Political Disagreement, Lack of Commitment and the Level of Debt*

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Abstract

We analyze how public debt evolves when successive policymakers have different policy goals and cannot make credible commitments about their future policies. We consider several cases to be able to quantify the effects of imperfect commitment, political disagreement and political turnover. Imperfect commitment drives the long-run level of debt to zero. With political disagreement debt is a sizeable fraction of GDP. The frequency of political turnover does not produce quantitatively relevant effects. These results are consistent with and rationalize much of the existing empirical evidence. Finally, we find that political disagreement reduces the welfare gains of building commitment.

JEL *classification*: C61, E61, E62, P16

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1 Introduction

This paper analyzes the determinants of public debt in the long run. As shown in Barro (1979), Lucas and Stokey (1983) and Aiyagari et al. (2002), one of the roles of debt is to smooth over time the deadweight losses associated with distortionary taxation.[1] These models can account for many aspects of the debt evolution in many countries. However, these theories do not explain why public debt is a sizable fraction of GDP.[2]

In a world where markets are complete and fiscal policy is chosen optimally by a benevolent government with full-commitment, as in Lucas and Stokey (1983), the long-run level of debt crucially depends on initial conditions.[3] Countries starting with high debt will have high debt forever, and countries with low debt will have low debt forever. Since initial conditions are exogenous to the model and empirically difficult to determine, such a theory can not explain what induces countries to accumulate debt.

In this paper, we depart from the idealized environment described in Lucas and Stokey (1983) in considering the effects of imperfect commitment and political disagreement. There are important reasons to think that these two forces may induce countries to accumulate debt, thus reconciling the theory about optimal debt polices with the empirical evidence.

The role of commitment is related to the time-inconsistency problem in optimal policy choices, as illustrated in the seminal works of Kydland and Prescott (1977) and Barro and Gordon (1983). In the Lucas and Stokey (1983) framework, if a government with full-commitment were allowed to revise its plans, it would run a deficit and accumulate debt.[4] A natural question is therefore if a positive long-run level of debt can be the outcome of the policymakers' inability to commit.

[1] When lump-sum taxes are available, the debt policy is irrelevant, since the so-called Ricardian equivalence holds, see e.g. Barro (1979).

[2] In the appendix, we report the values of the debt/GDP ratio for OECD countries.

[3] Lucas and Stokey (1983), as we do here, analyzed an economy with complete financial markets. Removing this assumption, as shown by Aiyagari et al. (2002) leads to asset accumulation.

[4] This happens unless the initial level of debt is sufficiently high. In that case, the improvement in the interest rate is applied to a larger base and can be sufficient to finance the initial tax cut.

Strikingly, we conclude that it is not. If a government cannot commit debt converges to zero in the long-run.[5] As we will discuss later, reducing debt over time is the only way the planner with no-commitment can affect favorably the interest rate. Interestingly, debt converges to zero also in intermediate commitment settings, when a planner occasionally renege on his past promises. This suggests that the steady-state dependency on initial conditions found in Lucas and Stokey (1983) is not robust to small deviations from the full-commitment case.

Lack of commitment and political disagreement are intrinsically related. The latter constitutes a natural limitation to the governments' ability to commit. Alesina and Tabellini (1990) and Persson and Svensson (1989) showed that political disagreement provides an incentive to accumulate debt. On the contrary, as explained above, lack of commitment *per se* drives debt to zero. Despite these considerations, the political economy literature has typically assumed that commitment does not influence private agent's choices, thus not playing any relevant role.[6] With respect to that literature, the novelty of this paper is to quantify and disentangle the effects of lack of commitment, political turnover and political disagreement in a joint framework. We find that debt is positive in the long-run, and that political disagreement seems to be the main driving force of debt accumulation. On the contrary, the degree of commitment and the frequency of political turnover have a small impact on the debt level. Our predictions are consistent with most of the existing empirical evidence.

Finally, we analyze the welfare implications of building commitment in a world with political disagreement. To the best of our knowledge, we are the first addressing this question. We find that the gains from commitment are lower in the presence of political disagreement. Intuitively, in the absence of political disagreement governments with more commitment will maximize overall social welfare. However, with

[5] As in Lucas and Stokey (1983), we assume that there is still commitment to honor debt payments. In this paper, the absence of commitment is referred to future policy actions. For a further discussion on this issue see Niepelt (2006).

[6] The dynamic political economy literature has been limited to frameworks where private agents' current choices do not depend on future policy, see e.g. Azzimonti-Renzo (2004).Alesina and Tabellini (1990), by setting the initial level of debt to zero, restrict their analysis to a case where the time inconsistency problem does not play any role.

political disagreement a better commitment technology can be used by each party to maximize specific groups' welfare.

Part of our contribution is methodological. The framework developed here allows us to integrate the analysis about the time-inconsistency of optimal policy choices, typical of the dynamic macroeconomic literature, into a political economy model. Our framework can be applied to study the effects of commitment in a wide set of infinite-horizon optimal policy problems, where policymakers with different preferences alternate in office.

This paper is related to many recent studies in the optimal fiscal policy and political economy literature. Krusell et al. (2006), analyze the no-commitment solution of the otherwise standard Lucas and Stokey (1983) model, where government expenditures are exogenous. They find a multiplicity of steady-states, discontinuous policy functions and conclude that the equilibria under no-commitment are close to those under full-commitment. In our model government expenditure is endogenous. The presence of this additional instrument in the hands of the policymaker widens the set of feasible choices. We obtain continuous policy functions and that debt converges to zero.[7]

Several papers have analyzed the effects of lack of commitment on debt in monetary economies (e.g. Martin (2009), Diaz-Gimenez et al. (2008)). They find that, depending on the degree of substitutability of cash-goods, the steady-state level of debt can be positive, negative or zero. Since in most countries central banks are independent and committed to price stability, we believe that focusing on a real economy is a reasonable assumption. Our result that debt converges to zero is neither due to the real erosion of nominal bonds nor to the presence of a cash-in-advance constraint.[8]

Azzimonti-Renzo (2004), as we do here, extends the political economy frameworks stemming from Alesina and Tabellini (1990) to an infinite horizon problem. The author considers a fiscal policy model with balanced budget, and public but no private capital. We instead focus on the effects on the debt level. In addition, we

[7] In section 3, we extensively discuss the differences between the two cases

[8] Ellison and Rankin (2007) and Diaz-Gimenez et al. (2008) also examine the case of indexed debt building on Nicolini (1998).

also consider a model where commitment plays a role in the strategic interactions between agents and policymakers, and solve the problem under several commitment settings. In recent work, Song et al. (2006) and Battaglini and Coate (2008) study the evolution of debt in a dynamic political economy framework, and provide an explanation for the presence of a long-run positive level of debt. In contrast to these models, in our model the interest rate is endogenously determined and constitutes the source of time-inconsistency of the policy plans.

Finally, Lucas and Stokey (1983) and Persson et al. (2006) show that a carefully chosen maturity of nominal and indexed debt for each contingent state of nature and at each maturity can solve the time-consistency problem. As in many papers in the literature, we do not consider this possibility. This is for three reasons. First, the necessary structure of debt to implement such policy is not observed in reality. Second, as shown in Faraglia et al. (2008) such strategies are intricate to implement and very sensitive to specific modeling assumptions. Finally and more importantly, this paper will consider a model with an endogenous public good. Rogers (1989) showed that in such case debt restructuring can not enforce the commitment solution.

