The Political Economy of Fiscal Deficits and Government Production

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Abstract

A key insight from political economy is that state variables can be used to influence future policy, potentially causing excess government deficits and investments. I extend the literature by considering government production. While existing studies are encompassed as extreme cases regarding substitutability and intensity of capital and labor in production, more empirically plausible values of these parameters turn conventional wisdom about strategic debt and capital accumulation on its head, as anticipated political turnover reduces the accumulation of physical capital rather than financial assets. Turnover is not costly due to excess deficits, but due to production inefficiency in the public sector.

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1 Introduction

A property of a well-functioning democracy is that current office holders may be replaced through future elections. Hence, when incumbents make policy choices with long-lived consequences, one would expect that they consider how these choices interact with the policies of their successors. This hypothesis is central in the literature on dynamic policy problems, where it has long been argued that politicians will use state variables to influence future decisions. Particularly prominent are the propositions that anticipated turnover will cause excess debt accumulation (Tabellini and Alesina (1990), Persson and Svensson (1989)) or excessively high investments (Glazer (1989)) as incumbents attempt to"tie the hands" of their successors.[1] These insights are important, as they imply that elected policymakers should face legal constraints, such as balanced budget rules, regarding how to spend public funds.

In this paper I challenge the conventional view of how anticipated turnover shapes politicians' savings decision. The essential aspect of government activity that I emphasize is public production of goods and services. That is, I assume that public goods are produced by combining capital and labor, consistently with the observation that most of government expenditure tends to be spent on wages and investments.[2] In addition, I assume that capital is a state variable determined by decisions in the past, whereas labor is a flow variable controlled by the current office holder. It then follows that if capital and labor complement each other in government production, the future allocation of wage expenditure across different public goods will depend on current investment decisions. For instance, if an incumbent invests heavily in capital used for national defense, and little in public

[1] These arguments are also referred to in economic textbooks, such as Romer (2001) and Persson and Tabellini (2000).

[2] For instance, Cavallo (2005) documents that in the U.S. since World War II 63 percent of total government expenditure on consumption and investment was spent on labor, which arguably is best understood as an input to production rather than a final good. Only 21 percent was spent on privately produced goods and services, while 16 percent was spent on investment.

hospitals, then the future productivity of military personnel increases relative to that of nurses and doctors. Conversely, the future allocation of wage expenditure will affect the returns to current investment. For instance, if an incumbent invests heavily in military equipment, while the successor prefers health services, then the returns to the incumbent's investments will be reduced by political turnover, as future decisionmakers prefer to direct wage expenditures towards health personnel. Together, these two effects tend to raise an incumbent's valuation of financial assets relative to his valuation of capital, tilting total savings toward the former, and away from the latter means of storage.[3] Hence, in contrast to the conclusions in the established literature, anticipated turnover will tend to depress public investments rather than to stimulate deficits.

The central results in this paper are driven by complementarity between capital and labor. When these inputs are highly substitutable, results are reversed and turnover tilts savings away from financial assets and toward capital. Indeed, the environment studied by Glazer (1989), where durable and non-durable public goods can be purchased at fixed prices, is encompassed by my proposed production framework as an extreme case where capital and labor perfect substitutes. With infinite substitutability, investments can be used to perfectly pin down which public goods are provided in the future. Similarly, the model studied in Tabellini and Alesina (1990), where public goods are non-durable and purchased at fixed prices, is encompassed as the special case where the only input to production is labor. However, with productive capital and a moderate elasticity of substitution between inputs, in line with evidence from macro studies such as Klump, McAdam, and Willman (2007), these results are overturned as politicians can influence the future use of financial wealth, while their investment returns depend on future policy.

On the normative side, the model predicts that political turnover leads to

[3] Unless otherwise is explicitly stated, the term "capital" in this paper refers to capital used in production of public goods. To avoid confusion with financial capital, i.e. bond holdings in this paper, I will sometimes also use the term "physical capital" to describe capital used for public production.

resource waste in government production. *Ex post*, governments allocate labor efficiently in the sense that production is on the production frontier given by existing physical capital and technology. However, the allocation of public resources will tend to be off the *ex ante* possibility frontier. If the identity of the decision-maker changes, production of the good that the previous policymaker prefers more strongly than the current policymaker will be too capital intensive, while production of the good that the successor prefers more strongly will be too labor intensive. Hence, more of both goods could be produced at no expense by re-allocating capital and labor. Importantly, this intratemporal production inefficiency is not addressed by a balanced budget rule. This contrasts with the policy implication which arises in an environment where government buys goods at fixed prices.

The results in this paper relate to an empirical literature investigating whether incumbents accumulate more debt when re-election is less likely, including Lambertini (2004), Franzese Jr. (2001) and Petterson-Lidbom (2001). None of these studies find that debt is systematically stimulated by anticipated turnover.[4] For public investments, a general fact is that across OECD countries public investment in physical capital has fallen relative to GDP since the 1970s (Heinemann (2006), Roubini and Sachs (1989)), and some have claimed that investments have become too low (Aschauer (1989)). More closely related to this paper, Darby, Li, and Muscatelli (2004) present cross-country evidence that public investments are low when political turnover is high, as my proposed model predicts when capital and labor are complements.[5] Fiva and Natvik (2009) use mid-term elections to study how changes in re-election probabilities influence public investments in a panel of Norwegian municipalities. The results from that study also indicate that the more likely is political turnover, the lower are investments.

[4]Notably, though, Petterson-Lidbom (2001) finds evidence that in Sweden, anticipated turnover generates higher deficits in municipalities run by conservatives, while it reduces deficits in municipalities run by socialist leaning incumbents.

[5]Darby, Li, and Muscatelli (2004) measure turnover as the share of seats added or lost by each party in government at the previous election.

Within the theoretical literature, several papers are related to the current one, although none of them consider public capital as an input to government production. In particular, Peletier, Dur, and Swank (1999) introduce a public asset for which the financial returns are not constant, as is assumed for bonds, but instead are decreasing in the amount invested. They show that while savings are optimally allocated between the two asset types if debt accumulation is unrestricted, these investments will be too low under a balanced budget requirement. Two studies that focus on public investment in physical capital are Besley and Coate (1998) and Azzimonti (forthcoming). These have in common that the role of public capital is to enhance private sector productivity and thereby future tax revenues. In their equilibria public investment is too low. Bassetto and Sargent (2006) analyze politically determined investment decisions in an overlapping generations model, and quantitatively assess how imperfect altruism for the unborn generations has lead to under-investment in the U.S. Battaglini and Coate (2007) consider the allocation of tax revenues between investments in a public good that benefits all citizens and spending targeted at specific recipients. Finally, Bai and Lagunoff (2009) analyze an environment where public investments determine candidates' popularity, rather than causation going just from popularity to investments. In contrast to the present paper, neither of these studies consider disagreement over different types of capital, nor do they consider how current investment may affect the relative price of different public goods in the future.

The remainder of this paper is organized as follows. Section 2 presents the model and Section 3 describes its equilibrium. Section 4 considers two special cases for which the model may be solved analytically. The main results, for a more general formulation of the model, are presented in Section 5. Section 6 discusses production efficiency, while Section 7 concludes.

2 The Model

The economy is populated by a large number of atomistic individuals who differ by their preferences over two public goods g and f. Individual i's preferences for public goods in period t are given by

$$u\left(g_t, f_t|\alpha^i\right) = \frac{\left[\left(\alpha^i g_t^{\frac{\phi-1}{\phi}} + \left(1-\alpha^i\right) f_t^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}}\right]^{1-1/\sigma}}{1-1/\sigma}, \tag{1}$$

where ϕ is the intratemporal elasticity of substitution between g and f within period t, and σ is the intertemporal elasticity of substitution for public goods measured in "efficiency units", $\left(\alpha^i g_t^{\frac{\phi-1}{\phi}} + \left(1-\alpha^i\right) f_t^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}}$. The parameter α_i differs across households.

There are two periods. Each period an elected government receives a given income, normalized to one, in order to provide the two public goods. In period t these goods must be produced with the production functions

$$h_t = h\left(n_t^h, k_t^h\right) = \left(\gamma n_t^{h\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) k_t^{h\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{2}$$

where n_t^h and k_t^h are labor and capital used to produce good h, $h = g, f$, $\varepsilon > 0$ is the elasticity of substitution between capital and labor, and γ is the distribution parameter that determines the labor intensity of public production.

Both capital and labor are in infinitely elastic supply at unit cost one. The amount of labor employed is freely chosen each period. Physical capital, on the other hand, is less flexible as it is chosen one period in advance and specific to the production of each public good.

In period one the government chooses $\left\{n_1^g, n_1^f, k_2^g, k_2^f, b\right\}$, subject to the budget constraint

$$n_1^g + n_1^f + k_2^g + k_2^f = (1-\delta)\left(k_1^g + k_1^f\right) + 1 + b, \tag{3}$$

where δ is the depreciation rate of physical capital, which is identical in the two public production activities. In period two the government chooses $\left\{n_2^g, n_2^f\right\}$ only, subject to the budget constraint

$$n_2^g + n_2^f = 1 - b \tag{4}$$

where b is the amount borrowed in the first period. This asset is traded on the world market, which clears at a net interest rate of zero. Clearly, (4) builds on the assumption that debt is always honored, and it implies that $b \in [-1, 1]$. This budget constraint also implies that public capital is of no value in the second period, apart from its contribution to the production of public goods. Hence, capital is irreversible for the period 2 decision-maker. The initial capital stocks k_1^g and k_1^f are exogenously predetermined.

Representatives from either of two political parties, denoted D and R, can hold office. Their preferences for public goods have the same form as voters', i.e. equation (1), with preference weights α^D and α^R, for party D and R respectively. Party J's preferences for public goods over the two periods are given by

$$W^J = E \sum_{t=1}^{2} u\left(g_t, f_t | \alpha^J\right); \quad J = D, R \tag{5}$$

I restrict attention to cases where $\alpha^J \in \langle 0, 1 \rangle$, and ignore the extreme cases $\alpha^J = \{0, 1\}$.

A period is defined as a term of office. Before period 2 there is an election, which party R wins with probability p_R and party D wins with probability $1 - p_R$.[6] This electoral uncertainty may be due to a random participation rate, for instance due to fluctuating costs of voting or changes in the eligibility of the voting population. Alternatively, the source of uncertainty may be random fluctuations

[6] The period one government is of course also elected, but that election is unimportant for my analysis since I only study choices that are made later in time.

in the parties' relative popularity along dimensions of politics that are independent of the composition of public goods.[7]

Compared to Tabellini and Alesina (1990)'s framework, the distinctions are that I allow for intratemporal non-separability between g and f in utility, and that providing public goods requires labor and predetermined capital. Intratemporal separability is encompassed as the special case where $\sigma = \phi$. An environment where public income is converted into public goods at constant unit cost, is encompassed as the special case where $\gamma = 1$. Clearly, the assumption that capital is completely predetermined while labor is fully flexible is strong. However, the central mechanisms in this paper are of a general nature, relying only on complementarity between inputs that differ by the flexibility with which politicians can alter them.

3 Political Equilibrium

The equilibrium objects of this economy are $\left\{n_1^g, n_1^f, k_2^g, k_2^f, b\right\}$ and $\left\{n_2^g, n_2^f\right\}$. Since first period choices are contingent on second period reactions, the model is solved by backward induction. Furthermore, to keep track of the policymaker's identity, define α_t^J as the preference weight of the party in office in period t.

3.1 The Second Period

In the second period the policymaker, identified by α_2^J, decides how much labor to assign to the production of each good. His problem is

$$\max_{n_2^g, n_2^f} u\left(g_2, f_2 | \alpha_2^J\right)$$

[7]My structure with exogenous re-election probabilities can be rationalized within a probabilistic voting model (Persson and Tabellini (2000), Lindbeck and Weibull (1993)), where voters share either of the two parties' preferences for public goods (i.e. $\alpha^i = \left\{\alpha^R, \alpha^D\right\}$), and in addition have a random preference, "ideology", for having a given party in office. Details are available upon request.

subject to (2) and (4). The first-order condition is

$$u_g\left(g_2, f_2|\alpha_2^J\right) g_n\left(n_2^g, k_2^g\right) = u_f\left(g_2, f_2|\alpha_2^J\right) f_n(n_2^f, k_2^f) \tag{6}$$

Together with the budget constraint (4), this equation implicitly defines equilibrium choices $n_2^{g,J*}$ and $n_2^{f,J*}$ as functions of α_2^J, b, k_2^g and k_2^f. Define these functions as

$$n_2^{g,J*} = G\left(\alpha_2^J, b, k_2^g, k_2^f\right)$$

$$n_2^{f,J*} = F\left(\alpha_2^J, b, k_2^g, k_2^f\right)$$

For notational convenience I will hereafter refer to $G\left(\alpha_2^J, b, k_2^g, k_2^f\right)$ as G^J and $F\left(\alpha_2^J, b, k_2^g, k_2^f\right)$ as F^J. Under mild restrictions on the utility and production functions, the partial derivatives satisfy $G^J_{\alpha_2^J} = -F^J_{\alpha_2^J} > 0$ and $G_b^J = -1 - F_b^J$ ϵ $[-1, 0]$. These restrictions are $\frac{u_{hh}\left(\cdot|\alpha_2^J\right)}{u_h\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_h\left(\cdot|\alpha_2^J\right)} < 0$, $0 < h_{n_2^{h,J}} < \infty$ and $-\infty < h_{n_2^{h,J} n_2^{h,J}} \leq 0$, for $h = g, f$. Further details are provided in the appendix.

