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On the Case for a Balanced Budget Amendment to the U.S. Constitution

Abstract

The purpose of this paper is to shed light on the case for a balanced budget amendment to the U.S. constitution. It studies, qualitatively and quantitatively, the impact of introducing a balanced budget rule (BBR) on fiscal policy and citizen welfare in the political economy model of Battaglini and Coate (2008). The qualitative analysis predicts that imposing a BBR will reduce debt and lead to lower average taxes and higher average public spending levels. In the short run, citizens will be worse off as public spending is reduced and taxes are raised to bring down debt. In the long run, the benefits of lower average taxes and higher average public spending must be weighed against greater volatility in taxes and less responsiveness to public good needs. To undertake the quantitative analysis, the model is calibrated to the U.S. economy and the impact of a BBR is simulated. While the average debt/GDP ratio is reduced by 89% and long run welfare is increased by 2.85%, imposing a BBR at current debt levels will reduce citizens' welfare.

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1 Introduction

A recurring debate in American politics concerns the desirability of amending the U.S. constitution to require that the federal government operate under a balanced budget rule (BBR). Calls for such a "balanced budget amendment" started in the late 1970s and became particularly strident during the high deficit era in the 1980s and 1990s. Indeed, in 1995 the House approved a balanced budget amendment by 300-132, but the Senate fell one vote short of the two-thirds majority that is needed for constitutional amendments (Schick (2007)).[1] Efforts to pass a balanced budget amendment continue today in the 110th Congress with bills pending in both the House and the Senate.[2]

While there is no shortage of policy discussion on the pros and cons of passing a balanced budget amendment, there has been remarkably little economic analysis of its likely impact. Indeed, we are not aware of *any* analysis that has tried to shed light, qualitatively or quantitatively, on the likely impact on fiscal policy and citizen welfare. Doubtless this reflects the inherent difficulty of developing an analysis that adequately captures the key trade-offs. Since it is clear that in a world in which policy is set by a benevolent planner a BBR can only distort policy and hurt citizen welfare, one must begin with a political economy model of fiscal policy. Moreover, the model must be sufficiently rich to be able to capture the short and long run consequences of imposing a BBR on policy and welfare.

As a first attempt to shed light on this important issue, this paper studies, qualitatively and quantitatively, the impact of introducing a BBR in the political economy model of fiscal policy recently developed by Battaglini and Coate (2008) (BC). The BC framework introduces legislative policy-making into a tax smoothing model of fiscal policy and incorporates the friction that legislators can redistribute tax dollars back to their districts via pork-barrel spending. This friction means that equilibrium debt levels are too high implying that, in principle, imposing a BBR has the potential to improve welfare. To undertake the quantitative analysis, the paper calibrates the BC model to the U.S. economy and simulates the effect of imposing a BBR. This represents the first calibration of the BC model to a real economy.

[1] The U.S. Constitution can be amended in two ways. The first is by a two-thirds vote in both the House and Senate followed by ratification by three-fourths of the states. The second is by two-thirds of the states calling a Constitutional Convention at which three-fourths of the states must ratify the amendment. The latter route to adopting a balanced budget amendment was pursued in the late 1970s but fell four states short of the two-thirds necessary to call a Convention. See Morgan (1998) for a discussion of this effort.

[2] The Senate bill (SJ Res 24) is sponsored by Senators Lindsay Graham and Jim DeMint and the House bill (HJ Res 45) is sponsored by Representative Kirsten Gillibrand and 31 cosponsors.

The paper models a BBR as a constitutional requirement that tax revenues must always be sufficient to cover spending and the costs of servicing the debt. Thus, budget surpluses are permitted, but not deficits. This is consistent with the balanced budget amendments that have been considered by Congress.[3] Because we are interested in modelling the impact of a balanced budget *amendment* rather than a rule imposed at the foundation of the state, we assume that the BBR is imposed *after* debt has risen to equilibrium levels.

Because it only imposes a cap on the ability to issue new debt, one may have conjectured that a BBR would only help stabilizing debt to the level prevailing at its introduction, and this is indeed the way it would affect policies in a static model. Our qualitative analysis, however, predicts that imposing a BBR will lead to a gradual reduction in the level of public debt. This occurs because a BBR, by restricting future policies, increases the expected cost of taxation and makes public savings more valuable as a buffer for future shocks. Once debt reaches its new level, pork barrel spending will re-emerge and, indeed, at higher rates than in the laissez-faire. Average tax rates are lower and public good provision is higher than in the steady state of the unconstrained equilibrium, because interest costs of debt are lower. However, the inability to use debt to smooth taxes, leads to more volatile tax rates and less responsive public good provision.

The qualitative impact of imposing a BBR on welfare is complex. In the short run, citizens experience a reduction in contemporaneous utility, as legislators reduce public spending and increases taxes to pay down debt. In the long run, they may or may not be better off. This depends on whether the benefits from lower average tax rates and higher average public spending are offset by the costs of more volatile tax rates and public good provision that is less responsive to shocks in the demand for public goods. Whether imposing a BBR increases citizens' welfare is therefore fundamentally a quantitative question and this motivates our effort to calibrate the model.

Despite its simplicity, the calibrated model performs well in fitting relevant moments of the data and predicting how policies respond to shocks in the demand for public goods. The model predicts that a BBR would reduce the average debt/GDP ratio by 89% and would also increase long run welfare by 2.85%. However, when account is taken of the welfare costs of transitioning to the new lower debt level, imposing a BBR from any debt level in the support of the long run

[3] As reported in Whalen (1995), the balanced budget amendment considered as part of the *Contract with America* in 1994 required that "total outlays for any fiscal year do not exceed total receipts for that year". Total receipts are defined as "all receipts of the United States except those derived from borrowing" and total outlays are defined as "all outlays of the United States except those for the repayment of debt principle".

equilibrium distribution actually reduces welfare.

We also consider how the performance of a BBR is affected by permitting overrides. This is motivated by the fact that the amendments considered by the U.S. Congress allow the BBR to be waived with support from at least 60% of legislators in both the House and Senate. We show theoretically that *a BBR with a super-majority override will have no effect on fiscal policy if it is imposed after debt has reached its long run equilibrium level.* Such a BBR can only have an effect if it is imposed before debt has grown too large.

The organization of the remainder of the paper is as follows. Section 2 provides a brief review of the debate concerning the desirability of a balanced budget amendment and the academic literature on BBRs. Section 3 briefly outlines the BC model of fiscal policy. In Section 4, we explain how to compute the model and calibrate it to the U.S. economy. Section 5, the heart of the paper, contains our qualitative and quantitative analysis of the impact of imposing a BBR on equilibrium fiscal policies and welfare. In Section 6, we discuss how the impact of a BBR is changed by permitting overrides and Section 7 concludes.

2 Literature review

Advocates of a balanced budget amendment to the U.S. constitution see a BBR as a necessary tool to limit the size of government and the level of public debt.[4] Opponents argue that a BBR would restrict government's ability to use debt for beneficial purposes like tax smoothing, counter-cyclical Keynesian fiscal policy, or public investment. Even if legislators tend to accumulate inefficiently high debt levels, this does not mean that they will not use debt *on the margin* in ways that enhance social welfare. Advocates respond that some flexibility may be preserved by allowing the BBR to be overridden in times of war or with a supermajority vote of the legislature. Moreover, investment expenditures might be exempted by the creation of separate capital budgets.[5]

A further common argument against a balanced budget amendment is that the BBR will be circumvented by bookkeeping gimmicks and hence will be ineffective. Such gimmicks include the establishment of entities, such as public authorities or corporations, that are authorized to borrow money but whose debt is not an obligation of the state. Another gimmick involves selling public

[4] Economists who have advocated a balanced budget amendment include Nobel Laureates James Buchanan and Milton Friedman, and former chairman of President Reagan's Council of Economic Advisors William Niskanen.

[5] On separating capital and operating budgets see Bassetto and Sargent (2006).

assets and recording the proceeds as current revenue. Moreover, critics argue that this process of circumvention will create a lack of transparency and accountability. Relatedly, critics fear that a BBR might lead Congress to further their social objectives by inefficient non-budgetary measures. For example, by imposing mandates on state and local governments or by imposing additional regulations on the private sector. Finally, critics worry whether the enforcement of a BBR will blur the line between the legislative and judicial branches of government.[6]

The academic literature that relates to the desirability of a balanced budget amendment has largely been devoted to the empirical question of whether the BBRs that are used in practice actually have any effect. Thus, the literature has honed in on the issue of the circumvention of BBRs via accounting gimmicks and the like. Empirical investigation is facilitated by the fact that BBRs are common at the state level in the U.S.. Moreover, not only is there significant variation in the stringency of the different rules, but this variation is plausibly exogenous since many of the states adopted their BBRs as part of their founding constitutions.[7] Researchers have explored how this stringency impacts fiscal policy (see, for example, Alt and Lowry (1994), Bayoumi and Eichengreen (1995), Bohn and Inman (1996), Poterba (1994) and Rose (2006)). Importantly, these studies find that stringency does matter for fiscal policy. For example, Poterba (1994) shows that states with more stringent restraints were quicker to reduce spending and/or raise taxes in response to negative revenue shocks than those without.[8]

Less work has been devoted to the basic theoretical question of whether, assuming that they can be enforced and will not be circumvented, BBRs are desirable. In the optimal fiscal policy literature, a number of authors point out that optimal policy will typically violate a BBR (see, for example, Lucas and Stokey (1983) and Chari, Christiano and Kehoe (1994)). In the context of the model developed by Chari, Christiano and Kehoe (1994), Stockman (2001) studies how a benevolent government would set fiscal policy under a BBR and quantifies the welfare cost of such a restraint. However, by omitting political economy considerations, none of this work allows for the possibility that a BBR might have benefits. Brennan and Buchanan (1980), Buchanan

[6] On enforcement issues see Primo (2007).

[7] Forty nine of the fifty U.S. states have some type of BBR (Vermont is the exception). Rhode Island was the first state to adopt a BBR in 1842 and thirty six more states adopted them before the end of the nineteenth century. See Savage (1988) for more on the history of BBRs and the importance of the balanced budget philosophy in American politics more generally.

