Transmission Mechanisms of the Public Debt in Political Economies

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We will discuss political-economy models of fiscal policy. In particular, we will see two different models: The first one is Pierre Yared (2010) and the second one is Marco Battaglini and Stephen Coate (2008).

These two models allow for political processes that permit citizens to throw politicians out of power, while details of their political process are different.

The government spending is productive in these models because it creates utility benefits of citizens.

My analysis then moves onto political equilibrium models of the productive public debt in which citizens have utility benefits from their holdings of government bonds.
The Key Questions

- The endogenous debt limits can arise in the presence of politicians.
  - Government debt cannot be too low since this tightens the incentive compatibility constraint of the incumbent politician by providing him with more resources to potentially appropriate.
  - Government debt cannot be too high, since this tightens the incentive compatibility constraint of the representative citizen by reducing the cost of throwing out the incumbent politician.

- What is the impact of the productive public debt on the endogenous debt limits generated by the presence of politicians?

- What is the impact of the productive public debt on the endogenous choice of a fiscal policy regime between “responsible policy-making” and “business-as-usual” regimes?
A Brief Summary of Pierre Yared (2010)

- A rent-seeking politician chooses policies: If the politician chooses extractive policies, citizens throw him out of power.
- In the efficient sustainable equilibrium, temporary economic shocks generate volatile and persistent changes in taxes along the equilibrium path. The reason for this result is that fiscal policy should be used to optimally limit rent-seeking by the politician and to optimally generate support for the politician from the citizens.
- In this political economy, it is costly to design a tax system that resembles those of the benevolent government because the government over-saves and resources are wasted on rents.
- The implication of political distortions for the financial market structure is that it makes the complete debt market behave as if it were incomplete. The difference from an incomplete-market economy, however, is that taxes do not converge to zero in the long-run and (under some conditions) they resemble taxes under a benevolent government.
Motivation for the Convenience Yield of Government Bonds in Equilibrium Models of Political Economies

- It is plausible to assume that the real amount of outstanding government bonds is positive if the convenience yield of government bonds is represented by utility benefits of holding government bonds.
- Politicians would have more pecuniary benefits by their default decisions if there is a substantial amount of the government debt.
- Citizens would find the default threat (by politicians) very costly if the default removes their utility benefits of holding government bonds.
- The introduction of default reduces the maximal amount of the public debt that politicians can collect when they deviate. The reason for this result is that, when citizens expect defaults of future governments, anticipated market prices of future debts are zero.
- However, the presence of the convenience yield of government bonds might have impacts on citizens’ expectations about future defaults of governments.
There is a continuum of mass 1 of identical households whose preferences at period 0 are represented by the following utility function:

$$\sum_{t=0}^{\infty} \beta^t E_0[c_t - \eta n_t^{\gamma} / \gamma + \theta(s_t) g_t^{\alpha} / \alpha]$$

for $0 < \alpha < 1 < \gamma$, $\eta > 0$, $\theta(s_t) > 0$, and $\theta(s_t)$ is high (low) when public spending is more (less) productive.

A stochastic state $s_t \in S = \{1, \ldots, N\}$ follows a first-order Markov process with full support for $N \leq 2$ and $s_0$ is given. Let $s^t = \{s_0, \ldots, s_t\}$ represent a history, and let $\pi(s^k | s^t)$ represent the probability of $s^k$ conditional on $s^t$ for $k \geq t$.

The flow budget constraint of each household $h$ is

$$c_t + b_t^h(s_t) = (1 - \tau_t) n_t + \sum_{s_t+1=1}^{S} q_t(s_{t+1}) b_t^h(s_{t+1})$$
Government policies are represented by
\[ \rho_t = \{\tau_t, \{b^g_{t+1}(s_{t+1})\}_{s_{t+1} \in S}, g_t, x_t\} \]
and must satisfy the government’s period budget constraint:

\[ g_t + x_t + b^g_t(s_t) = \tau_t n_t + \sum_{s_{t+1} \in S} q_t(s_{t+1}) b^g_t(s_{t+1}) \]

subject to \( g_t \geq 0 \) and \( x_t \geq 0 \). In addition, \( q_t(s_{t+1}) \) is the value at period \( t \) of one unit of consumption good at state \( s_{t+1} \) in period \( t + 1 \).

