma}\left[\left(\tfrac{h}{\gamma}+\bar{\eta}\right)/\sigma-1\right]\Leftrightarrow
\end{aligned}$$

$$\begin{aligned}
& \left[(1-\theta)y\Gamma'+\bar{\eta}-I\right]\left\{-\tfrac{1}{2}(\xi-1)\left[(1-\theta)(1+\Gamma(\gamma))y-I\gamma\right]+\xi\right\}+ \\
& \mathrm{E}\left\{-\tfrac{1}{2}(\xi-1)\left[(1-\theta)\Gamma'+\eta-I\right]\eta\gamma\right\}+\bar{\eta}(\xi-1)(\theta y-h+b)-\bar{\eta}\xi \\
& -(\xi-1)\tfrac{1}{6\sigma}\left[(\bar{\eta}+\sigma)^3-(\bar{\eta}-\sigma)^3\right]\gamma+p\theta y\Gamma'\left[-(\xi-1)(\theta\Gamma(\gamma)y-b)+\xi\right] \\
= & -\tfrac{1}{4}k\delta\left\{\left[2\left(\tfrac{h}{\gamma}+\bar{\eta}\right)-\sigma\right]+\left[\bar{s}^2-\left(\tfrac{h}{\gamma}+\bar{\eta}\right)^2\right]/\sigma\right\}-\tfrac{k\delta h}{2\gamma}\left[\left(\tfrac{h}{\gamma}+\bar{\eta}\right)/\sigma-1\right]\Leftrightarrow
\end{aligned}$$

$$\begin{aligned}
& \left[(1-\theta)y\Gamma'+\bar{\eta}-I\right]\left\{\xi-\tfrac{1}{2}(\xi-1)\left[(1-\theta)(1+\Gamma(\gamma))y-I\gamma\right]\right\} \\
& -\tfrac{1}{2}(\xi-1)\left[(1-\theta)y\Gamma'-I\right]\bar{\eta}\gamma-\tfrac{1}{2}(\xi-1)\tfrac{1}{6\sigma}\left[(\bar{\eta}+\sigma)^3-(\bar{\eta}-\sigma)^3\right]\gamma \\
& +\bar{\eta}(\xi-1)(\theta y-h+b)-\bar{\eta}\xi-(\xi-1)\tfrac{1}{6\sigma}\left[(\bar{\eta}+\sigma)^3-(\bar{\eta}-\sigma)^3\right]\gamma \\
& +p\theta y\Gamma'\left[\xi-(\xi-1)(\theta\Gamma(\gamma)y-b)\right] \\
= & -\tfrac{1}{4}k\delta\left\{\left[2\left(\tfrac{h}{\gamma}+\bar{\eta}\right)-\sigma\right]+\left[\bar{s}^2-\left(\tfrac{h}{\gamma}+\bar{\eta}\right)^2\right]/\sigma\right\}-\tfrac{k\delta h}{2\gamma}\left[\left(\tfrac{h}{\gamma}+\bar{\eta}\right)/\sigma-1\right]\Leftrightarrow
\end{aligned}$$

$$
\begin{aligned}
& [(1-\theta)\, y\Gamma' + \bar{\eta} - I] \left\{\xi - \tfrac{1}{2}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\, y - I\gamma]\right\} \\
& -\tfrac{1}{2}(\xi-1)\,[(1-\theta)\, y\Gamma' - I]\,\bar{\eta}\gamma - \tfrac{1}{4\sigma}(\xi-1)\left[(\bar{\eta}+\sigma)^3 - (\bar{\eta}-\sigma)^3\right]\gamma \\
& +\bar{\eta}(\xi-1)(\theta y - h + b) - \bar{\eta}\xi + p\theta y\Gamma'\,[\xi - (\xi-1)(\theta\Gamma(\gamma)\, y - b)] \\
= \; & -\tfrac{1}{4}k\delta\left\{\left[2\left(\tfrac{h}{\gamma}+\bar{\eta}\right)-\sigma\right] + \left[\bar{s}^2 - \left(\tfrac{h}{\gamma}+\bar{\eta}\right)^2\right]/\sigma\right\} - \tfrac{k\delta h}{2\gamma}\left[\left(\tfrac{h}{\gamma}+\bar{\eta}\right)/\sigma - 1\right].
\end{aligned}
$$

We can substitute the solutions for b and h obtained above and then solve this expression numerically for γ.

