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Social polarization, fiscal instability and growth

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Abstract

We present a dynamic model of fiscal policy in a simple growth framework where social polarization (of preferences) plays a central role in the evolution of fiscal instability and growth collapse. In a highly polarized society, a deficit occurs endogenously, fiscal spending path becomes more volatile, output collapses, and economic growth rate is reduced along the transition path to a new lower level of output. One novel feature is that the size of fiscal deficit, the magnitude of fiscal volatility, and the size of reduction in output and growth rate are explicitly shown to be increasing functions of the degree of social polarization. This is because of the positive relationship between the polarization of preferences and the incentive for policymakers (or socio-economic groups) to overexploit the government resources in a common pool setting (polarization effect). Thereby, we offer a fiscal instability channel that negatively links social polarization and growth, which is an alternative yet distinct explanation for the empirical finding that social polarization is harmful to growth. Moreover, we fully distinguish the incentive to engage in such short-term policies under political uncertainty from that under polarization. Polarization and political uncertainty are shown to be distinct yet critical to the dynamic coordination failure in the common pool setting.

JEL classification: E62; H60; H30; O40

Keywords: Social polarization; Fiscal deficit; Fiscal volatility; Growth collapse

1. Introduction

In recent years, empirical studies on long-term growth have found that social polarization that arises from ethnic divisions or struggles over the income distribution is detrimental to growth (see Rodrik, 1999; Easterly and Levine, 1997; Alesina and

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Rodrik, 1994, among others). Countries with polarized societies, as measured by ethnic fractionalization or income inequality, seem to be more prone to adopt growth-retarding policies—for example, unsustainable fiscal policies that lead to large budget deficits, volatile fiscal outcomes, and growth collapses (see Figs. 1A and 1B).[1] In such countries, socio-economic groups may have sharp disagreements on ideal government policies, which may cause a coordination failure among policymakers that leads to an adoption of individually rational but collectively inefficient policies.

Perhaps social polarization is perhaps one of the oldest ideas found in the political economy literature. Yet there are very few (or no) systematic theoretical studies on the role of social polarization (of preference) in collective decision-making process and in the development of aforementioned macroeconomic problems. In general, the heterogeneity of preferences is one factor that has not been well-recognized as critical to the coordination failure in collective action. Our paper provides a systematic analysis of the role of polarization among socio-economic groups in the evolution of fiscal instabilities (large deficits and fiscal volatilities) and their negative effects on the capital accumulation process.[2] We build a dynamic game model of fiscal policy in a simple growth framework in which social polarization (more precisely, polarization of preference for types of government spending between socio-economic groups) plays a central role in both generating fiscal instability and growth collapse. 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.

On the other hand, social polarization may not only be responsible for a coordination failure but is often thought to be associated with socio-political instability. Empirical growth literature also finds that socio-political instability is harmful to growth (see Perotti, 1996; Alesina et al., 1996). High levels of socio-political unrest may not only make the downfall of the present government more likely but may dramatically shorten the horizons of politicians. With a shortened expected tenure in office, the government would be more likely to engage in short-term policies at the expense of macroeconomic stability.

In our paper, we fully distinguish the incentive for policymakers to engage in individually rational but socially inferior policies under political uncertainty from that under polarization of preferences. We make a contribution to the literature by clearly bringing out the different roles of polarization and political uncertainty (reflected in the discount factor) in generating fiscal deficits, volatile fiscal outcomes and output collapses, and in reducing economic growth along a transition path to a steady state in a unified framework. Interestingly, social polarization and political uncertainty are shown to compound to produce even worse outcomes in terms of fiscal instability and poor growth.

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)

[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] Throughout this paper, the term "fiscal instability" means both a large fiscal deficit and fiscal volatility.