The only difference between these budget constraints and those of the standard economy is that the rent \( x_t \) is included on the left-hand side of the government’s budget equation.
### Market Clearing Conditions

1. **Bonds market:**
   \[ b^g_t(s_t) + b^h_t(s_t) = 0 \]

2. **Goods market:**
   \[ c_t + g_t + x_t = n_t \]

3. The following debt limits rule out Ponzi schemes:
   \[ b^g_t(s_{t+1}) \in [\underline{b}, \overline{b}] \]

4. This constraint does not bind at an equilibrium by choosing a sufficiently low value of \( \underline{b} \) and a sufficiently high value of \( \overline{b} \). For example \( \overline{b} = \frac{r^{\text{max}}}{1 - \beta} \) and \( r^{\text{max}} \) is the maximum tax revenue that the government can collect.
Citizens control politicians by potentially removing them from office.

$P_{t+1} = \{0, 1\}$ represents the decision by citizens to remove the incumbent in period $t$ with $P_{t+1} = 0$ representing replacement.

The interaction between citizens and politicians is a game:
- Nature chooses the state $s_t$.
- Citizens make the replacement decision $P_{t+1}$.
- The incumbent politician chooses policies $\rho_t$.
- Markets open and clear.
- If $P_{t+1} = 0$, the incumbent politician is replaced.

An incumbent can choose policies prior to removal from power.
Payoffs of Political Turnovers

1. Politicians and citizens derive payoffs associated with $P_{t+1}$.

2. Costs of Incumbent Politicians
   - The incumbent politician endures an exogenous cost $\chi^p(1 - \beta)/\beta (> 0)$ from period $t$ onward, if $P_{t+1} = 0$.
   - The parameter $\chi^p$ captures institutional constraints on politicians, which vary across societies and are empirically important determinants of economic activity around the world.

3. Payoffs of Citizens
   - Citizens receive an exogenous benefit $\chi^c(1 - \beta)$ at period $t$, if $P_{t+1} = 0$.
   - The parameter $\chi^c$ represents the social benefit of political turnover. Here, citizens may derive non-pecuniary benefits from replacement even though all candidate politicians are identical.
Description of a Sustainable Equilibrium

- Individual households are not strategic in their private market behavior, while the representative citizen is strategic in its replacement decision on politicians.
- The incumbent politician is strategic in his/her choice of government policies and must ensure that the government’s budget constraint should be satisfied given the private sector’s actions.
- There are lower bounds on continuation values for the incumbent politician and the representative citizen at a sustainable equilibrium.
- We will characterize incentive compatible constraints for the incumbent politician and the representative citizen.
The incumbent politician should receive a higher welfare than what he/she would receive from maximal extractive policies and replacement.

In each period, the incumbent politician can maximize his/her rent by choosing the revenue maximizing tax rate.

In each period, the incumbent politician can set public spending to zero and repay the currently existing debt, and borrow the maximal amount of debt $b = \frac{r_{\text{max}}}{1 - \beta}$.

In this case, the representative citizen will throw out all future politicians and politicians endure exogenous costs $\chi^p$.

The lower bound on the incumbent politician’s continuation welfare at period $t$ is

$$V = \frac{r_{\text{max}}}{1 - \beta} - b - \chi^p$$
Characterization of the Maximal Debt that Politician Can Extract

The Present Value of Government Budget Constraint (without rents for politicians)

\[ b_{t+1} = r_{t+1} - g_{t+1} + \beta b_{t+2} \]

No Default:

\[ b^{\text{max}} = \frac{r^{\text{max}}}{1 - \beta} \]

Default: When the default of government bonds exists, the optimal strategy of citizens is to set \( b_{t+2} = 0 \).

\[ b^{\text{max}} = r^{\text{max}} \]
We compute the representative citizen’s utility payoff from political turnover.

When the citizen throws out the incumbent politician, the existing politician maximizes his/her current rent by choosing the revenue maximizing tax rate.

$U^{AUT}$ is the discounted sum of the citizen’s current and future utilities conditional on maximally extractive government policies and replacement, where $U^{AUT}$ is defined as

$$U^{AUT} = \frac{(n^{max} - \eta(n^{max})^\gamma/\gamma - r^{max})/(1 - \beta)}{1 - \beta}$$

The citizen will throw out all future politicians for ever and receive $\chi^c(1 - \beta)$ in each future period.