A novelty of this framework is that the labor choices depend on purpose-specific capital (k_2^g and k_2^f):

$$\begin{aligned} G^J_{k_2^g} &= -F^J_{k_2^f} \\ &= \frac{-\left[\left(\frac{u_{gg}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)}\right) g_{k_2^{g,J}} + \frac{g_{n_2^{g,J} k_2^{g,J}}}{g_{n_2^{g,J}}}\right]}{\left(\frac{u_{gg}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)}\right) g_{n_2^{g,J}} + \frac{g_{n_2^{g,J} n_2^{g,J}}}{g_{n_2^{g,j}}} + \left(\frac{u_{ff}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)}\right) f_{n_2^{f,J}} + \frac{f_{n_2^{f,J} n_2^{f,J}}}{f_{n_2^{f,J}}}} \end{aligned} \tag{7}$$

$$\begin{aligned} F^J_{k_2^f} &= -G^J_{k_2^f} \\ &= \frac{-\left[\left(\frac{u_{ff}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)}\right) f_{k_2^{f,J}} + \frac{f_{n_2^{f,J} k_2^{f,J}}}{f_{n_2^{f,J}} f_{k_2^{f,J}}}\right]}{\left(\frac{u_{gg}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)}\right) g_{n_2^{g,J}} + \frac{g_{n_2^{g,J} n_2^{g,J}}}{g_{n_2^{g,J}}} + \left(\frac{u_{ff}\left(\cdot|\alpha_2^J\right)}{u_f\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_g\left(\cdot|\alpha_2^J\right)}\right) f_{n_2^{f,J}} + \frac{f_{n_2^{f,J} n_2^{f,J}}}{f_{n_2^{f,J}}}} \end{aligned} \tag{8}$$

The signs of these reactions are ambiguous. To gain insight, it is useful to consider them under the specific functional forms for utility and production technology displayed in equations (1) and (2). With these functional forms the denominators in (7) and (8) are negative, while the numerators may be written as $\left[\frac{h\left(n_2^h,k_2^h\right)}{k_2^h}\right]^{1/\varepsilon}\left[\frac{1}{\phi}-\frac{1}{\varepsilon}\right]$ for $h=g,f$. Hence, it follows that $G_{k_g}^J>0$ if and only if the elasticity of substitution between the different goods in the utility function (ϕ) is larger than the elasticity of substitution between the inputs of g-production (ε), and vice versa. The intuition is that an extra unit of physical capital has two opposing effects on labor demand in period two. On the one hand, an extra unit of k_2^g increases the marginal productivity of labor in the production of g_2 to the extent that the two input factors are complementary in production. All else equal this motivates the second period policymaker to allocate labor to the g-sector. On the other hand, since the utility function is concave in any specific good, the increase in g-goods when k_2^g increases makes the marginal utility of g-goods fall. This motivates moving labor from g-production to f-production. Hence, the use of labor in g-production increases with the amount of capital installed there if and only if the degree to which k_2^g substitutes for n_2^g in production (ε) is lower than the degree to which g_2 substitutes for f_2 in consumption (ϕ).

The above result holds somewhat more generally, as summarized in the following proposition:

Proposition 1 *Assume that* $u\left(g_t,f_t|\alpha_2^J\right)$ *is homogenous in* g *and* f*, and that* $h\left(n_t^h,k_t^h\right)$ *is homogenous of degree one in* n^h *and* k^h *with* $0<h_{n_2^h}<\infty$ *and* $-\infty<h_{n_2^h n_2^h}\leq 0$ *(*$h=g,f$*). Then* $\frac{dn_t^{h,J}}{dk_t^h}\gtreqless 0\Leftrightarrow\Phi\left(g_t,f_t\right)\gtreqless\epsilon\left(n_t^h,k_t^h\right)$*, where* $\Phi\left(g_t,f_t\right)$ *is the elasticity of substitution between* g *and* f *in utility and* $\epsilon\left(n_t^h,k_t^h\right)$ *is the elasticity of substitution between* k_t^h *and* n_t^h *in production of good* h*.*

Proof. See appendix. ■

3.2 The First Period

For convenience, introduce the notation $h_2^J = h\left(n_2^{h,J}, k_2^h\right)$, and assume, without loss of generality, that the office-holder in period one is from party R. The policymaker in period one solves the following problem:

$$\max_{n_1^g, n_1^f, k_2^g, k_2^f, b} u\left(g_1, f_1 | \alpha^R\right) + p_R u\left(g_2, f_2 | \alpha^R\right) + \left(1 - p_R\right) u\left(g_2^D, f_2^D | \alpha^R\right)$$

subject to the production technology (2), the budget constraint (3) and the reaction functions (7) and (8). Thus, the first period decisionmaker acknowledges how his investment choices will influence second period outcomes. A solution to this problem must satisfy

$$u_g\left(g_1, f_1 | \alpha^R\right) g_n\left(n_1^g, k_1^g\right) = u_f\left(g_1, f_1 | \alpha^R\right) f_n(n_1^f, k_1^f) \tag{9}$$

$$\left\{\begin{array}{c} u_g\left(g_1, f_1 | \alpha^R\right) g_n\left(n_1^g, k_1^g\right) \\ -p_R\left[u_g\left(g_2^R, f_2^R | \alpha^R\right) g_n\left(n_2^{g,R}, k_2^g\right)\right] \\ +\left(1 - p_R\right)\left[\begin{array}{c} u_g\left(g_2^D, f_2^D | \alpha^R\right) g_n(n_2^{g,D}, k_2^{g,D}) G_b^D \\ +u_f\left(g_2^D, f_2^D | \alpha^R\right) f_n(n_2^{f,D}, k_2^{f,D}) F_b^D \end{array}\right] \end{array}\right\} = 0 \tag{10}$$

$$\left\{\begin{array}{c} -u_g\left(g_1, f_1 | \alpha^R\right) g_n\left(n_1^g, k_1^g\right) \\ +p_R\left[\, u_g\left(g_2^R, f_2^R | \alpha^R\right) g_k(n_2^{g,R}, k_2^g) \,\right] \\ +\left(1 - p_R\right)\left[\begin{array}{c} u_g\left(g_2^D, f_2^D | \alpha^R\right) g_n(n_2^{g,D}, k_2^g) G_{k_2^g}^D \\ +u_f\left(g_2^D, f_2^D | \alpha^R\right) f_n(n_2^{f,D}, k_2^f) F_{k_2^g}^D \\ +u_g\left(g_2^D, f_2^D | \alpha^R\right) g_k(n_2^{g,D}, k_2^g) \end{array}\right] \end{array}\right\} = 0 \tag{11}$$

$$\left\{\begin{array}{c} -u_g\left(g_1, f_1|\alpha^R\right) g_n\left(n_1^g, k_1^g\right) \\ +p_R\left[\begin{array}{c} u_f\left(g_2^R, f_2^R|\alpha^R\right) f_k(n_2^{f,R}, k_2^f) \end{array}\right] \\ (1-p_R)\left[\begin{array}{c} u_g\left(g_2^D, f_2^D|\alpha^R\right) g_n(n_2^{g,D}, k_2^g) G_{k_2^f}^D \\ +u_f\left(g_2^D, f_2^D|\alpha^R\right) f_n(n_2^{f,D}, k_2^f) F_{k_2^f}^D \\ +u_f\left(g_2^D, f_2^D|\alpha^R\right) f_k(n_2^{f,D}, k_2^f) \end{array}\right] \end{array}\right\} = 0 \qquad (12)$$

in addition to the budget constraint (3). These are the first-order conditions for labor use, debt accumulation, investment in the g-sector and investment in the f-sector, respectively.

4 Two Special Cases

While the model does not have a general analytical solution, there are two interesting special cases where the equilibrium choices may be described analytically. First, when utility is linear in the two goods g and f, while production is linear in capital and labor, anticipated turnover affects equilibrium policy as follows::

Proposition 2 *Assume* $u\left(g_t, f_t|\alpha^J\right) = \frac{\left[\alpha^J g_t + \left(1-\alpha^J\right) f_t\right]^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$, $h_2 = \gamma n_2^h + (1-\gamma)\, k_2^h$ *and* $h_1 = \gamma n_1^h$ *for* $h = g, f$, *that* $\alpha^R < 1/2$, $\alpha^D > 1/2$, *and that party R holds office in period 1. Compared to a scenario with certain re-election, anticipated turnover affects policy as follows:*

1. *If* $1 - \alpha_1 > \gamma > 1/2$, *investments* ($k_2^f + k_2^g$) *are increased from zero to* $2\frac{(1-\gamma)^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$, *and deficits* ($b$) *are increased from zero to* 1. *Hence, total savings* ($k_2^f + k_2^g - b$) *are reduced if* $\sigma > 1$, *increased if* $\sigma < 1$, *and are unaffected if* $\sigma = 1$.

2. *If* $1 - \alpha_1 < \gamma$, *investments* ($k_2^f + k_2^g$) *are unaffected while deficits* (b) *are changed from zero to* $\frac{(1-\alpha_1)^{\sigma-1}-\alpha_1^{\sigma-1}}{\alpha_1^{\sigma-1}+(1-\alpha_1)^{\sigma-1}}$. *Hence, deficits are increased if* $\sigma > 1$, *increased if* $\sigma < 1$ *and are unaffected if* $\sigma = 1$. *Total savings* ($k_2^f + k_2^g - b$) *are reduced if* $\sigma > 1$, *increased if* $\sigma < 1$ *and are unaffected if* $\sigma = 1$.

3. If $\gamma < 1/2$, policy is unaffected by anticipated turnover.

Proof. *See appendix.* ■

Intuitively, when capital and labor are perfect substitutes the incumbent can perfectly pin down which goods are produced in period 2, by simply investing in the appropriate capital, and leaving no financial wealth for the successor to spend on labor. If $\gamma > 1/2$, this strategy comes at a cost, as labor is the most effective input to produce public goods. Hence, the incumbent will only pursue overinvestment if its preferences are sufficiently strongly tilted towards one of the goods. This explains part 1of Proposition 2, where the incumbent finds the effect of investment on increased production of f-goods worthy of the cost in terms of g-goods lost. In part 2 of the proposition, the efficiency loss from using capital rather than labor in production is too large, and the incumbent chooses not to invest in physical capital, but to let future goods be produced using labor instead. This coincides with what a planner without certain of re-election would choose. If $\gamma < 1/2$, capital is the most efficient input to second period production, and hence is the favored input also by a planner certain of re-election, which explains part 3.

Because physical capital and bonds are two alternative means for storing public wealth, a relevant question is how political turnover influences total public savings, defined as accumulation of both two asset types summed together. Proposition 2 shows that when anticipated turnover does affect policy, the impact on total savings is determined by the intertemporal elasticity of substitution, σ. The reason is that to the incumbent, turnover implies that resources will be suboptimally utilized in the future. Hence, in order to smooth the utility from public goods over time, the incumbent must leave more resources available for future rather than current production. On the other hand, since the return to spending on current rather than future production increases, anticipated turnover also gives an incentive to spend more in the current period. When $\sigma < 1$, the former effect dominates and total savings are increased, while if $\sigma > 1$ the latter effect dominates and total savings are reduced.[8]

Proposition 2 illustrates how the proposed framework of government production encompasses existing studies in the literature as special cases. With perfect substitutability between capital and labor, the choice between these two inputs is equivalent to the choice between non-durable and durable versions of public goods studied by Glazer (1989). He argues that when a government can choose between two such versions of a public good, anticipated turnover biases the choice toward excess durability. This is what occurs in Proposition 2, as anticipated turnover stimulates investment. Furthermore, the assumption in Tabellini and Alesina (1990) that public goods are simultaneously consumed and purchased at fixed prices, is encompassed as the special case where labor is the only input to production ($\gamma = 1$), and consequently their main result regarding debt bias is captured in part 2 of Proposition 2.[9]

Perfect substitutability between capital and labor is a restrictive assumption, which rules out that current investments may affect the marginal product of labor in the future. The following Proposition is obtained under the alternative assumption that the elasticity of substitution in production is unity ($\varepsilon = 1$), and illustrates how the degree of input complementarity determines how anticipated turnover will influence debt and capital accumulation:

Proposition 3 *Assume* $u\left(g_t, f_t|\alpha^J\right) = \frac{\left[\alpha^J g+\left(1-\alpha^J\right)f\right]^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$, $h_2 = \left(n_2^h\right)^{\gamma}\left(k_2^h\right)^{(1-\gamma)}$ *and* $h_1 = \gamma n_1^h$ *for* $h = g, f$, $\alpha^R < 1/2$, $\alpha^D > 1/2$, *and that party R holds office in period 1. In this case, anticipated turnover will not affect policy choices.*

[8] These two effects are reminiscent of conventional income and substitution effects of variation in returns on savings.