[8] For overviews of this research see Inman (1996) and Poterba (1996).

(1995), Buchanan and Wagner (1977), Keech (1985) and Niskanen (1992) provide some interesting discussion of the political economy reasons for a BBR, but do not provide frameworks in which to evaluate the costs and benefits. Besley and Smart (2007) provide an interesting welfare analysis of BBRs and other fiscal restraints within the context of a two period political agency model. The key issue in their analysis is how having a BBR influences the flow of information to citizens concerning the characteristics of their policy-makers. This is a novel angle on the problem to be sure, but this argument has not, to this point, played a role in the policy debate.

In a precursor to this analysis, Battaglini and Coate (2008) briefly consider the desirability of imposing a constitutional constraint at the foundation of the state that prevents government from *either* running deficits *or* surpluses. They present a condition under which citizens will be better off with such a constraint. This condition concerns the size of the economy's tax base relative to the size of the public spending needs.[9] The analysis in this paper goes beyond this initial exploration in four important ways. First, it considers a BBR that allows for budget surpluses and hence public saving or debt reduction. Second, it assumes that the BBR is imposed after debt has reached equilibrium levels rather than at the beginning of time. Third, it calibrates the model to the U.S. economy and develops quantitative predictions concerning the impact of a BBR. Fourth, it considers BBRs with super-majority and state-contingent overrides.

3 The BC model

3.1 The economic environment

A continuum of infinitely-lived citizens live in n identical districts indexed by $i = 1, ..., n$. The size of the population in each district is normalized to be one. There is a single (nonstorable) consumption good, denoted by z, that is produced using a single factor, labor, denoted by l, with the linear technology $z = wl$. There is also a public good, denoted by g, that can be produced from the consumption good according to the linear technology $g = z/p$.

Citizens consume the consumption good, benefit from the public good, and supply labor. Each citizen's per period utility function is

$$z + A \ln g - \frac{l^{(1+1/\varepsilon)}}{\varepsilon + 1}, \tag{1}$$

[9] We will discuss the Battaglini and Coate result in more detail in Section 5.1.

where $\varepsilon > 0$. The parameter A measures the value of the public good to the citizens. Citizens discount future per period utilities at rate δ.

The value of the public good varies across periods in a random way, reflecting shocks to the society such as wars and natural disasters. Specifically, in each period, A is the realization of a random variable with range $[\underline{A}, \overline{A}]$ and cumulative distribution function $G(A)$.

There is a competitive labor market and competitive production of the public good. Thus, the wage rate is equal to w and the price of the public good is p. There is also a market in risk-free, one period bonds. The assumption of a constant marginal utility of consumption implies that the equilibrium interest rate on these bonds must be $\rho = 1/\delta - 1$.

3.2 Government policies

The public good is provided by the government. The government can raise revenue by levying a proportional tax on labor income. It can also borrow and lend by selling and buying bonds. Revenues can also be diverted to finance targeted district-specific monetary transfers which are interpreted as (non-distortionary) pork-barrel spending.

Government policy in any period is described by an $n+3$-tuple $\{\tau, g, b', s_1, ..., s_n\}$, where τ is the income tax rate; g is the amount of public good provided; b' is the amount of bonds sold; and s_i is the transfer to district i's residents. When b' is negative, the government is buying bonds. In each period, the government must also repay the bonds that it sold in the previous period which are denoted by b. The government's initial debt level in period 1 is b_0.

In a period in which government policy is $\{\tau, g, b', s_1, ..., s_n\}$, each citizen will supply

$l^*(\tau) = (\varepsilon w(1-\tau))^{\varepsilon}$ units of labor. A citizen in district i who simply consumes his net of tax earnings and his transfer will obtain a per period utility of $u(\tau, g; A) + s_i$, where

$$u(\tau, g; A) = \frac{\varepsilon^{\varepsilon}(w(1-\tau))^{\varepsilon+1}}{\varepsilon+1} + A \ln g. \tag{2}$$

Since citizens are indifferent as to their allocation of consumption across time, their lifetime expected utility will equal the value of their initial bond holdings plus the payoff they would obtain if they simply consumed their net earnings and transfers in each period.

Government policies must satisfy four feasibility constraints. First, we have a resource constraints that requires the total amount of private sector income to be larger than the amount borrowed by the government x:

$$\sum_i s_i + (1+\rho)b + n(1-r)w(\varepsilon w(1-r))^{\varepsilon} \geq x \tag{3}$$

Using the budget balance condition for the government, it is easy to see that (3) amounts to:

$$nw(\varepsilon w(1-r))^{\varepsilon} \geq pg \tag{4}$$

This condition is easily satisfied in the calibration of the model for the U.S. economy presented in Sections 4 and 5. In the theoretical analysis, we will assume this condition is always satisfied.[10]

Second, we require tax revenues to be sufficient to cover public expenditures. To see what this implies, consider a period in which the initial level of government debt is b and the policy choice is $\{\tau, g, b', s_1, ..., s_n\}$. Expenditure on public goods and debt repayment is $pg + (1+\rho)b$, tax revenue is $R(\tau) = n\tau wl^*(\tau)$, and revenue from bond sales is b'. Letting the *net of transfer surplus* be denoted by

$$B(\tau, g, b'; b) = R(\tau) - pg + b' - (1+\rho)b, \tag{5}$$

the constraint requires that $B(\tau, g, b'; b) \geq \sum_i s_i$. Third, district-specific transfers must be non-negative (i.e., $s_i \geq 0$ for all i). Fourth, the government cannot borrow more than it can repay which requires that b' is less than $\overline{b} = \max_\tau R(\tau)/\rho$.

3.3 The political process

Government policy decisions are made by a legislature consisting of representatives from each of the n districts. One citizen from each district is selected to be that district's representative. Since all citizens have the same policy preferences, the identity of the representative is immaterial and hence the selection process can be ignored. The legislature meets at the beginning of each period. These meetings take only an insignificant amount of time, and representatives undertake private sector work in the rest of the period just like everybody else. The affirmative votes of $q < n$ representatives are required to enact any legislation.

To describe how legislative decision-making works, suppose the legislature is meeting at the beginning of a period in which the current level of public debt is b and the value of the public good

[10] Condition (4) is always satisfied for a sufficiently high level of w. Indeed, national income always exceeds $nw(\varepsilon w(\frac{\varepsilon}{1+\varepsilon}))^{\varepsilon}$ and public good spending is always less than $pg_S(\overline{A})$. So a sufficient condition for (4) is $nw(\varepsilon w(\frac{\varepsilon}{1+\varepsilon}))^{\varepsilon} \geq pg_S(\overline{A})$.

is A. One of the legislators is randomly selected to make the first proposal, with each representative having an equal chance of being recognized. A proposal is a policy $\{\tau, g, b', s_1, ..., s_n\}$ that satisfies the feasibility constraints. If the first proposal is accepted by q legislators, then it is implemented and the legislature adjourns until the beginning of the next period. At that time, the legislature meets again with the difference being that the initial level of public debt is b' and there is a new realization of A. If, on the other hand, the first proposal is not accepted, another legislator is chosen to make a proposal. There are $T \geq 2$ such proposal rounds, each of which takes a negligible amount of time. If the process continues until proposal round T, and the proposal made at that stage is rejected, then a legislator is appointed to choose a default policy. The only restrictions on the choice of a default policy are that it be feasible and that it treats districts uniformly (i.e., $s_i = s_j$ for all i, j).

3.4 Political equilibrium

Battaglini and Coate study the symmetric Markov-perfect equilibrium of this model. In this type of equilibrium, any representative selected to propose at round $r \in \{1, ..., T\}$ of the meeting at some time t makes the same proposal and this depends only on the current level of public debt (b), the value of the public good (A), and the bargaining round (r). Legislators are assumed to vote for a proposal if they prefer it (weakly) to continuing on to the next proposal round. It is assumed, without loss of generality, that at each round r proposals are immediately accepted by at least q legislators, so that on the equilibrium path, no meeting lasts more than one proposal round. Accordingly, the policies that are actually implemented in equilibrium are those proposed in the first round.

3.4.1 Characterization of equilibrium

To understand equilibrium behavior note that to get support for his proposal, the proposer must obtain the votes of $q-1$ other representatives. Accordingly, given that utility is transferable, he is effectively making decisions to maximize the utility of q legislators. It is therefore *as if* a randomly chosen minimum winning coalition (mwc) of q representatives is selected in each period and this coalition chooses a policy choice to maximize its aggregate utility.

In any given state (b, A), there are two possibilities: either the mwc will provide pork to the districts of its members or it will not. Providing pork requires reducing public good spending or increasing taxation in the present or the future (if financed by issuing additional debt). When b and/or A are sufficiently high, the marginal benefit of spending on the public good and the marginal cost of increasing taxation may be too high to make this attractive. In this case, the mwc will not provide pork and the outcome will be *as if* it is maximizing the utility of the legislature as a whole.

If the mwc does provide pork, it will choose a tax rate-public good-public debt triple that maximizes coalition aggregate utility under the assumption that they share the net of transfer surplus. Thus, (τ, g, b') solves the problem:

$$\begin{gathered} \max u(\tau, g; A) + \frac{B(\tau,g,b';b)}{q} + \delta E v(b', A') \\ s.t. \quad b' \leq \overline{b}, \end{gathered} \tag{6}$$

where v is the continuation value function. The optimal policy is $(\tau^*, g^*(A), b^*)$ where the tax rate τ^* satisfies the condition that

$$\frac{1}{q} = \frac{\left[\frac{1-\tau^*}{1-\tau^*(1+\varepsilon)}\right]}{n}, \tag{7}$$

the public good level $g^*(A)$ satisfies the condition that

$$\frac{A}{g^*(A)} = \frac{p}{q}, \tag{8}$$

and the public debt level b^* satisfies

$$b^* = \arg\max\{\frac{b'}{q} + \delta E v(b', A') : b' \leq \overline{b}\}. \tag{9}$$

To interpret condition (7) note that $(1-\tau)/(1-\tau(1+\varepsilon))$ measures the marginal cost of taxation - the social cost of raising an additional unit of revenue via a tax increase. It exceeds unity whenever the tax rate (τ) is positive, because taxation is distortionary. Condition (7) therefore says that the benefit of raising taxes in terms of increasing the per-coalition member transfer ($1/q$) must equal the per-capita cost of the increase in the tax rate. Condition (8) says that the per-capita benefit of increasing the public good must equal the per-coalition member reduction in transfers it necessitates. Condition (9) says that the level of borrowing must balance the benefits of increasing the per-coalition member transfer with the expected future costs of higher debt next period. We will discuss this condition further below.