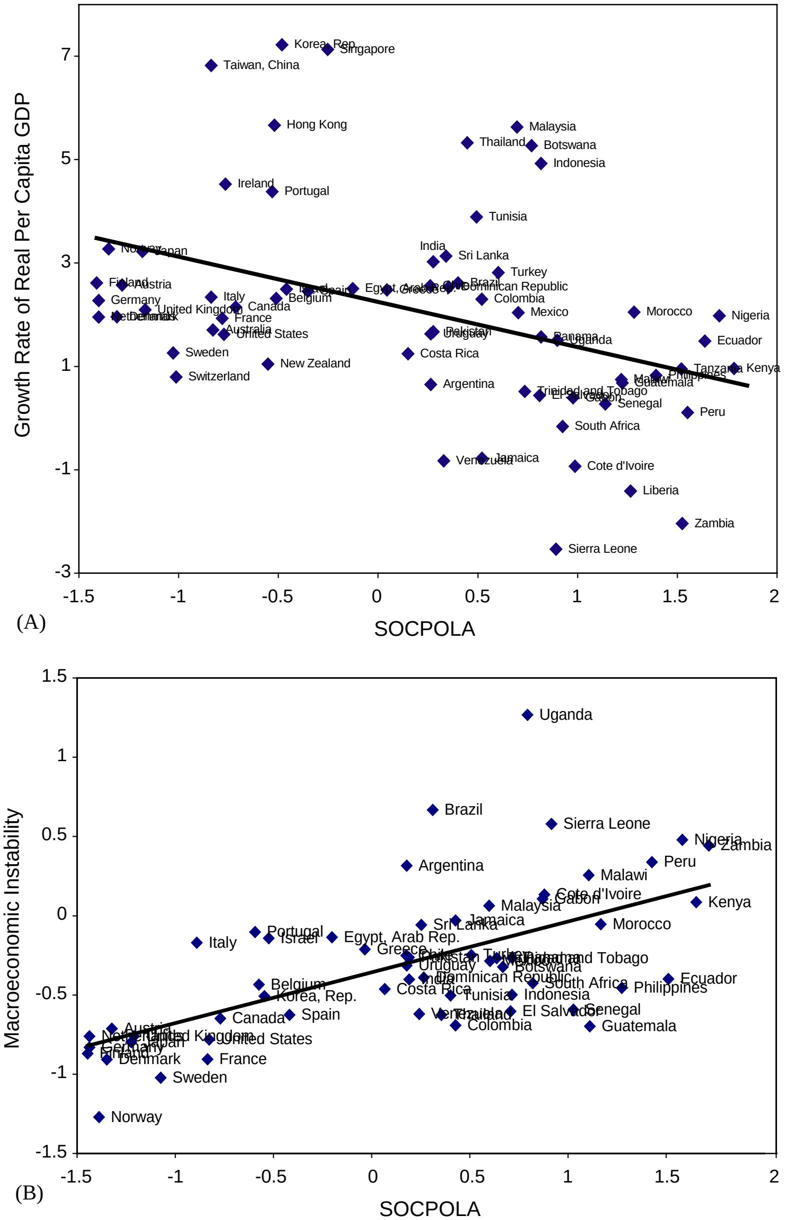

Fig. 1. (A) Growth rate and social polarization. A scatter plot of average growth rate of real per capita GDP for the period of 1970–98 against a composite index of social polarization (SOCPOLA) that is based on Gini coefficients, ethno-linguistic fractionalization, and institutional quality around 1970. Higher values of SOCPOLA indicate higher social polarization. *Data source*: World Bank (2000), Deininger and Squire (1996), and Easterly and Levine (1997). (B) Macroeconomic instability and social polarization. A scatter plot of a measure of macroeconomic instability over the period of 1970–98 against 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 (A).

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 and labor workers, manufacturing (formal) and traditional (informal) sectors, right-wing and left-wing parties, urban and rural sectors, or two powerful ethnic groups.

When the preferences for types of government spending differ substantially among policymakers (or equivalently among the groups they represent), a fiscal deficit occurs endogenously. This is due to strategic behaviors of the 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. The size of deficit rises with the degree of preference polarization because of the positive relationship between the preference polarization and the incentive to exploit the common resources (polarization effect). Political uncertainty facing policymakers, as reflected in a high discount rate, has an effect similar to that of polarization.

Importantly, an economy with a higher degree of polarization will also exhibit greater fluctuations in fiscal spending in response to shocks to the government revenue. The higher the degree of polarization, the more volatile the fiscal path. Relatively heavy discounting of the future events by the policymakers will cause a volatile fiscal spending path too. In the presence of preference polarization (or impatience) among the policymakers, a shock to tax revenue is translated into a more than proportional change in spending. That is, if the degree of polarization is positive or if the policymakers' subjective discount rate is substantially high, then government spending rises (falls) more than proportionally in response to a positive (negative) shock to tax revenue—this can shed light on the procyclicality of fiscal policies in Latin America that is extensively documented by Gavin and Perotti (1997). The intuition is similar to the polarization effect. This is due to an interaction between the shock to the government revenue and the policymakers' incentives to exploit it in the presence of the dynamic negative externality operated by the preference polarization or the political uncertainty.

The output level and the transition dynamics of economic growth also depend crucially on polarization and political uncertainty. A fiscal deficit arising from polarization or political uncertainty leads to inefficient capital accumulation in the private sector and permanently lowers the levels of capital stock and output 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 (and/or political uncertainty), the economic growth rate is reduced along a transition path to a new steady state of a lower level of output. The higher the degree of polarization or the subjective discount rate is, the sharper the decline in the growth rate is. In our model the growth collapse is caused by fiscal instability that is ultimately attributed to social polarization (and/or political uncertainty). We also characterize the transitional dynamics of growth as a function of polarization and political uncertainty.

Our fiscal mechanism is related to a growing literature on fiscal politics (see Alesina and Perotti, 1995; Persson and Tabellini, 1999, for a literature survey), and particularly to the common pool or pork barrel problem approach. The related papers are Weingast et al. (1981), Chari and Cole (1993a), Tornell and Lane (1998), Hallerberg and von Hagen (1999), and Velasco (1999).[3] 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. 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 (although in different contexts), addressing issues such as whether an increase in the number of groups n leads to a worse economic outcome, the possibility of delayed fiscal reforms, or the effect of budgetary institutions on the size of deficits.[4]

Here we address different issues, however. In general, the heterogeneity of preferences among the players is one factor that has not been well-understood as critical to the coordination failure (i.e., dynamic negative externality) in collective action in a common pool setting. So is the subjective discount factor of the players. In our paper, a general model is developed that introduces two new dimensions of preference polarization and political uncertainty into a class of two-player common pool games.[5] It is shown that preference polarization and discount factor are critical conditions for the dynamic negative externality to become operative in the common pool context. Not only would this help us to theoretically identify critical conditions leading to overexploitation of the common resources, but also would yield richer, yet distinct, theoretical and empirical implications for fiscal dynamics and the capital accumulation process as shown in the paper. For example, our result suggests that the common pool problem would be more likely to occur and be more severe in societies with higher degrees of polarization (and/or political instability). By sharp contrast, the existing literature tends to associate the severity of the common pool problem with the number of participants in the collective decision-making process. However, the theoretical relationship between the number of groups and the common pool problem is fragile because it turns out to depend crucially on the assumptions about the shape of utility function (see Kontopoulos and Perotti, 1999).

Moreover, we go well beyond the issue of budget deficit by analyzing the theoretical linkage of social polarization (and political uncertainty) to fiscal volatility, procyclicality of fiscal spending, and economic growth process. Again, in contrast, the existing

[3] 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. The existence of Pareto inefficient Nash equilibrium in this context was first shown by Levhari and Mirman (1980). See Fudenberg and Tirole (1992) for more details.

[4] The relationship between the number of groups n and the common pool problem is addressed by Weingast et al. (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).

[5] Thus, a typical two-player common pool model in the existing literature can be viewed as a special case in our framework.

models of fiscal deficits do not address the volatility or procyclicality of fiscal outcomes, let alone economic growth. The innovation of our paper is that the size of fiscal deficit, the magnitude of fiscal volatility, and the decline in output and economic growth rate are explicitly shown to be increasing functions of the degree of social polarization and the subjective discount factor. Social polarization has long been mentioned as an important explanation for populist fiscal policies and poor macroeconomic performance in many developing countries.[6] Yet there have been very few systematic theoretical studies on the role of social polarization per se in these problems.[7] We fill this void in the literature by demonstrating how social polarization can cause the aforementioned fiscal and growth problems.

Last but not the least important, we offer an alternative explanation for an important empirical finding that social polarization is harmful to economic growth: A fiscal instability channel. This can be viewed as an alternative fiscal policy channel, but distinct from the redistributive 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, our theoretical explanation is highly plausible since fiscal deficits are found to be harmful to growth in numerous empirical growth studies (Fischer, 1993, to begin with). And recently Woo (2003) finds a strong evidence that social polarization, as measured by income inequality, is robustly and positively associated with fiscal deficits in a comprehensive empirical investigation.