[9] Tabellini and Alesina (1990) assume that utility is separable in g and f, and show that if the "concavity index" $\lambda(h) \equiv -u''(h)/[u'(h)]^2$, $h = g, f$, of the utility function is decreasing, anticipated turnover motivates an incumbent to issues more government debt (b). With the CES utility function in (1) preferences are separable when $\phi = \sigma$, and the condition that $\lambda'(h) \lesseqgtr 0$ is satisfied when $\sigma \gtreqless 1$. Hence, just as in part 2 of Proposition 2, the incumbent borrows ($b > 0$) if $\sigma > 1$, saves ($b < 0$) if $\sigma < 1$, and balances the budget ($b = 0$) if $\sigma = 1$.

Proof. *See appendix.* ■

The reason why policy is not affected by anticipated turnover in this case, is that labor now is unproductive without a capital stock to complement it. Hence, a successor will not allocate any labor to projects without a pre-existing capital stock, and the incumbent, who strictly prefers one good (f in the example) over the other (due to the linear utility function), is able to implement his favored future intratemporal resource allocation by investing only in the project he prefers. Any successor will then spend all available funds on labor in that sector.

5 Numerical Results

While Propositions 2 and 3 illuminate the importance of input complementarity for the impact of anticipated turnover, they remain stylized examples as they rest on particular parameter values for the utility and production functions. Hence, it is interesting to ask how anticipated turnover affects policies for less extreme, and more empirically plausible, parameter values than those assumed above. To answer this question I numerically solve the set of equations composed by the first-order conditions and budget constraints, and analyze the model for different values of σ, ε, and ϕ. The benchmark set of parameter values I will use are given in Table 1, and they are motivated by the following considerations.

The elasticity of substitution between capital and labor, ε, is quantified in line with estimates of macroeconomic production functions. Two recent examples using U.S. time series are Klump, McAdam, and Willman (2007), who estimate the elasticity of substitution to be between 0.5 and 0.6, and Antràs (2004), who concludes more generally that the elasticity is "likely to be considerably less than one". A priori there is no reason believe that capital-labor substitutability is very different in the public sector. I therefore set ε to 0.7. The distribution parameter γ is set to be consistent with a labor share of 70 percent if government were minimizing costs.[10] Hence, whenever ε is varied in the analysis that follows, γ is updated so that the labor share does not change.[11] This parametrization is roughly consistent with the evidence for US government expenditure in Cavallo (2005). He documents that in the post-war period wage expenditure has accounted for 63 percent of total government spending on consumption and investment, while investment has accounted for 16 percent. The remaining 21 percent has been purchases of privately produced goods and services. It is unclear whether this last component should be categorized as capital or labor in my model, most likely it contains items of both input types. One period in the model is to be interpreted a term of office, which typically is around 4 years. Hence, the value assigned to δ is consistent with a yearly depreciation rate slightly below 5 percent, which is within the range that Blanchard and Giavazzi (2004) and Kamps (2004) argue is empirically reasonable for public capital.[12]

Finally, the intra- and intertemporal elasticities of substitution in utility, ϕ and σ, are both set to 1 as a starting point. This facilitates comparison with Tabellini and Alesina (1990), since an implication of their analysis is that in this case policy choices are not influenced by political turnover, as explained in the next section. Hence, the effects that are due to the public sector production technology are particularly clear in this case.

In order to solve the model, initial capital stocks $\left\{k_1^g, k_1^f\right\}$ must be specified. In the main analysis I will set these initial capital stocks at the levels that the incumbent would choose to maintain if he were certain to hold office also in period

[10]The mapping between observed use of labor and γ is complicated by the fact that cost minimization is inconsistent with the theoretical foundation of this paper, where investment and employment choices are affected by strategic considerations. In addition to the measurement problem that public sector output is not observed, this implies that a public production function cannot be estimated in the same way as macro production functions conventionally are (f.ex. in Arrow, Chenery, and Solow (1961) and Klump, McAdam, and Willman (2007)).

[11]Formally, γ is updated according to $\gamma = \delta^{1/\varepsilon} / \left[(1/ls - 1)^{1/\varepsilon} + \delta^{1/\varepsilon}\right]$, where ls is the labor share of total expenditure.

[12]Blanchard and Giavazzi (2004) argue that a 5 percent yearly depreciation rate is reasonably consistent with observed public physical capital investment in Germany and Italy. Based on data on capital accumulation in 22 OECD countries, Kamps (2004) argues that the yearly depreciation rate on public capital has risen from 2.5 percent in 1960 to 4 percent in 2001.

2. Hence, $\left\{k_1^g, k_1^f\right\}$ are set so that if $p_R = 1$ it is optimal to choose $k_2^h = k_1^h$ for $h = g, f$. Analytical expressions for the equilibrium objects in this case are given in the appendix. In a robustness analysis below, I assess the role of these initial conditions, and document that they are unimportant for the results below.

5.1 Debt Accumulation

Figure 1 plots the deficit chosen by an incumbent from party R who is certain to be replaced by a candidate from party D ($p_R = 0$), minus the deficit he would choose if he were certain to be re-elected ($p_R = 1$) . The magnitudes can be interpreted as shares of government income per period. Each curve shows the deficit bias as a function of σ. The dashed curve plots the case where public goods are produced with constant returns to scale with labor as the only input ($\gamma = 1$). Hence, the government essentially is a price-taking consumer. The reaction of public deficits to turnover is therefore determined by the intertemporal elasticity of substitution. When $\sigma < 1$, the incumbent has a strong desire to smooth consumption of public goods over time, and therefore saves more if re-election is unlikely, while if $\sigma > 1$ the incumbent is willing to sacrifice intertemporal smoothing, and reduces savings so as to get a better intratemporal allocation between g and f.[13]

The solid curve in Figure 1's shows how the introduction of a production function with a an empirically plausible capital share and elasticity of substitution between inputs (ε) alters the incentive for debt accumulation. Now anticipated turnover does not motivate excessively high deficits even if σ is relatively high, but generally provides a moderate incentive to operate with a surplus. Furthermore, the curve shows that the quantitative effect of turnover on debt accumulation always remains rather muted, and does not depend heavily on politicians' willingness to shift consumption between periods (σ).

[13] Tabellini and Alesina (1990) use a utility function which is separable ($\sigma = \phi$). We see that the relationship between the intertemporal elasticity of substitution and excess debt accumulation holds also when utility is non-separable, that is when the intratemporal elasticity of substitution is held constant.

Complementarity between capital and labor is important for how the presence of production capital affects the deficit bias. To illustrate this, the dotted curve in Figure 1 plots the deficit bias with a relatively high degree of substitutability between capital and labor ($\varepsilon = 1.5$). We see that now there is a relatively strong tendency for turnover to motivate excess deficits, even for low values of σ. This is reminiscent of part 1 of Proposition 2, where inputs are perfectly substitutable, and an incumbent would pin down future production by debt financing capital investments when turnover is likely.

Intuitively, complementarity counteracts the deficit bias because it makes capital a powerful tool to influence how public funds are utilized in period 2, as emphasized in Proposition 1. Furthermore, because the current capital stock is fixed, complementarity implies that the marginal cost of raising current production, in terms of future production foregone, is increasing. Both these effects reduce the incentive to shift resources between periods. In addition, the higher is the degree of input complementarity, the more sensitive are physical capital returns to the future labor allocation. Hence, with a low value of ε, turnover makes it important to leave resources that can finance labor to complement the incumbent's investments. As explained further in the next section, this also tends to reduce an incumbent's valuation of physical capital. Hence, for a given level of total savings in financial assets and physical capital, the composition of savings will be tilted toward financial capital when inputs are not easily substitutable.

5.2 Investment in Physical Capital

Figure 2 plots the difference between investment in physical capital when the incumbent is sure not to be re-elected and such investment when re-election is certain.[14] The figure displays this difference as a function of σ, and shows that

[14] Because the initial capital stocks, k_1^g and k_1^f, are identical in the two cases, the curves in Figure 2 show the difference between the second period capital stock, $k_2^g + k_2^f$, under certain turnover and certain re-election. Since government revenues are set to 1 each period, the magnitudes along

with $\varepsilon = 0.7$, expected turnover tends to reduce accumulation of physical capital, and more so the higher is voters' willingness to substitute public consumption between periods. Comparing Figure 2 to Figure 1 gives the following insight: When capital and labor are complements in public production, political turnover tends to motivate under-accumulation of physical capital rather than financial assets. In contrast, if capital and labor are easily substitutable, turnover has the opposite effect.

The intuition behind the shift away from physical capital is as follows. When capital and labor complement each other, the future returns to capital depend on the amount of labor it is combined with. Since the successor has different preferences over public goods than the incumbent, he will tend to allocate relatively more labor to production of the good the incumbent prefers relatively weakly (g in the numerical example) and less to the good the incumbent prefers more strongly (f). Hence, from the incumbent's perspective the capital he builds will be inefficiently combined with labor in the future. This counters the desire to invest excessively in order to pin down which public goods are produced in the future, emphasized in Proposition 2 and Glazer (1989). Instead, the incumbent's valuation of physical capital available for future public production is reduced by expected turnover when ε is small.

5.3 Total Public Savings

Figure 3 plots how σ affects the difference between total savings, defined as the sum of investment in physical capital and financial surplus, under certain re-election and under expected political turnover. We see that political turnover reduces total savings when $\sigma > 1$ while it increases savings when $\sigma < 1$ as in Proposition 2, irrespective of the production technology. The presence of capital, and the degree of complementarity, will matter only quantitatively. Comparing the solid curve,

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the vertical axis represent the share of government revenues.

which is constructed under the benchmark parameter values, to the other curves in the figure, we see that the framework with complementarity between capital and labor dampens the extent to which turnover alters total savings. This reflects how policy choices at different points in time are tied closer together in the production economy, as the returns to labor depend on investment decisions made in the past while capital returns depend on labor allocations chosen in the future.

5.4 Sensitivity Analysis

This section explores the robustness of the above results with respect to the elasticity of substitution between capital and labor, the intratemporal elasticity of substitution and the initial capital stocks.

5.4.1 The Elasticity of Substitution Between Capital and Labor

Figure 4 plots how the effects of anticipated turnover on deficits, physical capital investments, and total savings, vary with the elasticity of substitution between capital and labor, ε, for three different values of σ. Overall, these plots confirm the main insights of the earlier sections, regarding how input substitutability influences the incentive for an incumbent's savings decision.When ε is low, anticipated turnover motivates higher savings of financial capital and lower savings of physical capital, while the opposite applies if ε is high. The dashed curves show that in the special case where $\varepsilon = \sigma = 1$, turnover affects neither investments nor deficits. In contrast, for total savings the qualitative effect of turnover is determined by σ, whereas ε matters only quantitatively.[15]

Evidently, when ε is low, its effect on the investment and deficit biases is non-monotonic. To understand why, it is useful to start with the Leontief technology

[15] For high values of ε, the procedure of updating γ to hold the cost minimizing capital labor ratio constant, becomes important. If γ is not updated in this way, but held constant irrespective of ε, then the cost-minimizing capital share would approach zero (if $\gamma > 0.5$) or unity (if $\gamma < 0.5$) as ε grows. As in Proposition 2, with a high value of γ the investments of a strategic politician would also approach zero as ε grows, and hence capital would play no role in the model. This was considered in a previous version of the paper, and results are available upon request.

case where $\varepsilon = 0$. In such a scenario labor allocations are determined entirely by the relative capital stocks. Hence, if an incumbent invests as if he were certain to be re-elected, he will obtain his preferred use of resources in period 2 irrespective of who is in charge in that period. Anticipated turnover is therefore irrelevant for savings in this case. When ε increases beyond zero, the incumbent can no longer pin down the future labor allocation. Hence, physical capital will be sub-optimally combined with labor in period 2, which reduces the returns to investment in physical capital, and induces the savings composition to be tilted away from physical capital and towards financial assets. This composition effect underlies the negative slope of the deficit and investment biases for small values of ε (approximately 0.35) in the plot. What pulls in the other direction, is that a higher value of ε also makes capital less dependent on labor in order to yield returns. Hence, the larger is ε, the less does a given mismatch between the composition of capital and labor reduce the value of physical capital. Similarly, as higher substitutability between capital and labor reduces an incumbent's influence on the future labor allocation, his valuation of financial assets falls with ε. Both these two last effects make the value of financial capital fall relative to the value of physical capital, and together they underlie the increasing relationships between ε and the deficit and investment biases in Figure 4.

5.4.2 The Intratemporal Elasticity of Substitution

In order to explore the importance of the intratemporal elasticity of substitution, Figure 5 displays the impact of turnover for different values of ϕ. The first two panels display the impact on deficits and investment when technology is such that turnover tilts savings towards physical capital ($\varepsilon = 0.7$), towards financial assets ($\varepsilon = 1.5$) or does not affect the savings composition at all ($\varepsilon = 1$). The last panel plots the the effect of turnover on total savings for three different values of σ.

The central insight from Figure 5 is that the intratemporal elasticity does not alter the qualitative effect of anticipated turnover emphasized above. When ϕ is close to zero, the composition of public goods provided by the successor is independent of the incumbents' decisions. Hence the best an incumbent can do is to facilitate efficient production in the future, and invest as much as if re-election were certain. When ϕ approaches infinity, the incumbent prefers to produce only one public good, and can implement this in period 2 by investing in only that sector. Thus, in the polar cases with extremely low or extremely high substitutability between g and f, the biases induced by turnover are negligible. When ϕ is in an intermediate range, the aforementioned effects of political turnover on the composition of savings occur, as the accumulation of physical capital relative to financial assets is reduced if ε is low, and increased if ε is high. Total savings are determined by σ.