The mwc will choose pork if the net of transfer surplus at this optimal policy $B(\tau^*, g^*(A), b^*; b)$ is positive. Otherwise the coalition will provide no pork and its policy choice will maximize aggregate legislator (and hence citizen) utility. Conveniently, the equilibrium policies turn out to solve a constrained planning problem:

Proposition 1. *The equilibrium value function $v(b, A)$ solves the functional equation*

$$v(b,A) = \max_{(\tau,g,b')} \left\{ \begin{array}{c} u(\tau, g; A) + \frac{B(\tau,g,b';b)}{n} + \delta E v(b', A') : \\ B(\tau, g, b'; b) \geq 0,\ \tau \geq \tau^*,\ g \leq g^*(A),\ \&\ b' \in [b^*, \overline{b}] \end{array} \right\} \tag{10}$$

and the equilibrium policies $\{\tau(b, A)$,$g(b, A)$,$b'(b, A)\}$ are the optimal policy functions for this program.

The objective function in problem (10) is average citizen utility. A social planner would thus maximize this objective function without the constraints on the tax rate, public good level and debt. Thus, political determination simply amounts to imposing three additional constraints on the planning problem. The only complication is that the lower bound on debt b^* itself depends upon the value function via equation (9) and hence is endogenous.

Given Proposition 1, it is straightforward to characterize the equilibrium policies. Define the function $A^*(b, b')$ from the equation $B(\tau^*, g^*(A), b'; b) = 0$. Then, if the state (b, A) is such that $A \leq A^*(b, b^*)$ the tax-public good-debt triple is $(\tau^*, g^*(A), b^*)$ and the mwc shares the net of transfer surplus $B(\tau^*, g^*(A), b^*; b)$. If $A > A^*(b, b^*)$ the budget constraint binds and no transfers are given. The tax-debt pair exceeds (τ^*, b^*) and the level of public good is less than $g^*(A)$. The solution in this case can be characterized by obtaining the first order conditions for problem (10) with only the budget constraint binding. The tax rate and debt level are increasing in b and A, while the public good level is increasing in A and decreasing in b.

The characterization in Proposition 1 takes as fixed the lower bound on debt b^* but as we have stressed this is endogenous. Taking the first order condition for problem (9) and assuming an interior solution, we see that b^* satisfies

$$\frac{1}{q} = -\delta E[\frac{\partial v(b^*, A')}{\partial b'}]. \tag{11}$$

This tells us that the marginal benefit of extra borrowing in terms of increasing the per-coalition member transfer must equal the per-capita expected marginal cost of debt. Using Proposition 1 and the *Envelope Theorem*, it can be shown that:

$$-\delta E[\frac{\partial v(b^*, A)}{\partial b'}] = [G(A^*(b^*, b^*)) + \int_{A^*(b^*,b^*)}^{\overline{A}} (\frac{1 - \tau(b^*, A)}{1 - \tau(b^*, A)(1 + \varepsilon)}) dG(A)]/n. \tag{12}$$

The intuition is this: in the event that $A \leq A^*(b^*, b^*)$ in the next period, increasing debt will reduce pork by an equal amount since that is the marginal use of resources. This has a per-capita cost of $1/n$. By contrast, in the event that $A > A^*(b, b^*)$, there is no pork, so reducing debt means increasing taxes. This has a per-capita cost of $(1-\tau)/[n(1-\tau(1+\varepsilon))]$ when the tax rate is τ.

Substituting (12) into (11), observe that since $1/q > 1/n$, for (11) to be satisfied, $A^*(b^*, b^*)$ must lie strictly between $\underline{A}$ and $\overline{A}$. Intuitively, this means that the debt level b^* must be such that next period's mwc will provide pork with a probability strictly between zero and one.

3.4.2 Equilibrium dynamics

The long run behavior of fiscal policies in the political equilibrium is summarized in the following proposition:

Proposition 2. *The equilibrium debt distribution converges to a unique, non-degenerate invariant distribution whose support is a subset of* $[b^*, \overline{b}]$. *When the debt level is* b^**, the tax rate is* τ^**, the public good level is* $g^*(A)$*, and a minimum winning coalition of districts receive pork. When the debt level exceeds* b^**, the tax rate exceeds* τ^**, the public good level is less than* $g^*(A)$*, and no districts receive pork.*

In the long run, equilibrium fiscal policies fluctuate in response to shocks in the value of the public good. Legislative policy-making oscillates between periods of pork-barrel spending and periods of fiscal responsibility. Periods of pork are brought to an end by high realizations in the value of the public good. These trigger an increase in debt and taxes to finance higher public good spending and a cessation of pork. Once in the regime of fiscal responsibility, further high realizations of A trigger further increases in debt and higher taxes. Pork returns only after a suitable sequence of low realizations of A. The larger the amount of debt that has been built up, the greater the expected time before pork re-emerges.

Figure 1 illustrates the dynamic evolution of debt under the assumption that there are just two public good shocks, high and low, denoted A_H and A_L. The horizontal axis measures the initial debt level b and the vertical the new level b'. The dashed line is the 45^o line. The Figure depicts the two policy functions $b'(b, A_H)$ and $b'(b, A_L)$. In the first period, given the initial debt level b_0, debt jumps up to b^* irrespective of the value of the shock. In the second period, debt remains at b^* if the shock is low, but increases if the shock is high. It continues to increase for as long as the shock is high. When the shock becomes low, debt starts to decrease, eventually

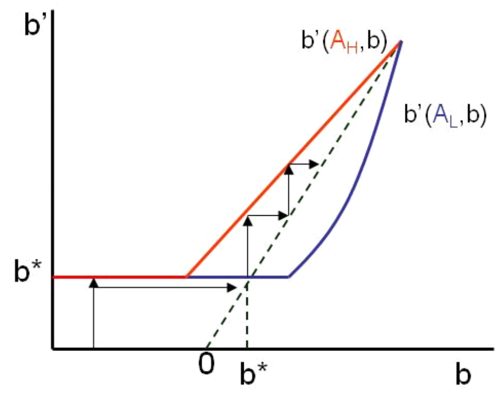

Figure 1: Evolution of debt

returning to b^* after a sufficiently long sequence of low shocks.

The debt level b^* plays a key role in equilibrating the system. If it is positive, the economy is in perpetual debt, with the extent of debt spiking up after a sequence of high values of the public good. When it is negative, the government will have positive asset holdings at least some of the time. The key determinant of b^* is the size of the tax base as measured by $R(\tau^*)$ relative to the economy's desired public good spending as measured by $pg^*(A)$. The greater the relative size of the tax base, the larger is the debt level chosen when the mwc engages in pork-barrel spending. In what follows we will assume that b^* is positive which is the empirically relevant case for the U.S. economy.

It is instructive to compare the equilibrium behavior with the planning solution for this economy. The latter is obtained by solving problem (10) without the lower bound constraints on taxes and debt, and the upper bound constraint on public goods. The solution involves the government gradually accumulating sufficient bonds so as to always be able to finance the Samuelson level of the public good solely from the interest earnings. Thus, in the long run, the tax rate is equal to zero. In each period, excess interest earnings are rebated back to citizens via a uniform transfer.

4 Calibration to the U.S.

This section describes how to compute the political equilibrium of the BC model and how we calibrate it to the U.S. economy. It then discusses the fit of the model and performs some simulations to see how well the model captures the behavior of the key fiscal policy variables. The limitations of the model are also discussed.

4.1 Numerical implementation and computation

The "state-space" of the BC model is the set of (b, A) pairs such that $b \leq \overline{b}$ and $A \in [\underline{A}, \overline{A}]$. We discretize this state-space by assuming that the preference shock A belongs to a finite set $\mathcal{A} = \{A_1, ..., A_I\}$ and requiring that the debt level b belongs to the finite set $\mathcal{B} = \{b_1, ..., b_m\}$. We assume that the lowest debt level b_1 is equal to the level that the planner would choose in the long run; that is, $b_1 = -pg_S(A_I)/\rho$ where $g_S(A_I)$ is the Samuelson level of the public good. We will discuss how the maximum debt level b_m is chosen below.

The characterization in Proposition 1 suggests a simple algorithm to compute the laissez-faire equilibrium. Given a value of b^*, (10) is a functional equation that can be solved for the equilibrium value function $v(b, A)$. The equation has a unique solution since the mapping defined by the maximization on the right hand side of (10) is a contraction. The only difficulty is that the lower bound b^* is endogenously determined along with the value function. However, this difficulty can be overcome by exploiting the fact that b^* solves the maximization problem described in (9).

These observations motivate the following computational procedure:

- **Step 1**. Choose some $z \in \mathcal{B}$ as a value for b^* and obtain the values τ^* and $g^*(A)$ from equations (7) and (8) respectively.

- **Step 2**. Solve for v_z by iterating on the value function below

$$v_z(b, A) = \max_{(\tau, g, b')} \left\{ \begin{array}{c} u(\tau, g) + A \ln g + \frac{B(\tau, g, b'; b)}{n} + \delta E v_z(b', A') \\ B(\tau, g, b'; b) \geq 0, \; g \leq g^*(A), \; \tau \geq \tau^*, \; \& \;\; b' \in \{z, .., b_m\}. \end{array} \right\}$$

- **Step 3**. Calculate

$$\arg\max\{b'/q + \delta E v_z(b', A') : b' \in \mathcal{B}\}.$$

- **Step 4**. If the optimal value calculated in Step 3 is not z, select another $z \in \mathcal{B}$ as a value for b^* and repeat the procedure. If the optimal value is z, then z is the estimate of b^* and v_z is the estimated equilibrium value function. The equilibrium policy functions can then be obtained by solving the constrained planning problem described in Step 2.