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 linkage between social polarization and fiscal instabilities. The social planner's solution is then computed and compared

[6] As a matter of fact, most of the existing studies tend to focus on either income inequality or ethnic fractionalization (sources of social polarization), rather than social polarization of preferences per se. For example, many economists have argued that unequal income distribution provides an important answer to the questions of why populist fiscal policies appear more often in Latin American countries than other regions. See Rodrik (1996) and Kauffman and Stallings (1991) among others. Even in this literature, however, there are very few theories that explain why unequal income distribution can lead to large deficits and volatile fiscal outcomes!

[7] A partial exception is Alesina and Tabellini (1990) who briefly discuss the linkage between polarization and budget deficit in a different mechanism. They show that faced with re-election uncertainty, the incumbent may fail to internalize the costs of additional debt and hence tend to have a deficit bias. Then they extend their argument into the case where two political parties have different preferences. Let alone the different mechanism we employ in our paper (i.e., the common pool setting), however, in this type of model it is not the polarization of preference per se but the re-election uncertainty that is the critical condition for an endogenous deficit to arise (see also Chari and Cole, 1993b on this point). If the government is not faced with the re-election uncertainty, deficit bias would not occur regardless of the opponent's preference.

On the other hand, it is surprising that social polarization has largely been ignored in the empirical studies of fiscal deficits. Woo (2003) presents the first econometric evidence that countries that have suffered greatest fiscal deficits also tend to be those with highly polarized societies as measured by indicators of income inequality in a panel of 57 countries over the period of 1970–90.

with the non-cooperative feedback Nash equilibrium determined by two heterogeneous policymakers. This is followed by an extension of the model into the case of policymakers facing political uncertainty. Section 4 analyzes the effect of this endogenous fiscal policy on the capital accumulation and growth in the presence of polarization and political uncertainty. Our conclusions are in Section 5.

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 and labor workers, manufacturing (formal) and traditional (informal) sectors, urban and rural sectors, two powerful vested interest (ethnic) groups, or right-wing and 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:

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

where c_i is private consumption; g_1 and g_2 are two different public goods provided by the government; and ρ 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 λ_i. We assume that $0 \leqslant \lambda_i \leqslant 1$, for $i = 1, 2$ and $\lambda_2 \leqslant \frac{1}{2} \leqslant \lambda_1$. 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.[8] 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 θ as a degree of polarization between the two groups. We note that $0 \leqslant \theta \leqslant 1$. While $\theta = 1$ 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 θ in the evolution of fiscal deficit and fiscal volatility. Also, capital accumulation and growth process depend crucially on θ, 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 $\forall t \geqslant 0$ and $a_0 > 0$ given,

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

[8] 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.

where a_{it} is the asset held by an agent and hence $a_{it} = k_{it} + b_{it}$, and τ_i is a lump-sum tax collected by the government from group i.[9] We also impose the No–Ponzi–Game (NPG) condition:

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

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

$$c_{it} = c_0 e^{(r-\rho)t}, \tag{5}$$

where c_0 remains to be determined (see footnote 12 for the solution).

The budget constraint for the whole private sector is

$$\dot{a}_t = r a_t - c_t - \tau, \qquad \forall t \geqslant 0, \tag{6}$$

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 $t \geqslant 0$ (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.[10]

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 δ 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[11]

$$c_{it} = c_0 e^{(A-\delta-\rho)t}. \tag{9}$$

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

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

[11] 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,

$$J^i = \int_0^{\infty} [\log(c_0) + (A - \delta - \rho)t + \lambda_i \log(g_1) + (1 - \lambda_i)\log(g_2)] e^{-\rho t} \, dt < \infty.$$

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):

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

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 $b_t = b_0$, $\forall t \geqslant 0$. Under the balanced budget assumption, the equilibrium capital stock k_t is given by [12]

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

The capital accumulation equation specified in (11) will be useful in computing the impact of polarization on capital stock and growth in Section 4. 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 $A-\delta-\rho$. [13] In other words,

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

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 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 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

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

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

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 ∞. We then have

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

By applying the NPG condition $\lim_{t\to\infty} k_t\mathrm{e}^{-rt} = 0$ to the integration, we can derive (11).
Since $y = Ak$, we easily find the output path by using (11). $\dot{y} = A\dot{k}$.
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 the capital stock, the lump-sum tax, and initial bond holdings.

[13] Note that in the standard AK growth model, there is no transitional dynamics; c_t, k_t, and y_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 y_t are not constant at $A-\delta-\rho$, but only asymptotically approach that rate. This can be checked in (11) and (12). This also implies that changes in polarization affect the growth rate of the economy only along the transition path to the steady state; the same is true for political uncertainty. For more about this, see Sections 4.

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 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*, which are 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.[14]

Each minister, i, has the following objective function:

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

where $0 \leqslant \lambda_2 \leqslant \frac{1}{2} \leqslant \lambda_1 \leqslant 1$ and the minister's discount rate is assumed to be equal to the interest rate.[15] 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 λ_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 tax of τ from the private sector (with normalization of the number of agents in each group to one). Government expenditures can also be financed by issuing bonds at a constant real rate of r. The government

[14] 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).

[15] 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 $\log(\bar{c})=0$ justifies the specification of the utility form.

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.[16]

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 the 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.[17]

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 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."[18] Let us now consider the following linear strategies:

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

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

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

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

[17] 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.

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

and the budget constraint becomes

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

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 χ_i subject to (18). Minister i's Hamiltonian is given by

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

where χ_i is the control variable, μ_{it} the costate variable, and ψ_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):

$$\chi_1^\star = \lambda_1,\ \chi_2^\star = (1 - \lambda_2);\ \text{and hence}\ g_{1t}^\star = \lambda_1 R_t,\ g_{2t}^\star = (1 - \lambda_2)R_t. \tag{20}$$

Substituting $g_{it}^\star = \chi_i^\star R_t$ and $R_t = \tau - rb_t$ into (14) yields

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

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, $\dot{b} > 0$.[19] 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.[20] 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 (polarization

[19] 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 $b_t = (\tau/r) - (\tau/r)\mathrm{e}^{-\theta rt}$. Thus, the NPG (No–Ponzi–Game) condition is satisfied: $\lim_{t\to\infty} b_t \mathrm{e}^{-rt} = ((\tau/r) - (\tau/r)\mathrm{e}^{-\theta rt})\mathrm{e}^{-rt} = 0$. As $t \to \infty$, b approaches τ/r. This is because the game and the strategies are constructed such that it is in each minister's best interest to spend less so as to satisfy the NPG condition. Note that each minister's spending g_i depends only on the state variable, net tax revenue $(\tau - rb)$. As debt (b) is accumulated, the net tax revenue shrinks, which forces each minister to spend less. As a result, total government spending shrinks asymptotically to zero when there is polarization $(\theta > 0)$. This is merely due to the lump-sum tax assumption. By contrast, when $\theta = 0$, the budget is then balanced, and total government spending equals the lump-sum tax for each time period.