The paper is organized as follows: in section 2 we introduce the model and, as a benchmark for our analysis, we recover the solution under full-commitment. In section 3, we describe the solution under no-commitment, i.e. the time-consistent solution. In section 4, we illustrate the behavior of debt under the less extreme assumption of *loose commitment*. In section 5, we study the joint implications of political disagreement and imperfect commitment and we compare our findings with the existing empirical literature. Finally, we discuss welfare implications. Section 6 concludes.

2 The model

We consider an economy where labor is the only factor of production, technology is linear, and there is no uncertainty.[9] Output can be used either for private

[9]In the presence of exogenous shocks, many of our considerations are still valid under the assumption of complete financial markets.

consumption c_t or for public consumption g_t. The economy's aggregate budget constraint is

$$c_t + g_t = 1 - x_t \tag{1}$$

The public good is provided by a benevolent government and financed through a proportional tax τ_t on labor income and by issuing a one-period bond b_t^G with price p_t. At any point in time, the government budget constraint is

$$g_t + b_{t-1}^G = \tau_t(1 - x_t) + p_t b_t^G. \tag{2}$$

In a decentralized equilibrium, given taxes, prices and the quantities of public expenditure, the representative household chooses consumption, savings and leisure by solving the following problem

$$\begin{aligned} &\max_{\{c_t, x_t, b_t^P\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_t, x_t, g_t) \\ &s.t. \qquad c_t + p_t b_t^P = (1 - x_t)(1 - \tau_t) + b_{t-1}^P, \qquad \forall t = 0, 1, 2, ... \end{aligned} \tag{3}$$

where b_t^P denotes private bond holdings. The household's first order conditions are

$$\frac{u_{x,t}}{u_{c,t}} = (1 - \tau_t) \tag{4}$$

$$p_t = \beta \frac{u_{c,t+1}}{u_{c,t}}, \tag{5}$$

together with the budget constraint (3). Equation (4) and (5) represent the equilibrium condition in the labor market and the bond market, respectively.

2.1 The case of full-commitment

In what follows, we analyze the problem of the government under the assumption of full-commitment. This will serve as a benchmark for our discussion in subsequent sections. For a given initial level of debt (b_{-1}), the government solves the following problem

$$\begin{aligned} &\max_{\{c_t, g_t, b_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_t, 1 - c_t - g_t, g_t) \\ &s.t. \qquad c_t u_{c,t} + \beta u_{c,t+1} b_t = (c_t + g_t) u_{x,t} + b_{t-1} u_{c,t}, \qquad \forall t = 0, 1, 2, ... \end{aligned} \tag{6}$$

where we made use of the household's optimality conditions (3)-(5), the resource constraint (1) and the market clearing condition $b_t^P + b_t^G = 0$, to substitute for taxes, public expenditure, leisure and government debt. We rule out Ponzi schemes, by imposing the transversality condition

$$\lim_{T\to\infty} \beta^T u_{c,T} b_T = 0. \tag{7}$$

For our purposes it is worth recalling some features of the resulting equilibrium. As discussed in Lucas and Stokey (1983), in the full-commitment case, after an initial jump, all the allocations reach their steady-state level remaining constant from then on. This is because, apart from $t = 0$, all the periods are identical and the government is willing to smooth private and public consumption over time. However, the steady-state allocations depend on the initial condition b_{-1}. Because of this dependency on initial conditions, which are exogenous to the model and empirically difficult to determine, this theory cannot explain why countries accumulate debt.

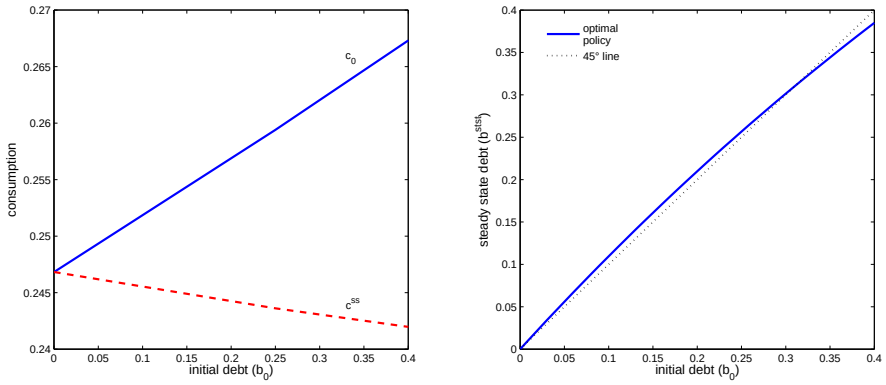
For a generic $t > 0$, as can be seen in eq. (5), current consumption influences both p_t and p_{t-1}. As a consequence, if the government uses taxes and public expenditure to increase the price of the bond p_t, other things equal, it also decreases p_{t-1}. At an optimum, it turns out that $p_{t-1} = p_t$. However, at $t = 0$ consumers' savings and previous prices (p_{-1}) are given. Therefore, if the government inherits a positive level of debt, it can benefit from an increase in the price of the bond without incurring any additional cost. By setting its policies such that current consumption is higher than in the future, the government is able to foster the demand for savings, thus selling bonds at a more convenient price.[10] These incentives to increase initial consumption prevail whenever the government is allowed to make a new policy plan.

In figure 1 (left panel), we plot the level of consumption at $t = 0$ (c_0) and the steady-state level of consumption (c_{ss}), for a given positive initial level of debt ($b_{-1} \geq 0$).[11] We can see that the higher is debt, the bigger is the difference between current and future consumption, and thus the lower the interest rate in $t = 0$. This

[10] The opposite happens when $b_{-1} < 0$.

[11] The picture is based on the calibration of the next sections. See Lucas and Stokey (1983) for the analytical solution of the model in the case of a quadratic utility function.

Figure 1: Consumption and debt under full-commitment



Note: In the left-panel, the figure shows, for different level of initial debt, the level of consumption in the first period (solid line) and the steady-state level of consumption (dashed line). In the right panel the steady-state level of debt is reported. Values correspond to the calibration specified in table A-2.

is because the higher is the inherited level of debt, the greater is the government's benefit from lowering the interest rate.

The behavior of debt is determined by equation (2). On the one hand, the tax cut necessary to foster initial consumption reduces the tax revenues of the government. On the other hand, the resulting lower interest rate allows the government to sell bonds at a higher price. In the right panel of figure 1, we plot the level of debt chosen in the first period (the steady-state level of debt), as a function of b_{-1}. For low levels of b_{-1}, the government accumulates debt. Conversely, if the initial level of debt is large enough, the increase in bond prices applies to a larger base. As a consequence, the tax cut can be self-financed and the level of debt can also decrease.

3 The time-consistent solution

In this section, we analyze the problem of a benevolent planner which does not have access to a commitment technology. We keep the assumption that the planner can credibly commit to repay his loans. Due to the reasons explained

in the introduction, we are not considering the possibility of enforcing the time-inconsistent solution through the maturity of debt. In what follows, we also assume that reputation mechanisms are not operative, focusing only on Markov-Perfect equilibria, as defined for instance in Klein et al. (2008).

