# Social Polarization, Fiscal Instability and Growth*

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Current Version: October 2001

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## Abstract

We analyze the theoretical linkage between social polarization and macroeconomic problems such as fiscal deficits and poor economic growth. We develop a dynamic model of fiscal policy in which the government public good provision is strategically controlled by policymakers with different preferences. We show that when different policymakers disagree on the desirable composition of government spending between two public goods, an endogenous fiscal deficit occurs. Moreover, the greater the degree of polarization, the larger the fiscal deficit. It is because the polarization of preference leads a policymaker to spend more for her favorite public good, collectively contributing to large deficits. This polarization effect implies that a shock to tax revenue is translated into a more than proportional change in spending. In a highly polarized society, the intertemporal fiscal path becomes more volatile. The polarization is harmful to the economy; it leads to a permanently lower level of output and slows growth along the transition path to a new steady state. Similarly, when policymakers are less patient (for example, due to uncertainty over the re-appointment), they also have a deficit bias.

JEL Classification: E6, H6, and H3.

Key Words: polarization, fiscal deficit, fiscal volatility, growth.

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*I am indebted to Gadi Barlevy, Jason Furman, Philip Lane, Jeffrey Sachs; and especially my advisors, Alberto Alesina, Dani Rodrik, and Aaron Tornell; and two anonymous referees for their insightful comments and discussions. I also thank participants in seminars at Harvard university, DePaul University, University of Illinois at Chicago, ZEI at University of Bonn, the OECD Development Center and the Far Eastern Meeting of the Econometric Society held in Hong Kong. This paper is based on a chapter of my PhD dissertation submitted to Harvard University. Financial support by the Korea Foundation for Advanced Studies is gratefully acknowledged. The views expressed herein are solely the responsibility of the author and do not necessarily reflect those of the OECD. Correspondence: jaejoon.woo@oecd.org

# 1 Introduction

In recent years, empirical studies on long-term growth have found that social conflicts that arise from ethnic divisions or struggles over the income distribution are detrimental to growth. (See Rodrik (1999), Easterly and Levine (1997), Alesina and Rodrik (1994) among others.) Countries with polarized societies, such as measured by ethnic division or income inequality, seem to be more prone to adopt growth-retarding policies – for example, unsustainable fiscal policies that lead to large budget deficits and high inflation. (See Figures 1A and 1B.) In such countries, different groups or sectors would find it much harder to derive a consensus on ideal government policies due to potential conflicts of interest among themselves, which may have caused policymakers to choose individually rational but collectively inefficient policies.[1]

Our paper explores the theoretical linkage between social polarization and macroeconomic problems such as fiscal instability (large deficits and fiscal volatilities) and poor economic growth. We develop a dynamic model of fiscal policy in a simple growth framework, and highlight the role of social polarization (more precisely, polarization of preference for types of government spending between socio-economic groups) in the evolution of fiscal instability and slow growth. In particular, we show that a more polarized country runs a bigger budget deficit and exhibits greater fluctuations in fiscal spending, consequently experiencing slow growth.[2] Thereby, we emphasize that society's polarization and degree of polarization are key factors underlying policy decisions that are responsible for such undesirable macroeconomic outcomes.

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[1] In a comprehensive study of public sector deficit, Easterly et al. (1994) conclude that large fiscal deficits are largely explained by conscious fiscal policy choices and not by external or by domestic macroeconomic shocks.

[2] We can shed some light on macroeconomic volatility (such as the volatility of fiscal outcomes and real GDP growth) that has been observed in much of Latin America and sub-Saharan Africa. See Gavin and Perotti (1997) and Hausmann and Gavin (1996) for more details about Latin America.

Here we consider an economy in which two heterogeneous policymakers jointly control fiscal policy, but have different objective functions. Each policymaker maximizes her own utility from her public good provision that benefits a specific group (or sector) more than the other. Each represents a different group that may have a different preference for the public goods. The two groups can be thought of as either capitalists or labor workers, manufacturing (formal) or traditional (informal) sectors, right-wing or left-wing parties, urban or rural sectors, or two powerful ethnic groups.

When different policymakers disagree on the desired composition of government spending between two public goods, an endogenous fiscal deficit occurs. The greater the polarization of preference for different public goods, the larger the fiscal deficit (polarization effect). This is due to strategic behaviors of these policymakers who have different preferences yet share the government budget. Each policymaker is aware that whatever government resources she does not exploit may or may not be available for the future provision of her preferred public good, depending on the spending decision of the other policymaker. When policymakers disagree on the composition of government spending, each of them has a greater incentive to overexploit the common government resources and consequently exerts a net negative externality on the other. This prevents them from achieving a socially optimal fiscal outcome. Similarly, when policymakers are less patient (for example, due to uncertainty over the re-appointment) and hence discount future events more heavily, they also have a deficit bias.

Importantly, the higher the degree of polarization (or the higher the policymakers' subjective discount rate), the more volatile the fiscal path. For any given level of tax revenue, a rise in the degree of polarization has two effects. (An increase in the discount rate of the policymakers has similar effects.) The first effect, which we call the *polarization effect*, is that the level of government spending rises, thereby raising the level of government debt. The second effect is that subsequent government spending falls more quickly because the increase in debt lowers the net tax revenues. Thus, greater polarization means larger fiscal deficits today and more drastic spending cuts tomorrow, resulting in bigger swings of its fiscal spending path. This polarization effect implies that a shock to tax revenue is translated into a more than proportional change in spending, and that the higher the polarization, the bigger the absolute size of the change in fiscal spending.

Output level and transition dynamics of economic growth depend crucially on the degree of polarization. When a fiscal deficit occurs due to polarization, this leads to inefficient capital accumulation in the private sector and permanently lowers output level in the economy. This is because policymakers waste valuable government resources to maximize their utility from producing public goods; hence, they overspend beyond the socially optimal level for a given tax revenue. In the presence of polarization, the economic growth rate is also reduced along the transition path to a new steady state of a lower level of output, compared to that in the absence of polarization.[3]

Motivated by recent episodes of rapid government debt accumulation in some industrial countries, a growing literature on fiscal politics has developed theories to explain how political and institutional factors determine fiscal outcomes (see, for example, Alesina and Perotti (1995) and Persson and Tabellini (1997) for a literature survey). Our paper belongs to this literature and particularly is related to the pork barrel or common pool problem approach. The related papers are Weingast et al. (1981), Chari and Cole (1993), Tornell and Lane (1998), Hallerberg and von Hagen

[3]Thus, our model can explain why some nations are rich and others are poor, while the differences in growth rates across countries can be explained by appealing to the transition dynamics. From the empirical point of view, this explanation that different growth rates among different countries can be viewed as transition process works reasonably well. For seminal empirical works, see Mankiw et al. (1992), Barro (1991), and Barro and Sala-i-Martin (1992) among others.

(1999), and Velasco (1999).[4] Under this approach, an excessive spending or deficit (i.e., an overexploitation of a common property) can arise because interest groups that have access to the government resource fail to internalize the full cost of their own appropriation. That is, each interest group enjoys the full benefit of a specific public spending, while it pays only a fraction $1/n$ of the cost (i.e. the cost spread through generalized taxation). These studies typically consider $n$-player symmetric games (in all different contexts), addressing issues such as whether an increase in the number of groups $n$ (i.e., decrease in power concentration) leads to a worse economic outcome or the possibility of delayed fiscal reforms or the effect of budgetary institutions on the size of deficits.[5] Our fiscal mechanism in this paper shares the underlying intuition of the common pool problem approach. However, our paper addresses a different issue: what are the critical conditions for the dynamic negative externality to be operative in a common pool context? We show that preference polarization and discount factor are such conditions and analyze their role in fiscal deficit dynamics and capital accumulation process.

We develop a general framework that introduces new dimensions of preference polarization and time preference in the class of common pool games. Not only would this help us to theoretically identify the critical conditions leading to overexploitation of the common resources, but also yield richer fiscal dynamics such as the interaction

[4]The common pool problem refers to a situation in which a productive asset is exploited jointly by economic agents whose noncooperative behavior results in an overexploitation of the asset that is not Pareto optimal. Levhari and Mirman (1980) first show the existence of Pareto inefficient Nash equilibrium in this context. See Fudenberg and Tirole (1992) for more details.

[5]The relationship between the number of groups $n$ and the common pool problem is addressed by Weingast et. (1981), Tornell and Lane (1998) and Velasco (1999); the possibility of delayed fiscal reforms by Velasco (1999); and the effect of budgetary institutions on the size of deficits by Hallerberg and von Hagen (1999). The theoretical relationship between the number of groups and the fiscal outcome turns out to depend on the assumptions about the shape of utility function. For example, Tornell and Lane (1998) show that the overexploitation is the most severe when the game is played by two players in contrast to the other studies.

between the two factors in determining fiscal outcomes. Moreover, we address both fiscal deficits and volatilities in a single framework, whereas the existing models of deficits do not deal with the volatility of fiscal outcomes. The innovation in our paper is that the size of budget deficit and the magnitude of fiscal volatility are explicitly shown to be positive functions of the degree of polarization and discount factor. This yields a completely new empirical prediction that highly polarized countries are more likely to suffer severe fiscal instabilities.[6]

Also, our general model helps to clarify a distinct mechanism in other fiscal deficit models such as Alesina and Tabellini (1990) and Persson and Svensson (1989). From a theoretical point of view, each model of fiscal deficit relies on some type of failure by policymakers to internalize the cost of accumulating additional debt. In Alesina and Tabellini (1990), for example, faced with the uncertainty over re-appointment, the incumbent government may fail to internalize the costs of additional debt and run a large deficit, for these costs are born by the succeeding government that might be controlled by the opposing party. In this type of model, the uncertainty of re-election is the critical condition for an endogenous deficit to arise. If the government is not faced with the re-election uncertainty, debt bias would not occur regardless of the opponent's preference. This point is well illustrated in our paper. Even when there is no disagreement between these policymakers, a deficit can occur if they are impatient enough to heavily discount future events, possibly due to re-election uncertainty.[7] That is, preference polarization and impatience are two separate forces that create a bias toward larger deficits.

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[6]In line with this prediction, I found that countries that have run greatest fiscal deficits are those with highly polarized economic societies as measured by indicators of income inequality in a panel of 57 countries over the period of 1970–90. See Woo (forthcoming).

[7]Of course, it should also be noted that we study a simultaneous dynamic game between two policymakers, whereas Alesina and Tabellini (1990) study a sequential game between two alternating parties.

Lastly, we provide a theoretical explanation for an important empirical finding in the recent literature of economic growth that social conflicts are harmful to economic growth. Our model predicts that a highly polarized society is more likely to adopt socially suboptimal policies – an inefficient public good provision and the accompanying fiscal instability – that retard economic growth.[8]

Our results have important policy implications. For example, decentralization in a polarized economy could threaten macroeconomic stability unless it is checked by the rules of the game, such as institutional constraints. This has been observed in some countries such as the Balkans, Indonesia, and Brazil in recent years. In the presence of social conflict, decentralizing power to local governments may only increase tension between central governments and regions, reducing the consensus for macroeconomic policies and making more likely the adoption of inefficient policies.

The plan of the paper is as follows. Section 2 presents a simple endogenous growth model with optimizing interest groups. Section 3 derives an endogenous government fiscal policy and establishes our main results on the negative linkage between social polarization and fiscal outcomes. The social planner's solution is also computed and compared with the non-cooperative feedback Nash equilibrium determined by two polarized policymakers. This is followed by an extension of the model into the case of policymakers facing tenure uncertainty. Section 4 analyzes the effect of this endogenous fiscal policy on the capital accumulation and growth in the presence of polarization. Our conclusions are in Section 5.