[20] It is not the level of tax that causes a deficit in our model. This holds true for any given level of tax revenue.

effect). 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 the state variable b gets bigger, as the degree of polarization 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 Fig. 2A).

Along with this result, the intertemporal budget constraint implies that polarization is positively associated with greater changes in fiscal outcomes over time, such as spending and fiscal balance for a given path of tax revenue. The greater the polarization is, the larger the fiscal spending and current fiscal deficit are. But this only raises the debt level more quickly and reduces available government resources, which forces policymakers to cut tomorrow's spending by more.[21] 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 Fig. 2A again).

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

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

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

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

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

[21] 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 12). 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.

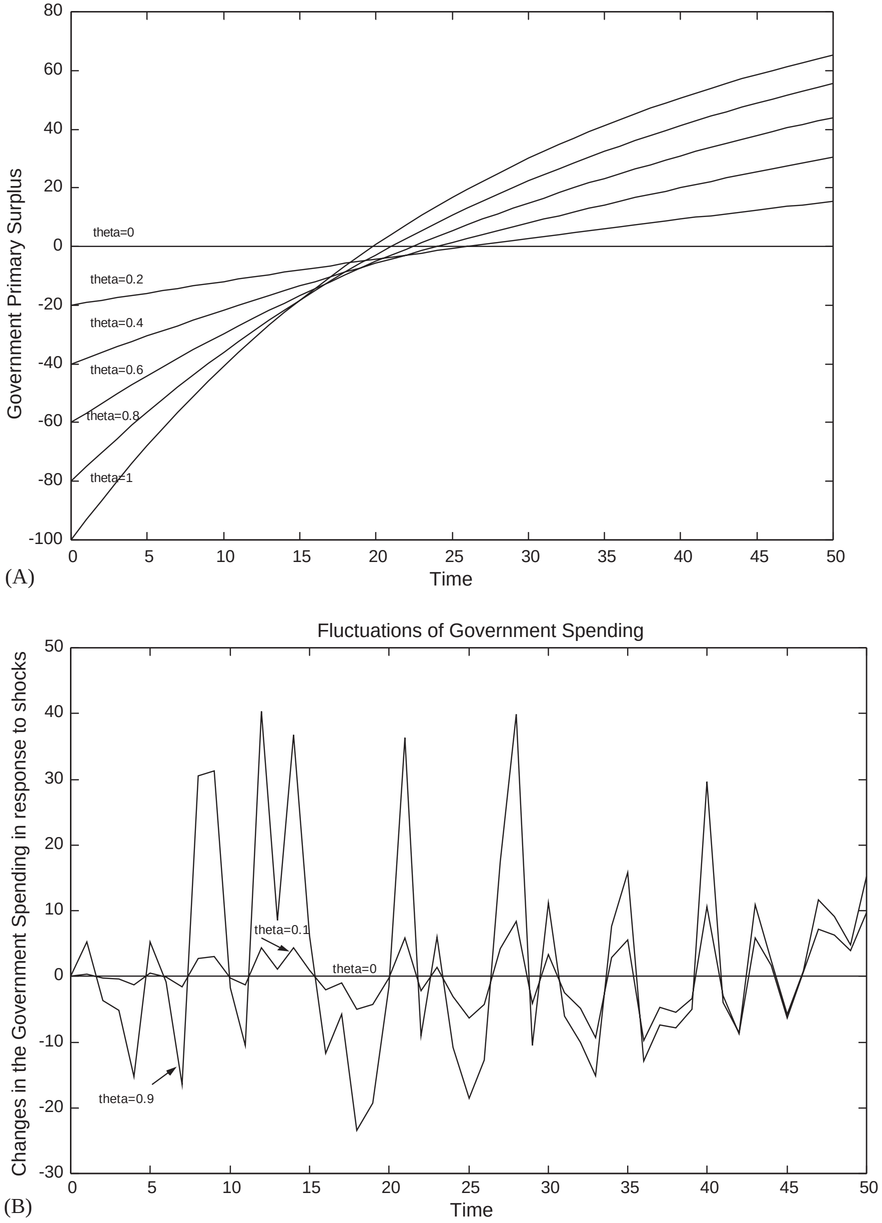

Fig. 2. (A) Government primary surplus and polarization. Primary surplus is given by $\tau - \widetilde{g}(t:\theta,\rho) = \tau - (1+\theta)(\tau - rb_0)e^{-\theta rt}$. The figure displays time path of primary surplus for various degrees of polarization, θ (theta), where it is assumed that $\tau = 100$, $b_0 = 0$, and $r = 3.5\%$. (B) Government spending fluctuations and polarization. The figure shows fluctuations in government spending in response to shocks to net tax revenue for different degrees of polarization, θ (theta), where the government spending is given by $\widetilde{g}(t:\theta,\rho) = (1+\theta)(\tau - rb_0)e^{-\theta rt}$. We have used $\tau = 100$ and $b_0 = 0$, and assumed that r is a random variable following a uniform distribution on $r \in [0.035, 1]$.

spending in the presence of polarization.[22] The absolute size of the change in $\widetilde{g}$ will be even greater with the size of θ. 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 to be equal to the multiproduct of λ_1 (or $(1-\lambda_2)$ for minister 2) and net tax revenue R. For a given shock to tax revenue $\Delta\tau$, minister 1 will claim $\lambda_1 \times \Delta\tau$, while minister 2 will want to increase her favorite spending by $(1-\lambda_2)\times\Delta\tau$. Unless $\lambda_1=\lambda_2=1/2$, it will result in a more than proportional increase in total spending ($\Delta\widetilde{g}=(1+\theta)\times\Delta\tau$). 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 shown in a diagram when we allow R_t (either T or r) to follow a stochastic process (see Fig. 2B).[23] As one can see from Fig. 2B, even for the same size of exogenous shock to revenue R_t, government spending ($\tilde{g}_t$) 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). 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 $\widetilde{g}$ rises more than proportionally, yielding a procyclical pattern of fiscal spending.[24]