In this case the problem of the planner is

$$V(b_{t-1}) = \max_{\{c_t, g_t, b_t\}} u(c_t, 1 - c_t - g_t, g_t) + \beta V(b_t) \tag{8}$$

$$s.t. \qquad c_t u_{c,t} + \beta u_c(\Psi(b_t)) b_t = (c_t + g_t) u_{x,t} + b_{t-1} u_{c,t}. \tag{9}$$

The function $\Psi(b_t)$ in constraint (9) determines the quantity of consumption the consumer expects for period $t+1$ as a function of the debt level outstanding at the beginning of next period (b_t). Since the current planner cannot make credible commitments about his future actions, the future stream of consumption is not under his direct control. By taking as given the policy $\Psi(b_t)$ of his successor (or himself in the next period), the current planner can only influence future consumption through his current debt policy. Being the function $\Psi(b_t)$ unknown, the solution of this problem relies on solving a fixed point problem in $\Psi(b_t)$.[12]

Solving the above problem, the following generalized Euler equation is obtained:[13]

$$\gamma_t(u_{cc,t+1}\Psi_{b,t} b_t + u_{c,t+1}) = u_{c,t+1}\gamma_{t+1}, \tag{10}$$

where γ_t indicates the Lagrange multiplier attached to constraint (9).[14] For eq. (10) to be satisfied in steady-state, it must be that

$$\gamma u_{cc} \Psi_b b = 0. \tag{11}$$

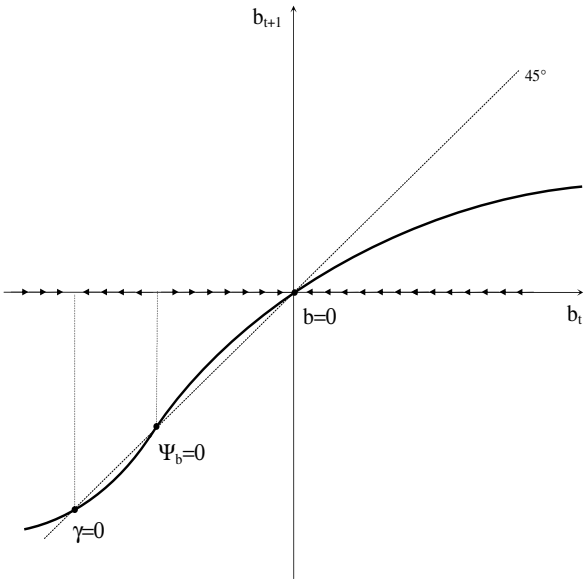
Such relationship can hold in three different cases, as illustrated in figure 2. This figure, together with the steady-states implied by eq. (11), gives a qualitative representation of the transition dynamics obtained in our numerical experiments.

[12] See Klein et al. (2008) and Judd (2004) for a detailed discussion on this topic. Ortigueira (2006) analyzes different assumptions on the extent of government's intra-period commitment.

[13] In the present framework, the generalized Euler equation is the derivative of the Lagrangian associated with the problem (8) w.r.t. b_t. The other optimality conditions can be found in the appendix.

[14] By doing so, we are implicitly assuming differentiability of the function $\Psi(b_t)$. We do not have a formal proof about the existence and/or uniqueness of this solution. However, in our numerical exercises we do find a continuous and differentiable solution.

Figure 2: Debt dynamics in the time-consistent Case



Note: The figure is a qualitative representation of debt equilibrium dynamics resulting from our numerical experiments.

First, we have the case in which $\gamma = 0$. This means that constraint (9) is not binding, and we are at an unconstrained optimum. From an economic point of view, this corresponds to the case in which the planner can avoid to raise distortionary taxes and can finance his public expenditure through the interest payments received on his outstanding assets. This represents the first-best solution.[15]

Second, we have the case $\Psi_b = 0$. This can happen when a marginal change in the level of debt does not induce any change in the equilibrium level of private consumption.[16] When the planner inherits a higher level of debt, he has to raise more distortionary taxes. Because of the bigger distortions created, by a substitution effect, this will reduce hours worked. An increase in debt also create a positive wealth

[15]In this case, the level of government debt should be $b = -g^\star/(1-\beta)$, where $g^\star$ is the first-best level of public consumption.

[16]Given the presence of distortionary taxation, this is not due to Ricardian equivalence.

effect, which furtherly decreases hours worked. Altogether, this implies that leisure (x) increases as debt increases ($\partial x/\partial b > 0$).

The composite effect on private consumption can be understood by examining the aggregate resource constraint. By differentiating equation (1) with respect to debt (b) it holds

$$\frac{\partial c}{\partial b} + \frac{\partial g}{\partial b} = -\frac{\partial x}{\partial b}. \tag{12}$$

It is possible that a marginal change in the level of debt does not produce any effect on the level of equilibrium consumption (i.e. $\Psi_b = 0$) as long as the effects on leisure (x) and public expenditure (g) exactly offset each other. On the contrary, in a model where public expenditure is exogenous as in Krusell et al. (2006), the effects on consumption must be equal to the ones on hours worked. In such case, Ψ_b cannot be zero.

Finally, we have a steady-state associated with a level of debt equal to zero. When debt is zero, the government does not have any incentive to manipulate the interest rate. At this point, policymakers' commitment is irrelevant and debt remains constant at a zero level.

3.1 Transition dynamics

As illustrated in Figure 2 we find that, in the (more relevant) cases in which the government initially holds a positive amount of debt or relatively small amount of assets, the economy will converge to the steady-state with zero debt. In the full-commitment case, whenever a government inherits a positive amount of debt, it has the incentive to use the instruments at its disposal to reduce the interest rate payments. To do so, the demand for savings should increase, which will happen if current consumption increases more than future consumption. A government with full-commitment could promise the desired level of future consumption regardless of the debt level, as long as the allocation is feasible.

In the no-commitment case, the government can only influence future actions through the state variables, which in our case is debt. The higher the inherited debt, the higher will be the incentive in the next period to increase consumption again. Therefore, to face favorable bond prices, the current government needs to

leave a lower debt to its successor. If it does not do so, the successor will raise consumption even more, and the anticipated positive consumption growth would harm the current bond price. It follows that debt is reduced until a level of zero debt is reached. At this point, the incentive to manipulate the interest rate vanishes. A symmetric argument also explains why a government that starts with assets, but to the right of the point where $\Psi_b = 0$, would instead reduce the asset holdings to manipulate the bond price, until the zero debt level is reached.

3.1.1 Transition dynamics: special cases

The mechanism explained above relies on the temptation of every government to manipulate the bond price. If a government reduces debt, then tomorrow's government will face a smaller temptation to manipulate the bond price. Yet, there is a second effect. As we mentioned before, when debt is lowered, the government can afford to lower taxes. As a consequence, leisure decreases, output increases and the economy can increase both private and public consumption. According to this effect, if tomorrow's government has lower debt then it will increase private consumption. Notice that this second effect goes in an opposite direction of the first one. At the point $\Psi_b = 0$ the two effects exactly cancel out. To the left of $\Psi_b = 0$ the second effect dominates, i.e. when assets are accumulated (debt is reduced) consumption increases. The amount of debt at which $\Psi_b = 0$ depends on the marginal rate of substitution between private and public consumption and between consumption and leisure.[17] Under our baseline calibration, as it can be seen in Figure 2 the point where $\Psi_b = 0$ is associated with government asset holdings ($b < 0$). In this case, the steady-state with $\Psi_b = 0$ is unstable, while the steady state with $b = 0$ is stable.[18]

From a theoretical point of view, it is also possible to have $\Psi_b = 0$ at a point where

[17] Unlike Diaz-Gimenez et al. (2008), our model does not have a cash in advance constraint, and the steady-state level of debt is not only determined by the utility specification on private consumption.