[8]This can be viewed as an alternative fiscal policy channel linked to economic growth, but distinct from the redistributive fiscal policy channel proposed by Alesina and Rodrik (1994) and Persson and Tabellini (1994). In their models, distributive conflicts within a society lead the government to engage in redistributive policies that may be harmful to economic growth. However, there seems to be a lack of empirical support. What matters for growth in their models is the distortion caused by income tax that accompanies redistributive spending. Perotti (1996) does not find any negative relationship between tax variables and growth. By contrast, we offer a fiscal channel that negatively links social polarization of preference to economic growth through fiscal deficits.

## 2 Endogenous Growth Model with Optimizing Interest Groups

We consider an endogenous growth model with no population growth. The economy is populated by a government and a private sector composed of two groups, indexed by $i$, $i = 1, 2$. These two groups may represent either capitalists or labor workers, manufacturing (formal) or traditional (informal) sectors, urban or rural sectors, two powerful vested interest (ethnic) groups, or right-wing or left-wing parties. Each group consists of a large number of atomistic individuals. The government and the private sector have perfect foresight. The infinitely-lived representative agent in group $i$ seeks to maximize her lifetime utility, which is additively separable:

$$J^i = \int_0^\infty [log(c_i) + \lambda_i log(g_1) + (1 - \lambda_i) log(g_2)] e^{-\rho t} dt, \tag{1}$$

where $c_i$ is private consumption; $g_1$ and $g_2$ are two different public goods provided by the government; and $\rho$ is a subjective discount rate, $\rho > 0$. Being small, each member of group $i$ takes $g_i$ as given and has the same preference for the two public goods within the group. But these two groups differ in their preferences for the public goods, which is reflected by $\lambda_i$. We assume that $0 < \lambda_i < 1$, for $i$=1, 2 and $\lambda_2 \leq \frac{1}{2} \leq \lambda_1$. This implies that group 1 prefers $g_1$ to $g_2$ and group 2 prefers $g_2$ to $g_1$. Even though the agent in group $i$ may not like the public good $g_j$, $j \neq i$ as much as $g_i$, it is included in her utility function because of non-exclusiveness of public goods. We also assume that she derives positive utility from the consumption of public good which is not her most favorite one.[9] We define $\theta = \lambda_1 - \lambda_2$ and interpret it as the degree of difference in their preferences for two public goods. We can think of $\theta$ as a degree of polarization between the two groups. We note that $0 \leq \theta \leq 1$. While $\theta = 1$

[9]For example, even though an agent may care about the public education expenditures much more than the national defense expenditures, she will also benefit from the national defense.

implies the complete disagreement on the composition of two public goods between two groups. $\theta = 0$ implies the total agreement in their preferences. We will see the important role played by $\theta$ in the evolution of fiscal deficit and hence the debt. Also, capital accumulation and output path depend crucially on $\theta$, as we will show later.

In the economy there are two kinds of real assets: capital, denoted by $k$, and government bonds, denoted by $b$. The bonds are assumed to be a perfect substitute for capital and therefore to pay the same rate of interest, $r$. The dynamic budget constraint of the representative agent in group $i$ is then for $\forall t > 0$ and $a_0 > 0$ given,

$$\dot{a}_{it} = ra_{it} - c_{it} - \tau_i, \tag{2}$$

where $a_{it}$ is the asset held by an agent and hence $a_{it} = k_{it} + b_{it}$, and $\tau_i$ is a lump-sum tax collected by the government from group $i$.[10] We also impose the No-Ponzi-Game (NPG) condition:

$$\lim_{t \to \infty} a_{it} e^{-rt} \geq 0. \tag{3}$$

As long as marginal utility is positive, the agent will not want to have increasing wealth forever at the rate of $r$, and that condition will hold as an equality. (See Barro and Sala-i-Martin (1995).) The representative agent in group $i$ maximizes the lifetime utility (1) with respect to $c_i$, subject to (2) and (3). It follows from the first-order conditions for this maximization problem that we get

$$\frac{\dot{c}_{it}}{c_{it}} = r - \rho. \tag{4}$$

Thus, the optimal consumption path of the agent $i$ is

$$c_{it} = c_{i0} e^{(r-\rho)t}. \tag{5}$$

[10] We assume $\tau_1 = \tau_2$. The assumption of lump-sum taxation is only for simplicity of algebra and can be relaxed without affecting the qualitative results in the paper. See Section 4. In what follows, we mean $\frac{dx}{dt}$ by $\dot{x}$.

where $c_{i0}$ remains to be determined. (See footnote [13] for the solution.)

The budget constraint for the whole private sector is

$$\dot{a}_t = ra_t - c_t - \tau, \ \forall t \geq 0, \tag{6}$$

where $a_t = a_{1t} + a_{2t}$, $k_t = k_{1t} + k_{2t}$, $b_t = b_{1t} + b_{2t}$, $c_t = c_{1t} + c_{2t}$, and $\tau = \tau_1 + \tau_2$, for all $t \geq 0$ (we normalize as if there is one agent in each group).

Now, following Barro (1990), we introduce firms that have the linear production function:

$$y = f(k) = Ak, \tag{7}$$

where $A > 0$ is the constant marginal product of capital. We can think of capital as encompassing human and nonhuman capital.[11]

In a competitive equilibrium, the marginal product of capital is equal to the rental price for a unit of capital services. This is the first-order condition for maximization of profit. Therefore, in competitive equilibrium

$$A = r + \delta, \tag{8}$$

where $\delta$ is a constant depreciation rate and $r + \delta$ is the rental price for a unit of capital services. Thus, consumption at time $t$ is given by[12]

$$c_{it} = c_{i0} e^{(A-\delta-\rho)t}. \tag{9}$$

From the dynamic budget constraint (6) and the profit maximization condition (8), we get the following (We suppress the time index, $t$, when there is no confusion.):

[11] Also see Barro and Sala-i-Martin (1995).

[12] If the marginal productivity of capital is sufficiently large so that $A - \delta - \rho > 0$, then consumption grows over time. However, this does not yield unbounded utility because for given $g_1$ and $g_2$,

$$J^i = \int_0^\infty [log(c_{i0}) + (A - \delta - \rho)t + \lambda_i log(g_1) + (1 - \lambda_i) log(g_2)] e^{-\rho t} dt < \infty.$$

$$\dot{k} = (A - \delta)k - c - g_1 - g_2. \tag{10}$$

Thus, the equilibrium for the private sector is completely described by (9), (10), and (3), given government debt, $b$, and the government budget constraint.

Suppose that the government budget is balanced at each point in time. Then $\dot{b} = 0$ and $b_t = b_0$, $\forall t \geq 0$. Under the balanced budget assumption, the equilibrium capital stock $k_t$ is given by[13]

$$k_t = \frac{\tau - rb_0}{r} + \frac{2c_0}{\rho} e^{(r-\rho)t}. \tag{11}$$

The capital accumulation equation specified in (11) will be useful in computing the impact of polarization on capital stock in Section 4 on growth. It is straightforward to see that the asymptotic growth rate of capital $(\dot{k}/k)$ is $A - \delta - \rho$. In fact, the growth rates of consumption, capital stock, and output all asymptotically approach

[13] Using (10) and NPG condition (3), we get $k_t$. Under the assumption of a balanced budget, (10) is

$$\dot{k} - rk = rb_0 - \tau - 2c_0 e^{(r-\rho)t}.$$

To solve this first-order differential equation, multiply both sides of the equation by the integration factor, $e^{-rt}$, and integrate it from $t$ to $\infty$. We then have

$$\int_t^\infty e^{-rt}(\dot{k} - rk)dt = \int_t^\infty e^{-rt}(rb_0 - \tau - 2c_0 e^{(r-\rho)t})dt.$$

By applying the NPG condition $\lim_{t\to\infty} k_t e^{-rt} = 0$ to the integration, we can derive (11).

Since $y = Ak$, we easily find the output path by using (10). That is, $\dot{y} = A\dot{k}$.

The initial level of consumption, $c_0$, is determined by the following condition. From (11),

$$k_0 = \frac{\tau - rb_0}{r} + \frac{2c_0}{\rho},$$

and $c_0$ is thus determined by the initial level of capital stock, lump-sum tax, and initial bond holding.

$A - \delta - \rho$.[11] In other words,

$$\lim_{t\to\infty} \frac{\dot{k}}{k} = \lim_{t\to\infty} \frac{\dot{c}}{c} = \lim_{t\to\infty} \frac{\dot{g}}{g} = r - \rho = A - \delta - \rho. \tag{12}$$

For now, we assume that the agents' subjective discount rate is equal to the interest rate, i.e., $\rho = r$, so that capital stock and output stay constant under a balanced budget ($\dot{b} = 0$). Also, note that consumption is constant at $c_0$ if $\rho = r$. This assumption is only made to serve as a benchmark and to highlight the main points of the paper. Later, we will discuss the consequences of relaxing this assumption (see Sections 3.3 and 4).

Before we move to government fiscal policy, we make an additional assumption on the timing structure. Policymakers are assumed to simultaneously move before the private sector moves; therefore, when the private sector makes a decision, it has information about government fiscal policy that was determined by policymakers and takes the government policy as given.

# 3 Endogenous Fiscal Deficit and Volatility: Polarization

In the previous section, we took the government budget as given and assumed a balanced budget, $\dot{b} = 0$. Now we consider the endogenous fiscal policy controlled by two policymakers (interchangeably called ministers) who jointly represent the Fiscal Authority (FA) of the government. We assume that the government can transform the consumption goods produced by the private sector into two non-storable public goods, $g_1$ and $g_2$. Two ministers indexed by $i$, $i = 1, 2$, represent the corresponding

[11] Note that in the standard AK growth model, there is no transitional dynamics; $c_t$, $k_t$, and $g_t$ grow at the constant rate of $A - \delta - \rho$. However, in our paper where we introduce tax and the government bond, the growth rates of $k_t$ and $g_t$ are not constant at $A - \delta - \rho$, but only asymptotically approach that rate. This can be checked in (11) and (12).

group, $i = 1, 2$, in the private sector. Minister $i$ provides the public good $g_i$ to the private sector, which is financed by government revenues. Each minister, $i$, derives greater utility from the provision of her favorite public good $g_i$ than from the other $g_j$. Since they have different preferences for the two public goods and seek to maximize their own utility, two ministers faced by the common government budget constraint behave strategically in determining the amount of public goods they provide.

To describe this endogenous fiscal policy determination process, we consider a differential game between two ministers. Specifically, we explore the set of *feedback Nash equilibria*, *subgame perfect* and *time consistent*, in a game-theoretic model in which two ministers can jointly exploit the government net revenues to maximize their utility from providing their favorite public goods.[15]

Each minister, $i$, has the following objective function:

$$V^i = \int_0^\infty [\lambda_i log(g_{1t}) + (1 - \lambda_i) log(g_{2t})] e^{-rt} dt, \tag{13}$$

where $0 \leq \lambda_2 \leq \frac{1}{2} \leq \lambda_1 \leq 1$ and the minister's discount rate is assumed to be equal to the interest rate.[16] Minister $i$ prefers $g_i$ to $g_j$, $j \neq i$ and $i, j = 1, 2$, which implies that she puts more weight on her favorite public good, $g_i$, in her utility function. Minister $i$ shares the same weight $\lambda_i$ with her favorite group, so that $\theta = \lambda_1 - \lambda_2$ is also the degree of preference polarization between the two ministers.