I.7 Work out (41), (42) and (43)

We work out the first-order conditions (41), (42) and (43) under the assumption of quadratic utilities (19). Working out (41) yields again (47). Working out (43) yields in a straightforward manner:

$$h = E_1 + E_2 b,$$

where

$$E_1 \equiv \tfrac{\xi(\omega-1)+(\xi-1)(\theta y - \bar{\eta}\gamma)}{(\xi-1)(\omega+1)}, \quad E_2 \equiv \tfrac{1}{\omega+1}.$$

Combining (47) with the solution for h, we can solve for b and h as functions of γ:

$$b = \tfrac{(1-p)\xi - k}{(\xi-1)[(1+p)-E_2]} + \tfrac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+E_1}{(1+p)-E_2},$$

$$h = E_1 + E_2\left\{\tfrac{(1-p)\xi - k}{(\xi-1)[(1+p)-E_2]} + \tfrac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+E_1}{(1+p)-E_2}\right\}.$$

Working out (42) in analogous way to what we did above:

$$
\begin{aligned}
& [(1-\theta)\, y\Gamma' + \bar{\eta} - I] \left\{\xi - \tfrac{1}{2}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\, y - I\gamma]\right\} \\
& -\tfrac{1}{2}(\xi-1)\,[(1-\theta)\, y\Gamma' - I]\,\bar{\eta}\gamma - \tfrac{1}{4\sigma}(\xi-1)\left[(\bar{\eta}+\sigma)^3 - (\bar{\eta}-\sigma)^3\right]\gamma \\
& +\bar{\eta}(\xi-1)(\theta y - h + b) - \bar{\eta}\xi + p\theta y\Gamma'\,[\xi - (\xi-1)(\theta\Gamma(\gamma)\, y - b)] = 0.
\end{aligned}
$$

Again we can substitute the solutions for b and h as functions of γ into this equation and solve it numerically for γ.

I.8 Work out (41), (44) and (45)

We work out the first-order conditions (41), (44) and (45) under the assumption of quadratic utilities (19).Working out (41) yields again (47). Working out (43) yields:

$$\omega\,[-(\xi-1)\,h + \xi] = -(k\delta)/\gamma - (\xi-1)\,[\theta y - (h+\bar{\eta}\gamma) + b] + \xi.$$

Hence,

$$h = F_1 + F_2 b,$$

where

$$F_1 \equiv \tfrac{\xi(\omega-1)+(\xi-1)(\theta y-\bar{\eta}\gamma)+(k\delta)/\gamma}{(\xi-1)(\omega+1)}, \quad F_2 \equiv \tfrac{1}{\omega+1}.$$

Combining (47) with the solution for h, we can solve for b and h as functions of γ:

$$b = \tfrac{(1-p)\xi-k}{(\xi-1)[(1+p)-F_2]} + \tfrac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+F_1}{(1+p)-F_2},$$

$$h = F_1 + F_2\left\{\tfrac{(1-p)\xi-k}{(\xi-1)[(1+p)-F_2]} + \tfrac{\theta y[p\Gamma(\gamma)-1]+\bar{\eta}\gamma+F_1}{(1+p)-F_2}\right\}.$$

Working out (44) in analogous way to what we did above:

$$\begin{aligned}
&[(1-\theta)\,y\Gamma' + \bar{\eta} - I]\left\{\xi - \tfrac{1}{2}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\,y - I\gamma]\right\} \\
&-\tfrac{1}{2}(\xi-1)\,[(1-\theta)\,y\Gamma' - I]\,\bar{\eta}\gamma - \tfrac{1}{4\sigma}(\xi-1)\left[(\bar{\eta}+\sigma)^3 - (\bar{\eta}-\sigma)^3\right]\gamma \\
&+\bar{\eta}(\xi-1)(\theta y - h + b) - \bar{\eta}\xi + p\theta y\Gamma'\,[\xi - (\xi-1)(\theta\Gamma(\gamma)\,y - b)] = -k\delta\bar{\eta}.
\end{aligned}$$

Again we can substitute the solutions for b and h as functions of γ into this equation and solve it numerically for γ.