[18] If the initial condition is to the left of the point where $\Psi_b = 0$, an increasing path of consumption is instead obtained by accumulating assets over time, until the point where a level of zero taxation is reached and public expenditure can be financed only through the interest payments on the asset holdings. In the subsequent analysis, as it seems more reasonable, we will ignore that case.

debt is positive. In that case, such steady-state with positive debt is stable, while the steady-state with $b = 0$ is unstable. In our numerical exercises, we found that for calibrations implying a plausible level of public expenditure the case depicted in Figure 2 is the relevant one. In particular, one can obtain that the steady-state with zero debt is unstable only when the steady-state public expenditures are unreasonably low.[19] In what follows we abstract from considering these cases and focus on the case where the steady-state with $b = 0$ is stable.

3.1.2 Transition dynamics: numerical simulations

To provide a more concrete description of the behavior of our economy, we solve the model numerically by assuming the following functional form for the utility function:[20]

$$u(c, x, g) = (1 - \phi_g)\left[\phi_c \frac{c^{1-\sigma_c} - 1}{1 - \sigma_c} + (1 - \phi_c)\frac{x^{1-\sigma_x} - 1}{1 - \sigma_x}\right] + \phi_g \frac{g^{1-\sigma_g} - 1}{1 - \sigma_g}, \qquad (13)$$

where ϕ_c and ϕ_g denote the preference weights on private and public consumption. We use a standard calibration for an annualized model of the US economy in order to match long-run ratios of our variables. Table A-2 summarizes the parameter values.[21]

The evolution of the allocations is illustrated in figure 3 where, for comparison, we also display the solution under full-commitment. For a given level of initial debt, we observe a decreasing pattern of private consumption and an increasing interest rate.[22] This is achieved by lowering taxation and increasing public consumption over time.

In the initial period, in the no-commitment case taxes are higher and public

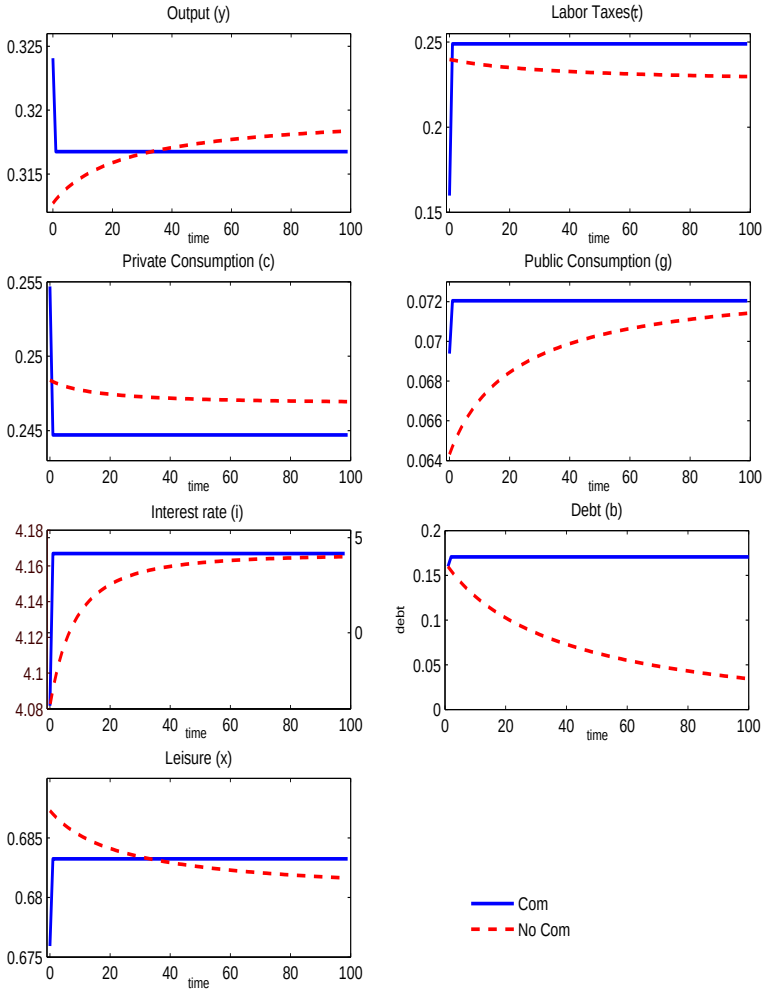
[19] If the first-best level of g is relatively low, an increase in production (due to a reduction in debt) will mainly imply a higher consumption instead of a higher g.

[20] We assume separability as it is convenient for our analysis in section 5.

[21] The ratios that we match are c/g, c/y, income taxes (τ), the fraction of time devoted to leisure (x) and the interest rate. We have tried many parameter specifications to check that results do not change qualitatively.

[22] Here we initialize debt at approximately 50% of steady-state GDP under commitment. Even though the steady-state under commitment depends on initial conditions, long-run GDP is almost insensitive to variations of debt.

Figure 3: Commitment vs. no-commitment: time pattern of allocations



Note: The figure plots the equilibrium allocations over time, giving an initial condition of $b = .16$ which is roughly 50% of GDP under our parametrization. The interest rate (lower-left panel) for the full-commitment case (continuous line) has to be referred to the right-hand scale.

consumption is lower than in the full-commitment case. Such policies allow not only to foster private consumption in the desired way, but also to run a surplus. As a result debt decreases over time. As the level of debt and interest payments are reduced, public consumption is raised and taxes are reduced. This will make consumers work more and consume less over time.

As discussed above, it is feasible to have lower taxes and lower levels of private consumption only if the level of public consumption is increased. In a model where public expenditure is exogenously determined it will not be possible to have lower taxes and lower consumption at the same time. In that context, lower taxes will imply a higher amount of hours worked and, by the resource constraint, higher consumption.[23] This prevents having a decreasing pattern of consumption and reducing debt at the same time.

We find that with no-commitment the exposure of the government in terms of debt/assets will be lower than in the case of full-commitment. This result may seem counterintuitive when compared with our discussion about the temptation to deviate from full-commitment (see section 2.1). In general, there is no reason why the policy with no-commitment should mimic the policy implemented in a one-time deviation from full-commitment. In the commitment case, the planner can benefit from the interest rate manipulation simply by taxing less today, and promising that future consumption will be lower, regardless of the level of debt. In the case of no-commitment, the government realizes that in order to conveniently manipulate the interest rate, it has to leave a lower debt to its successor. Thus debt decreases over time.

Figure 3 also shows that the movements in the interest rate are quite small, being only 8 basis points. Even though the interest rate does not display large movements, one should not conclude that the government does not face a severe time-inconsistency problem related specifically to the interest rate. In fact, lack of commitment is present in the model and has dramatic effects on the debt level.

[23] In this reasoning, we are considering that we are in the upward-sloping part of the Laffer curve.

4 Loose commitment

As shown in the previous sections, the evolution of debt changes dramatically depending on whether we assume full-commitment or no-commitment. In this section we analyze an intermediate *loose commitment* setting. We consider that governments have the ability to commit but, under some circumstances (like wars, political pressures, etc.), policy plans are reneged on. We assume that successive governments share the same objectives (i.e. there is no political disagreement). In this context, it is equivalent to consider that a new government is appointed or that the same government reneges on its past promises.