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 Section 3.1, we confine the

[22] This result is reminiscent of the voracity effect in Tornell and Lane (1999) that interest groups' total appropriation of the economy capital stock rises more than proportionally to the windfall to the capital stock. Although the motive and the issues we address in our paper are sharply different from theirs, the underlying mechanism for both polarization effect and voracity effect is the negative externality in common pool settings. Aside from other major differences from the existing common pool problem literature, the novel feature of our paper is that we not only demonstrate that the polarization of preferences (and the political uncertainty, as will be shown in Section 3.3) cause the fiscal volatility to arise endogenously but also fully show that the size of fiscal volatility itself is an increasing function of the degree of polarization and the discount factor, which yields a new testable prediction. Moreover, the polarization of preference and the discount factor are shown to be the critical conditions for the dynamic negative externality to become operative in a more general two-player common pool game. Therefore, the kind of voracity effect cannot occur in our framework, if (i) there is no polarization of preferences, and (ii) players are patient enough.

[23] Fig. 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.

[24] Alternatively, 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.

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 χ_1 and χ_2, subject to (18): [25]

$$W(\chi_1, \chi_2) = \int_0^\infty [(\lambda_1 + \lambda_2)\log(\chi_1) + (2 - \lambda_1 - \lambda_2)\log(\chi_2) + 2\psi_t]\mathrm{e}^{-rt}\,\mathrm{d}t, \tag{24}$$

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

$$\chi_1^* = \frac{\lambda_1 + \lambda_2}{2} \quad \text{and} \quad \chi_2^* = \frac{2 - \lambda_1 - \lambda_2}{2}. \tag{25}$$

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 $\lambda_2 \leqslant \frac{1}{2} \leqslant \lambda_1$, it is straightforward to see that $\chi_1^{\bigstar} \geqslant \chi_1^*$ and $\chi_2^{\bigstar} \geqslant \chi_2^*$. 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 $g_1^* = ((\lambda_1 + \lambda_2)/2)R$ and $g_2^* = ((2 - \lambda_1 - \lambda_2)/2)R$, $g_1^* + g_2^* = R$ and $\dot{b} = 0$, $\forall t \geqslant 0$; therefore, each public good is produced depending on preferences, λ_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 in half (i.e., $\chi_i^* \neq \frac{1}{2}$ unless $\lambda_1 = \lambda_2 = \frac{1}{2}$). Rather, it depends on how policymakers value one type of public good relative to the other.

3.3. Policymakers faced with political uncertainty

So far, we have assumed that policymakers' subjective discount rate is equal to the interest rate. We relax 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 and volatile fiscal outcomes, which yields richer yet distinct implications for fiscal dynamics and the capital accumulation process.

To see this, we allow the possibility of $\rho \neq r$, and specifically introduce the political uncertainty that faces the policymakers. Let us suppose that they face a constant probability of being removed from office per unit time, $p > 0$. This uncertainty of tenure effectively increases the ministers' subjective discount rate. We can interpret the

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

subjective discount rate ρ as the sum of real interest rate r and the probability of being removed from office p. We may then write the objective function of minister i, (13), as

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

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

$$\chi_1^\star = \lambda_1 \frac{\rho}{r}, \quad \chi_2^\star = (1-\lambda_2)\frac{\rho}{r}, \quad \text{and} \quad g_{1t}^\star = \frac{\lambda_1 \rho}{r} R_t, \quad g_{2t}^\star = \frac{(1-\lambda_2)\rho}{r} R_t. \tag{26}$$

Thus, the government budget flow equation is

$$\begin{aligned} \dot{b}_t &= \left(\lambda_1 - \lambda_2 + 1 - \frac{r}{\rho}\right)\frac{\rho}{r}(\tau - rb) \\ &= \left(\theta + 1 - \frac{r}{\rho}\right)\frac{\rho}{r}(\tau - rb) \geqslant 0, \quad \text{if } \rho \geqslant \frac{r}{1+\theta}. \end{aligned} \tag{27}$$

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 office ($p > 0$). It is clear from Eq. (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 political uncertainty, as reflected in a greater subjective discount rate, means that the effective horizon of ministers is shortened.[26] 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 deficit bias grows even larger.

It is worthwhile emphasizing that *polarization* and *political uncertainty* are two separate forces working toward generating fiscal deficits. For a given level of the time preference ρ, 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 ρ for any given degree of polarization θ. Figs. 3A and 3B illustrate this point. Fig. 3A shows the time path of primary surplus in the absence of polarization (θ=0), whereas Fig. 3B displays it in the presence of polarization (θ=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.

[26] With the constant probability assumption (say, exponential distribution), it can be shown that the expected time until removal from office is $1/p$, 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.