The incumbent politician can set public spending to zero and repay the existing debt denoted by $b$.

In sum, the lower bound on the household’s continuation welfare at period $t$ is

$$U = U^{AUT} + b + \chi^c$$
Incentive Compatibility Constraint for the Incumbent Politician and Government Debt Net of Rents

1. Definition of government debt net of current and future rents:

   \[ z_t = b_{t-1} + \sum_{k=0}^{\infty} \beta^k E_t[x_{t+k}] \]

2. Rewriting the present-value government budget constraint

   \[ \sum_{k=0}^{\infty} \beta^k E_t[r_{t+k} - g_{t+k}] = z_t \]

3. Incentive compatibility constraint for the incumbent politician in terms of the government debt net of rents

   \[ z \geq \frac{r_{\text{max}}}{1 - \beta} - \chi^p \]
Incentive Compatibility Constraint for Households

1. We eliminate $b$ in the lower bound on the continuation value of households by using government debt net of rents.

2. The lower bound on the household’s continuation welfare at period $t$ becomes

$$U_{t+1} = U^{AUT} + z_{t+1} - \sum_{k=0}^{\infty} \beta^k E_{t+1}[x_{t+k+1}] + \chi^c$$

3. We set the discounted sum of future rents equal to zero in the lower bound on the household’s continuation welfare:

$$U_{t+1} = U^{AUT} + z_{t+1} + \chi^c$$

4. Incentive compatibility constraint for households

$$J_{t+1} - z_{t+1} \geq U^{AUT} + \chi^c$$

where $J_{t+1}$ represents the welfare of households at period $t+1$ in the absence of replacement of the incumbent politician.
The Planning Problem for an Efficient Sustainable Equilibrium

1. Planning Problem

\[ J(s, z) = n - g - \eta \frac{n^\gamma}{\gamma} + \theta(s) g^\alpha + \beta \sum_{k \in S} \pi_{ks} J(k, z_k) \]

subject to

\[ z = r(n) - g + \beta \sum_{k \in S} \pi_{ks} z_k \]

\[ z_k \geq \frac{r_{\text{max}}}{1 - \beta} - \chi^p \]

\[ J(k, z_k) - z_k \geq U^{AUT} + \chi^c \]

2. \( J(s, z) \) represents the highest possible welfare to households, net of the stream of rents, that can be achieved conditional on the state \( s \) and on the value of debt net of rents being equal to \( z \).
Optimality Conditions of the Planning Problem

1. Labor
   \[ \eta n^{\gamma-1} = \frac{1 + \lambda}{1 + \gamma \lambda} \]

2. Public Spending
   \[ \theta(s_t)g^{\alpha-1} = 1 + \lambda \]

3. Future Rent
   \[ J_z(k, z_k) = -\lambda + \phi_k - \psi_k \]

4. Current Rent
   \[ J_z(s, z) = -\lambda \]

5. \( \lambda \): multiplier for government budget constraint, \( \phi_k \): multiplier for incentive compatible constraint for politician, \( \psi_k \): multiplier for incentive compatible constraint for citizen.
**Characterization of Equilibrium Dynamics**

1. Law of Motion for Lagrange Multiplier of Government Budget Constraint

\[ \lambda_t = \frac{\lambda_{t-1} + \phi_t - \psi_t}{1 + \psi_t} \]

- **CASE I:** \( \lambda_t \leq \lambda_{t-1} \leq \bar{\lambda}_t \) implies that \( \lambda_t = \lambda_{t-1} \), \( \phi_t = 0 \), and \( \psi_t = 0 \).
- **CASE II:** \( \bar{\lambda}_t \leq \lambda_{t-1} \) implies that \( \lambda_t = \bar{\lambda}_t \), \( \phi_t = 0 \), and \( \psi_t > 0 \).
- **CASE III:** \( \underline{\lambda}_t \geq \lambda_{t-1} \) implies that \( \lambda_t = \underline{\lambda}_t \), \( \phi_t > 0 \), and \( \psi_t = 0 \).

2. Income tax rate is determined by the following equation

\[ \tau_t = (\gamma - 1)/(\gamma + \lambda_t^{-1}) \]
1. The government chooses an indicator $D_t = \{0, 1\}$, which represents a
decision to default on outstanding debt.