- **Step 5** Once we obtain an approximated value for b^*, we refine the search by allowing the threshold z to be a real number and use a bisection method to obtain a more accurate approximation (interpolating the expected value function using Chebyshev polynomials).

Effectively, our computational procedure searches for a b^* that is a fixed point of the above system. Intuitively, we are searching for the value of b^* that determines a value function for which the mwc would actually choose to borrow b^* when providing pork to its members. Because we span the whole domain of possible values for debt when looking for b^*, the equilibrium can be closely approximated by increasing the number of points in the grid $\mathcal{B}$.

In our numerical implementation, we use a 200-point grid $\mathcal{A}$ for the preference shocks. We choose the grid $\mathcal{B}$ for debt so that further increases in the number of points neither change the lower bound b^* nor the value of the key statistics we attempted to match (more detail on this when discussing the calibration). The resulting set $\mathcal{B}$ has 4000 non-evenly spaced grid points, which are more concentrated at values of debt greater than zero. A global approximation method is used in the computation of the equilibrium.

4.2 Calibration

We normalize the number of districts to $n = 100$. Consistent with Cooley and Prescott (1995), we set the discount factor δ equal to 0.95. This implies that the annual interest rate on bonds ρ is 5.26%. Following Aiyagari et. al. (2002) and consistent with the measure used in Greenwood, Hercowitz and Huffman (1988) for a similar disutility of labor function, we assume the elasticity of labor supply ε is equal to 2. The wage rate w is normalized so that the value of GDP when the tax rate is τ^* is 100. This implies a value of w equal to 0.72. Finally, the relative price of public to private goods p is set equal to 1.

In terms of the shock structure, we assume that in any period, the economy can be in one of two regimes: "peace" or "war". In peace, A is log-normally distributed with mean μ and variance θ^2, so that $\log(A) \sim N(\mu, \theta^2)$. In war, $\log(A)$ is equal to $\mu_w > \mu$ implying that the demand for public good provision (i.e., defense) is higher. The assumption that there is no volatility in A during wartime is just made for simplicity. We further assume that the economy is in peace 95.5% of the time and in war 4.5% of the time (corresponding to 3 war years with large government expenditures during our 66 year sample). In peacetime, the shocks are discretized using Tauchen's method.

The values of μ, μ_w and θ are calibrated to match three target moments in the data. The first two targets are the conditional mean and variance of government expenditures *as a proportion of GDP* in the U.S. during the period 1940-2005 (excluding the war years). This proportion averaged 17.36% and had a standard deviation of 2.32%. The third target is the maximum value of expenditures (net of interest payments) as a proportion of GDP. This maximum was reached during WWII in 1944 and equals 40.5%.

There are two other free parameters that need to be calibrated. The first is q - the required number of votes needed for a proposal to be approved by the legislature. While it may seem natural to set this equal to 51%, in the U.S. context super-majority approval of budgets will typically be necessary to overcome the threats of presidential vetos or Senate filibusters. Rather than trying to guess an appropriate value of q based on institutional considerations, we decided to infer the value of q from the data.

The second free parameter is the upper bound on debt b_m. In the BC model the upper bound on debt $\overline{b}$ is set equal to $\max_\tau R(\tau)/\rho$ - the present value of the stream of maximal possible tax revenues. With this upper bound, it is very difficult to match all the moments. In particular, the average debt/GDP ratio predicted by the model is too high. We think that this is a reflection of the fact that this upper bound is unrealistically high. More specifically, since repaying $\overline{b}$ would imply setting all future public good provision equal to zero, we suspect that the government would in fact be sure to default if saddled with this amount of debt. We are not sure what is the true maximum amount the government could borrow and so we simply assume that b_m is the maximum level of debt actually observed in the data.

The two moments that are used to pin down these remaining two free parameters (i.e., q and b_m) are the average and maximum ratio of government debt to GDP during 1940-2005. The former equals 56.2% and the latter 121% which was attained during WWII.[11]

Our five free parameters (μ, μ_w, θ, q, and b_m) are determined so that the model generates, under the stationary distribution, the same values that are observed in the data. The resulting values, together with other relevant parameters, are listed in Table 1.

[11] All the moments used in the calibration are constructed from the dataset contained in "Historical Statistics of the United States", Millennial Edition, Cambridge University Press (2008). The series for the ratio expenditures to GDP is constructed from the Treasury series (which ranges from 1789 to 1970) and the OMB series (ranging from 1940 to 2005), and includes Total Federal Expenditures, net of Interest Payments (all as a fraction of GDP). The measure of Total Expenditures includes Defense, Social Security and Veteran's Compensations (so "mandatory" expenditures will be taken into account when calibrating average spending). The series of debt corresponds to Federal Public Debt, and it is deflated to be converted in constant dollars using the GDP deflator.

n	δ	ε	w	p	μ	μ_w	θ	q	b_m
100	0.95	2	0.72	1	-1.05	-0.12	0.13	55.2	91.7

Table 1: Model Parameters

4.3 Model fit

Table 2 summarizes the model's fit for a set of selected variables. The first two rows include the model's simulated mean and variances, and the last two rows their counterparts in the data. The statistics are based on a numerical approximation to the theoretical invariant distribution of debt. This is obtained by iterating on the measure of realizations of a given state (A, b), given the equilibrium debt policy function and the probability distribution of expenditure shocks.[12] The conditional mean and standard deviation of expenditures as a ratio of GDP (first column), as well as the (unconditional) average value of the debt/GDP ratio (third column), are three of our five target values, and thus match the data by construction.

		g/y (peace)	g/y	b/y	c/y	Rev/y=τ
Model	Mean	**17.37**%	18.43%	**56.98**%	79%	21%
	Stdev	**2.33**%	5.40%	18%	1%	1%
Data	Mean	17.36%	18.18%	56.19%	63%	17%
	Stdev	2.32%	5.49%	20%	4%	3%

Table 2: Model Simulation vs Data

The unconditionals mean and standard deviation (second column) seem to match the data pretty well, suggesting that our approximation of the shock process is accurate.

Consistent with tax smoothing principles, we see from Table 2 that the volatility of the debt/GDP ratio in the data is much higher than that of the revenue/GDP ratio (20% for the former, 6% for the latter). Despite the fact that we did not directly target the debt/GDP volatility, the model generated a value quantitatively similar to that observed in the data. The volatility of revenue/GDP is much lower in the model suggesting that there is more tax smoothing going on in the model than in the data. Nonetheless, the average revenue/GDP ratio generated by the

[12] Using the theoretical distribution approach resulted in more robust estimates of the moments than the alternative of simulating the economy for a given length of time.

model is very much in line with the data. The only variable whose moments are poorly matched is the consumption/GDP ratio, which is probably due to the simplifying assumption of quasilinear utility and the fact that there is no physical capital in the model.

There are two other statistics not reported in Table 2 that are nonetheless important to mention. The first one, is the targeted maximum debt/GDP ratio. The model delivers an expected value of the maximum debt/GDP ratio of 120.6%, very close to the 121% observed in the data. The second statistic, not a target value, is the lower bound on the debt/GDP ratio. During the period 1940-2005 this was never below 31.5%. Encouragingly, the lower bound generated by the model—calculated as $b^*/E(y)$—is 29.4%. Thus, the political frictions captured by the model generate quantitatively a realistic and *endogenous* lower bound for debt. Moreover, the long-run stationary distribution of debt/GDP that our model generates is in line with that observed in the U.S. as seen in Figure 2.

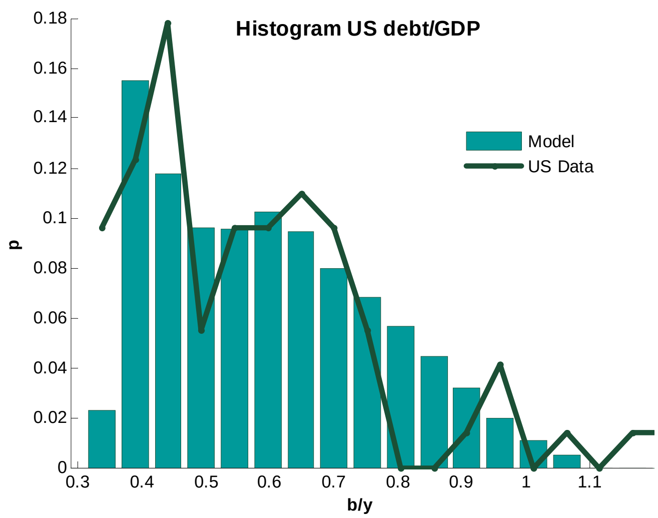

Figure 2: Stationary distribution of debt/GDP

The fact that the model delivers such a good fit with the actual distribution of the debt/GDP ratio should not be overlooked. It is very difficult to explain the observed debt distribution with a normative model. As observed earlier, the planner's solution converges to a steady state where the government has sufficient assets to finance the Samuelson level of the public good with the interest earnings and taxes are zero. Obviously such a prediction is untenable. Aiyagari et. al

(2002) showed that a non-degenerate distribution for debt could be generated by imposing an ad-hoc lower bound on debt (i.e., an upper limit on how many assets the government could hold). However, as they observe, it is not clear why the government should face such a constraint. The BC model provides a theoretical resolution of this difficulty and our calibration shows that, for the U.S., this resolution works rather nicely empirically.

4.4 Simulations

To test how well the model captures the behavior of the key policy variables, we simulated the economy for the period 1940-2005. As an initial condition, we assumed that debt/GDP in the model was identical to that in the data. We further assumed that the economy was in peace until 1942, where we hit the system with a "war" shock for three years. After that, we assume the economy remains in peace for the remainder of the sample. Given the initial value of b and the sequence of shocks, we computed the evolution of spending, revenues, and debt.

The left hand panel of Figure 3 shows the time paths of spending and revenue as a proportion of GDP in the data. Revenues are much more stable than spending reflecting the government's tax smoothing. The right hand side show the impulse-responses from the model. The Figure shows the model nicely replicates the tax smoothing behavior observed in the data.