Now we turn to the budget constraint of the government which faces the ministers. The government collects the lump-sum taxation of $\tau$ from the private sector (with normalization of the number of agents in each group to one). Government

[15] It is well known that the subgame perfect equilibrium is time consistent. For more about the feedback Nash Equilibrium and time-inconsistency problem, see Cohen and Michel (1988).

[16] Each minister's utility is assumed not to depend on her consumption, which might bias the policies towards an oversupply of public goods. Yet the assumption that the discount factor is equal to the interest rate delivers a constant consumption path as one can see from (5). Without loss of generality, we can normalize the constant consumption to 1. Then $log(c) = 0$ justifies the specification of the utility form.

expenditures can also be financed by issuing bonds at a constant real rate of $r$. The government budget constraint at each instant is then

$$\dot{b} = rb + g_1 + g_2 - \tau, \tag{14}$$

where $b$ is the stock of national debt.[17]

## 3.1 Non-cooperative Feedback Nash Equilibrium

Each minister $i$ chooses her control variable, $g_i$, so as to maximize her utility (13) subject to the government budget constraint (14) and NPG condition for every possible choice of the other minister's control variable $g_j$, $j \neq i$. Here we employ the feedback Nash equilibrium concept, which allows players to revise their actions through time as the game evolves.[18]

To facilitate the computation of equilibrium in this game, we define government net revenue, $R_t$, as

$$R_t = \tau - rb_t. \tag{15}$$

In general, the feedback strategy is a function of time and state; however, very few differential games can be solved in closed form because the first-order condition for this feedback Nash equilibrium involves a system of partial differential equations. In order to get a closed-form solution, we restrict the strategy set to linear Markov strategies that depend on the current state. We then conduct transformation of the

[17]Note that the No-Ponzi-Game condition relevant for the government budget constraint is $\lim_{t \to \infty} b_t e^{-rt} = 0$.

[18]In differential games, open-loop and feedback Nash equilibria are among the most commonly employed equilibrium concepts. Open-loop strategies are ones for which each player chooses all the values of his control variable for each point in time at the outset of the game. This is relatively easy to solve for, but in general is time inconsistent. On the other hand, feedback strategy consists of a contingency plan that indicates what the best thing to do is for each value of the state variable at each point in time. That is, it allows the player to revise her action at each instant on the basis of the state at that point in time. Hence, the feedback strategy has the property of being subgame perfect.

variables so that we can construct a game structure in which an open-loop strategy calls for the same rate of public good provision at every point in time as that of the feedback strategy. This is known as "synthesizing the feedback control."[19] (See Fudenberg and Tirole (1992).) Let us now consider the following linear strategies:

$$g_{it} = \chi_i R_t, \tag{16}$$

where $\chi_i$ will be endogenously determined as a part of the solution. We assume that the set of strategies is $\chi_i \subset [0, \infty)$. Let $v_t = log R_t$. Then, we can rewrite the minister's objective function (13) as

$$V^i(\chi_1, \chi_2) = \int_0^\infty [\lambda_i log(\chi_1) + (1 - \lambda_i) log(\chi_2) + v_t] e^{-rt} dt, \tag{17}$$

and the budget constraint becomes

$$\dot{v}_t = r - r\chi_1 - r\chi_2. \tag{18}$$

Now we solve for the feedback Nash equilibrium, which is also the Markov perfect equilibrium, by maximizing the objective function of minister $i$, (17), with respect to $\chi_i$ subject to (18). Minister $i$'s Hamiltonian is given by

$$H^i(\chi_1, \chi_2, v_t) = [\lambda_i log(\chi_1) + (1 - \lambda_i) log(\chi_2) + v_t] e^{-rt} + \mu_{it}[r - r\chi_1 - r\chi_2], \tag{19}$$

where $\chi_i$ is the control variable, $\mu_{it}$ the costate variable, and $v_t$ the state variable.

The feedback Nash equilibrium to this game is as follows (See Appendix A for the derivation of the following feedback Nash equilibrium.):

$$\chi_1^* = \lambda_1, \ \chi_2^* = (1 - \lambda_2), g_{1t}^* = \lambda_1 R_t, \ g_{2t}^* = (1 - \lambda_2) R_t. \tag{20}$$

[19] In the differential game literature, it is very common to consider the linear strategies due to the aforementioned technical complications. See Fudenberg and Tirole (1992) for more.

Substituting $g_i^* = \lambda_i^* R_t$ and $R_t = \tau - rb_t$ into (14) yields

$$\dot{b}_t = (\lambda_1 - \lambda_2)(\tau - rb) = \theta(\tau - rb) \geq 0. \tag{21}$$

Recall that the parameter $\theta \in [0, 1]$ is the degree of the polarization between two ministers. Whenever there are differences in the ministers' preferences for two public goods (i.e., $\theta > 0$), there occurs an endogenous fiscal deficit, $\dot{b} > 0$.[20] This result is due to the strategic behaviors of these ministers who have different preferences, but share the government budget. Each minister is aware that whatever government resources she does not exploit may or may not be available for future provision of her preferred public good, depending on the spending decision of the other minister.[21] Thus, when they disagree on the ideal composition of government spending, each has an incentive to overexploit the common resource today. The polarization of preference leads each policymaker to insist on a higher spending for her favorite sector and to exert (net) negative externality on the other, contributing to bigger overall spending and a larger deficit than the social optimum. Whenever two ministers value public goods with different weights, the negative externality of minister $j$'s one-unit provision of $g_j$ on minister $i$'s utility through the state variable $b$ always dominates the positive effect that directly enters minister $i$'s utility function.

Moreover, the incentive for each minister to overexploit the government revenues increases with the amount of disagreement between the two ministers. This is because the positive effect of minister $j$'s one-unit provision of $g_j$ that directly enters minister $i$'s utility function gets smaller, whereas its negative externality operating through

[20] However, the growth of debt is not explosive. If we solve the differential equation (21) for $b_t$, assuming $b_0 = 0$ for simplicity, we obtain $b_t = \frac{\tau}{r} - \frac{\tau}{r}e^{-\theta r t}$. Thus, the No-Ponzi-Game condition is satisfied: $\lim_{t \to \infty} b_t e^{-rt} = (\frac{\tau}{r} - \frac{\tau}{r}e^{-\theta r t})e^{-rt} = 0$. As $t \to \infty$, $b$ approaches $\frac{\tau}{r}$.

[21] It is not the level of tax that causes a deficit in our model. This holds true for any given level of tax revenue. If we introduce a distortionary tax rather than lump-sum tax, we still get the same results. For more detailed discussion on this issue, see Section 4.

the state variable $b$ gets bigger. From the point of view of minister $i$, therefore, one unit of resource devoted to her opponent's favorite type of spending brings a greater net negative externality, inducing her to spend even more for her favorite item ahead of her opponent. This implies that the size of the *current* budget deficit is a positive function of the degree of polarization (see Figure 2A).

Along with this result, the intertemporal budget constraint implies that polarization is positively associated with greater changes in fiscal outcomes, such as spending and fiscal balance over the time periods for a given path of tax revenue. The greater the polarization is, the larger the fiscal spending and current fiscal deficit are (*polarization effect*). But this only raises the debt level more quickly and reduces available government resources, which forces policymakers to cut tomorrow's spending by more.[22] The intertemporal budget constraint means that larger deficits today must be met by larger surpluses tomorrow, causing an even bigger swing of fiscal policy over time (see Figure 2A again).

Importantly, an economy with a higher degree of polarization will exhibit greater fluctuations in fiscal spending in response to shocks to the government revenues. We can illustrate this point by using the solution for $g_1^*$ and $g_2^*$. Using (20), we can write the total government spending ($\tilde{g}$) at time $t$ as

$$\tilde{g}_t = g_{1t}^* + g_{2t}^* = (1+\theta)(\tau - rb_t). \tag{22}$$

[22] It should be noted that our model is not related to the Ricardian equivalence experiment. The Ricardian equivalence proposition implies that the timing of taxes does not matter as long as the present value of taxes is equal to the present value of government spending plus the value of the initial government debt. This is because the government spending path is exogenously given, whereas taxes are endogenous. In sharp contrast, government spending is endogenous, while taxes are exogenous in our model. Therefore, government debt acts like net wealth for the private sector. Recall that the level of initial consumption depends on the initial levels of capital stock and government bond holdings, and the lump-sum tax (see Footnote 13). In the Ricardian world, higher bond holdings just mean a higher present value of future taxes, which makes government bonds irrelevant for consumption. In our model, however, higher initial bond holdings reduce the present value of future government spending.

For any point in time $t$, government spending is proportional to the net tax revenue $\tau - rb$. Since the policymaker revises her action at each instant on the basis of the state at that point in time, it should be $\tau - rb_{t+}$. Thus, if we take the total differentiation on this equation at an instant $t+$, then

$$\frac{d\tilde{g}_{t+}}{d\tau} = (1+\theta) \geq 1 \text{ with equality when } \theta = 0. \tag{23}$$

This yields a striking prediction that government spending rises more than proportionally in response to an increase in tax revenue if the degree of polarization is positive ($\theta > 0$). Whenever there is a positive (negative) shock to the government net revenue, it is translated into a more than proportional increase (decrease) in government spending in the presence of polarization.[23] The absolute size of the change in $\tilde{g}$ will be even greater with the size of $\theta$. The intuition behind this result is quite similar to that behind the polarization effect. Recall that the equilibrium Markov strategy in (20) calls for minister 1's spending being equal to the multiproduct of $\lambda_1$ (or $(1-\lambda_2)$ for minister 2) and net tax revenue $R$. For a given shock to tax revenue $\triangle$, minister 1 will claim $\lambda_1 \times \triangle$, while minister 2 will want to increase her favorite spending by $(1-\lambda_1) \times \triangle$. Unless $\lambda_1 = \lambda_2 = 1/2$, it will result in a more than proportional increase in total spending ($\triangle\tilde{g} = (1+\theta) \times \triangle$). In the case of complete agreement ($\lambda_1 = \lambda_2 = 1/2$), the increase in tax revenue will be evenly split between two types of spending so that a balanced budget is maintained.

This relation between polarization and government spending volatility is clearly shown in a diagram when we allow $R_t$ (either $T$ or $r$) to follow a stochastic process (see

[23] Tornell and Lane (1999) obtain an analogous result called "voracity effect" in a different context where interest groups have access to the economy capital stock. The underlying mechanism for both polarization effect and voracity effect is the negative dynamic externality that operates in common pool games. The innovation in our paper is that this effect itself is a positive function of the degree of polarization. Indeed, the voracity effect would disappear in the absence of polarization.

Figure 2B).[24] As one can see from Figure 2B, even for the same size of exogenous shock to the revenue $R_t$, government spending ($\bar{g}_t$) is much more volatile in an economy with greater polarization.