We introduce *loose commitment* into the basic model following the methodology developed in Debortoli and Nunes (2009).[24] For simplicity, we consider an institutional setting where the ability to commit is driven by an exogenous shock $s_t \in \{0, 1\}$. At any point in time t, with probability π the previously announced plans are fulfilled ($s_{t+1} = 1$), while with probability $1 - \pi$ plans will be revised ($s_{t+1} = 0$).[25] The policymaker's problem becomes

$$V(b_{-1}) = \max_{\{c_t, g_t, b_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} (\beta\pi)^t \{u(c_t, 1 - c_t - g_t, g_t) + \beta(1 - \pi)V(b_t)\}, \tag{14}$$

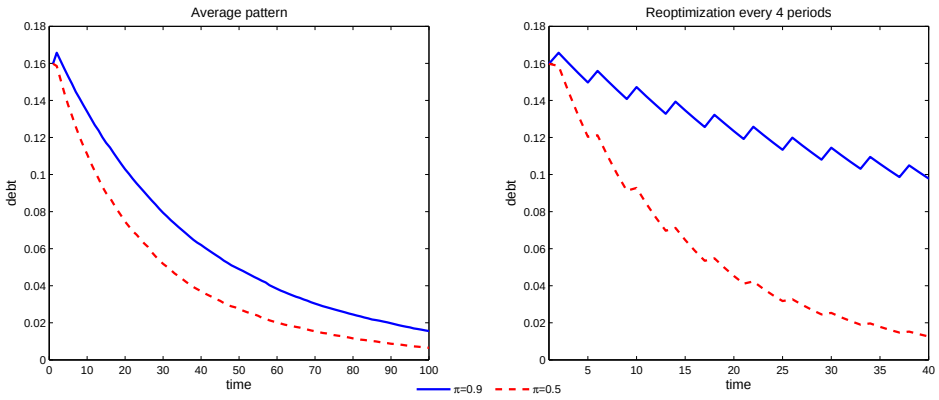
$$s.t.\ c_t u_{c,t} + \beta\pi u_{c,t+1} b_t + \beta(1 - \pi)u_c(\Psi(b_t))b_t = (c_t + g_t)u_{x,t} + b_{t-1}u_{c,t}. \tag{15}$$

The objective function (14) contains two parts. The first term in the summation refers to the plan currently made by the planner. The possibility of future reoptimizations makes the planner to discount the future at the rate $\beta\pi$. Second, at any point in time, with probability $1-\pi$ a new plan will be made. The value the planner obtains in that case is summarized in the function $V(b_t)$. This also clarifies that the planner can influence the choices made when a reoptimization occurs through the the state variable b.

[24] Schaumburg and Tambalotti (2007) developed a similar methodology than can be applied only to linear-quadratic problems. Our problem is not linear-quadratic and the non-linearity of the policy functions is crucial to determine the level of debt.

[25] Since the average duration of the announced plans is $1/(1 - \pi)$, a higher π can be interpreted as a longer horizon over which the government is expected to commit.

Figure 4: Loose commitment: time pattern of debt



Note: The figure plots the evolution of debt over time, for values of parameter $\pi = .9$ (solid line) and $\pi = .5$ (dashed line). In the left-panel average across simulations of the histories of the shock $\{s_t\}_{t=0}^{\infty}$ are reported. The right-panel shows a particular history with reoptimizations every 4 periods. The initial condition is $b = .16$ (roughly 50% of GDP).

The constraint in equation (15) is obtained by expanding the term $\beta u_{c,t+1}$ in the Euler equation (6). With probability π, the plans announced by the planner will be fulfilled. With probability $1 - \pi$, a new plan will be made, previous promises will be disregarded and the new policies $\Psi(b_t)$ will be implemented. In Debortoli and Nunes (2009) we prove that such kind of problems can be written recursively, and solved using dynamic programming. We solve the problem numerically, by a collocation method on the first-order conditions of problem.

In the left panel of figure 4, we show the average value of debt for several degrees of commitment (measured by the parameter π). We find that even a relatively small departure from the full-commitment assumption makes the economy to behave very similarly to the no-commitment case. If at period $t = 0$ the government holds debt (assets), it accumulates surpluses (deficits), until the level of zero debt is reached. Hence, the property that the steady-state level of debt is determined by the initial conditions is not robust to small deviations from the full-commitment case.

In the right-panel of figure 4, we consider a particular realization of the shocks

$\{s_t\}_{t=0}^{\infty}$ where a reoptimization occurs every 4 periods. In the *loose commitment* framework debt is increased when a reoptimization occurs. On the other hand, debt is decreased when promises are fulfilled. This is in contrast with the no-commitment solution, where debt is always reduced. This occurs because in the no-commitment solution the planner knows that he can conveniently affect the interest rate if and only if debt is reduced. In the *loose commitment* setting this is no longer true. With probability $1-\pi$ the planner will be replaced, and promises will not be kept. In that case, the level of debt is key to determine the policy of the successor and thus the interest rate. But with probability π promises will be fulfilled and will determine the interest rate independently of debt level. In a *loose commitment* setting, the planner can afford to increase debt when reoptimizing, and conveniently manipulate the interest rate, as long as he promises to reduce debt if he stays in office in the following period.

5 Political disagreement

In this section, we extend our analysis to take into account political disagreement among successive planners alternating in office. There are two reasons why we believe this case is interesting. First, this is a case where the assumption of imperfect commitment is natural. In the presence of political turnover, the party currently in office cannot make credible commitments about the choices of a successor, who in general has different objectives.[26] Second, as discussed in Alesina and Tabellini (1990), political disagreement and political uncertainty provide incentives to accumulate an excessive level of debt with respect to the standard (Ramsey) case.

Consider that two political parties (A and B) have equal preferences regarding

[26] Obviously, there may be other incentives to accumulate debt that are not present in our model. For instance, Ortigueira and Pereira (2008) examine optimal fiscal policy with no commitment in an economy with debt, capital, exogenous labor, and where the tax rate is equal for all sources of income. The authors find that one of the equilibriums is associated with issuance of public debt. In a full commitment model, Kumhof and Yakadina (2006) show that if the planner discounts the future more than what private agents do, then the planner will accumulate debt. Aiyagari and McGrattan (1998) and Shin (2006) find that if heterogeneous agents face undiversifiable idiosyncratic risk that is sufficiently large relative to aggregate risk, the Ramsey planner chooses to issue debt and facilitate the precautionary saving of the private sector.

private consumption and leisure, but disagree on how to allocate the public expenditure g. More formally, we assume that when a given party is in power its period utility (u) is given by equation (13). Nonetheless, if the party is not in power the period utility ($\tilde{u}$) is given by

$$\tilde{u}(c_t, l_t, g_t) = (1-\phi_g)\left[\phi_c \frac{(c_t)^{1-\sigma_c}-1}{1-\sigma_c} + (1-\phi_c)\frac{(x_t)^{1-\sigma_x}-1}{1-\sigma_x}\right] + \phi_g \alpha \frac{(g_t)^{1-\sigma_g}-1}{1-\sigma_g} \tag{16}$$

where the parameter $\alpha \leq 1$ measures the degree of disagreement between the two parties. Due to political disagreement the period utility of the party that is not in power is lower. A value of $\alpha = 1$ represents the limiting case of no disagreement. The political disagreement captured by α can be due to several reasons. Political parties may attach more weight to different social groups, or regions inside the country. Hence, parties may disagree on the geographical location of certain public goods, and consequently which social groups can benefit more from those goods. Different parties may also disagree on the composition of public expenditure, or which private contractors should provide the public goods. In the appendix, we provide specific examples where disagreement gives rise to the preferences specified in (13) and (16).