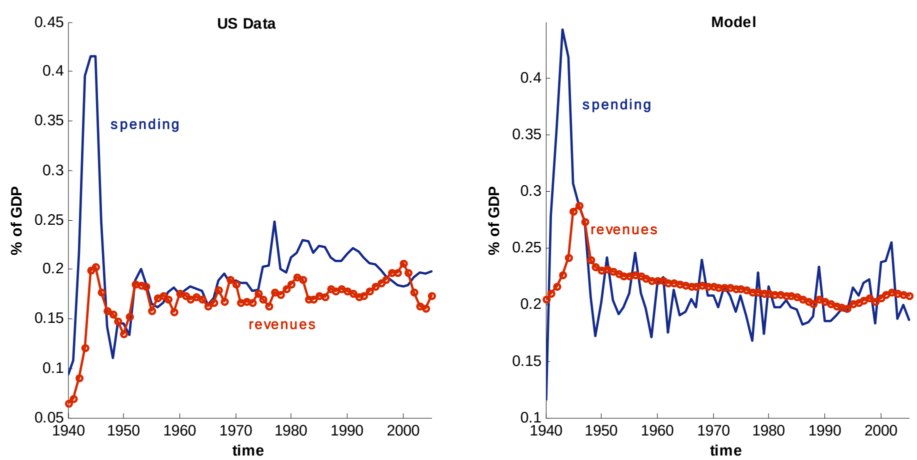

Figure 3: Response to a war shock, data (left panel) vs model (right panel)

The U.S. government financed the massive increase in public spending during the war years largely by issuing debt. The increase in the debt/GDP ratio can be seen in Figure 4, which also depicts the behavior of debt for our simulated economy. Notice that we target the level of expenditures during war years, but not the increase in debt during that time, a jump that the simulated model captures well. Another interesting thing to note is that while expenditures decreased rapidly after the shock, debt converged back at a much lower speed. While we capture this qualitatively, our model slightly over-predicts debt persistence. The model also has difficulty in explaining the up-turn in debt in the 1980s and 1990s. We suspect that there was a structural shift in the willingness to run deficits which is not picked up by the model.

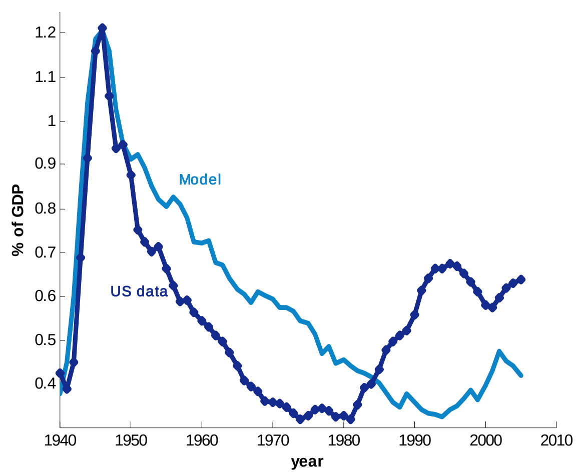

Figure 4: Response of debt to a war

4.5 Limitations

We feel that our calibrated BC model provides a remarkably good fit of the data given its simplicity. In particular, the fit of the debt distribution illustrated in Figure 2 is very encouraging. This gives us some confidence that using the model to analyze the impact of a BBR will shed light on how imposing a balanced budget amendment would impact the U.S. economy. Nonetheless, the limitations of the model should be acknowledged and we briefly discuss the three most important ones here.

Although dynamic, the BC model does not allow for persistent growth. Since there has been substantial growth in the U.S. economy over the period in question, to calibrate the model it is necessary to match the predictions of the model concerning policies *as a proportion of GDP* with the data on policies as a proportion of GDP. Matching policy *levels*, even when corrected for inflation, would not be possible. But this raises the question of whether the equilibrium behavior of fiscal policies that the model predicts would emerge in a growing economy. Preliminary work on an extension of BC with growth in the productivity of labor, however, suggests that this is indeed the case.

A second limitation concerns entitlements spending. We included Social Security and Medicare spending in our computation of the government spending/GDP ratio. Expenditure on these programs has grown significantly since WWII and this is primarily responsible for the upward trend in the spending/GDP ratio exhibited in the left panel of Figure 3. In calibrating the model, we target the average government spending/GDP ratio over the entire 1940-2005 period. Thus, our shock structure does not incorporate the increase in spending observed in the latter part of our sample period. This explains why when we simulate the reaction of the system to a war shock, we overestimate the government's response (i.e. expenditures/GDP are on average higher in the model than in the data), and predict a more rapid decrease to average levels right after the shock (see the right panel of Figure 3).

A third limitation concerns quasi-linear utility and constant interest rates. The assumption of quasilinear utility greatly simplifies the characterization of the problem when legislators bargain over policy. Without this characterization, computation of the political equilibrium would be significantly more involved. While the model captures the main trade-offs faced by the policymaker qualitatively, there is a cost in terms of the quantitative implementation. Since the interest rate remains constant regardless of the stock of debt held by the government, it becomes difficult to match all the target moments under the theoretical debt limit. If preferences over consumption streams were concave, the equilibrium interest rate would be increasing in b. As a shortcut, we imposed a realistic upper bound when computing the model, but recognize that endogenizing this would be an interesting extension.[13]

[13] In addition, when the demand for b is elastic, the government will have incentives to manipulate the interest rate in its favor. Under lack of commitment, this would cause further distortions in a political equilibrium. For a discussion on this, see Lucas and Stokey (1983) for a benevolent planner case, and Azzimonti, deFrancisco and Krusell (2007) for an analysis under majority voting.

5 The impact of a BBR

We are now ready to study the impact of imposing a BBR on the economy. We model a BBR as a requirement that tax revenues must always be sufficient to cover spending and the costs of servicing the debt. If the initial level of debt is b, this requires that

$$R(\tau) \geq pg + \sum_i s_i + \rho b.$$

Given the definition of $B(\tau, g, b'; b)$ (see (5)), the BBR is equivalent to adding, in each period, the feasibility constraint that $b' \leq b$; i.e., that debt cannot increase. Thus, under a BBR, next period's feasible debt levels are determined by this period's debt choice. In particular, if debt is paid down in the current period, that will tighten the debt constraint in the next period. We first study what can be said theoretically about the impact of a BBR and then turn to the quantitative analysis.

5.1 Qualitative analysis

Under a BBR, the equilibrium will still have a recursive structure. Let $\{\tau_c(b, A), g_c(b, A), b'_c(b, A)\}$ denote the equilibrium policies under the constraint and $v_c(b, A)$ the equilibrium value function. As in the laissez-faire equilibrium, in any given state (b, A), either the mwc will provide pork to the districts of its members or it will not. If the mwc does provide pork, it will choose a tax rate-public good-public debt triple that maximizes coalition aggregate utility under the assumption that they share the net of transfer surplus. Thus, (τ, g, b') solves the problem:

$$\max u(\tau) + A \ln g + \tfrac{B(\tau,g,b';b)}{q} + \delta E v_c(b', A')$$

$$s.t. \quad b' \leq b.$$

The optimal policy is $(\tau^*, g^*(A), b^*_c(b))$ where the tax rate τ^* satisfies the condition that

$$\frac{1}{q} = \frac{\left[\frac{1-\tau^*}{1-\tau^*(1+\varepsilon)}\right]}{n},$$

the public good level $g^*(A)$ satisfies the condition that

$$\frac{A}{g^*(A)} = \frac{p}{q},$$

and the public debt level $b^*_c(b)$ satisfies

$$b^*_c(b) \in \arg\max\{\frac{b'}{q} + \delta E v_c(b', A') : b' \leq b\}. \tag{13}$$

As in the case without a BBR, if the mwc does not provide pork, the outcome will be *as if* it is maximizing the utility of the legislature as a whole. Following the logic of Proposition 1, we obtain:

Proposition 2. *Under a BBR, the equilibrium value function $v_c(b, A)$ solves the functional equation*

$$v_c(b, A) = \max_{(\tau,g,b')} \left\{ \begin{array}{c} u(\tau) + A \ln g + \frac{B(\tau,g,b';b)}{n} + \delta E v_c(b', A') : \\ B(\tau, g, b'; b) \geq 0,\ \tau \geq \tau^*,\ g \leq g^*(A),\ \&\ b' \in [b_c^*(b), b] \end{array} \right\} \tag{14}$$

and the equilibrium policies $\{\tau_c(b, A), g_c(b, A), b_c'(b, A)\}$ *are the optimal policy functions for this program.*

As in Proposition 1, the equilibrium can be expressed as a particularly constrained planner's problem. There are however two key differences between this result and the case without a BBR. First, there is now an additional constraint on debt - an upper bound, $b' \leq b$. Second, the lower bound on debt $b_c^*(b)$ may now be a function of b. Because of these two features the set of feasible policies is state dependent and endogenous. Determining the shape of $b_c^*(b)$ will be crucial in the analysis of the dynamics and the steady state of the equilibrium. Before doing this, however, we can use Proposition 2 to characterize the equilibrium policies for a given $b_c^*(b)$. If A is such that $A < A^*(b, b_c^*(b))$ the tax-public good-debt triple is $(\tau^*, g^*(A), b_c^*(b))$ and the mwc shares the net of transfer surplus $B(\tau^*, g^*(A), b; b_c^*(b))$. If $A \geq A^*(b, b_c^*(b))$ the budget constraint binds and no transfers are given. The tax rate exceeds τ^*, the level of public good is less than $g^*(A)$, and the debt level exceeds $b_c^*(b)$. In this case, the solution can be characterized by obtaining the first order conditions for the above problem with only the budget constraint binding and the constraint that $b' \leq b$. Let $\widehat{A}(b)$ be the value of A such that above this, the BBR constraint binds.