I.9 Computation social welfare

Social welfare is given by

$$2\mathrm{E}[u(c_1)] + \mathrm{E}[v(f_1)] + \mathrm{E}[v(f_2)].$$

We work out each of these terms:

$$\begin{aligned}
&\mathrm{E}[u(c_1)] \\
=\;& \int_{\bar{\eta}-\sigma}^{\bar{\eta}+\sigma}\left\{\begin{array}{c} -\tfrac{1}{8}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta-I)\,\gamma]^2 \\ +\tfrac{1}{2}\xi\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta-I)\,\gamma] \end{array}\right\}\tfrac{1}{2\sigma}d\eta \\
=\;& \tfrac{1}{8\sigma\gamma}\left[-\tfrac{1}{3}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta-I)\,\gamma]^3 + \xi\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\eta-I)\,\gamma]^2\right]_{\bar{\eta}-\sigma}^{\bar{\eta}+\sigma} \\
=\;& \tfrac{1}{8\sigma\gamma}\left\{\begin{array}{c} \xi\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\bar{\eta}+\sigma-I)\,\gamma]^2 - \xi\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\bar{\eta}-\sigma-I)\,\gamma]^2 \\ +\tfrac{1}{3}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\bar{\eta}-\sigma-I)\,\gamma]^3 \\ -\tfrac{1}{3}(\xi-1)\,[(1-\theta)(1+\Gamma(\gamma))\,y + (\bar{\eta}+\sigma-I)\,\gamma]^3 \end{array}\right\},
\end{aligned}$$

$$
\begin{aligned}
& \mathrm{E}\left[v\left(f_1\right)\right] \\
= & \int_{\bar{\eta}-\sigma}^{\bar{\eta}+\sigma}\left\{-\tfrac{1}{2}(\xi-1)[\theta y-(h+\eta\gamma)+b]^2+\xi[\theta y-(h+\eta\gamma)+b]\right\} \tfrac{1}{2\sigma} d\eta \\
= & \tfrac{1}{2\sigma}\left[\tfrac{1}{6}(\xi-1) \tfrac{1}{\gamma}[\theta y-(h+\eta\gamma)+b]^3-\tfrac{1}{2}\xi \tfrac{1}{\gamma}[\theta y-(h+\eta\gamma)+b]^2\right]_{\bar{\eta}-\sigma}^{\bar{\eta}+\sigma} \\
= & \tfrac{1}{4\sigma\gamma}\left[\tfrac{1}{3}(\xi-1)[\theta y-(h+\eta\gamma)+b]^3-\xi[\theta y-(h+\eta\gamma)+b]^2\right]_{\bar{\eta}-\sigma}^{\bar{\eta}+\sigma} \\
= & \tfrac{1}{4\sigma\gamma}\left\{\begin{array}{c}
\tfrac{1}{3}(\xi-1)[\theta y-(h+(\bar{\eta}+\sigma)\gamma)+b]^3-\tfrac{1}{3}(\xi-1)[\theta y-(h+(\bar{\eta}-\sigma)\gamma)+b]^3 \\
+\xi[\theta y-(h+(\bar{\eta}-\sigma)\gamma)+b]^2-\xi[\theta y-(h+(\bar{\eta}+\sigma)\gamma)+b]^2
\end{array}\right\},
\end{aligned}
$$

$$
\mathrm{E}\left[v\left(f_2\right)\right]=-\tfrac{1}{2}(\xi-1)[\theta\Gamma(\gamma) y-b]^2+\xi[\theta\Gamma(\gamma) y-b] .
$$

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