5.4.3 Initial Capital Stocks

In the analysis above the initial capital stocks k_1^g and k_1^f were assumed to be at the level a planner would choose to maintain. As this assumption was chosen primarily for analytical convenience, Figure 6 shows the effects of relaxing it.

The two upper plots let the fraction $\frac{k_1^g}{k_1^f}$ vary from half to twice its value in the benchmark, holding the total amount of initial capital $(k_1^g + k_1^f)$ constant. We see that the strategically induced debt and investment biases both are unaffected by the initial composition of the capital stock. The two lower panels in Figure 6 hold the composition $\frac{k_1^g}{k_1^f}$ constant at the same level as in the benchmark, but instead let the total amount of capital vary from half to twice the level assumed previously. Again the main qualitative results for excess debt and capital accumulation are unaffected. Quantitatively, there is an effect, as the magnitude of the two biases increase with the total initial stock of physical capital.[16]

[16]While Figure 6 displays results only when $\sigma = 1$, the results are similar for other values of σ too.

5.4.4 The Re-election Probability

Not surprisingly, the effects of anticipated turnover on deficits and investment are monotonically affected by the re-election probability, p_R.[17]

6 The Costs of Political Turnover

When government production is homogenous of degree one, as with the specific production functions in (2), the highest level of public production attainable at a given cost is achieved for a unique capital-labor ratio $\kappa = \frac{k^h}{n^h}$, $h = f, g$.[18] Thus, as physical capital is fully reversible between periods, the production possibility frontier for the second period is linear from the viewpoint of period one, with capital-labor ratios always equal to κ along it. In a situation without political turnover, preferences matter only by pinning down where along the ex ante possibility frontier production ends up.

However, if capital and labor are complements ($h_{nk}\left(n_2^h, k_2^h\right) > 0$), then ex post, when the capital stocks k_2^g and k_2^f are installed, the production possibility frontier is no longer linear, but concave. Hence, although the policymaker in this period allocates resources to achieve ex post efficiency, from an ex ante perspective the allocation may be inefficient. The following proposition states that if the office holder in period 2 has different preferences than the office holder in period 1, ex ante inefficiency will indeed result:

Proposition 4 *Assume that* $0 < h_{n_2^h} < \infty$, $-\infty < h_{n_2^h n_2^h} \leq 0$, $h_{k_2^h n_2^h} > 0$ *and* $\frac{u_{hh}\left(\cdot|\alpha_2^J\right)}{u_h\left(\cdot|\alpha_2^J\right)} - \frac{u_{gf}\left(\cdot|\alpha_2^J\right)}{u_h\left(\cdot|\alpha_2^J\right)} < 0$, *for* $h = g, f$. *Assume that the office holder in period* 1 *is of type R. Then* $\frac{g_k'(n_2^{g,D}, k_2^g)}{g_n'\left(n_2^{g,D}, k_2^g\right)} = \frac{f_k'(n_2^{f,D}, k_2^f)}{f_n'\left(n_2^{f,D}, k_2^f\right)} = 1$ *if and only if* $\alpha^R = \alpha^D$. *When* $\alpha^R < \alpha^D$, $\frac{g_k\left(n_2^{g,D}, k_2^g\right)}{g_n\left(n_2^{g,D}, k_2^g\right)} > 1 > \frac{f_k\left(n_2^{f,D}, k_2^f\right)}{f_n\left(n_2^{f,D}, k_2^f\right)}$. *When* $\alpha^R > \alpha^D$, $\frac{g_k\left(n_2^{g,D}, k_2^g\right)}{g_n\left(n_2^{g,D}, k_2^g\right)} < 1 < \frac{f_k\left(n_2^{f,D}, k_2^f\right)}{f_n\left(n_2^{f,D}, k_2^f\right)}$. *Hence,*

[17] To preserve space, results on the effect of p_R are not displayed here, but are available upon request.

[18] $\kappa = \left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon}$ with the specific production function in (2).

second-period production is not on the ex ante production possibility if there is political turnover.

Proof. See appendix. ■

This proposition reflects that when there is turnover, the second-period policymaker allocates too much labor to production of the good he prefers more strongly than his predecessor (good g if $a^D > \alpha^R$), and too little labor to the other purpose. With a different combination of the inputs into second period production more could have been produced of either good. I will later refer to this source of resource waste as "inefficient allocation of inputs". Note that this inefficiency is not driven by uncertainty about the election outcome, as it arises also when $p_R = 0$ and the incumbent thus has the information that enables him to invest in a way that supports efficiency in period 2. It is driven by the incumbent's motive to invest so as to push the composition of government production in the second period toward his own preferences rather than onto the ex ante possibility frontier.

There is a further cause of production inefficiency in this economy. This is the first-period decision-maker's choice of how much to save in physical relative to financial capital. As shown in the preceding analysis, the composition of savings is likely to be affected by anticipated political turnover. Hence, the total capital-labor ratio in the second period, $\frac{k_2^g+k_2^f}{n_2^g+n_2^f}$, will generally deviate from its first best level κ. I refer to this as "inefficient composition of savings".

The upper panel of Figure 7 illustrates the impact of the two inefficiency sources in the political equilibrium when $p_R = 0$. It shows how many more f-goods that could have been produced in the second period if public resources were used more efficiently than in the political equilibrium, without reducing g_1, $f_1$or g_2. The dashed line isolates the effect of the inefficient allocation of inputs. Hence it is computed holding savings in bonds $(-b)$ and capital $(k_2^f + k_2^g)$ at their political equilibrium levels, while labor and capital types are allocated so as to minimize the costs of producing g_2. The solid line shows how many more f-goods that would have been produced if the composition of savings were optimal as well. Thus, the distance between the dashed and solid line isolates the contribution of the suboptimal savings composition to production inefficiency.[19]

We see that a substantial portion of public goods may be lost due to a bad resource allocation in the political equilibrium. Furthermore, it is the inefficient allocation of inputs that contributes most to overall inefficiency, while the influence of the savings composition is negligible.[20]

The bottom panel in Figure 7 distinguishes between production inefficiency in the political equilibrium where the incumbent is aware that he will not be re-elected, and inefficiency in the situation where the incumbent behaves as if he were sure to decide both periods, but is replaced by someone else in the second period. The former is referred to as a "strategic politician" while the latter is referred to as a "naive planner" in the figure. We see that the two curves in the figure nearly coincide. Hence, whether the incumbent is aware of his re-election outlook or not, is almost irrelevant for production efficiency.[21]

The small difference between the two inefficiency measures reflects two effects that almost completely cancel each other out in the political equilibrium. On the one hand, the incumbent who is aware of his successor's preferences may use this information by investing so as to facilitate efficiency in future production. On the other hand, the strategic politician has an incentive to invest so as to push the composition of second period production toward his own preferences. Figure 7 shows that the potential gain from the incumbent's knowledge about the successor's preferences is close to eliminated by the strategic behavior.

[19] Details on these calculations are in the appendix.

[20] As is clear from Figures 1 and 2, the quantitative importance of inefficiently composed public savings will depend on σ. However, the conclusion that the bad composition of input expenditures is more severe than the bad composition of savings is robust to variations in σ. Sensitivity results are available upon request.

[21] This finding is robust to alternative parameterizations of the model.

7 Conclusion

In this paper I have accounted for government production of public goods, using public capital and labor as inputs. With an empirically plausible degree of complementarity between the two inputs, I have found that the anticipation of political turnover is likely to motivate politicians to cut their accumulation of physical capital rather than financial assets. This contrasts with the established literature which argues that turnover is likely to generate too high deficits and too much investment, as governments seek to constrain their successors. The central mechanism behind my result is that input complementarity on the one hand makes current investments affect the future use of financial wealth, and on the other hand makes future decisions determine the returns to current investments. By considering government as a consumer buying public goods at fixed prices, the conventional approach to fiscal policy ignores this mechanism.

A normative implication of my analysis is that political turnover renders government production less cost efficient. The potential welfare gains from knowledge about changing preferences for public goods provision do not materialize, as the incumbent about to be replaced uses capital to affect the future resource allocation. In order to mitigate such inefficiencies due to strategic behavior, the conventional device of a balanced budget rule is unlikely to work. What would help are instead institutions that make policymakers apply resources where the preconditions for public activity are good, even though these activities need not be what the current policymaker prefers most strongly. This would support production efficiency in the public sector, raise the returns to capital and thereby stimulate public investment.

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A Appendix

A.1 The Reaction Functions

Implicitly differentiating the first-order condition (6), and taking into account the budget constraint (4), yields the following general expressions for $G^J_{\alpha^J_2}$ and G^J_b:

$$G^J_{\alpha^J_2} = \frac{\frac{u_{f\alpha}\left(\cdot|\alpha^J_2\right)}{u_f\left(\cdot|\alpha^J_2\right)} - \frac{u_{g\alpha}\left(\cdot|\alpha^J_2\right)}{u_g\left(\cdot|\alpha^J_2\right)}}{L\left(n^{g,J}_2, n^{f,J}_2, k^g_2, k^f_2\right)} \tag{13}$$

$$G^J_b = \frac{-\left[\left(\frac{u_{ff}\left(\cdot|\alpha^J_2\right)}{u_f\left(\cdot|\alpha^J_2\right)} - \frac{u_{gf}\left(\cdot|\alpha^J_2\right)}{u_g\left(\cdot|\alpha^J_2\right)}\right) f_n\left(n^{f,J}_2, k^f_2\right) + \frac{f_{nn}\left(n^{f,J}_2, k^f_2\right)}{f_n\left(n^{f,J}_2, k^f_2\right)}\right]}{L\left(n^{g,J}_2, n^{f,J}_2, k^g_2, k^f_2\right)} \tag{14}$$

where $u_g\left(\cdot|\alpha^J_2\right) \equiv u_g\left(g^J_2, f^J_2|\alpha^J\right)$, $u_{gg}\left(\cdot|\alpha^J\right) \equiv u_{gg}\left(g^J_2, f^J_2|\alpha^J\right)$, and

$$L\left(n^{g,J}_2, n^{f,J}_2, k^g_2, k^f_2\right) = \left(\frac{u_{gg}\left(\cdot|\alpha^J_2\right)}{u_g\left(\cdot|\alpha^J_2\right)} - \frac{u_{gf}\left(\cdot|\alpha^J_2\right)}{u_f\left(\cdot|\alpha^J_2\right)}\right) g_n\left(n^{g,J}_2, k^g_2\right) \tag{15}$$
$$+\frac{g_{nn}\left(n^{g,J}_2, k^g_2\right)}{g_n\left(n^{g,J}_2, k^g_2\right)} + \left(\frac{u_{ff}\left(\cdot|\alpha^J_2\right)}{u_f\left(\cdot|\alpha^J_2\right)} - \frac{u_{gf}\left(\cdot|\alpha^J_2\right)}{u_g\left(\cdot|\alpha^J_2\right)}\right) f_n\left(n^{f,J}_2, k^f_2\right) + \frac{f_{nn}\left(n^{f,J}_2, k^f_2\right)}{f_n\left(n^{f,J}_2, k^f_2\right)}$$

The budget constraint (4) implies that $G^J_{\alpha^J_2} = -F^J_{\alpha^J_2}$ and $G^J_b = -1 - F^J_b$. Assume that the utility and production functions are such that the following conditions always hold:

Condition 1: $\frac{u_{gg}(\cdot|\alpha)}{u_g(\cdot|\alpha)} - \frac{u_{gf}(\cdot|\alpha)}{u_f(\cdot|\alpha)} < 0$ and $\frac{u_{ff}(\cdot|\alpha)}{u_f(\cdot|\alpha)} - \frac{u_{gf}(\cdot|\alpha)}{u_g(\cdot|\alpha)} < 0$.

Condition 2: $0 < h_n < \infty$ and $-\infty < h_{nn} \leq 0$, for $h = g, f$.

Because $u_{f\alpha}\left(\cdot|\alpha^J_2\right) < 0$ and $u_{g\alpha}\left(\cdot|\alpha^J_2\right) > 0$, these two properties imply that $G^J_{\alpha^J_2} > 0$. They also imply that $G^J_b \epsilon \left\langle -1, 0\right]$. Note that Property 1 holds when the utility function is homogenous in g and f (this is clear from Lemma 1 below). With Leontief production functions, Property 2 will not hold.

A.2 Proof of Proposition 1

To simplify notation, this section ignores the preference and party indexes α^J and J. G_{k_g} may then be written as

$$G_{k_g} = \frac{-\frac{g_k}{g}\left[z\left(g,f\right)+\frac{g_{nk}g}{g_n g_k}\right]}{\left(\frac{u_{gg}(g,f)}{u_g(g,f)}-\frac{u_{gf}(g,f)}{u_f(g,f)}\right)g_n+\frac{g_{nn}}{g_n}+\left(\frac{u_{ff}(g,f)}{u_f(g,f)}-\frac{u_{gf}(g,f)}{u_g(g,f)}\right)f_n+\frac{f_{nn}}{f_n}}, \tag{16}$$

where $z\left(g,f\right) \equiv \left(\frac{u_{gg}(g,f)}{u_g(g,f)}-\frac{u_{gf}(g,f)}{u_f(g,f)}\right)g$.