2. A politician’s best deviation will involve defaulting on outstanding
debt in addition to choosing maximal taxes and minimal public
spending.

3. If the politician attempts to extract the maximal amount of debt $b$, the optimal punishment strategy will involve households expecting
default by future governments, and this induces a market clearing
price of zero for this debt.

4. The politicians best deviation yields:

$$V = r^{\text{max}} - \min\{0, b(s_t|s_{t-1})\} - \chi^p$$
Technical Point: Politicians’ Incentive Compatibility Condition in the Presence of Default Possibility

1. In the presence of default possibility, the politician’s incentive constraint is equivalent to the following two constraints for $z$.

2. Default Case: $b(s_t|s_{t-1}) \geq 0$ and $\min\{0, b(s_t|s_{t-1})\} = 0$

   \[
   V = r_{\text{max}} - \chi^p
   \]
   \[
   V_t \geq r_{\text{max}} - \chi^p
   \]

3. No Default Case: $b(s_t|s_{t-1}) \leq 0$ and $\min\{0, b(s_t|s_{t-1})\} = b(s_t|s_{t-1})$

   \[
   V = r_{\text{max}} - b(s_t|s_{t-1}) - \chi^p
   \]
   \[
   z(s^t|s^{t-1}) \geq r_{\text{max}} - \chi^p
   \]
Characterization of the Maximal Debt that Politician Can Extract

- The Present Value of Government Budget Constraint

\[ b_{t+1} = r_{t+1} - g_{t+1} + \beta b_{t+2} \]

- No Default:

\[ b_{\text{max}} = \frac{r_{\text{max}}}{1 - \beta} \]

- Default: When the default of government bonds exists, the optimal strategy of citizens is to set \( b_{t+2} = 0 \).

\[ b_{\text{max}} = r_{\text{max}} \]

- Generalization (Convenience Yield of Government Bonds): The expected default rate at period \( t + 2 \) is \( \delta_{t+2} \).

\[ b_{t+1} = r_{t+1} - g_{t+1} + \beta (1 - \delta_{t+1}) b_{t+2} \]
Households at period $t$ have utility benefits of holding government bonds that are represented by the following function:

$$\sum_{s_{t+1} \in S} \pi_{s_{t+1}|s_t} H(b_{t+1}^h(s_{t+1}|s_t))$$

where function $H$ is increasing, concave, and twice differentiable in its argument. The representative citizen’s period utility function becomes

$$c_t - \eta n_t^\gamma / \gamma + \theta(s_t) g_t^\alpha / \alpha + \sum_{s_{t+1} \in S} \pi_{s_{t+1}|s_t} H(b_{t+1}^h(s_{t+1}|s_t))$$

The government chooses an indicator $D_t = \{0, 1\}$, which represents a decision to default on outstanding debt.

A politician’s best deviation will involve defaulting on outstanding debt in addition to choosing maximal taxes and minimal public spending: $V = r^{\text{max}} - \min\{0, b(s_t|s_{t-1})\} - \chi_p$. 
The Planning Problem for an Efficient Sustainable Equilibrium: Default and Convenience Yield of Government Bonds

1 Planning Problem

\[ J(s, z) = n - g - \eta \frac{n^\gamma}{\gamma} + \theta(s) \frac{g^\alpha}{\alpha} + \sum_{k \in S} \pi_{ks} H(b_k) + \beta \sum_{k \in S} \pi_{ks} J(k, z_k) \]

subject to

\[ z = r(n) - g + \beta \sum_{k \in S} \pi_{ks} z_k \]

\[ z_k \geq b_k + r^{\max} - \chi^p \quad \text{and} \quad z_k \geq r^{\max} - \chi^p \]

\[ J(k, z_k) - z_k \geq \tilde{U}^{AUT} + \chi^c \]

2 \( J(s, z) \) represents the highest possible welfare to households, net of the stream of rents, that can be achieved conditional on the state \( s \) and on the value of debt net of rents being equal to \( z \).
A political economy theory of fiscal policy: Policy choices are made by a legislature that can raise revenues via an income tax and by borrowing. Revenues can be used to finance a public good, whose value is stochastic, and pork-barrel spending.