5.1.1 What determines $b_c^*(b)$?

To understand what $b_c^*(b)$ is, it is first useful to understand what it can not be. Assume that the expected value function $Ev_c(b, A')$ were strictly concave (as it happens in the case without a BBR). In this case, the objective function of the maximization problem in (13) would also be strictly concave, and so there would be a unique $\widehat{b}$ such that $b_c^*(b) = \min\{\widehat{b}, b\}$. If this were true, however, we would have a contradiction. To see this, note that for $b < \widehat{b}$, we would have $b_c'(b, A) = b$ for all A and the BBR would always be binding; if $b > \widehat{b}$, on the other hand, we would have a strictly positive probability of a state A in which $b'_c(b, A) < b$ and in which the BBR would not bind. This would imply that when $b < \widehat{b}$, a marginal reduction of debt would be permanent: all future minimal winning coalitions would be forced to reduce debt by the same amount. For $b > \widehat{b}$, a marginal reduction in debt would have an impact on the following period, but it would affect the remaining periods only in the states in which the BBR is binding. Indeed, when the BBR is not binding, then $b_c^*(b)$ would be $\widehat{b}$, and so it would be independent of b. It follows that the marginal benefit of reducing debt at the left of $\widehat{b}$ would be higher than the marginal benefit of decreasing debt on the right of b: a contradiction with the assumption of a concave expected value function. The problem with this construction is that the marginal effect of b on $b_c^*(b)$ changes too abruptly at $\widehat{b}$, from 1 to zero. To construct an equilibrium, we need $b_c^*(b)$ to change more smoothly. This is not possible when the value function is strictly concave, because the maximization problem in (13) has a unique solution which does not allow any flexibility in choosing $b_c^*(b)$.

Let us therefore conjecture that the expected value function is weakly concave. Define

$$\begin{aligned} b_0 &= \min \arg\max\{\frac{b'}{q} + \delta E v_c(b', A')\} \\ b_1 &= \max \arg\max\{\frac{b'}{q} + \delta E v_c(b', A')\} \end{aligned}$$

By the previous argument we know that we must have $b_0 < b_1$, and so any point in $[b_0, b_1]$ maximizes $\frac{b'}{q} + \delta E v_c(b', A')$. In such an equilibrium if $b \leq b_0$, then we must have $b_c^*(b) = b$. But if $b > b_0$ then $b_c^*(b)$ could be freely chosen in $[b_0, b]$. This extra flexibility can be used to select $b_c^*(b)$ to guarantee that the conjectured properties are verified. We will now show that there is a unique equilibrium that satisfies these properties and that, in addition, has a differentiable expected value function and a monotonically non decreasing $b_c^*(b)$. In the following, we will refer to and equilibrium with these properties simply as a *monotonic equilibrium.*

To construct this equilibrium, we first need to investigate the properties of the value function.

Using Proposition 2, we can write the value function as:

$$v_c(b,A)=\begin{cases}\max_{(\tau,g)}\left\{\begin{array}{c}u(\tau)+A\ln g+\frac{B(\tau,g,b,b)}{n}+\delta E v_c(b,A')\\ :B(\tau,g,b,b)\geq 0\end{array}\right\} & \text{if } A>\widehat{A}(b)\\ \max_{(\tau,g,b')}\left\{\begin{array}{c}u(\tau)+A\ln g+\frac{B(\tau,g,b',b)}{n}+\delta E v_c(b',A')\\ :B(\tau,g,b,b)\geq 0\end{array}\right\} & \text{if } A\in[A^*(b,b_c^*(b)),\widehat{A}(b)]\\ u(\tau^*)+A\ln\frac{qA}{p}+\frac{B(\tau^*,\frac{qA}{p},b_c^*(b),b)}{n}+\delta E v_c(b_c^*(b),A') & \text{if } A<A^*(b,b_c^*(b)).\end{cases} \tag{15}$$

where $\widehat{A}(b)$ is the threshold (possibly larger than $\overline{A}$) such that for $A\geq\widehat{A}(b)$ the constraint that the debt level be less than b will bind. In this case, the initial debt level will directly determine the debt/productivity level chosen next period. Then we have that

$$\frac{\partial v_c(b,A)}{\partial b}=\begin{cases}-\left(\frac{1-\tau_b(A)}{1-\tau_b(A)(1+\varepsilon)}\right)\left(\frac{\rho}{n}\right)+\delta E\frac{\partial v_c(b,A')}{\partial b} & \text{if } A>\widehat{A}(b)\\ -\left(\frac{1-\tau_c(b,A)}{1-\tau_c(b,A)(1+\varepsilon)}\right)\left(\frac{1+\rho}{n}\right) & \text{if } A\in[A^*(b,b_c^*(b)),\widehat{A}(b)]\\ \left(\frac{db_c^*(b)/db-(1+\rho)}{n}\right)+\delta E\frac{\partial v_c(b_c^*(b),A')}{\partial b}\frac{db_c^*(b)}{db} & \text{if } A<A^*(b,b_c^*(b)).\end{cases}$$

where $\tau_b(A)$ and $\tau_c(b,A)$ are the tax rates that solve the respective maximization problems in (15). Taking expectations and assuming that $b_c^*(b)$ is differentiable, we obtain:

$$\begin{aligned}-\delta nE\tfrac{\partial v_c(b,A)}{\partial b}&=G(A^*(b,b_c^*(b)))\delta[1+\rho-\tfrac{db_c^*(b)}{db}-n\delta E\tfrac{\partial v_c(b_c^*(b),A)}{\partial b}\tfrac{db_c^*(b)}{db}]\\&\quad+\textstyle\int_{A^*(b,b_c^*)}^{\min\{\overline{A},\widehat{A}(b)\}}(\tfrac{1-\tau_c(b,A)}{1-\tau_c(b,A)(1+\varepsilon)})dG(A)\\+\textstyle\int_{\min\{\overline{A},\widehat{A}(b)\}}^{\overline{A}}(\tfrac{1-\tau_b(A)}{1-\tau_b(A)(1+\varepsilon)})dG(A)(1-\delta)&-\delta^2nE\tfrac{\partial v_c(b,A)}{\partial b}(1-G(\min\{\overline{A},\widehat{A}(b)\})).\end{aligned} \tag{16}$$

Using this expression, we can characterize the equilibrium starting from b_0. When $b<b_0$, we know that $\frac{db_c^*(b)}{db}=1$, moreover, since $b_c^*(b)=b$, we have that that $\widehat{A}(b)=A^*(b,b)$ and so we can rewrite (16) as:

$$-\delta nE\frac{\partial v_c(b,A)}{\partial b}=G(A^*(b,b))+\int_{A^*(b,b)}^{\overline{A}}\left(\frac{1-\tau_b(A)}{1-\tau_b(A)(1+\varepsilon)}\right)dG(A). \tag{17}$$

Since $\frac{b'}{q}+\delta Ev_c(b',A')$ is constant in $[b_0,b_1]$, the right hand derivative of the value function at b_0 and the left hand side derivative at b_1 must be $1/q$. In an equilibrium with differentiable expected value function, then, we must have that at b_0 the left hand side derivative (which is given by (17)) is $1/q$:

$$G(A^*(b_0,b_0))+\int_{A^*(b_0,b_0)}^{\overline{A}}\left(\frac{1-\tau_{b_0}(A)}{1-\tau_{b_0}(A)(1+\varepsilon)}\right)dG(A)=\frac{n}{q}. \tag{18}$$

The next step is to characterize $b_c^*(b)$ in $[b_0, b_1]$. To make $\frac{b}{q} + \delta E v_c(b, A')$ flat in $[b_0, b_1]$ we need:

$$-\delta n E \frac{\partial v_c(b, A)}{\partial b} = \frac{n}{q}, \tag{19}$$

for any $b \in [b_0, b_1]$. Since $E\frac{\partial v_c(b,A)}{\partial b}$ is a function of $b_c^*(b)$ and its derivative, (19) implies a differential equation that needs to be satisfied by $b_c^*(b)$ along with the initial condition $b_c^*(b_0) = b_0$. Using (16), we can show that this condition requires that $b_c^*(b)$ in $[b_0, b_1]$ is equal to a function $f(b)$ that solves the following differential equation:

$$\begin{aligned} \tfrac{n}{q} &= G(A^*(b, f(b))) \left[1 - \tfrac{df(b)}{db}\delta\left(1 - \tfrac{n}{q}\right)\right] \\ &+ (\tfrac{n}{q})(1-\delta)G(A^*(b,b)) - (\tfrac{n}{q})G(A^*(b, f(b))) + \textstyle\int_{A^*(b,b)}^{\overline{A}} \left(\tfrac{1-\tau_b(A)}{1-\tau_b(A)(1+\varepsilon)}\right) dG(A)(1-\delta) + \delta\tfrac{n}{q}. \end{aligned} \tag{20}$$

with the initial condition $f(b_0) = b_0$. Note that if this condition is satisfied, then any point in $[b_0, b]$ would be a legitimate choice for $b_c^*(b)$ in a state $b \in [b_0, b_1]$. We would therefore be free to choose any $b_c^*(b)$ we liked - in particular, $b_c^*(b) = f(b)$.

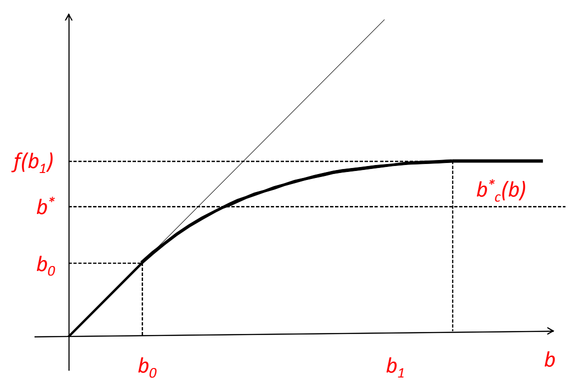

Figure 5: The lower bound $b_c^*(b)$.