Note first that when $g\left(n,k\right)$ is homogenous of degree 1, its elasticity of substitution $\epsilon\left(n,k\right)$ equals $\frac{g'_n g'_k}{g''_{nk}g2}$(see f. ex. Sydsæter, Strøm, and Berck (2005)). For $z\left(g,f\right)$, the following applies:

Lemma 1 *If $u(g,f)$ is homogenous of any degree k, then $z\left(g,f\right)=-1/\Phi\left(g,f\right)$, where $\Phi\left(g,f\right)$ is the elasticity of substitution between g and f in $u(g,f)$.*

Proof. *For any function $u(g,f)$, $\Phi\left(g,f\right)=\frac{-u_g u_f\left(gu_g+fu_f\right)}{gf\left[\left(u_f\right)^2u_{gg}+(u_g)^2u_{ff}-2u_gu_fu_{gf}\right]}$ (see f. ex. Sydsæter, Strøm, and Berck (2005)). The term $z\left(g,f\right)$ in (16) may be written as*

$$z\left(g,f\right)=\frac{\overbrace{\left(u_{gg}u_fg-u_{gf}u_gg\right)\left(gu_g+fu_f\right)}^{N}}{u_gu_f\left(gu_g+fu_f\right)}$$

The following shows that the numerator of $z\left(g,f\right)$, denoted P, equals the denominator of $\Phi\left(g,f\right)$. By adding and subtracting $fgu''_{ff}\left(u'_g\right)^2$ we may rewrite P as

$$P=fgu_{gg}\left(u_f\right)^2+fgu_{ff}\left(u_g\right)^2+u_gg\left[u_{gg}gu_f-u_{ff}fu_g-u_{gf}\left(gu_g+fu_f\right)\right]$$

If $u\left(g,f\right)$ is homogenous of degree k, then $u_{gg}g=\left(k-1\right)u_g-u_{gf}f$. Inserting this *inside the brackets of the expression above and rearranging gives:*

$$\begin{aligned}
P &= fgu_{gg}(u_f)^2 + fgu_{ff}(u_g)^2 + u_g g \begin{bmatrix} ((k-1)\,u_g - u_{gf} f)\, u_f \\ -((k-1)\,u_f - u_{gf} g)\, u_g - u_{gf}(gu_g + fu_f) \end{bmatrix} \\
&= fgu_{gg}(u_f)^2 + fgu_{ff}(u_g)^2 + u_g g\left[-u_{gf} f u_f + u_{gf} g u_g - u_{gf}(gu_g + fu_f)\right] \\
&= fg\left[u_{gg}(u_f)^2 + u_{ff}(u_g)^2 - 2u_{gf} u_g u_f\right],
\end{aligned}$$

which is identical to the denominator in $\Phi(g,f)$. Thus, $z(g,f) = -1/\Phi(g,f)$. ■

Hence, if $u(g,f)$ is homogenous of degree k and the production functions are homogenous of degree 1, we can express the reaction G_{k_g} as

$$G_{k_g} = \frac{\frac{g_k}{g}\left[1/\epsilon(n,k) - 1/\Phi(g,f)\right]}{\frac{g_n}{g}1/\Phi(g,f) - \frac{g_{nn}}{g_n} + \frac{f_n}{f}1/\Phi(g,f) - \frac{f_{nn}}{f_n}}$$

$\frac{-\frac{g_k}{g}\left[z(g,f)+\frac{g_{nk}g}{g_n g_k}\right]}{\left(\frac{u_{gg}(g,f)}{u_g(g,f)}-\frac{u_{gf}(g,f)}{u_f(g,f)}\right)g_n+\frac{g_{nn}}{g_n}+\left(\frac{u_{ff}(g,f)}{u_f(g,f)}-\frac{u_{gf}(g,f)}{u_g(g,f)}\right)f_n+\frac{f_{nn}}{f_n}}$ Under Condition 2 this expression implies that $G_{k_g} \gtreqless 0$ if $\Phi(g,f) \gtreqless \epsilon(n,k)$ as stated in the proposition. The same argument holds for F_{k_f}.

A.3 Planner Problem

Define a planner as an agent with preference weight α who holds office in both periods with certainty. Hence, the planner problem is to maximize $\sum_{t=1}^{2} u\left(g\left(n_t^g, k_t^g\right), f\left(n_t^f, k_t^f\right)|\alpha\right)$, subject to (3) and (4). The first-order conditions are

$$\alpha u_g(g_2, f_2|\alpha)\, g_n'(n_2^g, k_2^g) = u_f(g_2, f_2|\alpha)\, f_n\left(n_2^f, k_2^f\right) \tag{17}$$

$$u_g(g_1, f_1|\alpha)\, g_n'(n_1^g, k_1^g) = u_f(g_1, f_1|\alpha)\, f_n\left(n_1^f, k_1^f\right) \tag{18}$$

$$u_g g_n(n_1^g, k_1^g) = u_g(g_2) g_n(n_2^g, k_2^g) \tag{19}$$

$$g_n(n_2^g, k_2^g) = g_k(n_2^g, k_2^g) \tag{20}$$

$$f_n\left(n_2^f, k_2^f\right) = f_k\left(n_2^f, k_2^f\right) \tag{21}$$

Note that (20) and (21) imply that $g_n\left(n_2^g, k_2^g\right) = f_n(n_2^f, k_2^f)$. Furthermore, when the production functions are identical and homogenous of degree one, $\frac{k_2^g}{n_2^g} = \frac{k_2^f}{n_2^f} \equiv \kappa$.

A.3.1 Planner Solution when $k_2^h = k_1^h$, for $h = g, f$

With the utility and production functions in (1) and (2), and under the assumption $k_2^h = k_1^h$ for $h = g, f$, the first-order conditions (17) - (21) and the resource constraint (4) may be solved for the choice variables as follows

$$n^g = \left[1 + \frac{\delta}{2}\left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon}\right]^{-1}\left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\phi}\right]^{-1} \tag{22}$$

$$n^f = \left[1 + \frac{\delta}{2}\left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon}\right]^{-1}\left[1 + \left(\frac{\alpha}{1-\alpha}\right)^{\phi}\right]^{-1}$$

$$k^g = \left[\left(\frac{\gamma}{1-\gamma}\right)^{\varepsilon} + \frac{\delta}{2}\right]^{-1}\left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\phi}\right]^{-1} \tag{23}$$

$$k^f = \left[\left(\frac{\gamma}{1-\gamma}\right)^{\varepsilon} + \frac{\delta}{2}\right]^{-1}\left[\left(\frac{\alpha}{1-\alpha}\right)^{\phi} + 1\right]^{-1} \tag{24}$$

$$b = \frac{\delta}{2}\left(k^g + k^f\right) = \left[\frac{2}{\delta}\left(\frac{\gamma}{1-\gamma}\right)^{\varepsilon} + 1\right]^{-1} \tag{25}$$

A.4 Proof of Proposition 2

In period 2, party J sets n_2^g and n_2^f so as to maximize $\frac{1}{1-\frac{1}{\sigma}}\left(\alpha^J g_2 + \left(1-\alpha^J\right) f_2\right)^{1-\frac{1}{\sigma}}$ subject to $h_2 = \gamma n_2^h + (1-\gamma) k_2^h$ for $h = g, f$, the budget constraint (4), $n_2^f \geq 0$ and $n_2^g \geq 0$. The Kuhn-Tucker first order conditions to this problem imply that $\alpha^J + \frac{1}{\gamma}\left(\lambda_2^g - \lambda_2^f\right)\left(\alpha^J g_2 + \left(1-\alpha^J\right) f_2\right)^{\frac{1}{\sigma}} = \left(1-\alpha^J\right)$, where $\lambda_2^g \geq 0$ ($= 0$ if $n_2^g > 0$) and $\lambda_2^f \geq 0$ ($= 0$ if $n_2^f > 0$). We see that if $\alpha^J = \alpha^D > 1/2$ then $\lambda_2^f > \lambda_2^g \geq 0$. Hence $n_2^f = 0$ and $n_2^g = 1 - b$ if party D holds office in period 2. If $\alpha^J = \alpha^D < 1/2$, then $\lambda_2^g > \lambda_2^f \geq 0$. Hence $n_2^g = 0$ and $n_2^f = 1 - b$ if party R decides in period 2.

In period 1 party R sets n_1^g, n_1^f, k_2^g, k_2^f and b so as to maximize $\frac{1}{1-\frac{1}{\sigma}} \Big[\left(\alpha^R g_1 + \left(1-\alpha^R\right) f_1\right)^{1-\frac{1}{\sigma}} + (\alpha$ subject to the production functions, the budget constraint (3), and $k_2^g > 0$, $k_2^f > 0$, $n_1^f \geq 0$, $n_1^g \geq 0$ and $b < 1$. The first order conditions for this problem are

$$\alpha^R \gamma + \left(\lambda_1^g - \mu_1\right) \left(\alpha^R g_1 + \left(1-\alpha^R\right) f_1\right)^{\frac{1}{\sigma}} = 0 \tag{26}$$

$$\left(1-\alpha^R\right) \gamma + \left(\lambda_1^f - \mu_1\right) \left(\alpha^R g_1 + \left(1-\alpha^R\right) f_1\right)^{\frac{1}{\sigma}} = 0 \tag{27}$$

$$\alpha^R \left(1-\gamma\right) + \left(\omega_1^g - \mu_1\right) \left(\alpha^R g_2 + \left(1-\alpha^R\right) f_2\right)^{\frac{1}{\sigma}} = 0 \tag{28}$$

$$\left(1-\alpha^R\right)\left(1-\gamma\right) + \left(\omega_1^f - \mu_1\right) \left(\alpha^R g_2 + \left(1-\alpha^R\right) f_2\right)^{\frac{1}{\sigma}} = 0 \tag{29}$$

$$\alpha^R \gamma \frac{dn_2^g}{db} + \left(\mu_1 - \lambda^b\right) \left(\alpha^R g_2 + \left(1-\alpha^R\right) f_2\right)^{\frac{1}{\sigma}} = 0 \tag{30}$$

Here $\mu_1 > 0$ is the multiplier on the period one budget constraint, while $\lambda_1^g \geq 0$ ($= 0$ if $n_2^g > 0$), $\lambda_1^f \geq 0$ ($= 0$ if $n_2^f > 0$), $\omega_1^g \geq 0$ ($= 0$ if $k_2^g > 0$), $\omega_1^f \geq 0$ ($= 0$ if $k_2^f > 0$) and $\lambda^b \geq 0$ ($= 0$ if $b < 1$).

From (26) and (27) it follows that because $\alpha^R < 1/2$, $\lambda_1^g > \lambda_1^f \geq 0$, and hence $n_1^g = 0$.

Similarly, from (28) and (29) it follows that because $\alpha^R < 1/2$, $\omega_1^g > \omega_1^f \geq 0$, and hence $k_2^g = 0$.

With $n_2^g = 0$, equation (27) now implies that $\left(\mu_1 - \lambda_1^f\right)^\sigma n_1^f = \left[\left(1-\alpha^R\right)\gamma\right]^{\sigma-1}$. Thus $n_1^f > 0$ and hence $\lambda_1^f = 0$. Solved for n_1^f, we now have

$$n_1^f = \frac{\left[\left(1-\alpha^R\right)\gamma\right]^{\sigma-1}}{\mu_1^\sigma} \tag{31}$$

Consider now R's policy when it knows that it will not be re-elected. Using that $n_2^f = 0$, $n_2^g = 1-b$ and $k_2^g = 0$ equation (30) now reads $\alpha^R\gamma + \left(\lambda^b - \mu_1\right)\left(\alpha^R\gamma\left(1-b\right) + \left(1-\alpha^R\right)\left(1-\gamma\right)k_2^f\right)^{\frac{1}{\sigma}} = 0$ which implies that $b = 1$ and $k_2^f = 0$ is not a possible solution. Hence, there are three possible combinations of b and k_2^f. If $b = 1$ and $k_2^f > 0$, equations (29), (31) and the budget constraint

$k_2^f + n_1^f = 2$ imply that $n_1^f = 2\frac{\gamma^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$ and $k_2^f = 2\frac{(1-\gamma)^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$. This solution is consistent with equations (29) and (30) if and only if $1-\alpha^R \geq \gamma$. Next, if $k_2^f = 0$ and $b < 1$, equations (30), (31) and the budget constraint $n_1^f = 1+b$ imply that $n_1^f = 2\frac{\left(1-\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$ and $b = \frac{\left(1-\alpha^R\right)^{\sigma-1}-\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$. This solution is consistent with equations (29) and (30) if and only if $1-\alpha^R \leq \gamma$. Finally, $k_2^f > 0$ and $b < 1$ is consistent with equations (29) and (30) if and only if $1-\alpha_1 = \gamma$, in which case $n_1^f = 2\frac{\left(1-\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$, $k_2^f \in \left[0, 2\frac{\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}\right]$ and $b \in \left[\frac{\left(1-\alpha^R\right)^{\sigma-1}-\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}, 1\right]$ (with $k_2^f - b = 1 - n_1^f$). We may now summarize R's policy when it is certain not to be re-elected:

Summary 1 *When party R is certain to be replaced by party D in period 2, it sets policy in period* 1 *as follows. If $1-\alpha^R > \gamma$, then $n_1^f = 2\frac{\gamma^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$, $k_2^f = 2\frac{(1-\gamma)^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$, and $b = 1$. If $1-\alpha_1 < \gamma$, then $n_1^f = 2\frac{\left(1-\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$, $k_2^f = 0$ and $b = \frac{\left(1-\alpha^R\right)^{\sigma-1}-\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$. If $1-\alpha_1 = \gamma$, then $n_1^f = 2\frac{\left(1-\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}$, $k_2^f \in \left[0, 2\frac{\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}\right]$, $b \in \left[\frac{\left(1-\alpha^R\right)^{\sigma-1}-\left(\alpha^R\right)^{\sigma-1}}{(\alpha^R)^{\sigma-1}+(1-\alpha^R)^{\sigma-1}}, 1\right]$.*

Next, consider R's policy when it is certain to be re-elected. Using that $n_2^f = 1-b$, $n_2^g = 0$ and $k_2^g = 0$ equation (30) again implies that $b = 1$ and $k_2^f = 0$ is not a possible solution. Hence, there are three possible combinations of b and k_2^f. If $b = 1$ and $k_2^f > 0$, equations (29), (31) and the budget constraint $k_2^f + n_1^f = 2$ imply $n_1^f = 2\frac{\gamma^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$ and $k_2^f = 2\frac{(1-\gamma)^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$. This solution is consistent with equations (29) and (30) if and only if $1/2 \geq \gamma$. If $k_2^f = 0$ and $b < 1$, equations (30) and the budget constraints $n_1^f = 1+b$ and $n_2^f = 1-b$ imply $n_1^f = 1$, while $b = 0$. This solution is consistent with equations (29) and (30) if and only if $1/2 \leq \gamma$. Finally, $k_2^f > 0$ and $b < 1$ is consistent with equations (29) and (30) if and only if $1/2 = \gamma$, in which case $n_1^f = 1$, $b \in [0,1]$ and $k_2^f \in [0,1]$ (with $k_2^f - b = 0$). We may now summarize R's policy when re-election is certain:

Summary 2 *When party R is certain to remain in office in period* 2*, it sets policy in period* 1 *as follows. If $\gamma > 1/2$, then $n_1^f = n_2^f = 1$ while $n_2^g = b = k_2^f = 0$.*

If $\gamma < 1/2$, *then* $n_1^f = 2\frac{\gamma^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$, $k_2^f = 2\frac{(1-\gamma)^{\sigma-1}}{(1-\gamma)^{\sigma-1}+\gamma^{\sigma-1}}$ *and* $b = 1$, *while* $n_2^g = n_2^f = k_2^f = 0$. *If* $\gamma = 1/2$, $n_1^f = 1$, $b \in [0,1]$, $n_2^f \in [0,1]$ *and* $k_2^f \in [0,1]$.

By comparing Summary 1 and 2, Proposition 2 follows.

A.5 Proof of Proposition 3

Assume first that re-election is certain, so that the incumbent of type R chooses $n_1^g, n_1^f, n_2^g, n_2^f, k_2^g, k_2^f, b$ so as to maximize $W^{\alpha^R} = u\left(g_1, f_1|\alpha^R\right) + u\left(g_2, f_2|\alpha^R\right)$, subject to the budget constraints (3) and (4). Consider the optimal allocation of resources for production in period 2, given any use of n_1^f and n_1^g. This allocation must solve the problem of maximizing $f_2 = \left(n_2^f\right)^\gamma \left(k_2^f\right)^{1-\gamma}$, with respect to n_2^f, k_2^f, n_2^g and k_2^g, subject to $n_2^f + n_2^g + k_2^f + k_2^g = C$ and $g_2 = \left(n_2^g\right)^\gamma \left(k_2^g\right)^{1-\gamma} = \overline{g_2}$ for any $\overline{g}$ and $C = 2 - n_1^f - n_2^g$. The first-order conditions to this problem imply that $k_2^h = \frac{1-\gamma}{\gamma} n_2^h$ for $h = g, f$. By combining these expressions with the production functions, it follows that $n_2^h = h_2\left(\frac{\gamma}{1-\gamma}\right)^{1-\gamma}$ and $k_2^h = h_2\left(\frac{1-\gamma}{\gamma}\right)^\gamma$ for $h = g, f$. Hence, from the budget constraint it follows that $f_2 = \Omega C - \overline{g_2}$, where $\Omega \equiv \left[\left(\frac{\gamma}{1-\gamma}\right)^{1-\gamma} + \left(\frac{1-\gamma}{\gamma}\right)^\gamma\right]^{-1}$, and period 2 utility may be expressed as $u_2 = \frac{1}{1-1/\sigma}\left[\left(2\alpha^R - 1\right)\overline{g_2} + (1-\alpha_1)\,\Omega C\right]^{1-1/\sigma}$. Consequently, when $\alpha^R < 1/2$, utility is monotonically decreasing in $\overline{g_2}$. Hence, when re-election is certain, party R sets $\widetilde{n_2^g} = \widetilde{k_2^g} = 0$, where the tilde denotes that the choice is optimal with certain re-election. From the budget constraints and the optimality condition $k_2^f = \frac{1-\gamma}{\gamma} n_2^f$, it follows that in optimum $\widetilde{k_2^f} = (1-\gamma)\,\widetilde{C}$ and $\widetilde{n_2^f} = \gamma\widetilde{C}$, for some $\widetilde{C} = 2 - \widetilde{n_1^f} - \widetilde{n_1^g}$. Debt is residually determined from (4) as $\widetilde{b} = 1 - \widetilde{n_2^f} = 1 - \gamma\widetilde{C}$.

Assume now that the incumbent of type R is certain to be replaced by a party of type D. The decisionmaker in period 2 will then choose n_2^g and n_2^f so as to maximize $u\left(g_2, f_2|\alpha^D\right)$ subject to the budget constraint (4). The first-order condition for an interior solution to this problem is $\alpha_2\left(\frac{k_2^g}{n_2^g}\right)^{1-\gamma} = (1-\alpha_2)\left(\frac{k_2^f}{n_2^f}\right)^{1-\gamma}$.

Combined with the budget constraint this implies that

$$n_2^g = \frac{k_2^g}{k_2^f\left(\frac{1-\alpha^D}{\alpha^D}\right)^{\frac{1}{1-\gamma}} + k_2^g}(1-b)$$

and

$$n_2^f = \frac{k_2^f}{k_2^f + \left(\frac{\alpha^D}{1-\alpha^D}\right)^{\frac{1}{1-\gamma}} k_2^g}(1-b)$$

Thus, if the incumbent sets $b = \widetilde{b}$ and $k_2^g = \widetilde{k_2^g} = 0$, the decisionmaker in period 2 will choose $n_2^g = \widetilde{n_2^g} = 0$ and $n_2^f = \widetilde{n_2^f} = \gamma\widetilde{C}$. This implies that an incumbent certain to be replaced can implement the same allocation as if it were free to choose the labor allocation in period 2. Hence, the period 1 decisionmaker can always achieve its most preferred policy, irrespective of whether it is re-elected or not. It follows that anticipated turnover will not affect policy choices.

A.6 Proof of Proposition 4

The first-order conditions (10), (11) and (6) imply:

$$\frac{g_k\left(n_2^{g,R}, k_2^g\right)}{g_n\left(n_2^{g,R}, k_2^g\right)} = 1 + \frac{(1-p_R)}{p_R}\frac{u_g\left(g_2^D, f_2^D|\alpha^R\right)}{u_g\left(g_2^R, f_2^R|\alpha^R\right)}\frac{g_n\left(n_2^{g,D}, k_2^g\right)}{g_n\left(n_2^{g,R}, k_2^g\right)} \times \tag{32}$$

$$\left[1 - \frac{g_k\left(n_2^{g,D}, k_2^g\right)}{g_n\left(n_2^{g,D}, k_2^g\right)} + \left(\frac{u_f\left(g_2^D, f_2^D|\alpha^R\right)u_g\left(g_2^D, f_2^D|\alpha^D\right)}{u_f\left(g_2^D, f_2^D|\alpha^D\right)u_g\left(g_2^D, f_2^D|\alpha^R\right)} - 1\right)\left(1 + G_b^D + G_{k_2^g}^D\right)\right]$$

Equations (7) and (14) imply that $1 + G_b^D + G_{k_2^g}^D$ is given by:

$$1+G_b^D+G_{k_2^g}^D \quad (33)$$
$$= \frac{g_{n_2^{g,D}}\left(\frac{u_{gg}\left(\cdot|\alpha_2^D\right)}{u_g\left(\cdot|\alpha_2^D\right)}-\frac{u_{gf}\left(\cdot|\alpha_2^D\right)}{u_f\left(\cdot|\alpha_2^D\right)}\right)\left(1-\frac{g_{k_2^g}}{g_{n_2^{g,D}}}\right)-\frac{1}{g_{n_2^{g,D}}}\left(g_{n_2^{g,D}k_2^g}-g_{n_2^{g,D}n_2^{g,D}}\right)}{L\left(n_2^{g,D},n_2^{f,D},k_2^g,k_2^f\right)},$$

where $L\left(n_2^{g,D},n_2^{f,D},k_2^g,k_2^f\right)$ is given in (15), $u_g\left(\cdot|\alpha_2^D\right)\equiv u_g\left(g_2^D,f_2^D|\alpha_2^D\right)$ and $u_{gg}\left(\cdot|\alpha_2^D\right)\equiv u_{gg}\left(g_2^D,f_2^D|\alpha_2^D\right)$. Combining equation (32) with (33) and rearranging terms yields the following expression:

$$\frac{g_k\left(n_2^{g,R},k_2^g\right)}{g_n\left(n_2^{g,R},k_2^g\right)}=1+\frac{1-p_R}{p_R}N\left(\alpha^R,\alpha^D\right)+\left[1-\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)}\right]\frac{1-p_R}{p_R}M \quad (34)$$

where

$$M=\frac{u_g\left(g_2^D,f_2^D|\alpha^R\right)g_n\left(n_2^{g,D},k_2^g\right)}{u_g\left(g_2^R,f_2^R|\alpha^R\right)g_n\left(n_2^{g,R},k_2^g\right)}\times$$
$$\left[1+\frac{\left(\frac{u_f\left(g_2^D,f_2^D|\alpha^R\right)u_g\left(g_2^D,f_2^D|\alpha^D\right)}{u_f\left(g_2^D,f_2^D|\alpha^D\right)u_g\left(g_2^D,f_2^D|\alpha^R\right)}-1\right)\left(\frac{u_{gg}\left(\cdot|\alpha_2^D\right)}{u_g\left(\cdot|\alpha_2^D\right)}-\frac{u_{gf}\left(\cdot|\alpha_2^D\right)}{u_f\left(\cdot|\alpha_2^D\right)}\right)g_{n_2^{g,D}}}{L\left(n_2^{g,D},n_2^{f,D},k_2^g,k_2^f\right)}\right]$$

and

$$N\left(\alpha^R,\alpha^D\right)=\left(1-\frac{u_f\left(g_2^D,f_2^D|\alpha^R\right)u_g\left(g_2^D,f_2^D|\alpha^D\right)}{u_f\left(g_2^D,f_2^D|\alpha^D\right)u_g\left(g_2^D,f_2^D|\alpha^R\right)}\right)\frac{\frac{u_g\left(g_2^D,f_2^D|\alpha^R\right)g_{n_2^{g,D}}}{u_g\left(g_2^R,f_2^R|\alpha^R\right)g_{n_2^{g,R}}}\frac{g_{n_2^{g,D}k_2^g}-g_{n_2^{g,D}n_2^{g,D}}}{g_{n_2^{g,D}}}}{L\left(n_2^{g,D},n_2^{f,D},k_2^g,k_2^f\right)}.$$

Assume that the utility and production functions satisfy Conditions 1 and 2. It then follows that $M>0$. Furthermore, because $u_{g\alpha}>0$ and $u_{f_\alpha}<0$, the term $1-\frac{u_f\left(g_2^D,f_2^D|\alpha^R\right)u_g\left(g_2^D,f_2^D|\alpha^D\right)}{u_f\left(g_2^D,f_2^D|\alpha^D\right)u_g\left(g_2^D,f_2^D|\alpha^R\right)}\gtreqless 0\Leftrightarrow\alpha^R\lesseqgtr\alpha^D$. Assume that Conditions 1 and 2 hold, and that $g_{n_2^{g,D}k_2^g}>0$. It then follows that $N\left(\alpha^R,\alpha^D\right)\gtreqless 0\Leftrightarrow\alpha^R\lesseqgtr\alpha^D$.