There are two regimes: The first one is a “business-as-usual” regime in which legislators bargain over pork, and the second one is a “responsible policymaking” regime in which policies maximize the collective good.

Shocks in the value of the public good can generate transitions between regimes.

It is shown that equilibrium tax rates are too high, public good provision is too low, and debt levels are too high in a political economy model of fiscal theory.
A continuum of infinitely lived citizens live in $n$ identical districts indexed by $i = 1, \cdots, m$. The size of the population in each district is normalized to one.

There is a single (non-storable) consumption good, denoted by $c$, that is produced using a single factor, labor, denoted by $n$, with the linear technology $c = wn$. There is also a public good, denoted by $g$, that can be produced from the consumption good according to the linear technology $g = c/p$.

Household’s preferences are represented by the following utility function:

$$c + Ag^\alpha - \frac{n^{1+1/\epsilon}}{1 + \epsilon}$$

where $\alpha \in (0, 1)$ and $\epsilon > 0$. 
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 in the bond market by selling and buying risk-free one-period bonds.

Revenues can not only be used to finance the provision of the public good, but can also be diverted to finance targeted district-specific transfers, which are interpreted as (non-distortionary) pork-barrel spending.

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 $r = 1/\beta - 1$. At this interest rate, citizens will be indifferent as to their allocation of consumption across time.
Household’s Utility Maximization and Indirect Utility Function

1. **Utility Maximization**

   \[ n^h = (\epsilon w (1 - \tau))^\epsilon \]

2. **Indirect Utility Function**

   \[ u(w(1 - \tau), g; A) = \frac{\epsilon^\epsilon (w(1 - \tau))^{\epsilon+1}}{1 + \epsilon} + Ag^\alpha \]

3. **Tax Revenue**

   \[ R(\tau) = m\tau w(\epsilon w(1 - \tau))^\epsilon \]

4. The net of transfer surplus (i.e., the difference between revenues and spending on public goods and debt repayment) is

   \[ B(\tau, g, b; b_{-1}) = R(\tau) - pg + b - (1 + r)b_{-1}. \]
Three Feasibility Constraints for Government Policies

1. Revenue Constraint: The first is that revenues must be sufficient to cover expenditures.

\[ B(\tau, g, b; b_{-1}) \geq \sum_{i=1}^{m} s_i \]

2. Non-Negative Constraint: The second constraint is that the district-specific transfers must be nonnegative (i.e., \( s_i \geq 0 \) for all \( i \)).

\[ s_i \geq 0 \]

3. Feasibility Constraint for Government Borrowing: There is an upper limit \( \bar{b} \) on the amount of bonds the government can sell. This is motivated by the unwillingness of borrowers to hold bonds that they know will not be repaid.

4. If the government were borrowing an amount \( b \) such that the interest payments exceeded the maximum possible tax revenues, i.e., \( rb \geq \max_{r} R(\tau) \), then it would be unable to repay the debt even if it provided no public goods or transfers.
1. The legislature is meeting at the beginning of a period in which the current level of public debt is $b_{-1}$ and the value of the public good is $A$. One of the legislators is randomly selected to make the first proposal, with each representative having an equal chance of being recognized.

2. A proposal is a policy $\tau, g, b, s_1, \ldots, s_m$ 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.

3. 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.

4. 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 default proposal should be feasible and involve a uniform district-specific transfer (i.e., $s_i = s_j$ for all $i$ and $j$).
The Planner’s Planning Problem

\[
\max_{\tau, g, b} u(w(1 - \tau), g; A) + \frac{B(\tau, g, b; b_{-1})}{m} + \beta E[v(b, A')]
\]

subject to the following two constraints:

\[
B(\tau, g, b; b_{-1}) \geq 0, \quad b \in [b \ b_{-1}]
\]

where \(u(w(1 - \tau), g; A)\) and \(B(\tau, g, b; b_{-1})\) are given by

\[
B(\tau, g, b; b_{-1}) = m\tau w(\epsilon w(1 - \tau))^\epsilon - pg + b - (1 + r)b_{-1}
\]

\[
u(w(1 - \tau), g; A) = \frac{\epsilon(\epsilon(w(1 - \tau))^{1+\epsilon}}{1+\epsilon} + Ag^\alpha
\]
The social planners solution converges to a steady state in which the debt level is $b$, the tax rate is 0, the public good level is $g_S(A)$, and citizens receive $rb - pg_S(A)$ in transfers.
A symmetric Markov perfect equilibrium in which any representative selected to propose at round $\tau \in [1, \ldots, T]$ of the meeting at some time $t$ makes the same proposal. That is, the policy proposal depends only on the current level of public debt $b_{-1}$ and the value of the public good $A$.