We can relate this result to the procyclicality of fiscal outcomes predominantly observed in Latin American countries, which is documented by Gavin and Perotti (1997) and Hausmann and Gavin (1996). For example, during a boom (recession), the fiscal spending rises (falls) more than tax revenue does, causing a deficit (surplus) over this period. This procyclicality can be explained in our framework. Suppose that the tax revenue is no longer a lump-sum tax but an income tax, $T = tY$, where $t$ is a fixed tax rate and $Y$ is a total output of the economy. If $Y$ and $T$ rise during a boom in a country with high polarization, total spending $\bar{g}$ rises more than proportionally, yielding a procyclical pattern of fiscal spending.[25]

## 3.2 Fiscal Policy with a Social Planner

In this section, we establish that a balanced budget is the social optimum. A social planner's objective is to maximize both ministers' welfare with respect to $g_1$ and $g_2$, subject to the government budget constraint (14). As in subsection 3.1, we confine the strategies, $g_i$, to linear Markov strategies. Then the social planner's problem is to maximize the following objective function $W(\chi_1, \chi_2)$ with respect to $\chi_1$ and $\chi_2$.

[24] Figure 2B was drawn under the assumption of a uniform distribution for a random variable, $r \in [0.035, 0.1]$. If $T$ is a random variable instead, we still get qualitatively the same result.

[25] Similarly, countries that enjoyed the euphoria of resource booms in the past often ran fiscal deficits and current account deficits, contrary to the prediction of the neoclassical theory that a (temporary) resource boom should lead to a current account surplus due to consumption smoothing. Tornell and Lane (1998) show how windfall gains can result in a deterioration of the current account balance. On the other hand, Talvi and Vegh (1996) argue that procyclical fiscal policy can be optimal if there is greater political pressure for higher government spending with rising output levels.

subject to (18):[26]

$$W(\chi_1, \chi_2) = \int_0^\infty [(\lambda_1 + \lambda_2) log(\chi_1) + (2 - \lambda_1 - \lambda_2) log(\chi_2) - 2c\gamma^2] e^{-rt} dt, \qquad (24)$$

where it is assumed that the social planner's discount rate equals the interest rate $r$. The social planner's solution to this optimization problem can be computed in a way similar to each minister's maximization problem. Appendix B shows that the solutions are

$$\chi_1^* = \frac{\lambda_1 + \lambda_2}{2}, \chi_2^* = \frac{2 - \lambda_1 - \lambda_2}{2}. \qquad (25)$$

It is clear that the ministers' feedback Nash equilibrium is not socially optimal when compared to the above solution, (25). It is only when two ministers have the same preferences, that is, $\lambda_1 = \lambda_2$, that the feedback Nash equilibrium is socially optimal. Since $\lambda_2 \leq \frac{1}{2} \leq \lambda_1$, it is straightforward to see that $\chi_1^* \geq \chi_1$ and $\chi_2^* > \chi_2$. That is, for a given size of revenue $R$, the social planner's optimal spending level is always lower than the non-cooperative feedback Nash solution, except when $\lambda_1 = \lambda_2 = \frac{1}{2}$ (i.e., no polarization, $\theta = 0$).

Also, the social planner's solution requires that the government budget balance all times. This can be easily checked. Since the first-best allocation of public goods is $g_1^* = \frac{\lambda_1 + \lambda_2}{2} R$ and $g_2^* = \frac{2 - \lambda_1 - \lambda_2}{2} R$, $g_1^* + g_2^* = R$ and $\dot{b} = 0$, $\forall t > 0$; therefore, each public good is produced depending on preferences, $\lambda_i$, such that the total expenditure on public good provision is the same as the government net revenue. The smaller the polarization between two ministers, the closer to social optimum the decentralized solution. Finally, if they have the same preferences for public goods, their decentralized solution is socially optimal. It is also important to note that the first-best solution is not that each policymaker simply splits the net tax revenue half (i.e., $\chi_i^* \neq \frac{1}{2}$ unless

[26] The social planner's objective function is obtained by adding these two ministers' utility functions.

$\lambda_1 = \lambda_2 = \frac{1}{2}$). Rather, it depends on how policymakers value one type of public good relative to the other.

### 3.3 Policymakers Faced with Uncertainty of Tenure

So far, we have assumed that policymakers' subjective discount rate is equal to the interest rate. We weaken this assumption on policymakers' time preference and discuss how this affects our previous results. As will be shown below, the qualitative results and their positive implications remain the same. Yet it introduces a separate channel that works toward generating fiscal deficits, making the fiscal dynamics even richer. In this section, we show that preference polarization and impatience (as reflected in a greater subjective discount rate) are two separate forces that create a bias toward larger deficits.

Moreover, this allows us to give a new interpretation to the existing studies on fiscal politics such as Alesina and Tabellini (1990) and Persson and Svesson (1989). From a theoretical point of view, each model of fiscal deficit relies on some type of failure by policymakers to internalize the cost of accumulating additional debt. In Alesina and Tabellini (1990), for example, the incumbent government, faced with the uncertainty over re-appointment, may fail to internalize the costs of additional debt and hence run a large deficit, for these costs are born by the succeeding government that might be controlled by the opposing party. In this type of model, the uncertainty of re-election is the critical condition for an endogenous deficit to arise. If the government is not faced with the re-election uncertainty, debt bias would not occur regardless of the opponent's preference. This point is well-illustrated in our paper. Even in the absence of preference polarization between the policymakers ($\theta = 0$), a deficit can still occur if they are impatient enough to heavily discount future events, possibly due to re-election uncertainty.

To see this, we allow the possibility of $\rho \neq r$, and specifically introduce the uncertainty of tenure that faces the policymakers. Let us suppose that they face a constant probability of being removed from the office per unit time, $p > 0$. This uncertainty of tenure effectively increases ministers' time preference rate. We can interpret the subjective discount rate $\rho$ as the sum of real interest rate $r$ and the probability of being removed from the office $p$. We may then write the objective function of minister $i$, (13), as

$$V^i = \int_0^\infty [\lambda_i log(g_{1t}) + (1 - \lambda_i) log(g_{2t})] e^{-\rho t} dt, \text{ where } \rho = r + p. \qquad (13')$$

Minister $i$'s feedback Nash equilibrium level of public good provision becomes

$$\chi_1^* = \lambda_1 \frac{\rho}{r}, \ \chi_2^* = (1 - \lambda_2) \frac{\rho}{r}; g_{1t}^* = \frac{\lambda_1 \rho}{r} R_t, \ g_{2t}^* = \frac{(1 - \lambda_2)\rho}{r} R_t. \qquad (26)$$

Thus, the government budget flow equation is

$$\dot{b}_t = (\lambda_1 - \lambda_2 + 1 - \frac{r}{\rho}) \frac{\rho}{r} (\tau - rb) = (\theta + 1 - \frac{r}{\rho}) \frac{\rho}{r} (\tau - rb) \geq 0, \text{ if } \rho > \frac{r}{1 + \theta}. \qquad (27)$$

For a moment, suppose that there is no polarization between two ministers ($\theta = 0$), but that there is a constant probability of being removed from the office ($p > 0$). It is clear from equation (27) that if the ministers are impatient enough ($\rho > r$), an endogenous fiscal deficit can occur even in the absence of polarization between them ($\theta = 0$). The more impatient the ministers, the bigger the size of deficit today. The uncertainty of tenure as reflected in a greater subjective discount rate means that the effective horizon of ministers is shortened.[27] With a shortened expected tenure in office, the ministers fail to fully take account of the costs of additional debt, and hence would have greater incentives to spend more today. As their horizon shortens, the

[27] With the constant probability assumption (say, exponential distribution), it can be shown that the expected time until removal from office is $\frac{1}{p}$, which can be thought of the effective time horizon of policymakers. As the probability increases, it shortens the horizon. On the other hand, as the probability $p$ goes to zero, the horizon becomes infinite.

deficit bias grows even larger. This result reaches the similar point made in different models of fiscal deficits such as Alesina and Tabellini (1990), but in a much simpler way — that is, without the consideration of election between alternating governments.

It is worthwhile emphasizing that *polarization* and *uncertainty of tenure* are two separate forces working toward generating fiscal deficits. For a given level of time preference $\rho$, the deficit is larger when $\theta = 1$ relative to when $\theta = 0$. It is also clear that the size of deficit is bigger when the policymakers are more impatient as measured by *time preference $\rho$ for any given degree of polarization $\theta$*. Figures 3A and 3B illustrate this point. Figure 3A shows the time path of primary surplus in the absence of polarization ($\theta = 0$), whereas Figure 3B displays it in the presence of polarization ($\theta = 1$). Thus, the fact that the government budget is a common property that policymakers can jointly exploit does not automatically causes a fiscal deficit. Fiscal deficit cannot occur without either preference polarization or impatience. In other words, they are the critical conditions for the dynamic negative externality to be operative in a common pool context.

Similarly, the uncertainty of tenure contributes further to volatility of fiscal outcomes at times of shocks to revenue. For a given shock to revenue $\Delta\tau$ at an instant $t-$, the change in spending is now $\Delta\tilde{g}_{t+} = (1-\theta)\rho\Delta\tau/r$, whose size will be more than proportional to the shock if either $\rho > r$ or $\theta > 0$ (and $\rho/r$ is not small enough to make $(1-\theta)\rho/r$ less than 1!) or both. Note that if $\rho = r$, $\Delta\tilde{g}_{t+}/\Delta\tau$ is back to (23). That is, the uncertainty of tenure only reinforces the polarization effect on the fiscal instability and vice versa.

The social planner's solution still requires the budget to be balanced as long as the social planner's discount rate equals the interest rate $r$. Only when there is no polarization nor the difference between the ministers' subjective discount rate and the interest rate does the ministers' non-cooperative feedback Nash equilibrium coincide with that of the social planner. If we compute the social planner's solution, assuming that the social planner's discount rate is $\rho$ (which may or may not be equal to $r$), then we obtain

$$\chi_1^* = \frac{(\lambda_1 + \lambda_2)\rho}{2r}, \text{ and } \chi_2^* = \frac{(2 - \lambda_1 - \lambda_2)\rho}{2r}. \tag{28}$$

And the fiscal debt accumulation equation under the social planner's solution becomes

$$\dot{b}_t = (1 - \frac{r}{\rho})\frac{\rho}{r}(\tau - rb) \geq 0, \text{ if } \rho \geq r, \tag{29}$$

with the equality if $\rho = r$. We can easily check that if the social planner's time preference rate is equal to the real interest rate $r$, a balanced budget remains the socially optimal fiscal outcome.

# 4 Endogenous Fiscal Deficit and Growth

We return to the capital accumulation and growth in the decentralized economy with optimizing private sector and endogenous fiscal policy jointly but non-cooperatively determined by two ministers. We are mainly interested in how polarization is linked to the capital accumulation and growth process through fiscal deficit.

First, if there is no preference polarization between ministers nor tenure uncertainty, the government budget would be balanced. We will then have the same equilibrium condition and capital accumulation path for the economy as we saw in Section 2. Second, when there is polarization of preference on the composition of the public goods between ministers, a fiscal deficit arises endogenously. We show below that debt accumulation has negative effects on the capital accumulation of the private sector. This, in turn, affects output level and transition dynamics of economic growth. Indeed, the capital stock and output at each point in time will be permanently lower if a fiscal deficit occurs due to polarization. In the presence of polarization, economic growth rate is also reduced along the transition path to the new steady state with a lower level of output, compared to that in the absence of polarization.