Finally, in order to conclude we also need the following lemma:

Lemma 2 *If $g_{nk} > 0$ and Conditions 1 and 2 hold, then* $\frac{g_k(n_2^{g,R},k_2^g)}{g_n\left(n_2^{g,R},k_2^g\right)} \lesseqgtr \frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)}$ $\Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

Proof. *Under Conditions 1 and 2 $G^J_{\alpha_2^J} > 0$, which implies $n_2^{g,R} \lesseqgtr n_2^{g,D}$, when $\alpha^R \lesseqgtr \alpha^D$. Thus, the inequality holds since $g_{nk} \geq 0$ and $g_{nn} < 0$.* ■

Consider the situation with $p_R = 1$. It follows directly from (34) that $\frac{g_k\left(n_2^{g,R},k_2^g\right)}{g_n\left(n_2^{g,R},k_2^g\right)} = 1$. Lemma 2 then implies that $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} \gtreqless 1 \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

Consider the situation with $\alpha^R < \alpha^D$ and $0 < p_R < 1$. If $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} < 1$, Lemma 2 implies that $\frac{g_k(n_2^{g,R},k_2^g)}{g_n\left(n_2^{g,R},k_2^g\right)} < 1$ as well, and hence equation (34) holds only if $N\left(\alpha^R, \alpha^D\right) < 0$. However, $\alpha^R < \alpha^D$ implies $N\left(\alpha^R, \alpha^D\right) > 0$, a contradiction. If $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} > 1$, (34) holds with $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} > \frac{g_k(n_2^{g,R},k_2^g)}{g_n\left(n_2^{g,R},k_2^g\right)}$. Hence, when $\alpha^R < \alpha^D$ and $0 < p_R < 1$, equation (34) holds only if $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} > 1$.

Consider the situation with $\alpha^R > \alpha^D$ and $0 < p_R < 1$. If $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} > 1$, Lemma 2 implies that $\frac{g_k(n_2^{g,R},k_2^g)}{g_n\left(n_2^{g,R},k_2^g\right)} > 1$ as well, and hence equation (34) holds only if $N\left(\alpha^R, \alpha^D\right) > 0$. However, $\alpha^R > \alpha^D$ implies $N\left(\alpha^R, \alpha^D\right) < 0$, a contradiction. If $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} < 1$, (34) holds with $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} < \frac{g_k(n_2^{g,R},k_2^g)}{g_n\left(n_2^{g,R},k_2^g\right)}$. Hence, when $\alpha^R < \alpha^D$ and $0 < p_R < 1$, equation (34) holds only if $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} < 1$.

Consider the situation with $p_R = 0$. Equation (34) then implies that $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} \gtreqless 1 \Leftrightarrow N\left(\alpha^R, \alpha^D\right) \gtreqless 0$. It follows that when $p_R = 0$, $\frac{g_k(n_2^{g,D},k_2^g)}{g_n(n_2^{g,D},k_2^g)} \gtreqless 1 \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

In the same way it may be shown that $\frac{f_k\left(n_2^{f,D},k_2^f\right)}{f_n\left(n_2^{f,D},k_2^f\right)} < 1$ when $\alpha^R < \alpha^D$, that $\frac{f_k\left(n_2^{f,D},k_2^f\right)}{f_n\left(n_2^{f,D},k_2^f\right)} > 1$ when $\alpha^R > \alpha^D$, and that $\frac{f_k\left(n_2^{f,D},k_2^f\right)}{f_n\left(n_2^{f,D},k_2^f\right)} = 1$ when $\alpha^R = \alpha^D$.

A.7 Two Measures of Inefficiency

This section shows how the inefficiency measures in Figure 7 are calculated.

The first measure, termed "Inefficient allocation of inputs", is calculated by maximizing the production of f_2 with respect to $\left\{n_2^g, n_2^f, k_2^g, k_2^f\right\}$ holding $\left\{n_1^g, n_1^f, b\right\}$ and g_2 constant at the same levels as in the political equilibrium. A solution to this problem must satisfy

$$k_2^g + k_2^f = k_2^{g,pe} + k_2^{f,pe} \tag{35}$$

$$\left(\gamma n_2^{g\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)\, k_2^{g\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}} = g_2\left(n_2^{g,pe}, k_2^{g,pe}\right) \tag{36}$$

$$n_2^g + n_2^f = 1 - b^{pe} \tag{37}$$

$$\frac{k_2^g}{n_2^g} = \left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon} \equiv \kappa \tag{38}$$

where the superscript pe indicates that the variables are set to their political equilibrium values. The last equation indicates that production of g-goods is efficient (and is consistent with equations (22) and (23) above, describing the planner solution). The solution to (35) - (38), superscripted by $*$, is then used to calculate

$$\frac{f\left(n_2^{f,*}, k_2^{f,*}\right) - f\left(n_2^{f,pe}, k_2^{f,pe}\right)}{f\left(n_2^{f,pe}, k_2^{f,pe}\right)} \tag{39}$$

The second measure in Figure 7, termed "Total inefficiency", is calculated by maximizing the production of f_2 holding only$\left\{n_1^g, n_1^f\right\}$ and g_2 constant at the same levels as in the political equilibrium. The solution $\left\{n_2^g, n_2^f, k_2^g, k_2^f, b\right\}$ to this problem satisfies

$$\frac{k_2^g}{n_2^g} = \frac{k_2^f}{n_2^f} = \left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon} \equiv \kappa$$

$$\left(\gamma n_2^{g\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)\, k_2^{g\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}} = g_2\left(n_2^{g,pe}, k_2^{g,pe}\right)$$

$$n_1^{g,pe} + n_1^{f,pe} + k_2^g + k_2^f = 1 + b + (1-\delta)\, k_1^g + (1-\delta)\, k_1^f$$

$$n_2^g + n_2^f + b = 1$$

which differs from (35) - (38) because production of f_2 is also efficient, not only the production of g_2. This is feasible because b is not fixed at its political equilibrium level. The solution to these equations is then used to calculate the same measure as in (39).

Table 1: Parameterization

Parameter	Value	Parameter	Value	Parameter	Value
δ	0.2	ϕ	1	α^R	0.4
ε	0.7	σ	1	α^D	0.6

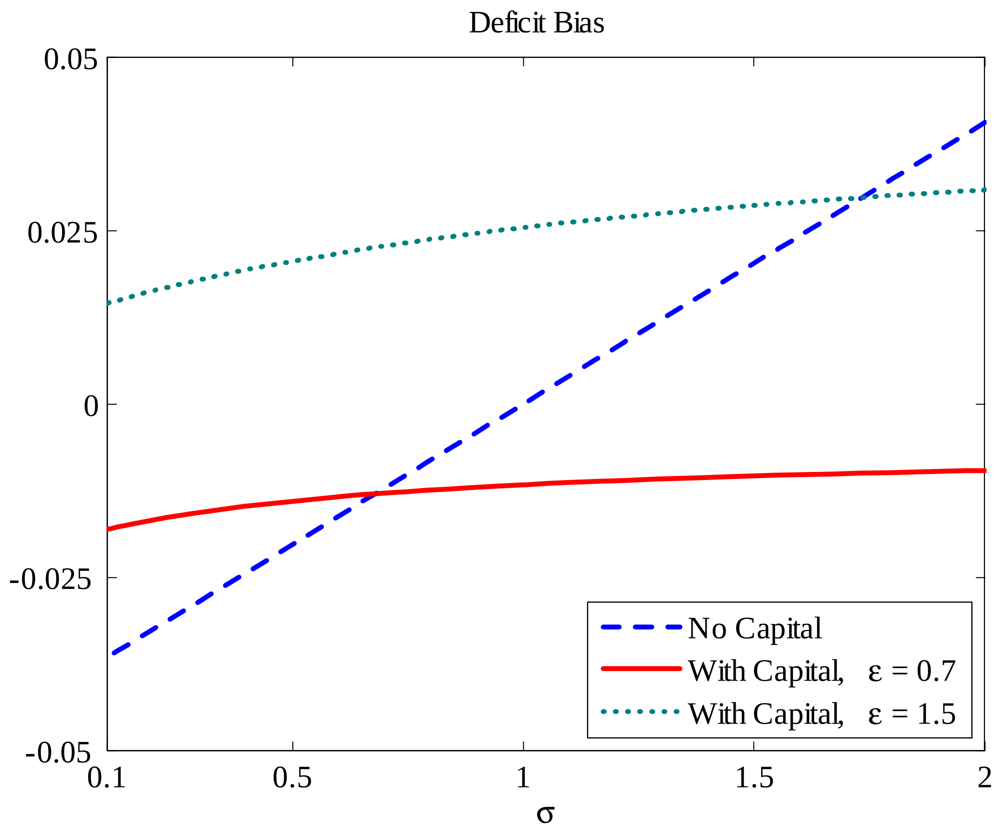

Figure 1: The public deficit under certain political turnover ($p_R = 0$) minus the deficit when the policymaker stays in office with certainty ($p_R = 1$). The dashed line displays the case when public goods are produced using labor only ($\gamma = 1$). The two other curves display cases where government uses capital to produce public goods ($\gamma = 0.7$) for different values of the elasticity of substitution between capital and labor, ε. Fixed parameter values: $\delta = 0.2$, $\phi = 1$, $\alpha^R = 0.4$, $\alpha^D = 0.6$.

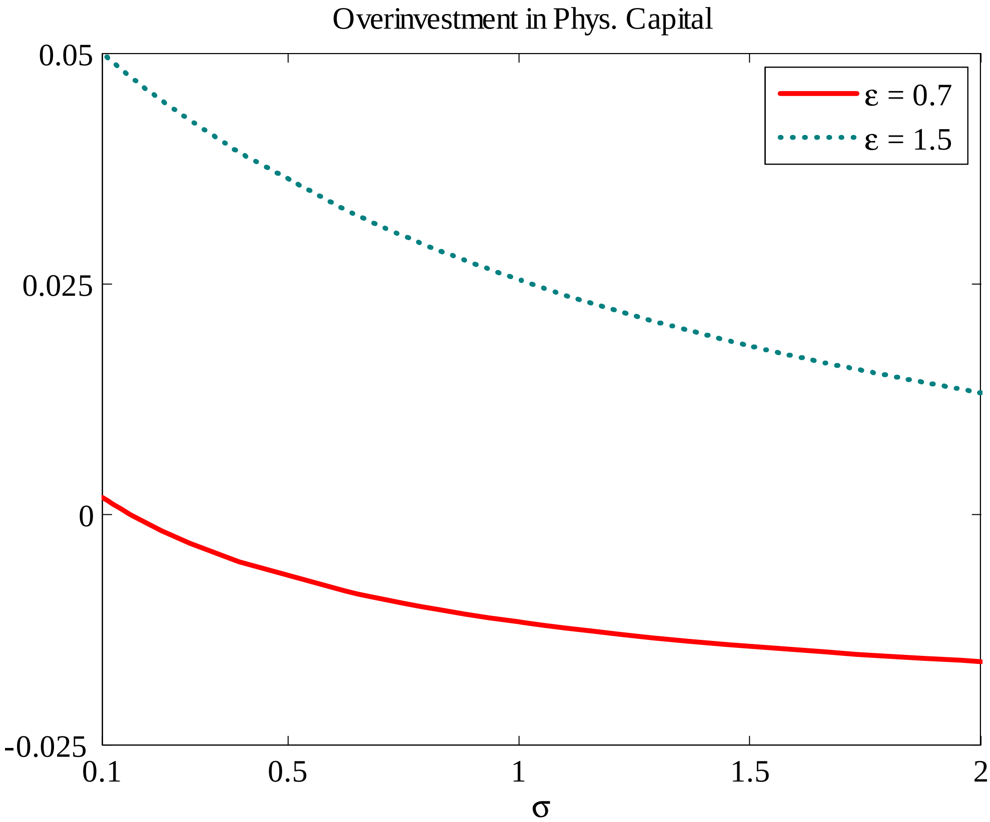

Figure 2: Accumulation of physical capital under certain political turnover ($p_R = 0$) minus accumulation of physical capital when the policymaker stays in office with certainty ($p_R = 1$). ε is the elasticity of substitution between capital and labor in production. Fixed parameter values: $\delta = 0.2$, $\phi = 1$, $\alpha^R = 0.4$, $\alpha^D = 0.6$.