Focus on equilibria in which at each round $\tau$, proposals are immediately accepted by at least $q$ legislators, so that on the equilibrium path, no meeting lasts more than one proposal round. The policies that are actually implemented in equilibrium are those proposed in the first round.

Implementation of a Political Equilibrium: To get support for his proposal, the proposer must obtain the votes of $q - 1$ other representatives. Since utility is transferable, he is effectively making decisions to maximize the utility of $q$ legislators, as if a randomly chosen coalition of $q$ representatives is selected in each period. This coalition chooses a policy choice to maximize its aggregate utility.
Two Equilibrium Policy Regimes

1. **Responsible Policy-making Regime (RPM):** The proposer will propose a no-transfer policy package that maximizes aggregate legislator utility. This proposal will be supported by the entire legislature.

2. **Business-as-usual Regime (BAU):** The proposer chooses a policy package that provides pork for his own district and those of a minimum winning coalition of representatives. The transfer paid out to coalition members will be just sufficient to make them favor accepting the proposal. Thus, only those legislators whose districts receive pork vote for the proposal.
The Proposer’s Problem for a Coalition of $q$ Representatives

$$
\max_{\tau, g, b} u(w(1 - \tau), g; A) + \frac{B(\tau, g, b; b_{-1})}{q} + \beta E[v(b, A')], \quad b \in [b \ b]$$

where $u(w(1 - \tau), g; A)$ and $B(\tau, g, b; b_{-1})$ are given by

$$B(\tau, g, b; b_{-1}) = m\tau w(\epsilon w(1 - \tau))^{\epsilon} - pg + b - (1 + r)b_{-1}$$

$$u(w(1 - \tau), g; A) = \frac{\epsilon \epsilon (w(1 - \tau))^{1+\epsilon}}{1 + \epsilon} + Ag^{\alpha}$$
First-Order Conditions to the Proposer’s Problem

1. Tax Rate

\[ \frac{m}{q} = \frac{1 - \tau^*}{1 - \tau^*(1 + \epsilon)} \]

2. Level of Public Good

\[ \alpha A(g^*)^{\alpha-1} = \frac{p}{q} \]

3. Public Debt

\[ q^{-1} \geq -\beta E[v_x(b^*, A)] \quad (= \text{ if } b^* < b) \]
Definition of the Threshold Value of $A$: Let’s define $A^*(b_{-1}, b)$ to be the largest value of $A$ consistent with the triple $(\tau^*, g^*, b^*)$ satisfying the constraint that $B(\tau, g, b; b_{-1}) \geq 0$.

**BAU Regime:** If the state $(b_{-1}, A)$ is such that $A < A^*(b_{-1}, b)$, the proposer proposes the triple $(\tau^*, g^*, b^*)$ together with a transfer just sufficient to induce members of the coalition to accept the proposal, and the legislature is in the BAU regime.

**RPM Regime:** If $A \geq A^*(b_{-1}, b)$, then the constraint that $B(\tau, g, b; b_{-1}) \geq 0$ must bind and the solution equals that which maximizes aggregate legislator utility.
Political Distortions

1. In the long run, the level of debt held by the government is too high relative to the optimal level, tax rates are too high, and public good levels are too low. Moreover, tax rates are too volatile.

2. Since in both the planners solution and the equilibrium all citizens receive the same expected utility (modulo any differences in initial bond holdings), these distortions mean that the political equilibrium is Pareto dominated by the planners solution.

3. **Static Distortion:** The distortions in the tax rate and the public good level are static distortions in the sense that, within any period in which the constraints are binding, aggregate citizen welfare would be higher if the tax rate were reduced and the public good level increased.

4. **Dynamic Distortion:** The distortion in the debt level is a dynamic distortion in the sense that the future benefits to citizens from lower debt offset the costs of lower revenues in the present.