We characterize the capital accumulation and output in the presence of polarization without imposing a constraint on the discount factor $\rho$ (i.e., allowing the case of $\rho \neq r$). For expositional purpose, we mostly discuss the role of polarization under the assumption of $\rho = r$. However, it would be straightforward to extend our discussion into a more general case such as $\rho \neq r$. If we substitute the solution $g_1^*$ and $g_2^*$ into (10) and solve the first-order differential equation for $k_t^{FD}$, imposing the NPG condition, we obtain

$$k_t^{FD} = \frac{(\tau - rb_0)}{r}e^{-\theta rt} + \frac{2c_0}{\rho}e^{(r-\rho)t} = \frac{(\tau - rb_0)}{r}e^{-\theta rt} + \frac{2c_0}{\rho}, \tag{30}$$

where the superscript FD stands for fiscal deficit and $\rho = r$ is assumed as a benchmark. We observe that capital stock is negatively associated with the degree of polarization and the greater the degree of polarization $\theta$, the smaller the capital stock $k_t$. The capital stock will be even smaller if policymakers discount the future heavily ($\rho > r$). Also, higher polarization implies a lower level of output $y$. It is because greater amount of disagreement leads to larger debt accumulation. This, in turn, reduces the share of output used for capital formation in the economy where there are only two assets: capital and government bonds. In other words, the fiscal authority controlled by two ministers wastes resources and overspends on each minister's favorite public good provision above its socially efficient level. This causes inefficient capital accumulation and permanently lowers output level.

We can directly show that when the government runs a fiscal deficit, the capital stock is lower than under the balanced budget. A little algebra shows that

$$k_t^{BB} - k_t^{FD} = \frac{(\tau - rb_0)}{r}(1 - e^{-\theta rt}) > 0, \tag{31}$$

with equality if $\theta = 0$ (i.e., ministers have the identical preference), where the superscript $BB$ stands for a balanced budget and $k^{BB}$ is the level of capital stock under a balanced budget (see (11)). In the presence of polarization, $k_t^{BB} > k_t^{FD}$. The higher the degree of polarization is, the larger the current gap between $k_t^{BB}$ and $k_t^{FP}$ is (see Figure 1). As $t \to +\infty$, $k_t^{BB} - k_t^{FP}$ approaches $\frac{\bar{\tau} - rb_0}{r}$. Thus, in a polarized society, both the capital stock and output will be permanently lower while the gap between $k_t^{BB}$ and $k_t^{FP}$ rises with the degree of polarization.[28] It is straightforward to see that the above result still holds even when policymakers are impatient so as to discount the future more heavily (i.e., $\rho > r$). Thus, these results clearly demonstrate that an analysis that assumes a benevolent government might be misleading. For example, the self-interest government is not efficient nor maximizing the growth rate for the economy as a whole in contrast to Barro (1990).[29]

We can gauge the size of the impact of an increase in polarization on social welfare in terms of consumption, using (11) and (30).[30] Note that an increase in polarization from $\theta = 0$ to $\theta = 1$ is associated with a permanent reduction in $k$ at the steady state by the amount of $\frac{(\bar{\tau} - rb_0)}{r}$. On the other hand, the consumption is given by $c_t = \rho \cdot (k_t - \frac{\bar{\tau} - rb_0}{r})$ from (11). A one unit decrease in capital stock $\triangle k$ amounts to a reduction in consumption by $\rho \triangle k$. Therefore, the consumption level at the steady state is permanently reduced by the amount of $\frac{\rho(\bar{\tau} - rb_0)}{r}$ when the degree of polarization rises from zero to one.

Transition dynamics of growth depends on the degree of polarization. When there is polarization ($\theta > 0$), the growth rate of capital stock is also lower than that in the absence of polarization ($\theta = 0$) for all finite periods of time. Respectively, the growth

[28] As for output, $y_t^{BB} - y_t^{FP} = \frac{A\bar{\tau}}{r}(1 - e^{-\theta r t}) \geq 0$, for $\forall t \geq 0$.

[29] For a Cobb-Douglas production technology, the maximization of representative consumer's utility corresponds to the maximization of the growth rate, which corresponds to the efficiency condition for the size of the government. Therefore, the benevolent government would achieve the Pareto-optimal outcome. Barro (1990) shows that the self-interest government that is run by an agent who has no electoral constraint and seeks to maximizes his own utility still chooses the same efficient outcome for a Cobb-Douglas production. However, this result does not hold in general.

[30] I thank an anonymous referee for suggesting this exercise.

rates when $\theta = 0$ and $\theta > 0$ are given by

$$(\frac{\dot{k}}{k})|_{\theta=0} = \frac{(r-\rho)}{\frac{\tau g}{r c_0} e^{-(r-\rho)t} + 1} = 0 \tag{32}$$

and

$$(\frac{\dot{k}}{k})^{FD}|_{\theta>0} = \frac{-\frac{\theta \tau g}{c_0} e^{-((\theta+1)r-\rho)t} + (r-\rho)}{\frac{\tau g}{r c_0} e^{-((\theta+1)r-\rho)t} + 1} = \frac{-\frac{\theta \tau g}{c_0} e^{-\theta r t}}{\frac{\tau g}{r c_0} e^{-\theta r t} + 1} < 0, \tag{33}$$

where the last term in each equation above is obtained under the assumption of $\rho = r$. It is clear from (32) and (33) that $(\dot{k}/k)_{\theta=0} > (\dot{k}/k)_{\theta>0}$, for all finite time $t$, regardless of whether $\rho = r$ or not. Over time, the growth rate of capital stock in the presence of polarization ($\theta > 0$) converges to the rate of growth under a balanced budget, $r - \rho$, whereas the level of $k$ itself is permanently lowered. That is, the asymptotic accumulation rate of capital is $r - \rho$: $\lim_{t\to\infty}(\frac{\dot{k}}{k})^{FD} = r - \rho$ (see Figure 5).

Interestingly, however, the relationship between growth rate and degree of polarization for the economies with polarization ($\theta > 0$) is not monotonic. A more polarized economy would experience a more dramatic change in its economic growth rate for a given period of time. For example, an economy with high degree of polarization $\theta$ would have a lower rate of growth initially as it runs a larger deficit. However, this same economy would grow more rapidly later as its fiscal balance improves compared to an economy with low degree of polarization $\theta$ (again Figure 5). This simply reflects the fiscal deficit dynamics in relation to polarization as illustrated in Section 3.1.

So far we have maintained the assumption that taxation is a lump-sum tax. Although this assumption helps to keep the model simple, it is not required to obtain our main results. In relation to a balanced growth path, one undesirable feature of the lump-sum tax assumption may be the fact that the tax revenue as a share of output asymptotically approaches zero in a growing economy (i.e., when $r > \rho$). To see how one can extend the model to the non-lump-sum tax case, we can consider a distortionary capital income tax $T = tr(k - b)$, where $0 < t < 1$ is the tax rate. As is shown in Appendix C, the effects of polarization on fiscal outcomes and transition dynamics of economic growth remain qualitatively the same. On the other hand, consumption $c$, capital stock $k$, output $y$, and government debt $b$ now grow at the steady-state growth rate of $r(1 - t) - \rho$ along the balanced growth path.

# 5 Concluding Remarks

We have examined the role of social polarization among different groups in the evolution of fiscal policy and its negative effects on the capital stock and output in a simple endogenous growth framework. If there is a polarization between ministers, an endogenous fiscal deficit occurs. The economic intuition behind this result is simple. In the presence of disagreement between ministers, each minister has a greater incentive to overexploit the government revenue in order to maximize her utility or equivalently the welfare of a specific group or sector she may represent. The higher the degree of polarization, the larger the deficit. More important, in a more polarized economy, the fiscal path exhibits greater fluctuations over time. This polarization leads to a permanently lower level of output and to slower growth along a transition path to a new steady state. On the other hand, when there is no polarization (and policymakers are patient enough), the fiscal budget is always balanced, which is shown to be the first-best solution. Interestingly, there are rich interactions between polarization and policymakers' time preference in determining the fiscal outcomes.

The results reported above can contribute to explaining why different countries with similar economic conditions can have different fiscal policies. Our model suggests that the fiscal volatility can be attributed to the polarization within the government or between different groups in a society. Thus, we provide a theoretical framework that is consistent with recent empirical studies on fiscal instability and poor growth. In short, social polarization, say, due to ethnic conflict or distributional struggle, may lie in depth behind many macroeconomic problems.

Yet the potential interactions between social polarization and institutional arrangements remain to be explored further.[31] For example, the decentralization that many countries have recently undergone may produce different results depending the underlying social polarization and institutional factors. In a highly polarized country, decentralizing power to local governments may only increase tension among central governments, regions and different groups, and could threaten macroeconomic stability if it is not checked by proper institutional restraints.

# 6 Appendix

A. Derivation of the decentralized feedback Nash equilibrium.

Minister 1's Hamiltonian is

$$H^1(\chi_1, \chi_2, v_1) = [\lambda_1 log\chi_1 - (1-\lambda_1) log\chi_2 + v_1]e^{-rt} + \mu_1[r - r\chi_1 - r\chi_2]. \quad (A1)$$

The first-order conditions are

$$H^1_{\chi_1} = \frac{\lambda_1}{\chi_1}e^{-rt} - \mu_1 r = 0,\ H^1_{v_1} = e^{-rt} = -\dot{\mu}_1,\ \lim_{t\to\infty}\mu(t) = 0\ (TVC). \quad (A2)$$

Using the transversality condition (TVC), we solve the first-order differential equation and we can get

$$\mu(t) = \frac{e^{-rt}}{r}. \quad (A3)$$

[31] Woo (forthcoming) presents an econometric evidence on the important role of institutions in mitigating the negative effects from social polarization. The effects on public sector deficits of the socio-polarization tend to be smaller in countries with better (budgetary) institutional arrangements. Conversely, the socio-polarization has very strong effects on deficits in the presence of poor institutions.

Thus, the solution is $\chi_1^* = \lambda_1$.

Similarly, we can solve the optimization problem of minister 2, getting $\chi_2^* = (1 - \lambda_2)$. Note that the first-order condition for the control variable, $\chi_i$, and the solution of $\mu(t)$ do not contain the state variable $c$. This makes the open-loop and feedback strategies coincide.

B. Derivation of the solution of social planner

By using a social planner's objective function and the government budget constraint, we set up the following Hamiltonian function:

$$H(\chi_1, \chi_2, c_t) = [(\lambda_1 + \lambda_2)log\chi_1 + (2 - \lambda_1 - \lambda_2)log\chi_2 + 2c_t]e^{-rt} + \mu_t[r - r\chi_1 - r\chi_2]. \quad \text{(B1)}$$

The first-order conditions are

$$H_{\chi_1} = \frac{\lambda_1 + \lambda_2}{\chi_1}e^{-rt} - \mu r = 0, \; H_{\chi_2} = \frac{2 - \lambda_1 - \lambda_2}{\chi_2}e^{-rt} - \mu r = 0, \quad \text{(B2)}$$
$$H_c = 2e^{-rt} = -\dot{\mu}, \text{ and } \lim_{t \to \infty} \mu(t) = 0 \; (TVC).$$

Using the transversality condition (TVC), the first order differential equation is solved to get

$$\mu(t) = \frac{2e^{-rt}}{r}. \quad \text{(B3)}$$

Thus, the solution is

$$\chi_1^* = \frac{\lambda_1 + \lambda_2}{2}, \; \chi_2^* = \frac{2 - \lambda_1 - \lambda_2}{2}. \quad \text{(B4)}$$

C. Derivation of the long-run balanced growth path under capital income taxation

Consider a capital income taxation $T = tra = tr(k + b)$. First, the optimal consumption path is now given by

$$c_t = c_0 e^{(r(1-t)-\rho)t} \quad \text{(C1)}$$

from the standard utility maximization of an individual agent. The only difference here is that the capital income taxation alters the individual agent's budget constraint (equation (2)).