It can be shown that the problem of a government of type $i = A, B$, at the beginning of its tenure, can be written as

$$V(b_{-1}) = \max_{\{c_t, g_t, b_t\}_{t=0}^{\infty}} \quad \sum_{t=0}^{\infty} (\beta\pi)^t \{u(c_t, 1-c_t-g_t, g_t) + \beta(1-\pi)\xi(b_t)\} \tag{17}$$

subject to (15). The main difference with respect to (14) is that when a reoptimization occurs, choices are taken by another party that will allocate the public expenditure g in a different way. Hence, in the objective function of party i, the function $\xi(b_t)$ is the lifetime utility that party i obtains if the other party is elected at $t+1$.

Since the problem faced by the two political parties is fully symmetric, they will always choose the same level of debt, private consumption, leisure, taxes and public expenditure.[27] This symmetry allows us to define the lifetime utility derived by a

[27]This symmetry is convenient because the policy functions of both parties are equal. Since in the solution technique we need to employ global methods and the model has two state variables

party i when the other party is in charge $\xi(\cdot)$ as

$$\xi(b_{-1}) = \sum_{t=0}^{\infty} (\beta\pi)^t \left[\tilde{u}(c_t^*, 1 - c_t^* - g_t^*, g_t^*) + \beta\,(1-\pi)\,V(b_{t+1}^*)\right] \tag{18}$$

where stars denote variables evaluated with the policy functions solving the problem with political disagreement. Since the other party is in charge, allocations are evaluated according to $\tilde{u}$ instead of u. The value function $V(\cdot)$ is present because party i may regain power, and obtain utility $V(\cdot)$ as defined in (17). In the case there is no disagreement, we have that $\xi(\cdot) = V(\cdot)$.

Definition 1 specifies our concept of equilibrium, which we restrict to be within the class of Markov equilibria.

Definition 1 *A Markov Perfect Equilibrium with Imperfect Commitment and Political Disagreement is an allocation* $\{c_t, g_t, b_t\}_{t=0}^{\infty}$ *satisfying the following conditions:*

1. Given $\Psi(b)$ and $\xi(b)$, the allocation $\{c_t, g_t, b_t\}_{t=0}^{\infty}$ solves (17) subject to (15);
2. The value function $\xi(b)$ is described by (18) and $V(b)$ is the maximum of problem (17);
3. The policy function of consumption $\psi(b, \gamma)$ solving problem (17) is such that $\Psi(b) = \psi(b, 0)$.

The first part of the definition is a simple optimality requirement. The second part states that the functions ξ and V need to be consistent between themselves. The third part of the definition states that the functions the future government is expected to implement are optimal. As in the loose commitment case of section 4, when a new government is elected the Lagrange multiplier (γ) is set to zero.

The policy functions $\Psi(b)$ and the value function $\xi(b)$ are unknown and need to be found as a solution of a fixed point problem. In the current case, the fact that $\xi(b)$ and $V(b)$ are not equal does not allow the use of envelope results.

and several decision variables, relaxing this symmetry significantly complicates our analysis. In a simpler framework, Azzimonti-Renzo (2004) considers asymmetric cases.

The formulation in this section allows to study all the combinations of degree of commitment and political disagreement. If $\pi = 1$ and $\alpha = 1$ we have full commitment and no disagreement among planners, as in the standard Ramsey formulation of section 2.1. On the other extreme, when $\pi = 0$ and $\alpha < 1$ we have political disagreement with no-commitment. By changing the values of the parameters π and α, we are able to disentangle the effects of these two sources of inefficiency.

5.1 The effects of political disagreement and no-commitment

We start by considering the effect of political disagreement, abstracting from commitment issues. In other words, as in Alesina and Tabellini (1990), we keep the extreme assumption that governments can never commit, no matter if they are re-elected or not. In this case, the parameter π is unrelated to the degree of commitment and only measures the probability of being reelected.

Table 1 (left panel) shows the long-run level of debt for different values of α and π. First, once there is political disagreement between successive planners, debt converges to a positive level in the long-run. Second, a higher degree of disagreement and more frequent turnover imply a higher level of debt. While the effects of different degrees of disagreement are relevant, those of the frequency of turnover seem quantitatively less important. For all the values of α reported, the difference on the level of debt between having $\pi = .9$ and $\pi = 0$ is less than 10% of GDP.

5.2 The effects of political disagreement with commitment

We now investigate the case where a government does commit over its tenure, but cannot commit on behalf of its successors. Besides being a more realistic depiction of reality, there are two main reasons to investigate this case. First, from a static point of view, to see the implications of political disagreement without removing completely the commitment assumption. Second, we can investigate the gains from commitment in a world characterized by political disagreement.

In this context, a higher political turnover also implies a lower degree of commitment. In other words, there are now two effects related to the parameter π. A higher π implies less frequent turnover which leads, *ceteris paribus* to slightly lower

Table 1: Long-run debt (% of GDP)

	No commitment over the tenure						Commitment over the tenure					
				π						π		
α	1	0.9	0.75	0.5	0.25	0	1	0.9	0.75	0.5	0.25	0
1	–	0.0	0.0	0.0	0.0	0.0	–	0.0	0.0	0.0	0.0	0.0
0.99	–	10.9	13.0	13.9	14.2	14.4	–	3.6	3.6	4.6	6.9	14.4
0.98	–	17.8	20.9	22.3	22.8	23.0	–	7.0	7.0	8.9	12.7	23.0
0.97	–	23.1	27.0	28.6	29.2	29.6	–	10.4	10.3	12.9	17.6	29.6
0.96	–	27.4	31.9	33.9	34.6	34.9	–	13.8	13.5	16.6	21.8	34.9
0.95	–	31.2	36.2	38.3	39.1	39.5	–	17.1	16.7	20.1	25.5	39.5

Note: The table reports the long-run level of debt, for different degree of disagreement (α) and frequency of turnover (π). In the left part of the table, governments do not have commitment, regardless of the probability (π). In the right part of the table, governments can commit over their tenures. Averages are taken across realizations of the shock s_T, where $T = 1000$.

debt, according to our analysis in section 5.1. But it also means a higher degree of commitment, as shown in section 4.

In table 1 (right panel), we show the average long-run level of debt in the case of political disagreement and commitment over the tenure. As in the previous case, the level of debt is considerably increasing in the degree of disagreement. The effects of π on debt are less clear. As opposed to the previous case, debt changes non monotonically in π. This is because of the following. A higher π means a longer tenure on average. On the one hand, the commitment horizon is longer. This means that debt can be increased by more when a reoptimization occurs. On the other hand, it is less likely that the other party comes into power, so the incentives to accumulate debt are smaller. The composite effect of changing π depends on the relative strength of these two forces, which are difficult to disentangle. Finally, the effects of a marginal change in the frequency of political turnover depend on the degree of disagreement. This has empirical implications. It suggests that one should consider the interaction between frequency of turnover and the degree of polarization.

5.3 Relationship with the empirical evidence

There is a large body of empirical studies about the effects of political polarization and frequency of turnover on deficits and debt accumulation. Nonetheless, in most of these studies, polarization and turnover are not analyzed together, since they are usually considered as alternative proxies of political instability.

There are many studies analyzing the effects of political polarization on public debt and deficits. Different works have measured polarization in different ways, but it is generally found that a larger degree of polarization increases debt. Roubini and Sachs (1989) find that coalition governments (interpreted as polarization) are more likely to run deficits.[28] Volkerink and de Haan (2001) and Huber et al. (2003) find that the fragmentation of governments (in terms of size or political ideology) is a source for relatively higher deficits. Alt and Lassen (2006) find that fiscal transparency and less polarization reduce debt. Woo (2003) finds that countries with high polarization, measured as income inequality, have bigger fiscal deficits.