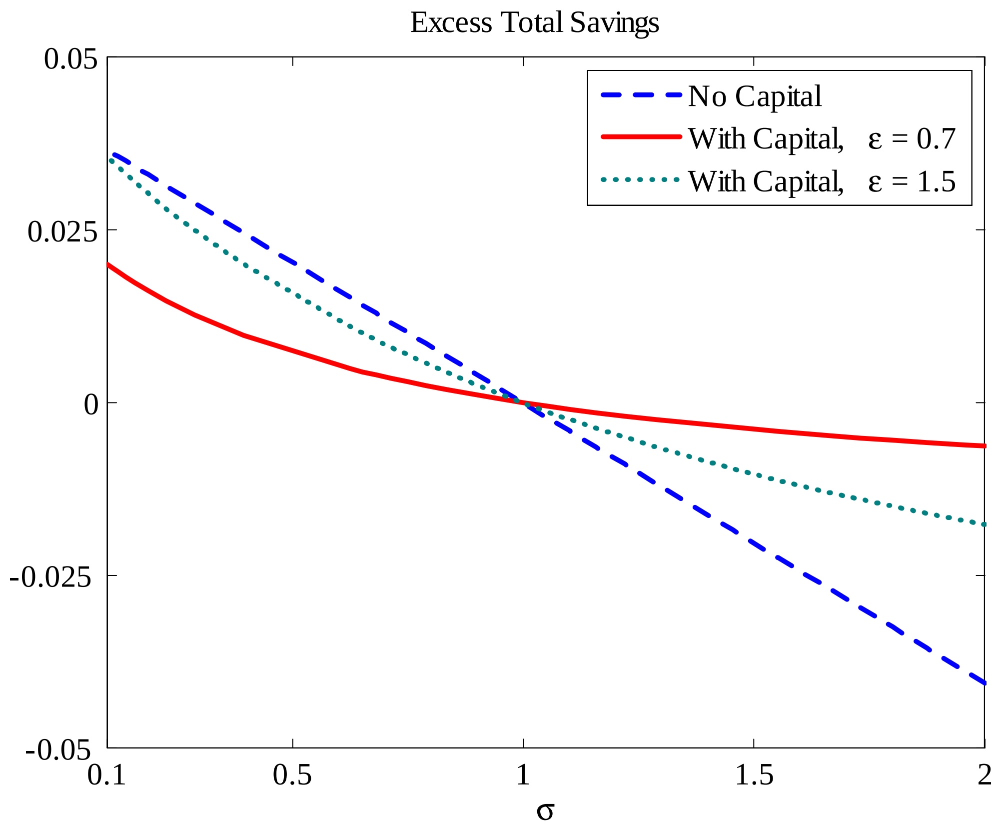

Figure 3: Total savings is defined as the sum of physical and financial capital accumulation. The plots present the gap between total savings under certain political turnover ($p_R = 0$) and total savings when the policymaker stays in office with certainty ($p_R = 1$). Fixed parameter values: $\delta = 0.2$, $\phi = 1$, $\alpha^R = 0.4$ and $\alpha^D = 0.6$

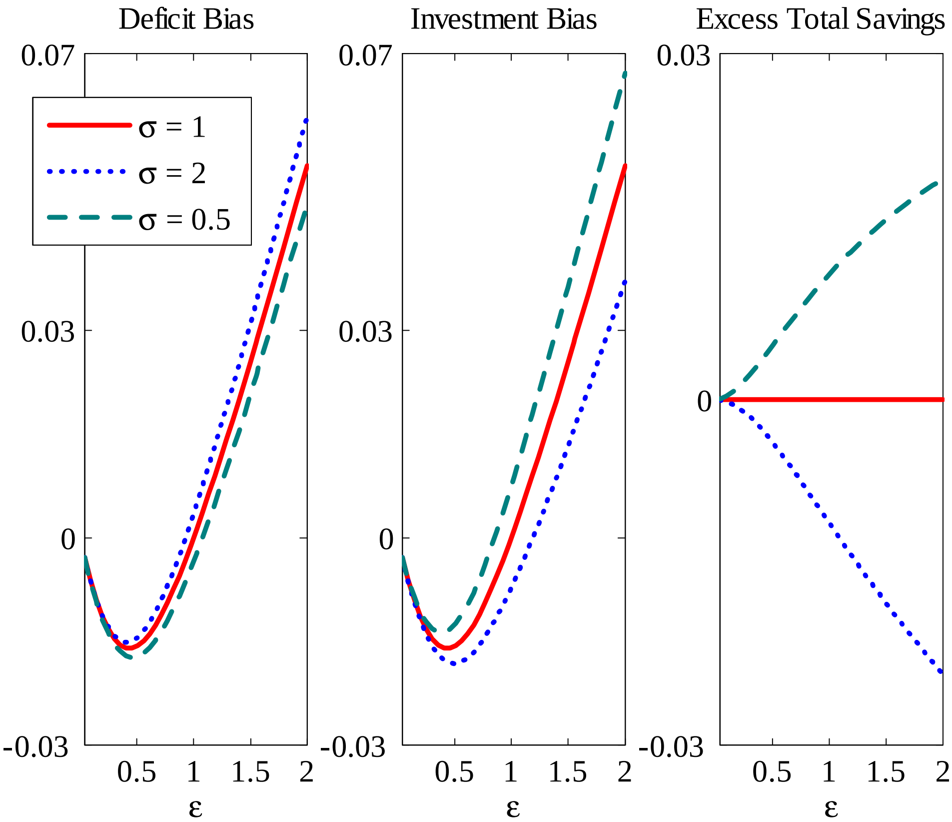

Figure 4: The public deficit and physical capital investment under certain political turnover ($p_R = 0$) minus the deficit and physical capital investment when the policymaker stays in office with certainty ($p_R = 1$). Fixed parameter values: $\delta = 0.2$, $\phi = 1$, $\alpha^R = 0.4$, $\alpha^D = 0.6$.

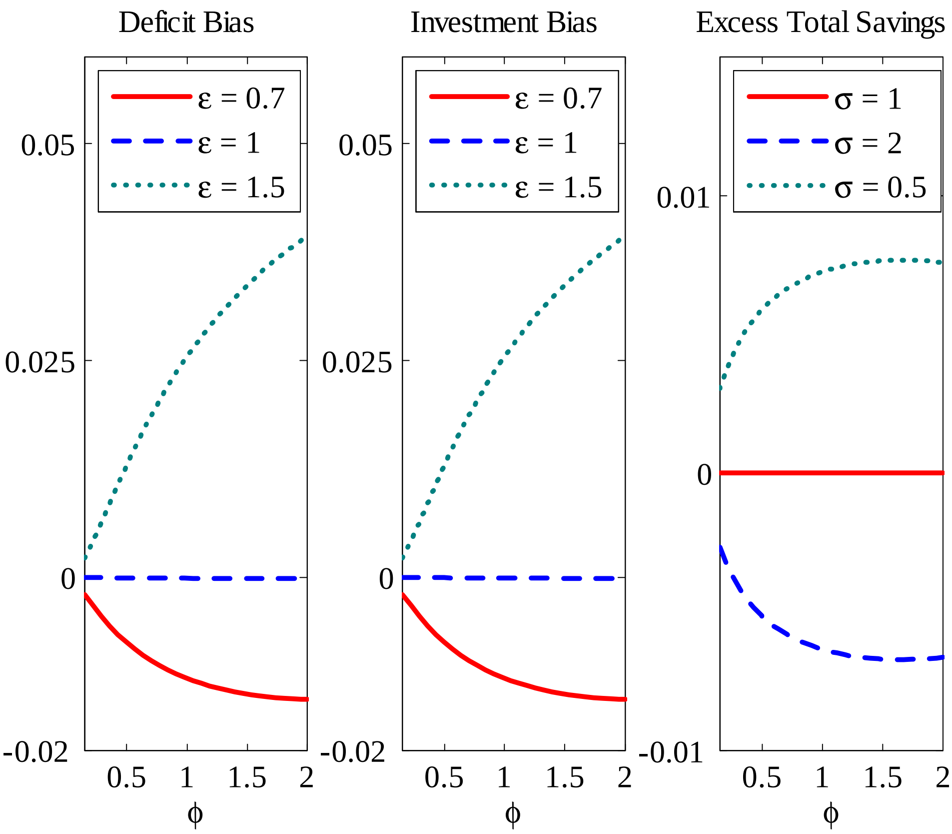

Figure 5: The public deficit and physical capital investment under certain political turnover ($p_R = 0$) minus the deficit and physical capital investment when the policymaker stays in office with certainty ($p_R = 1$). Fixed parameter values: $\delta = 0.2$, $\varepsilon = 0.7$, $\alpha^R = 0.4$, $\alpha^D = 0.6$.

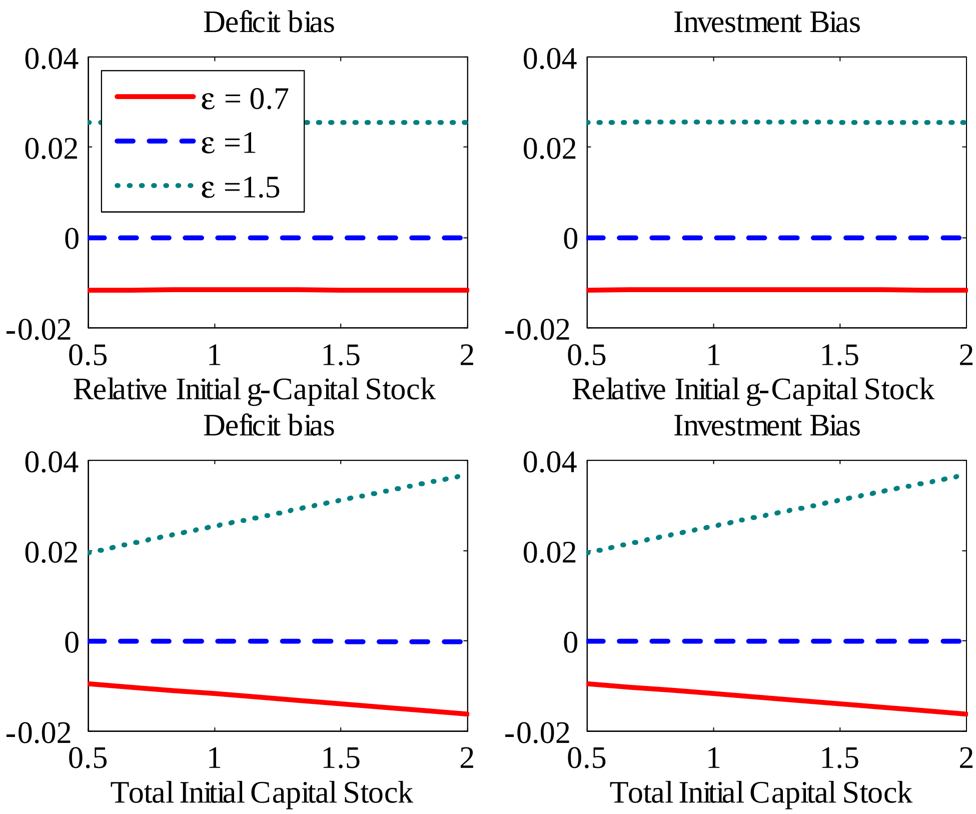

Figure 6: Deficit and physical capital investment under certain political turnover ($p_R = 0$) minus deficit and physical capital investment when the policymaker stays in office with certainty ($p_R = 1$). The horizontal axes vary the initial physical capital stock relative to the benchmark where initial physical capital stocks are as large and have the composition that would be maintained if there were no political turnover. The value 1 implies that initial physical capital stocks are at the benchmark levels. The two upper panels vary $\frac{k_1^g}{k_1^f}$ relative to the benchmark case. The two lower panels vary $k_1^g + k_1^f$ relative to the benchmark case. Fixed parameter values: $\delta = 0.2$, $\sigma = 1$, $\phi = 1$, $\alpha^R = 0.4$, $\alpha^D = 0.6$.

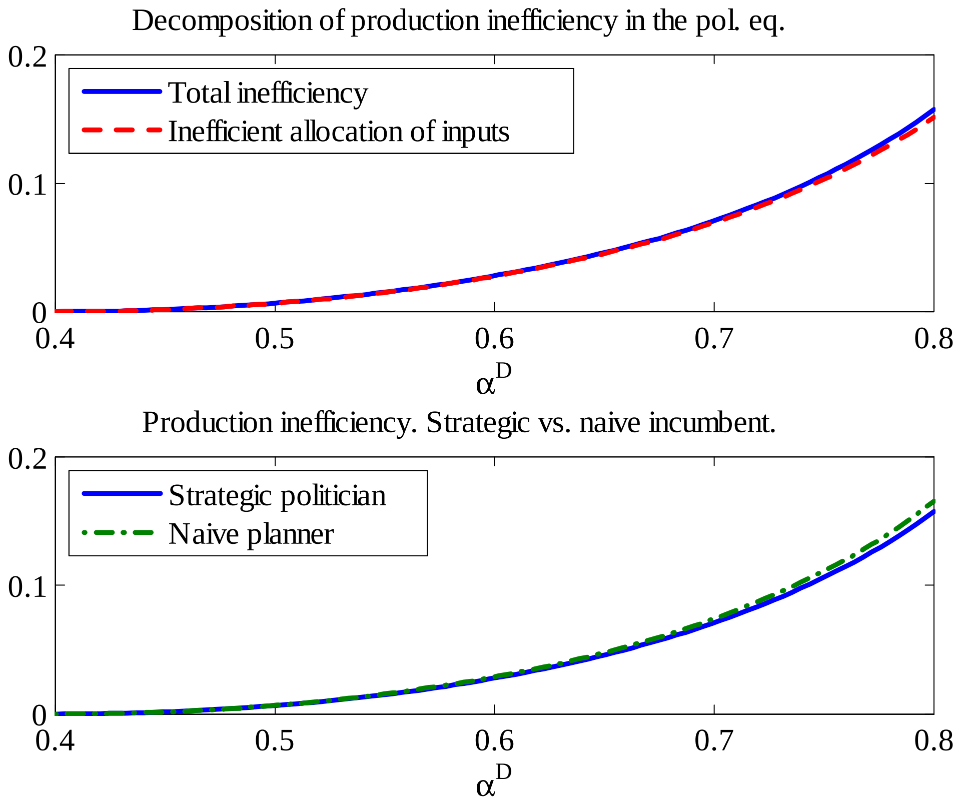

Figure 7: Inefficiency measured as how much f_2 could be increased by applying the resources in second period production differently. The upper panel separates how much the allocation of inputs and the composition of savings contribute to total inefficiency. The lower panel compares total inefficiency in the political equilibrium to total inefficiency when the first-period policymaker naively behaves as if he were certain to be re-elected. Details are in the appendix. Fixed parameter values: $\delta = 0.2$, $\sigma = 1$, $\phi = 1$, $\varepsilon = 0.7$, $\alpha^R = 0.4$, $p_R = 0$.