Second, from the resource constraint of the economy (equation (6)), the tax revenue is then

$$T = \frac{2rtc_0}{\rho} e^{(r(1-t)-\rho)t}. \tag{C2}$$

Third, the optimization program for each minister is similar to that under a lump-sum taxation, except for the tax being now a capital income tax that is given by C2. Applying the same procedure as described in appendix A, we can show that the flow budget constraint under the feedback Nash equilibrium spending path is given by

$$\dot{b} = (\varphi(1-\theta) - 1)(T - rb), \tag{C3}$$

where $\varphi = 1 + \frac{2tc_0(r(1-t)-\rho)}{\rho} \cdot \frac{1}{\left[\frac{2tc_0}{\rho} - b_0\right]}$, and it is assumed that $2trc_0 > \rho b_0$ so that $\varphi > 1$. This assumption turns out to have a reasonable interpretation. Note that $T_0 = 2rtc_0/\rho$ from equation C2. The condition $2trc_0 > \rho b_0$ simply requires the initial tax revenue $T_0$ to be large enough to cover the initial government debt $b_0$. Also, this turns out to be a sufficient condition for the existence of the positive initial capital stock as will be shown below. It is clear from C3 that with the capital income taxation we can still obtain qualitatively the same result: the higher the degree of polarization $\theta$, the larger the fiscal deficit. On the other hand, the government debt is

$$b(t) = \left[b_0 - \frac{2tc_0}{\rho}\frac{1}{r(1-t)-\rho}\right] e^{(\varphi(1-\theta)-1)rt} + \frac{2tc_0}{\rho}\frac{1}{r(1-t)-\rho} e^{(r(1-t)-\rho)t}. \tag{C4}$$

Now we turn to capital stock accumulation equation. From the fact that $T = rt(b+k)$ and C2, we note that $k(t) + b(t) = \frac{2c_0}{\rho} e^{(r(1-t)-\rho)t}$. Thus, the capital stock is given by

$$k(t) = \frac{2c_0(r(1-t)-\rho-t)}{\rho(r(1-t)-\rho)} e^{(r(1-t)-\rho)t} - \left[b_0 - \frac{2tc_0}{\rho}\frac{1}{r(1-t)-\rho}\right] e^{(\varphi(1-\theta)-1)rt}. \tag{C5}$$

Under the assumption of $2tc_0 > \rho b_0$ in C3, $k(0) = \frac{(2c_0 - \rho b_0)}{\rho} > 0$. Also, the capital stock is lower when $\theta > 0$, relative to that when $\theta = 0$.

$$k(t)_{\theta=0} - k(t)_{\theta=\theta} = -\left[b_0 - \frac{2tG_0}{\rho}\frac{1}{r(1-t)-\rho}\right] e^{(r(1-t)-\rho)t}\left(1 - e^{-\rho\theta t}\right) > 0, \text{ for } \forall t \geq 0. \tag{C6}$$

where $-\left[b_0 - \frac{2tG_0}{\rho}\frac{1}{r(1-t)-\rho}\right] > 0$ because it is assumed that $2tG_0 > \rho b_0$. Using the above results, we can easily show that

$$\lim_{t\to\infty}\frac{\dot{k}}{k} = \lim_{t\to\infty}\frac{\dot{b}}{b} = \lim_{t\to\infty}\frac{\dot{c}}{c} = \lim_{t\to\infty}\frac{\dot{T}}{T} = r(1-t)-\rho. \tag{C7}$$

Therefore, capital stock, output, consumption, government debt, and tax revenue are growing at the rate of $r(1-t)-\rho$ at the steady state along a balanced growth path.

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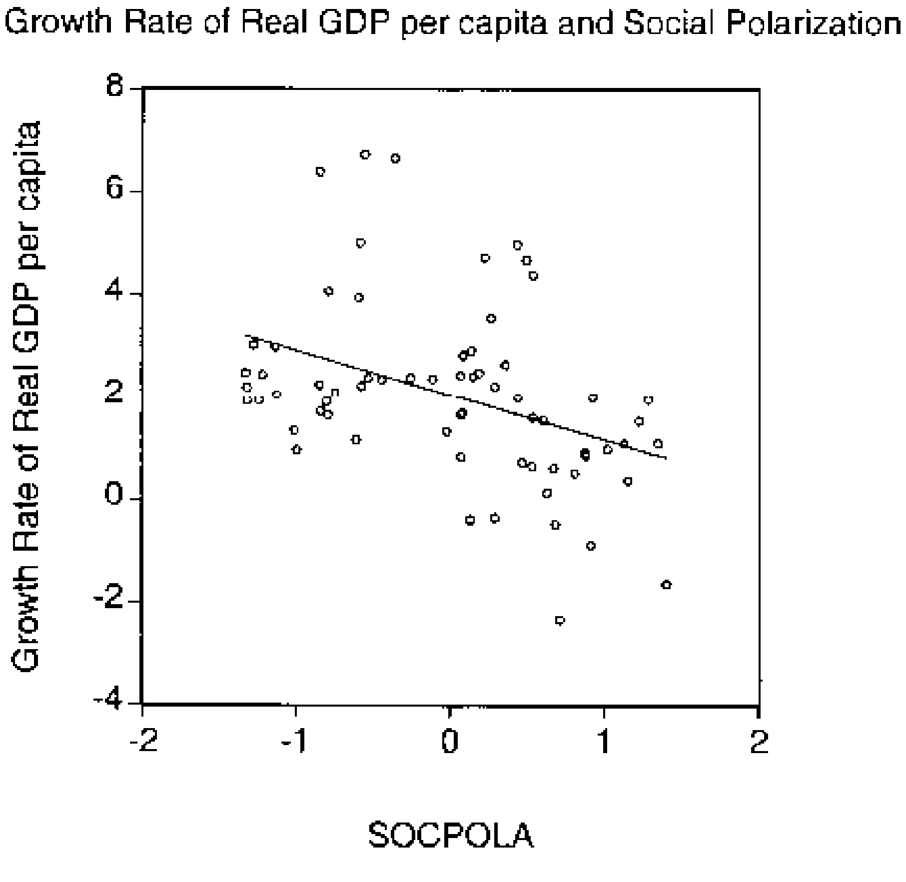
FIGURE 1A

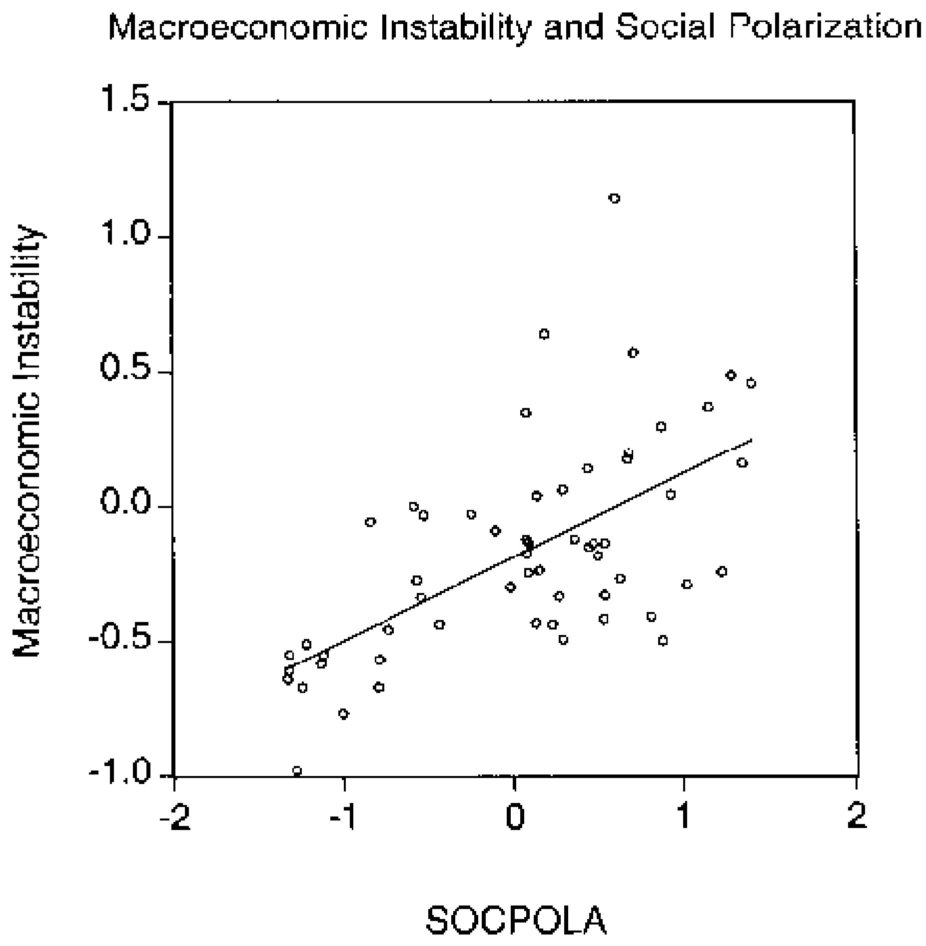



**Growth Rate versus Social Polarization**

The scatter plot above depicts average growth rate of real per capita GDP for the period 1970-98 against a composite index of social polarization (SOCPOLA) based on Gini coefficients, ethno-linguistic fractionalization, and institutional quality circa 1970. Higher values of SOCPOLA indicate higher social polarization.

*Data Source*: World Developments Indicator 2000, Deininger and Squire (1996), and Easterly and Levine (1997).