Finally, consider b_1. Because $b_c^*(b)$ is non decreasing and bounded in $[b_0, b_1]$, it must be constant and equal to $f(b_1)$ in $b \geq b_1$. Using (16) and $\frac{db_c^*(b)}{db} = 0$ for $b > b_1$we have that:

$$-\delta n E \frac{\partial v_c(b, A)}{\partial b} = \frac{\begin{array}{c} G(A^*(b, b_c^*(b))) + \int_{A^*(b, b_c^*(b))}^{\min\{\overline{A}, \widehat{A}(b)\}} \left(\frac{1-\tau_c(b,A)}{1-\tau_c(b,A)(1+\varepsilon)}\right) dG(A) \\ + \int_{\min\{\overline{A}, \widehat{A}(b)\}}^{\overline{A}} \left(\frac{1-\tau_b(A)}{1-\tau_b(A)(1+\varepsilon)}\right) dG(A)(1-\delta) \end{array}}{1 - \delta(1 - G(\min\{\overline{A}, \widehat{A}(b)\}))}. \tag{21}$$

for $b > b_1$. The same logic used to pin down b_0 can now be used for b_1: at b_1 we need the right hand side derivative (given by (21)) equal to $1/q$ so b_1 must satisfy:

$$\frac{n}{q}(1-\delta) = \frac{n}{q}(1-\delta)G(A^*(b_s,b_s)) - \left(\frac{n}{q}-1\right)G(A^*(b_s,f(b_s))) + \int_{A^*(b_s,b_s)}^{\overline{A}} \left(\frac{1-\tau_{b_s}(A)}{1-\tau_{b_s}(A)(1+\varepsilon)}\right) dG(A)(1-\delta). \tag{22}$$

These consideration leads to the following result:

Proposition 3. *Under a BBR, in a monotonic equilibrium we must have:*

$$b_c^*(b) = \begin{cases} b_0 & \text{if } b \le b_0 \\ f(b) & \text{if } b \in (b_0, b_1) \\ f(b_1) & \text{if } b \ge b_1 \end{cases} . \tag{23}$$

where b_0 solves (18), b_1 solves (22) and $f(b)$ solves the differential equation (20).

Figure **??** describes $b_c^*(b)$. The figure highlights two properties of this function that will have important implications for the long term behavior. First that $b_0 < b^*$, the lower bound of debt in the case without a BBR. Second that $b_c^*(b) < b$ for any $b > b_0$.

Together with Proposition 2, Proposition 3 give us a full characterization of the equilibrium. Notice that for a given $b_c^*(b)$, (14) is a contraction with a unique fixed-point. Proposition 2 and Proposition 3 then prove that there is a unique equilibrium with the properties described above and fully characterizes it.

5.1.2 Dynamics and steady state

We now turn to the dynamics. Since in the unconstrained equilibrium, debt must be at least as large as b^*, we assume that when the BBR is imposed the initial debt level is greater than or equal to b^*. We now have:

Proposition 4. *Suppose that the BBR is imposed on the economy when the debt level is at least b^*. Then debt will gradually decline to the level $b_0 < b^*$ and will remain at this level thereafter. Once debt has converged to b_0, when the value of the public good is less than $A^*(b_0, b_0)$, the tax rate will be τ^*, the public good level will be $g^*(A)$, and a mwc of districts will receive pork. When the value of the public good is greater than $A^*(b_0, b_0)$, the tax rate will exceed τ^*, the public good level will be less than $g^*(A)$, and no districts will receive pork.*

To understand this result, note first that it is clear from the description of the equilibrium policies that once debt has reached the level b_0 it will stay there. The key step is therefore to show that the equilibrium level of debt will decline to the level b_0. This follows from the fact that $b_c^*(b) < b$ for any b, and that there is always a positive probability of converging to a state in which pork is distributed. This implies that there is a positive probability that debt will decline given any initial level $b > b_0$.

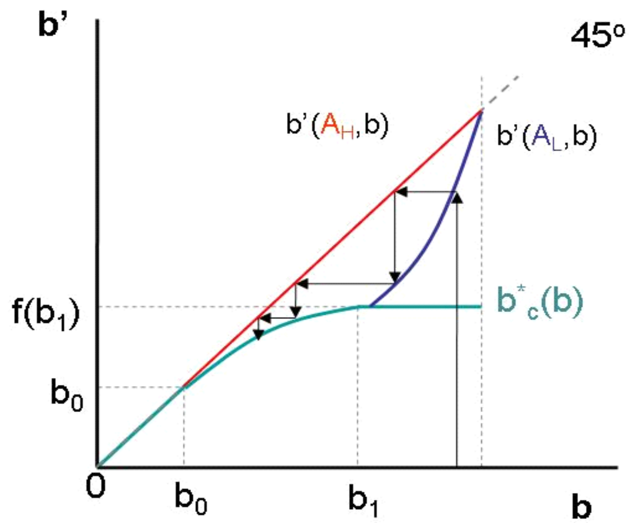

Figure 6: Evolution of debt under a BBR

Figure 6 illustrates what happens to debt in the two shock case depicted in Figure 1. The Figure depicts the two policy functions $b_c'(b, A_H)$ and $b_c'(b, A_L)$. When the shock is high, the constraint that debt cannot increase is binding and hence $b_c'(b, A_H) = b$ for all $b \geq b_0$. When the shock is low, however, the constraint is not binding and the proposer finds it optimal to pay down debt. Given an initial debt level exceeding b^*, the debt level remains at that this initial level as long as the shock is high. When the shock is low, debt starts to decrease. Once it has decreased, it can never go up because of the constraint. Eventually, debt will fall to the new steady state level of b_0. At this debt level, the proposer will not find it optimal to reduce debt further even when the shock is low.

In the new steady state with the lower debt level b_0, interest payments will be lower than in the unconstrained equilibrium. This may lead to a reduction of the average tax rate when the

BBR is imposed. Moreover, public good provision will on average be higher. However, along the transition, in circumstances in which the value of the public good is very high, tax rates will be higher and public good provision lower because the government will be unable to borrow to supplement its tax revenues. While pork is eliminated as debt declines to the new steady state, it is in fact more likely in the long run under a BBR. In the unconstrained equilibrium, the probability that pork is provided in any given period in the long run is no larger than $G(A^*(b^*, b^*))$. However, under a BBR, the probability that pork is provided in any given period once debt has reached b_0 is $G(A^*(b_0, b_0))$, which since b_0 is less than b^*, is larger than $G(A^*(b^*, b^*))$.

The above analysis provides a sharp picture of how imposing a BBR will impact fiscal policy. However, we are also interested in the impact on citizens' welfare. From Proposition 4, it is clear that imposing a BBR will reduce welfare in the short run, as the legislature pays down debt. In good times, instead of transfers being paid out to the citizens, debt will be being paid down. In bad times, the increase in taxes and reduction in public goods will be steeper than would be the case if the government could borrow. Thus, in either case, citizen welfare will be lower. In the long run, things are unclear. On the one hand, citizens gain from the higher average public good levels and lower taxes resulting from the smaller debt service payments. On the other hand, the government's ability to smooth tax rates and public good levels by varying the debt level is lost. Thus, there is a clear trade-off whose resolution will depend on the parameters. The welfare issue is therefore fundamentally a quantitative question and this motivates the calibration of the model.

Before turning to the calibration, it is worth noting that the analysis also sheds light on what would happen if a BBR were imposed at the beginning of time before the government had accumulated any debt. Assuming that initial debt equals zero and that $b_0 > 0$, under such a BBR, debt would remain at 0 forever. In a period in which A is less than $A^*(0, 0)$ the tax-public good pair would be $(\tau^*, g^*(A))$ and the mwc would share the net of transfer surplus $B(\tau^*, g^*(A), 0; 0)$. When A exceeds $A^*(0, 0)$, the tax-public good pair would be $(\tau_0(A), g_0(A))$ and no transfers would be given. Whether such a BBR would raise welfare is essentially the question addressed in Battaglini and Coate (2008). Their main theoretical result is that if $R(\tau^*) \geq pg^*(\overline{A})$, then it must be the case that $Ev_c(0, A)$ exceeds $Ev(0, A)$ and a BBR is welfare improving. To see the logic, note that the condition implies that $A^*(0, 0) \geq \overline{A}$ and hence the tax-public good pair would always be $(\tau^*, g^*(A))$ under a BBR. But without a BBR, by Proposition 2, the tax rate would never be lower than τ^* and sometimes would be strictly higher and the public good level would never be higher than $g^*(A)$ and sometimes would be strictly lower. Thus, citizens must be better off with a BBR. Battaglini and Coate's condition, however, is quite special and when it is not satisfied the answer to the welfare question will depend on whether the gain from the higher average public good levels and lower taxes resulting from smaller debt service payments offsets the cost of losing the ability to smooth tax rates and public good levels by varying the debt level. As they note, the resolution of this trade-off will depend on the parameters.

5.2 Quantitative analysis

The computation of the equilibrium is much simpler with a BBR than without because the function $b_c^*(b)$ can be directly solved for. To see this, note that the steady state value of debt b_0 can be computed directly from equation (18), since the tax function $\tau_b(A)$ solves the static problem

$$\max_{(\tau,g)} \{u(\tau, g; A) : B(\tau, g, b; b) = 0\}. \tag{24}$$

Given this, the function $f(b)$ can be found immediately by solving the differential equation (20) with initial condition $f(b_0) = b_0$, and the end condition b_1 can be found using equation (22).[14]

Once $b_c^*(b)$ is obtained, policy and value functions can be computed following Step 2 in the algorithm described above (with the exception that the constraint on debt is replaced by $b' \in [b_c^*(b), b]$). For the calibrated economy, we find that $b_0 = 5.9$, a significantly lower value than b^*, which was 29.4.

The long run impact of a BBR on the major fiscal policy variables is summarized in Table 3. Compared with the case without a BBR, the most striking difference is in the debt/GDP ratio which is now reduced from 29.4% to 5.9%, a 89% decline. Long run average tax rates are lower with a BBR and the long run average public good/GDP ratio is higher. However, the variance of the public good/GDP ratio is lower with a BBR reflecting the fact that public good provision is less responsive to preference shocks. The variance of tax rates is higher with a BBR, reflecting the intuition that taxes should be less smooth with a BBR. Without a BBR, the economy can have both responsive public good provision and smooth taxes by varying debt. This is evidenced by the high variance of the debt/GDP ratio without a BBR.