There is also a large empirical literature examining the effects of the average tenure or the re-election probability. In this case, results are controversial. Alt and Lassen (2006), in contradiction with the theory, find that shorter tenures reduce debt. Skilling and Zeckhauser (2002) also find that political competition decreases debt. Lambertini (2004) and Franzese (2001) find that the incumbent's probability of being voted out of office can not explain budget deficits. Grilli et al. (1991) find mixed results regarding the effects of the average tenure. de Haan and Sturm (1994) find that the frequency of government changes is positively correlated to budget deficits.

The overview of the empirical literature shows that there is some consensus that polarization is translated into more debt or deficits. In contrast, the findings on the re-election probability are quite mixed. Our paper can help understand these results. We find that both polarization and the probability of election matters. But the effect of the second variable is small and with ambiguous sign when commitment

[28]The authors do not present a regression with the average tenure and the evidence regarding this variable is only suggestive. The finding that coalition governments tend to accumulate more deficits has been challenged for instance by de Haan and Sturm (1997). See also Alesina et al. (1997) for some evidence supporting Roubini and Sachs.

issues are taken into account.

5.4 Welfare implications

In this context, building commitment is not necessarily welfare improving. Commitment is used to pursue partisan objectives, and can be detrimental for the parties disagreeing with the incumbent government. This also raises the question of how the desirability of building commitment depends on the degree of political polarization. To the best of our knowledge, we are the first analyzing this question.

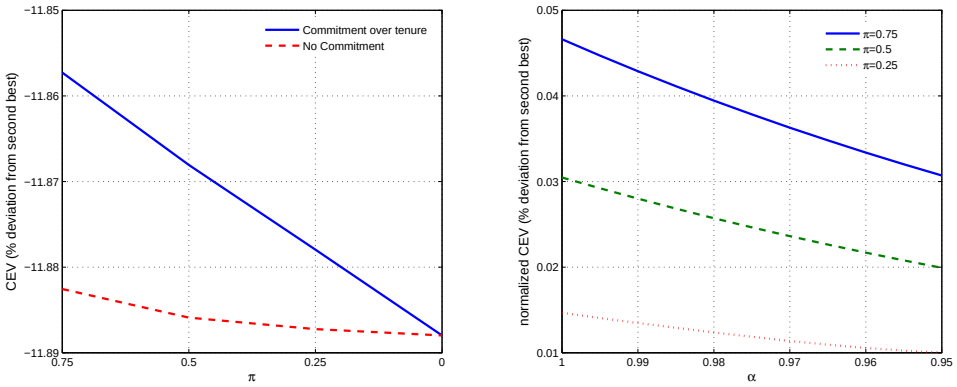
To address these questions, we compute social welfare as the average of the two types of agents lifetime utility.[29] The left panel of figure 5 shows how welfare, depends on the parameter (π), for a given degree of polarization (α).[30] Some considerations are in order. First, welfare is increasing in π, regardless of whether governments can commit over the tenure (solid line) or not (dashed line). The comparison between the two is interesting. In the former case increasing π implies both a less frequent turnover and a longer commitment horizon, while in the latter case it only affects the frequency of turnover. The difference between the two lines provides a measure of the welfare effects of building commitment. Being that difference positive and increasing in π, our analysis suggests that building commitment is welfare improving even in the presence of political disagreement. Second, being the dashed line almost flat, the welfare effects of changing the frequency of turnover, *per se*, seem to be irrelevant.

In the right panel of figure 5, we analyze the welfare effects of building commitment as the degree of political polarization (α) changes. The three lines plot the welfare gains achieved by increasing π from zero to .25, .5 and .75, respectively. We find that in all cases the higher is polarization (i.e. the lower is α) the lower are the welfare gains of increasing π. This result suggests that building commitment is less important in a country with more polarization among political parties. The rationale for this result is provided in figure 6, where we compare the welfare implications

[29] For comparability purposes, throughout our analysis welfare is always measured in consumption equivalent variation from the full-commitment and no-disagreement case.

[30] In figure 5 we set $\alpha = .95$. Results are robust for different values.

Figure 5: Welfare implications of building commitment with political disagreement



Note: The left panel plots the welfare effects as function (π) given a degree of polarization $\alpha = .95$. Both the cases where government can commit over the tenure (solid line) and cannot commit over the tenure (dashed line), are reported. The right panel plots the welfare changes of changing π from 0 to the values indicated in the legend, as a function of α. Values are expressed in percentage consumption-equivalent variation (CEV) from the benchmark case of full-commitment and no-disagreement.

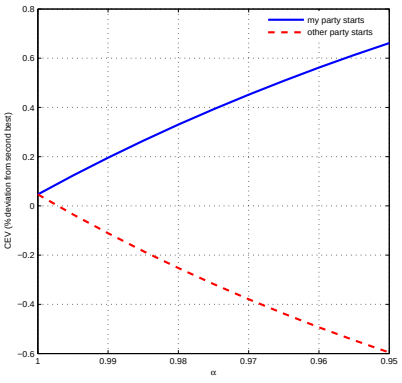
of commitment for the two types of agents.[31] We find that building commitment is welfare improving if the favorite party starts in office (continuous line). However, it is detrimental if the adverse party starts in office (dashed line). Moreover, the higher is polarization, the higher are the welfare costs of building commitment for agents having different preferences from the incumbent government.

We also find that unless the degree of polarization is very small, the costs associated with having the adverse party in power always outweigh the benefits of having more credible authorities. From a political point of view, this rules out the possibility that agents would vote for the adverse party to benefit of the gains of having having authorities with longer commitment horizons.[32]

[31] Since the problem is fully symmetric, the difference in the utilities of the two types of agents is only due to the type of party starting in office.

[32] We have formally investigated this option comparing the welfare with political turnover and the one an agent would obtain with the adverse party always in power. Results are available upon request.

Figure 6: Welfare implications for agents' groups



Note: The figure plots, for several degrees of disagreement (measured by α) the difference in welfare (in percentage consumption-equivalent variation (CEV) from second-best), between the case where governments have commitment over their tenure and the case where there is not commitment over the tenure (regardless of π). The continuous line refers to the case where the favorite party starts in office, while the dashed line indicates the case where the adverse party starts. The frequency of turnover is $\pi = .75$.

6 Conclusions

Imperfect commitment, political disagreement and political uncertainty may be important sources of inefficient fiscal policies. Our work provides an analysis to distinguish and quantify the effects of each of these forces on the level of debt. In our model, imperfect commitment drives the long-run level of debt to zero. Debt is instead positive in the presence of political disagreement. The frequency of turnover does not produce relevant effects. These results are consistent with most of the existing empirical literature. They also show that in empirical work one should distinguish between the degree of polarization and the frequency of political turnover.

From a normative point of view, we show that according to our model, the higher is the degree of polarization among political parties, the lower are the benefits of building commitment. In the presence of political disagreement, a better commitment technology will not be used to maximize overall welfare but to pursue partisan goals. This result is likely to be present in other institutional settings. Whenever a reform allows an institution to achieve a larger set of outcomes, then the welfare gains of such reform are likely to be larger if the institution cares about overall welfare instead of specific interests.