FIGURE 1B

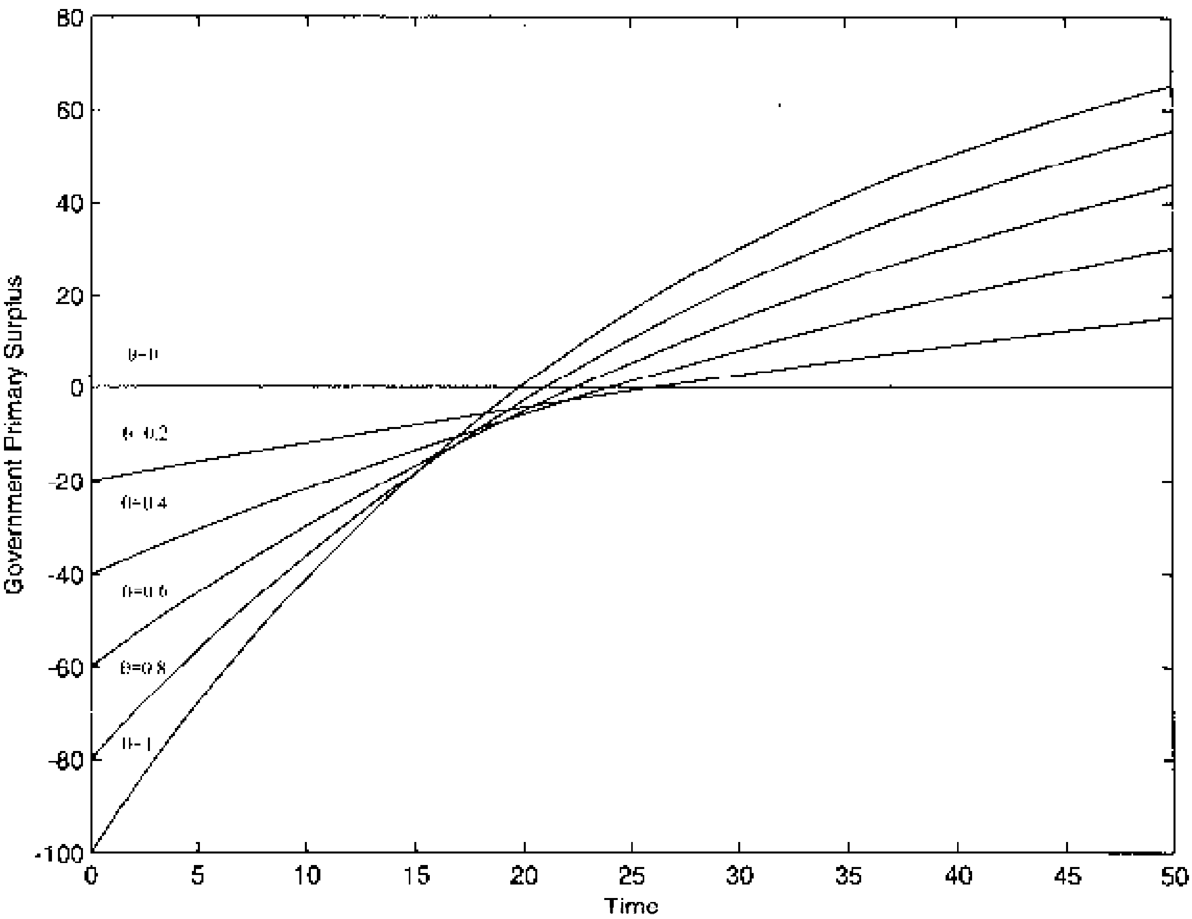



**Macroeconomic Instability versus Social Polarization**

This scatter plot depicts a measure of macroeconomic instability over the period 1970–98 versus the social polarization index (SOCPOLA). The index of macroeconomic instability is based on CPI inflation rates, central government deficits, and volatility of real GDP growth (measured by standard deviation), whose higher values indicate greater macroeconomic instabilities.

*Data Source*: the same as in Figure 1A.

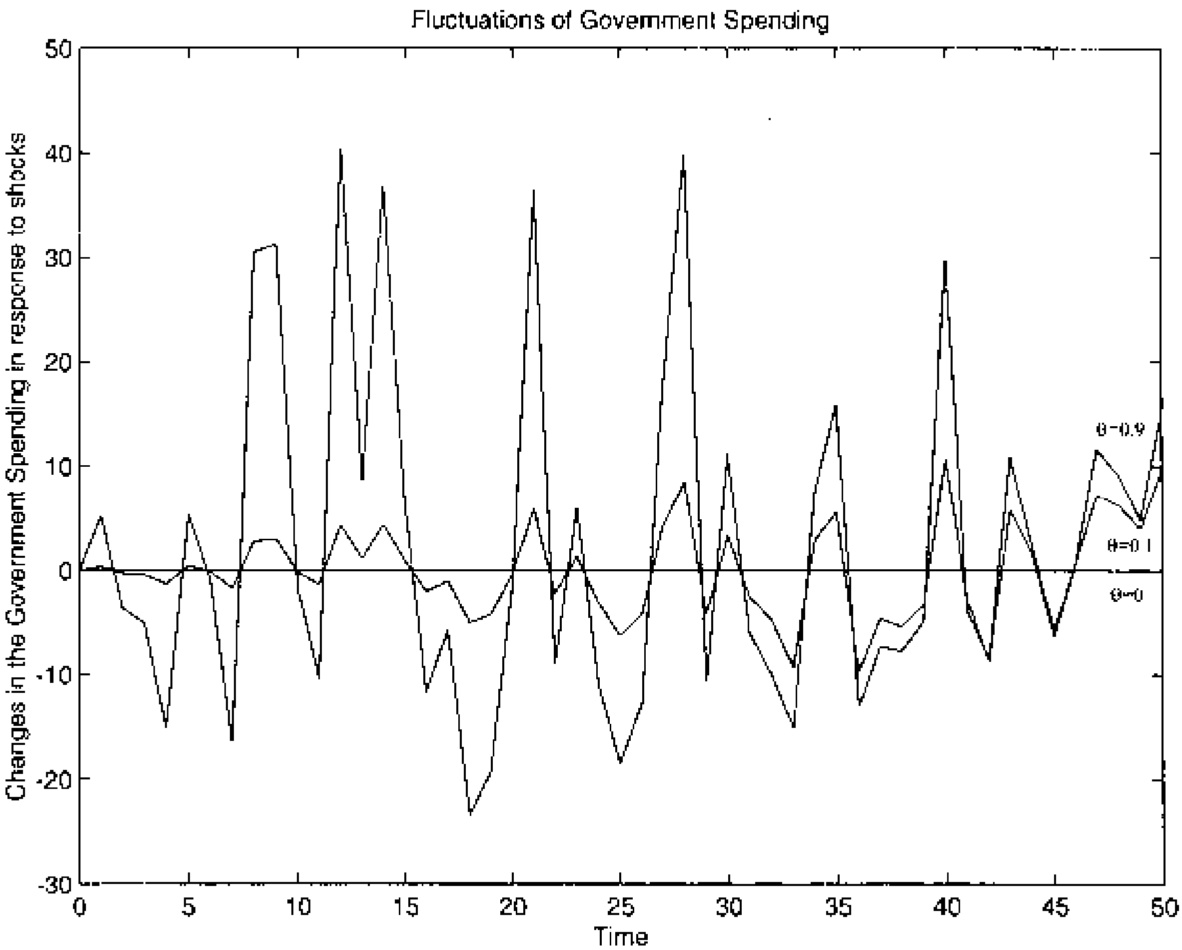
FIGURE 2A




**Government Primary Surplus versus Polarization**

Primary surplus is given by $\tau - \tilde{g}(t:\theta,\rho) = \tau - (1+\theta)(\tau - rb_0)e^{-\theta r t}$. Figure 2A displays time paths of primary surplus for various degrees of polarization $\theta$, where it is assumed that $\tau$=100, $b_0$=0, and $r$=3.5%.

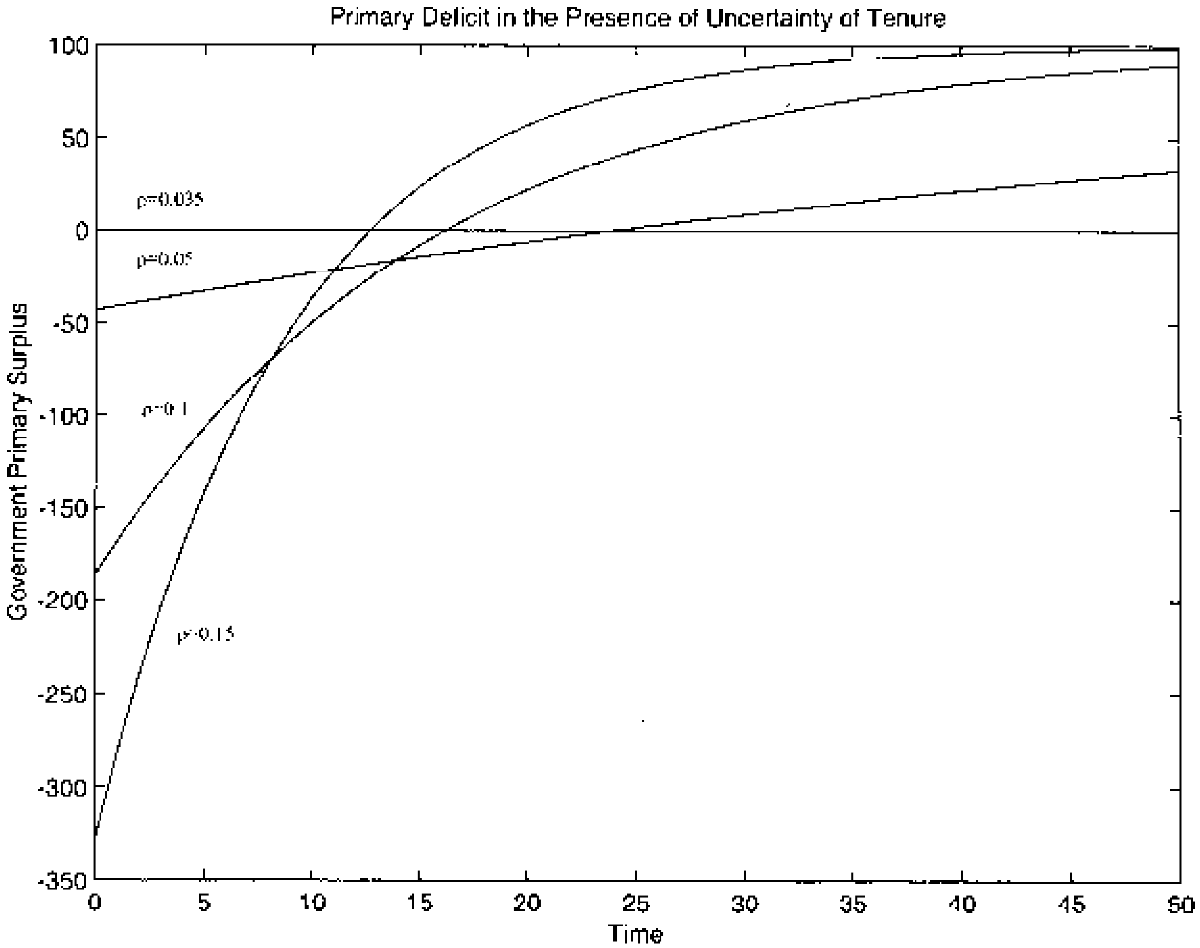
FIGURE 2B




**Government Spending Fluctuations versus Polarization**

Figure 2B shows fluctuations in government spending in response to shocks to net tax revenue for different degrees of polarization $\theta$, where the government spending is given by $\tilde{g}(t:\theta)=(1+\theta)(\tau-rb_0)e^{-\theta t}$. We have used $\tau$=100, $b_0$=0, and $r$ is assumed to be a random variable following a uniform distribution on $r\in[0.035, 1]$.