[14] We use a fourth-order Runge-Kutta method to solve for the differential equation.

		g/y	b/y	c/y	Rev/y=τ
Without BBR	Mean	18.43%	56.98%	79%	21%
	Stdev	5.40%	18.00%	1%	1%
With BBR	Mean	19.05%	6.20%	80%	19.78%
	Stdev	2.44%	0.34%	2%	2%

Table 3: Long run effects of a BBR

To understand the short run policy impact of imposing a BBR, we simulated the economy by drawing a sequence of shocks consistent with our calibrated distribution of A. As an initial condition, we assumed that the debt/GDP ratio equalled the level of 2005 in the US, the last year for which we have data. It took around 70 periods for the economy to transition to a value below b^*(the equivalent to about 30% of debt to GDP), with the transition to the new steady state (about 6% of debt to GDP) occurring at a much slower speed. Figure 7 illustrates how fiscal policy behaved during the transition comparing the behavior of policies with and without a BBR. As it can be seen in the first panel of Figure 7, in the benchmark case without a BBR (the dotted line) the government always issues debt in time of war: in the BBR regime, however, it is forced to have zero deficits. This induces a marked downward drift in the evolution of debt.

The second panel of Figure 7 measures the debt/GDP ratio. The main point to note is that this measure spikes during war-time even with a BBR. The reason is that, even though debt remains constant, GDP goes down due to the increase in taxation needed to finance the war. The spike in taxes during war time under a BBR is clearly illustrated in the third panel of Figure 7 which nicely illustrates the negative consequences of a BBR for tax smoothing. On the other hand, the panel also illustrates how a BBR serves to lower average tax rates over time. The fourth and final panel of Figure 7 illustrates that public good provision is much less responsive with a BBR. On the other hand, the average level of public good provision rises above the level of provision without a BBR as we approach the new steady state.

In the simulation, pork is not provided during the transition to the new steady state under a BBR. However, once at the new steady state, pork is more likely to be provided than in the laissez-faire. Indeed, while average pork-barrel spending as a proportion of total spending is close

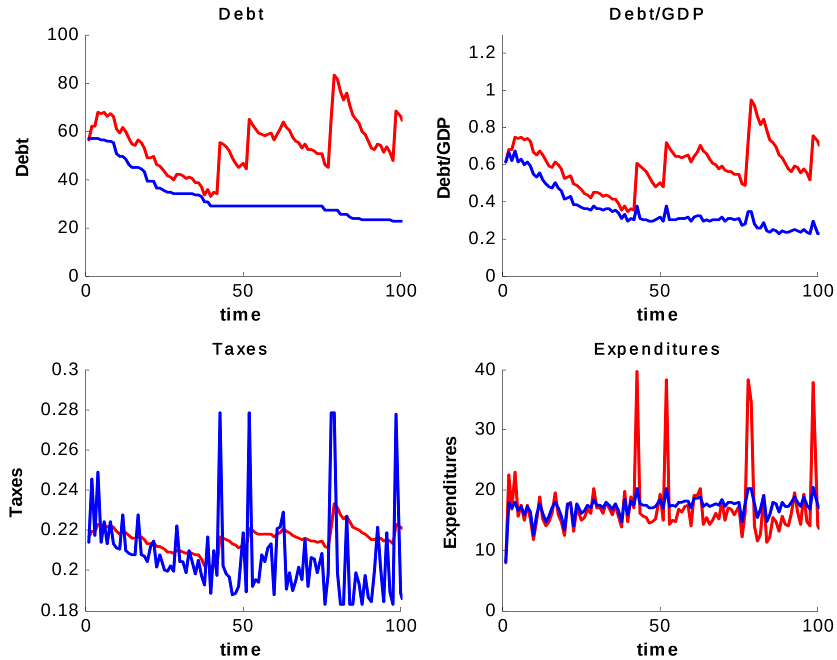

Figure 7: Evolution of key variables (- - red benchmark, – blue BBR)

to zero in the long run unconstrained case, it is about 2.3% of total spending under a BBR. We can see in Figure 8 that once the economy reaches a point where debt has converged, and there are low spending needs (a low realization of A during peace time), the extra resources instead of being used to save funds for rainy days are immediately redistributed as transfers to the members of the winning coalition.

Long run welfare under a BBR, as measured by $Ev_c(b_c^*, A)$, is 2.85% higher than corresponding long run value without a BBR[15] . This welfare gain reflects the lower cost of debt service at the new steady state. However, as discussed above, this long run gain does not mean that imposing a BBR will raise welfare because of the costs incurred in the transition to the new steady state.

Figure 9 illustrates the evolution of contemporaneous utility following the imposition of a BBR. In the first 40 periods, contemporaneous welfare is most of the time lower under a BBR. However, after the first war shock, debt is sufficiently lower under a BBR that contemporaneous welfare

[15] Long run welfare without a BBR is given by $\int_b Ev(b, A)d\psi(b)$ where $\psi(b)$ is the stationary distribution of debt.

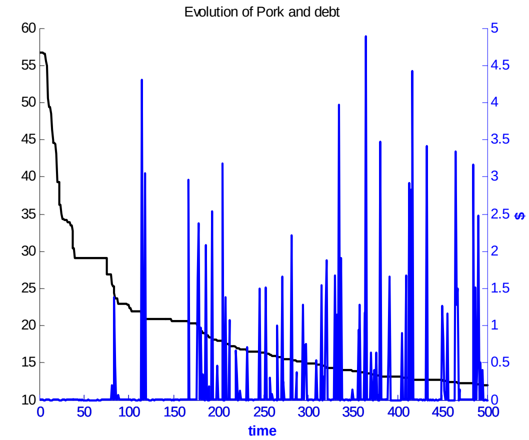

Figure 8: Pork under a BBR

overtakes that in the laissez-faire and exceeds it thereafter even during war time.[16] It turns out that these short run costs are sufficiently high that imposing a BBR will actually reduce welfare. Moreover, this is true for any initial debt level in the support of the long run distribution in the laissez-faire.

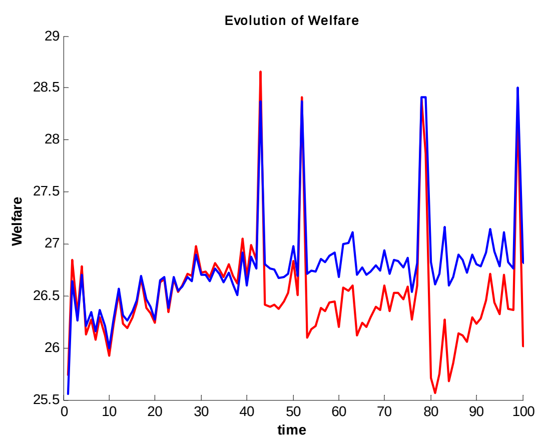

Figure 9: The Evolution of Welfare (- - red benchmark, – blue BBR)

[16] The fact that contemporaneous utility spikes up in war time is just an artifact of how we have modelled war as an increase in the value of public goods. There are obviously other utility costs of war that are not accounted for by the model.

While the question is purely academic, one can use the model to ask whether the U.S. would have been better off at its founding banning the use of debt. As discussed in Section 5.1, we can address this by comparing $Ev_c(0, A)$ and $Ev(0, A)$. We find that such a ban would have increased welfare by 0.017%.

6 Super-majority overrides

The analysis of the previous section assumes that once it has been imposed, a BBR can never be removed. However, as noted in the introduction, the balanced budget amendments considered by the U.S. Congress allow the BBR to be waived with support from at least 60% of legislators in both the House and Senate. In this section, we study how such override provisions would change the impact of a BBR.

Suppose that the BBR can be overruled with the support of $q' > q$ legislators. Thus, if the proposer can obtain the support of q' legislators, he can pass a proposal which raises the debt level. Otherwise, the rule binds. Of course, if the proposer is not planning to raise debt, then he only needs the support of q legislators to pass his proposal. We call such a rule a *BBR with super-majority override*. We now have the following striking result.

Proposition 5. *Suppose that a BBR with super-majority override is imposed on the economy when the debt level is at least b^*. Then the rule will have no effect on fiscal policies and citizens' welfare.*

The logic underlying this result is straightforward. In the long run equilibrium of the unconstrained model, whenever the mwc raises debt it provides no pork to its members. This follows from the fact that when the mwc is providing pork it must be choosing the debt level b^* which is the lowest level of debt in the support of the long run distribution. Thus, whenever the mwc increases debt above b^* it is effectively behaving as a planner would and its proposal is therefore supported unanimously.

When reflecting on this result, it is important to note that if a BBR with super-majority override were imposed on the economy before debt had risen to equilibrium levels, it would have an effect on the economy. This is because it will constrain the initial surge in debt-financed pork, thereby shifting the debt distribution to the left. The greater the required super-majority, the larger the shift. More generally, thinking outside the model, we would expect that a BBR with super-majority override will have an effect in a growing economy in which debt levels increase following larger than expected productivity shocks.

7 Conclusion

This paper has analyzed the likely impact of introducing a balanced budget amendment to the U.S. constitution. The analysis suggest that, in the long run, an amendment would reduce the average U.S. federal debt/GDP ratio by a very substantial 89%. Moreover, the net effect on citizens' welfare in the long run would be positive with welfare increasing by 2.85%. However, the short run welfare costs would be sufficiently large that they would swamp the long run gains. On balance, introducing a balanced budget amendment would be harmful.

These predictions assume the constitutional amendment imposes a BBR which could not be overridden. However, the analysis also suggests that permitting super-majority overrides does not change the basic conclusion. A super-majority override would make a BBR impotent.

In interpreting these findings, it should be remembered that our analysis ignores many of the disadvantages of BBRs that are stressed by opponents (see Section 2). Thus, our analysis might be thought of as providing a best case scenario for introducing a BBR. In light of this, we feel that our negative findings provide a rather strong argument against those who favor a balanced budget amendment for the U.S. constitution.

It should be stressed that our conclusions are based on a particular political economy model of fiscal policy. We have argued that the BC model provides a sufficiently good fit of the data to justify our analysis. Nonetheless, as we have also pointed out, the model has its limitations and there is no question that there is significant room for improvement. Of particular importance is to try and incorporate growth. As this and other improvements are incorporated into political economy models of fiscal policy, the balanced budget amendment question will likely be an attractive one to revisit. For, while it may wax and wane, we doubt that the pressure for a balanced budget amendment to the U.S. constitution will abate. We look forward to seeing how the findings of this paper will be refined by future work.

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