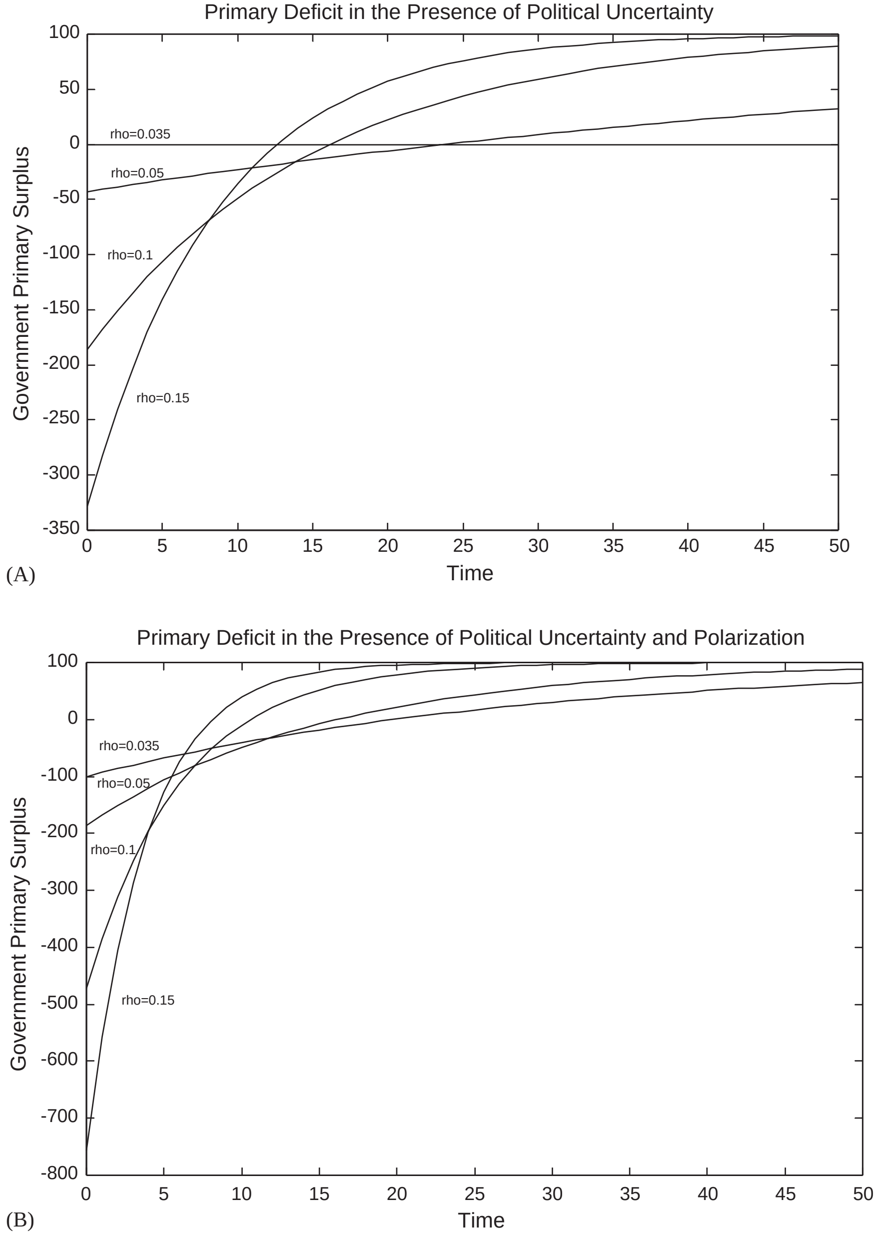

Fig. 3. (A) Government primary surplus and political uncertainty. Primary surplus is given by $\tau - \widetilde{g}(t:\theta,\rho) = \tau - ((1+\theta)\rho/r)(\tau - rb_0)\mathrm{e}^{-(1+\theta-(r/\rho))\rho t}$. The figure displays time paths of primary surplus in the absence of polarization ($\theta = 0$) for different values of discount rate ρ (rho), where it is assumed that $\tau = 100$, $b_0 = 0$, and $r = 3.5\%$. (B) Government primary surplus, political uncertainty and polarization. Primary surplus is given by $\tau - \widetilde{g}(t:\theta,\rho) = \tau - ((1+\theta)\rho/r)(\tau - rb_0)\mathrm{e}^{-(1+\theta-(r/\rho))\rho t}$. The figure displays time paths of primary surplus in the presence of polarization ($\theta = 1$) for different values of discount rate, ρ (rho), where it is assumed that $\tau = 100$, $b_0 = 0$, and $r = 3.5\%$.

Similarly, the uncertainty of tenure contributes further to the 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 ρ/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 neither polarization nor any 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 ρ (which may or may not be equal to r), then we obtain

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

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

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

with 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 capital accumulation and growth in the decentralized economy with the optimizing private sector and endogenous fiscal policy jointly but non-cooperatively determined by two ministers. Here we are interested in how polarization is linked to capital accumulation and the growth process through the fiscal instability channel that was described in the previous section.

First, if there is neither polarization nor political 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 transitional 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, the 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. Political uncertainty, as reflected in the discount factor of policymakers, also has similar effects on output and the growth process. Later, we characterize the transitional dynamics of growth as a function of polarization and political uncertainty.

We first characterize capital accumulation and output in the presence of polarization under the assumption of $\rho = r$. It is straightforward to extend our discussion into a more general case such as $\rho \neq r$, as becomes clear later. If we substitute the solution $g_1^\star$ and $g_2^\star$ into (10) and solve the first-order differential equation for k_t^{FD}, imposing the NPG condition, we obtain

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

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 θ, the smaller the capital stock k_t. Also, higher polarization implies a lower level of output y. It is because greater amounts of disagreement lead 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 the 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

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

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, $k_t^{\mathrm{BB}} > k_t^{\mathrm{FD}}$. The higher the degree of polarization is, the larger the current gap between k_t^{BB} and k_t^{FD} is (see Fig. 4). As $t \to \infty$, $k_t^{\mathrm{BB}} - k_t^{\mathrm{FD}}$ approaches $(\tau - rb_0)/r$. 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^{FD} rises with the degree of polarization.[27]

We can gauge the size of the impact of an increase in polarization on social welfare in terms of consumption, using (9), (11), and (30).[28] Note that an increase in polarization θ from zero to one is associated with a permanent reduction in k at the steady state by the amount of $(\tau - rb_0)/r$. On the other hand, the consumption is given by $c_t = \rho \cdot (k_t - (\tau - rb_0)/r)$ from (9) and (11). A one unit decrease in capital stock Δk amounts to a reduction in consumption by $\rho \Delta k$. Therefore, the consumption level at the steady state is permanently reduced by the amount of $\rho(\tau - rb_0)/r$ when the degree of polarization rises from zero to one.

[27] As for output, $y_t^{\mathrm{BB}} - y_t^{\mathrm{FD}} = A(\tau - rb_0)(1 - \mathrm{e}^{-\theta rt})/r \geqslant 0$, for $\forall t \geqslant 0$, with equality if $\theta = 0$.