There are many interesting aspects deserving further explorations. Among them, we have abstracted from the possibility of default on outstanding debt and from the presence of a richer debt-maturity structure. These elements may have an important impact on the government ability to influence the interest rate, a crucial element in our analysis.

On the methodological side, our framework integrates the analysis about the time-inconsistency of optimal policy choices, typical of the dynamic macroeconomic literature, into a political economy model. We believe this constitutes an important step towards a theory aimed at the design of measures to enhance fiscal discipline, like limits on deficits and debt holdings, currently imposed on many countries by supranational authorities. Extending our analysis to include other forms of political conflicts and voting mechanisms constitutes an interesting line for future research.

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Appendix

The no-commitment case - optimality conditions

The first-order necessary conditions of the planner problem under no-commitment are given by equations (9), (10) and

$$\begin{aligned} c_t: &\quad u_{c,t} - u_{x,t} = \gamma_t[u_{c,t} + u_{cc,t}(c_t - b_{t-1}) + (c_t + g_t)u_{xx,t} - u_{x,t}] \\ g_t: &\quad u_{g,t} - u_{x,t} = \gamma_t[(c_t + g_t)u_{xx,t} - u_{x,t}] \end{aligned}$$

where it was assumed separability in the utility function, implying $u_{cg} = u_{xc} = u_{xg} = 0$.

The loose commitment case - optimality conditions

The first-order conditions of the planner problem under *loose commitment* are given by (15) and

$$b_t: \gamma_t[(1-\pi)u^D_{cc,t+1}\Psi_{b,t}b_t + (1-\pi)u^D_{c,t+1} + \pi u_{c,t+1}] = \pi u_{c,t+1}\gamma_{t+1} + (1-\pi)u^D_{c,t+1}\gamma^D_{t+1}$$
$$c_t: u_{c,t} - u_{x,t} = \gamma_t[u_{c,t} + c_t u_{cc,t} - u_{x,t} + (c_t + g_t)u_{xx,t}] - (\gamma_t - \gamma_{t-1})u_{cc,t}b_{t-1}$$
$$g_t: u_{g,t} - u_{x,t} = \gamma_t[(c_t + g_t)u_{xx,t} - u_{x,t}]$$

In the FOC w.r.t debt, the subscript D denotes next period variables when previous plans are abandoned.

Alternative formulations of the problem with political disagreement

In this appendix, we explain specific cases that give rise to the disagreement specification considered in the main part of the text.

First Case: Consider that there is a continuum of households indexed from 0 to 1. The function f^i_h represents the weight that each party $i = A, B$ assigns to each household $h \in (0, 1)$. The functions satisfy the following property $\int_0^1 f^A_h dh = \int_0^1 f^B_h dh = 1$. Each party believes that a set M of households will benefit from the

public expenditure regardless of which party is in power. However, the remaining households (set N) will not receive any utility from the public good if the other party is in power. Denote I_h^M and I_h^N by the indicator functions with value 1 if the household is in group M, N and 0 otherwise. The functions satisfy the following two properties: i) $I_h^N I_h^M = 0$, and ii) $I_h^N + I_h^M = 1$.

Even if a party assigns different weights to individuals, the private consumption and leisure of all individuals will be the same. This is because we are assuming separable utility and that all individuals face the same tax schedule. When party i is in power the public expenditure is denoted by g^i, while if it is not in power it is denoted g^{-i}. Under these conditions, if a given party is in power it receives the utility:

$$\int_0^1 f_h^i(u(c) + v(x) + (I_h^M + I_h^N)h(g^i))dh = u(c) + v(x) + h(g)$$

While if the other party is in power, it receives the utility:

$$\int_0^1 f_h^i(u(c) + v(x) + I_h^M h(g^{-i}))dh = u(c) + v(x) + \alpha h(g)$$

where $\int_0^1 f_h^A I_h^M dh = \alpha \in (0, 1)$, and for the problem to be symmetric we also assume $\int_0^1 f_h^B I_h^M dh = \alpha$.

If the two parties only want to use the public expenditure with certain specific groups due to corruption or pork-barrel spending, then similar arguments to those presented above also lead to an equivalent specification of disagreement. For instance, consider the case where each party can make transfers to specific districts. And in turn the districts supply a local public good that, in practice, only gives utility to the residents of that district. This can be for instance the case of a small park, a local road or a local sports pavilion. For simplicity, assume that $f_h^i = 1$, but party i only wants to use public expenditure with a subset C_A of districts, while the other party wants to use the public expenditure with a subset C_B. In this example, the set of districts $M = C_A \cap C_B$ will receive transfers regardless of which party is in power, while the set $N = C_A - M$ will only receive transfers if party A is in power. The only difference from the previous example is that $\int_0^1 f_h^A(I_h^M + I_h^M)dh = \alpha^s < 1$

and $\int_0^1 f_h^A I_h^M dh = \alpha^b < \alpha^s$. To obtain an equivalent result, redefine $\tilde{h}(g) \equiv \alpha^s h(g)$, and $\alpha \equiv \alpha^b/\alpha^s$.

Second case: Consider that there are two composite public expenditure goods. Each of these public good differs in location, contractors, type and so on. Consider that for both parties each of these goods is a perfect substitute. More formally:

$$g_t^A = g_t^1 + \alpha_s g_t^2 \quad and \quad g_t^B = g_t^2 + \alpha_s g_t^1 \tag{A-1}$$

where $\alpha^s < 1$. Under this specification, party A will only provide good of type 1 and, viceversa, party B only provides good of type 2. Consider in addition that the utility function in g is homogenous of degree $p > 0$, which is satisfied for instance by any power function. In this case, the utility that each party receives while in power is simply $(u(c) + v(x) + h(g))$, while if the other party is in power, it receives the utility $(u(c) + v(x) + \alpha_s^p h(g))$. By denoting $\alpha_s^p = \alpha$ we obtain the specification in the main part of the text.

In the first case political turnover may occur because the number of households/districts which are better represented by a given party change stochastically. In the second case, political turnover may occur because the mass of agents with a given preference for a type of good change.

Data and calibration

Table A-1: Debt in the OECD countries in 2006

	gross	net		gross	net
Australia	15.0	-2.8	Korea	27.9	-30.2
Austria	69.1	41.8	Luxembourg	6.6	.
Belgium	91.2	76.8	Netherlands	59.4	33.7
Canada	68.0	27.6	New Zealand	29.8	-3.5
Czech Republic	39.3	2.8	Norway	48.1	-149.3
Denmark	39.7	6.9	Poland	51.7	16.6
Finland	48.2	-60.6	Portugal	74.3	46.6
France	75.3	43.0	Slovak Republic	38.4	-11.7
Germany	71.3	51.9	Spain	46.8	26.7
Greece	120.6	86.9	Sweden	56.0	-15.0
Hungary	68.8	43.9	Switzerland	54.2	21.0
Iceland	24.5	8.5	United Kingdom	47.9	41.7
Ireland	32.5	4.9	United States	60.9	42.8
Italy	120.8	95.4	Euro Area	76.8	51.3
Japan	176.2	89.5	Total OECD	76.9	44.4

General government financial liabilities (percent of nominal GDP). Source: OECD Economic Outlook

Table A-2: Parameter values

Parameter	Value	Description
β	.96	discount factor
ϕ_c	.2	weight of consumption (priv. + publ.) vs. leisure
ϕ_g	.2	weight of public vs. private consumption
σ_x	3	Elasticity of leisure
σ_c	2	Elasticity of private consumption
σ_g	.95	Elasticity of public consumption