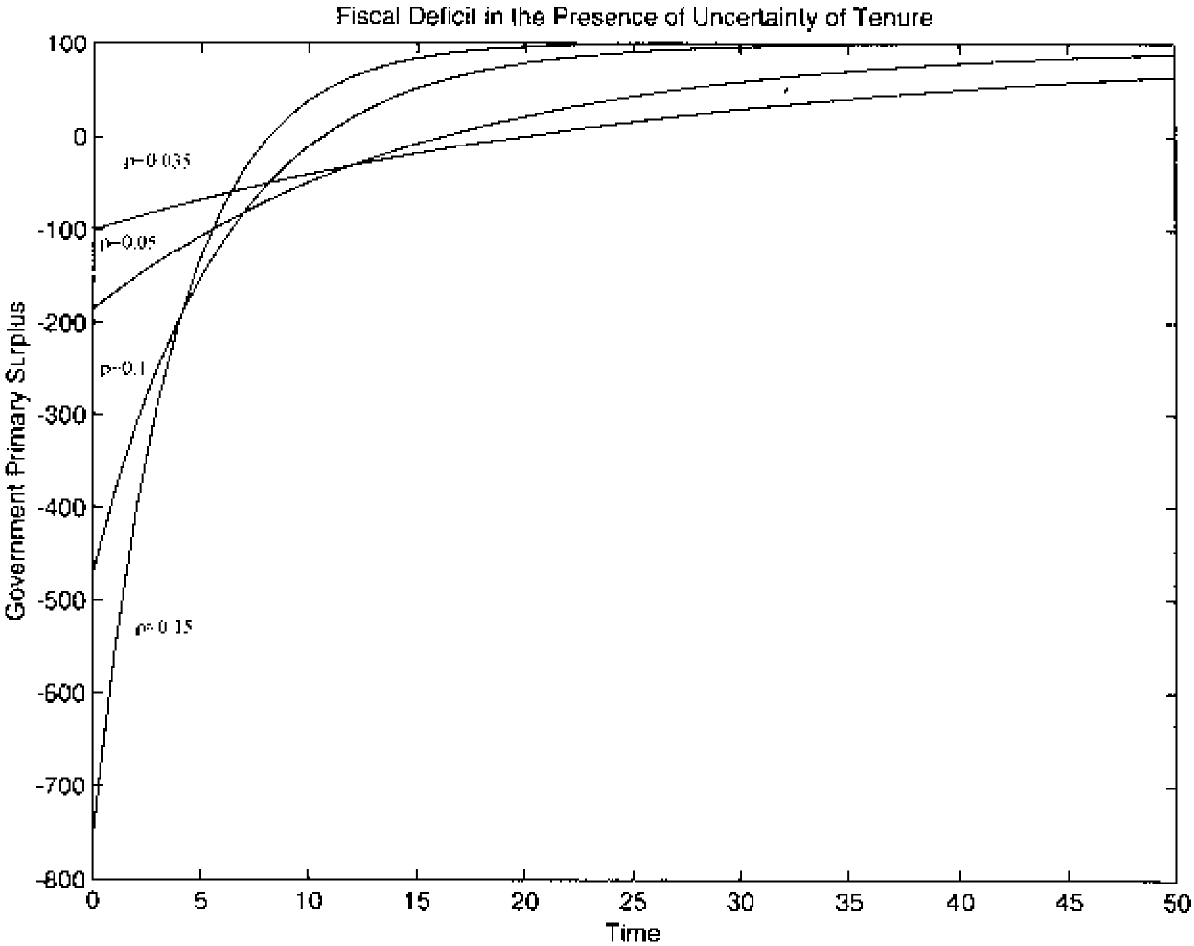
FIGURE 3A




**Government Primary Surplus versus Uncertainty of Tenure**

Primary surplus is given by $\tau - \tilde{g}(t:\theta,\rho) = \tau - \frac{(1+\theta)\rho}{r}(\tau - rb_0)e^{-(1+\theta-\frac{r}{\rho})\rho t}$. Figure 3A displays time paths of primary surplus *in the absence of polarization* ($\theta$=0) for different values of time preference $\rho$, where it is assumed that $\tau$=100, $b_0$=0, and $r$=3.5%.

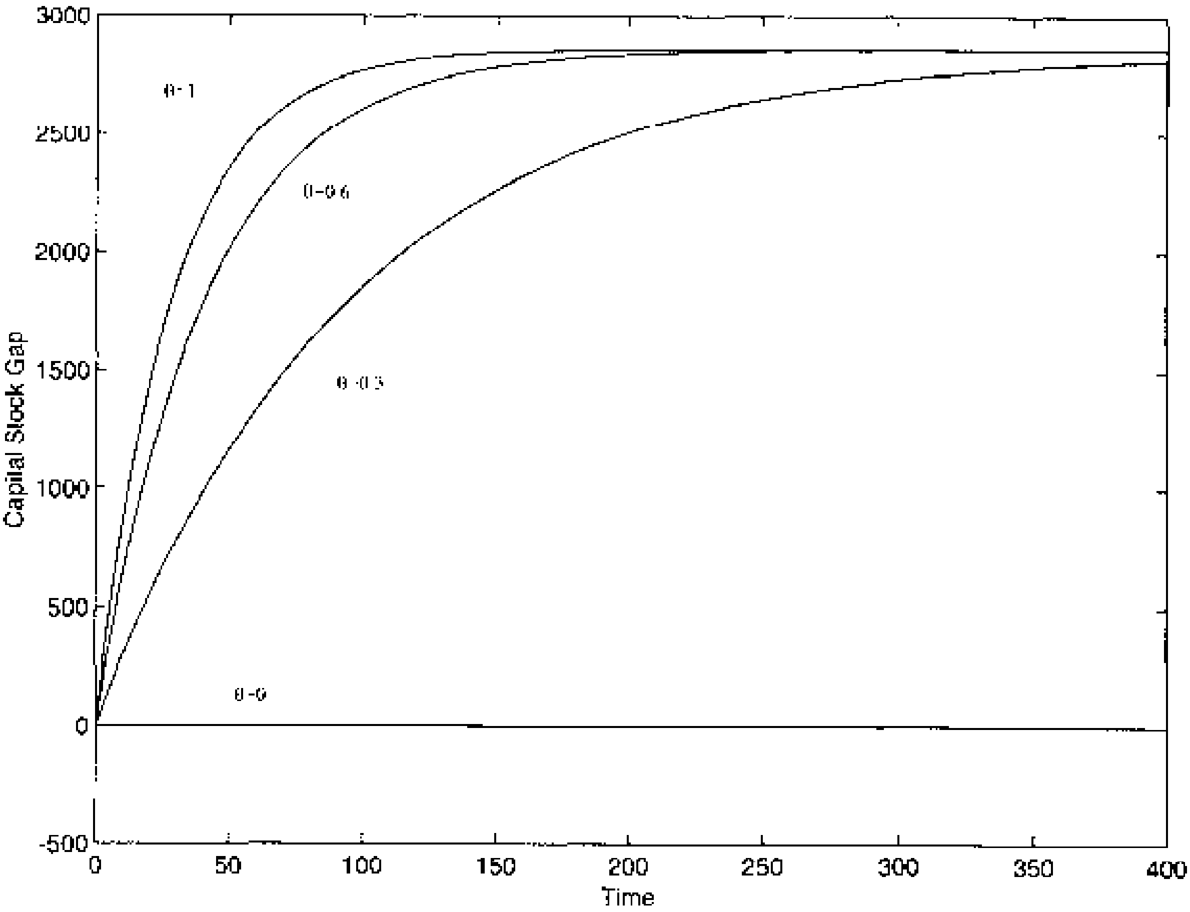
FIGURE 3B




**Government Primary Surplus versus Uncertainty of Tenure**

Primary surplus is given by $\tau - \tilde{g}(t:\theta,\rho) = \tau - \frac{(1+\theta)\rho}{r}(\tau - rb_0)e^{-(1+\theta-\frac{r}{\rho})\rho t}$. Figure 3B displays time paths of primary surplus *in the presence of polarization* ($\theta$=1) for different values of time preference $\rho$, where it is assumed that $\tau$=100, $b_0$=0, and $r$=3.5%.

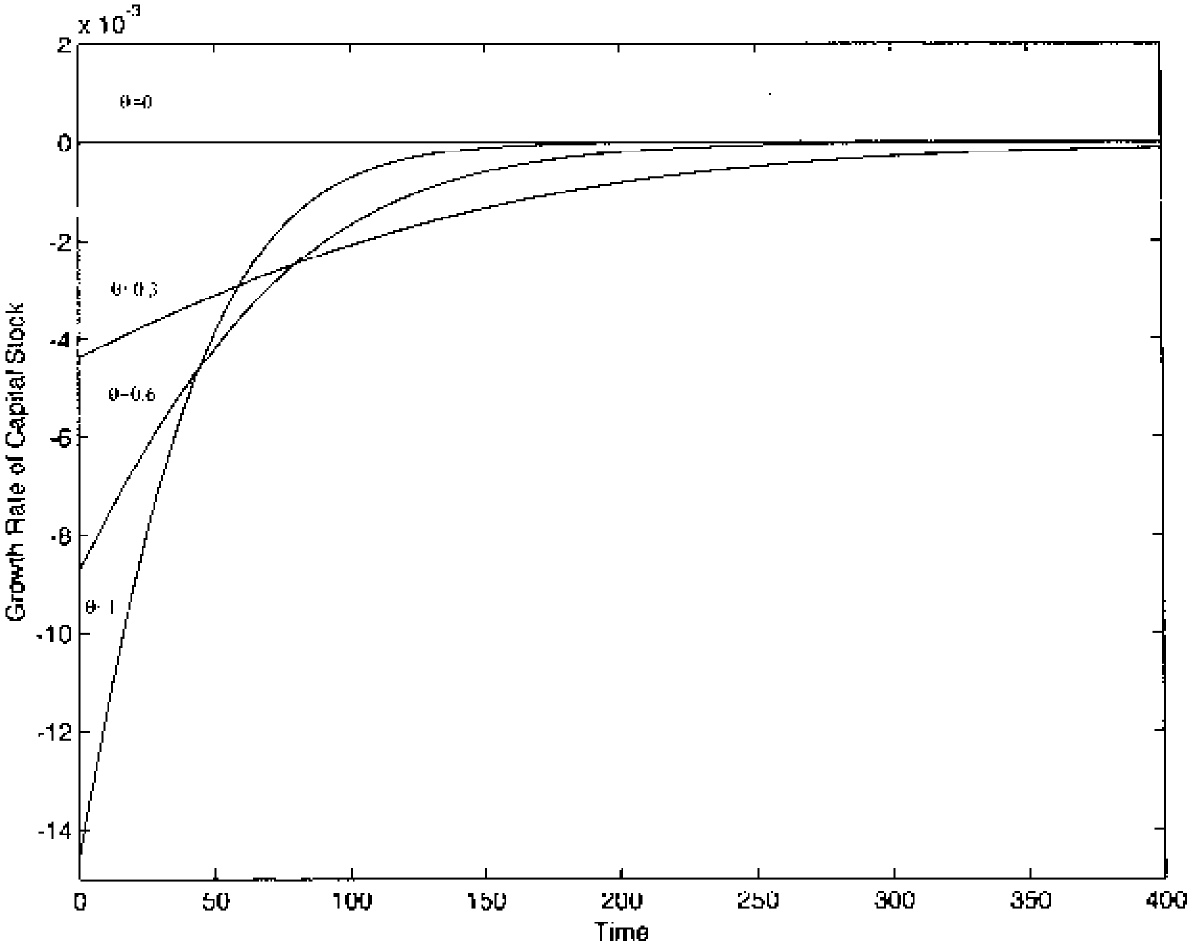
FIGURE 4




**Capital Stock versus Polarization**

Figure 4 compares capital stock gaps under a balanced budget and under a fiscal deficit for different degrees of polarization $\theta$. $k^{BB} - k^{FD} = \frac{(\tau - rb_0)}{r}(1 - e^{-\theta r t})$. It is assumed that $\tau$=100, $b_0$=0, and $r$=3.5%. Note that the term "balanced budget" has been abbreviated as "BB," and "fiscal deficit" has been abbreviated as "FD."

FIGURE 5




**Growth Rate of Capital Stock versus Polarization**

Figure 5 above depicts the growth rate of capital stock, $\left(\frac{\dot{k}}{k}\right)^{TD} = \frac{-\frac{\theta\tau\rho}{c_0} e^{-\theta t}}{\frac{\tau\rho}{rc_0} e^{-\theta t} + 1} < 0$, for different degrees of polarization $\theta$ under the assumption of $\rho = r$, $\tau$=100, $c_0$=1, and $r$=3.5%.