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

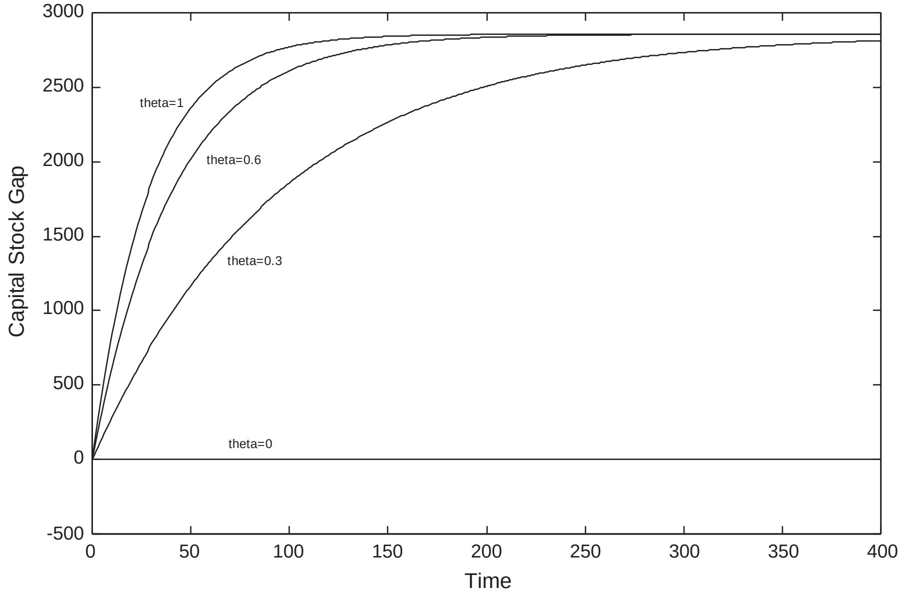

Fig. 4. Capital stock gap and polarization. The figure compares capital stock gaps between under a balanced budget and under a fiscal deficit due to various degrees of polarization, θ (theta): $k^{\mathrm{BB}} - k^{\mathrm{FD}} = (\tau - rb_0)(1-\mathrm{e}^{-\theta rt})/r$. It is assumed that $\tau = 100$, $b_0 = 0$, and $r = 3.5\%$. Note that the term "balanced budget" has been abbreviated as "BB", and "fiscal deficit" has been abbreviated as "FD".

Transition dynamics of growth depend crucially 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 rates when $\theta = 0$ and $\theta > 0$ are given by

$$\left(\frac{\dot{k}}{k}\right)\Bigg|_{\theta=0} = \frac{(r-\rho)}{\frac{\tau\rho}{r2c_0}\,\mathrm{e}^{-(r-\rho)t} + 1} = 0 \tag{32}$$

and

$$\left(\frac{\dot{k}}{k}\right)^{\mathrm{FD}}\Bigg|_{\theta>0} = \frac{\frac{-\theta\tau\rho}{2c_0}\,\mathrm{e}^{-((\theta+1)r-\rho)t} + (r-\rho)}{\frac{\tau\rho}{r2c_0}\,\mathrm{e}^{-((\theta+1)r-\rho)t} + 1} = \frac{\frac{-\theta\tau\rho}{2c_0}\,\mathrm{e}^{-\theta rt}}{\frac{\tau\rho}{r2c_0}\,\mathrm{e}^{-\theta rt} + 1} < 0, \tag{33}$$

where $b_0 = 0$ is assumed for simplicity, and 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 $t \geqslant 0$. Over time, the growth rate of capital stock in the presence of polarization ($\theta > 0$) converges to the rate of growth under a balanced

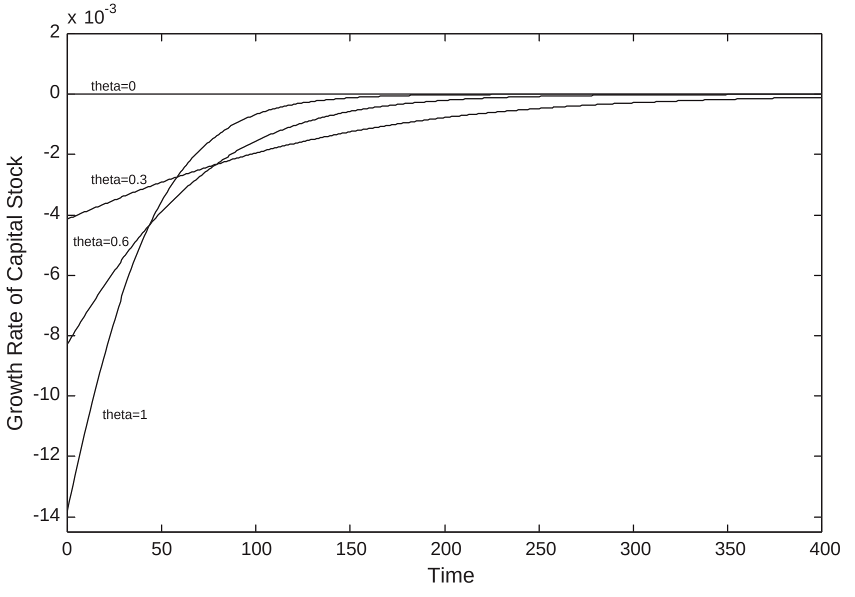

Fig. 5. Growth rate of capital stock and polarization. The figure above depicts the growth rate of capital stock, $\left(\frac{\dot{k}}{k}\right)^{\mathrm{FD}} = \frac{[(-\theta\tau\rho/2c_0)\mathrm{e}^{-\theta rt}]}{[(\tau\rho/r2c_0)\mathrm{e}^{-\theta rt}+1]} < 0$, for different degrees of polarization θ (theta) under the assumption of $\tau = 100$, $b_0 = 0$, $2c_0 = 1$, and $r = \rho = 3.5\%$.

budget, $r-\rho$, whereas the level of k itself is permanently lowered. That is, the asymptotic growth rate of capital is $r-\rho$: $\lim_{t\to\infty}(\dot{k}/k)^{\mathrm{FD}} = r-\rho$ (see Fig. 5). [29]

Interestingly, however, the relationship between the growth rate and the 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 a higher degree of polarization θ would see a sharper collapse of growth rate initially as it runs a larger

[29] Since the marginal productivity of capital stock is a constant A (and hence the value of $r-\rho$ is constant), it can produce perpetual growth without assuming some exogenous technological progress. However, the transitional dynamics of growth as a function of polarization θ looks similar to that of neoclassical models such as the Solow model. For example, a change in saving rate in the neoclassical model can lead to a permanent effect on the level of output, whereas it does not change the steady-state growth rate. Similarly, a change in the degree of polarization θ in our model leads to a permanent change in output and capital stock, but not to a permanent change in the steady-state growth rate.

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 interpretation that differences in growth rates across countries are due to the fact that countries are on different transition paths to their own steady states of output works reasonably well. For seminal empirical works, see Mankiw et al. (1992), Barro (1991) and Barro and Sala-i-Martin (1992) among others.

deficit. However, this same economy would grow more rapidly later as its fiscal balance improves compared to an economy with a lower degree of polarization θ (again Fig. 5). This reflects the fiscal deficit dynamics in relation to polarization as illustrated in Section 3.1.

It is straightforward to see that the above results still hold even when policymakers are impatient enough to discount the future more heavily (i.e., $\rho > r$). So far, we implicitly assumed that the policymakers still share the same time preference rate ρ with the private sector, even when we allowed the case of $\rho \neq r$. We can further distinguish them by assuming that policymakers faced with political uncertainty discount the future more heavily than the private sector—that is, $\widehat{\rho} \geqslant \rho$, where the policymakers' discount rate is $\widehat{\rho} = \rho + p$; ρ is the private agent's discount rate (which may be equal to r or not); and p is the constant probability of policymakers being removed from the office. Even in this case, the result still remains qualitatively the same. The transitional dynamics of growth with respect to the probability of losing office p is similar to that with respect to polarization θ, whereas the steady-state growth rate is still $r - \rho$. To see this point, note that the government budget flow Eq. (27) becomes

$$\dot{b} = \left(1 + \theta - \frac{r}{\widehat{\rho}}\right)\frac{\widehat{\rho}}{r}(\tau - rb) \geqslant 0, \quad \text{if } \widehat{\rho} \geqslant \frac{r}{1+\theta}, \tag{34}$$

and that capital accumulation takes place according to

$$k_t = \frac{2c_0}{\rho}\,\mathrm{e}^{(r-\rho)t} + \frac{(\tau - rb_0)}{r}\,\mathrm{e}^{(r-\rho)t}\mathrm{e}^{-(\theta\rho+(1+\theta)p)t}. \tag{35}$$

We can then clearly see that an increase in political uncertainty as reflected in p leads to a permanent reduction in output and capital stock, but not to a permanent decrease in the steady-state growth rate $(r - \rho)$.

5. Concluding remarks

This paper has presented a dynamic model of fiscal policy in a simple growth framework where social polarization of preferences among socio-economic groups plays a central role in the evolution of fiscal instability and growth collapse. One key feature of the paper is that the size of fiscal deficit, the magnitude of fiscal volatility, and the size of reduction in output and growth rate are explicitly shown to be increasing functions of the degree of social polarization and the degree of political uncertainty (reflected in policymakers' subjective discount factor).

Broadly consistent with recent empirical studies on fiscal instability and growth, our results can particularly contribute to explaining why many Latin American countries in the past decades have suffered from chronic fiscal deficits, volatile fiscal outcomes, procyclicality of fiscal policies, and disappointingly poor growth. Our theory suggests that all of these problems can be ultimately attributed to the polarization within the government or among socio-economic groups in a society. Although social polarization might be among the oldest ideas in the political economy literature, we first theoretically demonstrate how social polarization can cause the aforementioned fiscal and growth problems.

Furthermore, we fully distinguish the incentive for policymakers to engage in short-term policies under political uncertainty from that under social polarization of preferences. Not only do we show that these two are separate and distinct forces driving fiscal dynamics and growth process but also that these are critical to the coordination failure (that is, the negative dynamic externality) in a more general two-player common pool game.

On the other hand, recent studies on budgetary institutions have presented evidence that stringent budgetary procedures and rules can directly influence fiscal outcomes (see Alesina and Perotti, 1996, for a literature survey).[30] However, our theory suggests that social polarization may lie in depth behind the fiscal problems. So whether institutional arrangements (including budgetary institutions) can be made to mitigate the negative fiscal effects from social polarization remains to be an important question. In this regard, Woo (2003) reports encouraging econometric evidence that the effects on public sector deficits of the social polarization tend to be smaller in countries with better (budgetary) institutional arrangements. Conversely, the social polarization has very strong effects on deficits in the presence of poor institutions. This also has important policy implications. For example, the fiscal decentralization that many countries have recently undergone may produce different results depending on 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 can threaten macroeconomic stability unless it is checked by proper institutional restraints. This has been observed in some countries such as the Balkans, Indonesia, and Brazil in recent years.

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[30] See von Hagen (1992), Hallerberg and von Hagen (1999), and Alesina et al. (1999) among others.

Appendix A: Derivation of the decentralized feedback Nash equilibrium

Minister 1's Hamiltonian is

$$H^1(\chi_1, \chi_2, \psi_t) = [\lambda_1 \log \chi_1 + (1-\lambda_1)\log \chi_2 + \psi_t]\mathrm{e}^{-rt} + \mu_{1t}[r - r\chi_1 - r\chi_2]. \quad \text{(A.1)}$$

The first-order conditions are

$$H^1_{\chi_1} = \frac{\lambda_1}{\chi_1}\mathrm{e}^{-rt} - \mu_1 r = 0; \quad H^1_{\psi} = \mathrm{e}^{-rt} = -\dot{\mu}_1; \ \lim_{t\to\infty} \mu(t) = 0 \quad \text{(TVC)}. \quad \text{(A.2)}$$

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

$$\mu(t) = \frac{\mathrm{e}^{-rt}}{r}. \quad \text{(A.3)}$$

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

Similarly, we can solve the optimization problem of minister 2, getting $\chi_2^\star = (1-\lambda_2)$. Note that the first-order condition for the control variable, χ_1, and the solution of $\mu(t)$ do not contain the state variable ψ. This makes the open-loop and feedback strategies coincide.

Appendix 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:

$$H(\chi_1, \chi_2, \psi_t) = [(\lambda_1+\lambda_2)\log \chi_1 + (2-\lambda_1-\lambda_2)\log \chi_2 + 2\psi_t]\mathrm{e}^{-rt} + \mu_t[r - r\chi_1 - r\chi_2]. \quad \text{(B.1)}$$

The first-order conditions are

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

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

$$\mu(t) = \frac{2\mathrm{e}^{-rt}}{r}. \quad \text{(B.3)}$$

Thus, the solution is

$$\chi_1^* = \frac{\lambda_1+\lambda_2}{2} \quad \text{and} \quad \chi_2^* = \frac{2-\lambda_1-\lambda_2}{2}. \quad \text{(B.4)}$$

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