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The political economy of fiscal deficits and government production

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ABSTRACT

This paper studies how disagreement over which goods government should provide affects resource allocation in the public sector. An incumbent combines pre-determined capital with labor to produce different goods in the current period, and accumulates physical and financial capital for future production. Capital-labor complementarity determines how anticipated political turnover shapes governments' choice between saving in physical capital or financial assets. Turnover tends to render the stock of physical capital for public production too low and inefficiently combined with labor. The main cost of political turnover is production inefficiency in the public sector, not a suboptimal savings level.
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1. Introduction

A property of a well-functioning democracy is that current office-holders may be replaced through future elections. This might motivate incumbent politicians to use state variables, such as debt and capital, to affect the policies of their successors. How will then turnover affect resource allocation in the public sector?

To address this question I construct a theory which emphasizes the role of government as a producer. Consistently with the observation that wages and investments account for most of government expenditure, the provision of goods and services is assumed to require capital and labor as inputs.[1] Capital is a state variable determined by decisions in the past, whereas labor is a flow variable controlled by the current office holder. It follows that if capital and labor are complements in 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 hospitals, the future productivity of military personnel increases relative to that of nurses. 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 decision-makers 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 physical capital, tilting total savings toward the former, and away from the latter means of storage.[2]

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[1] For instance, Cavallo (2005) documents that in the U.S. since World War II, 63% 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% was spent on privately produced goods and services, while 16% was spent on investment.

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Beyond predicting underinvestment, a notable implication from the model is that political turnover leads to resource waste, as government production becomes too labor intensive and suffers from allocative mismatch of inputs. Ex post, governments allocate labor efficiently in the sense that production is on the production frontier given by existing capital. However, the allocation of public resources will be brought 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. More of both goods could be produced at no expense by re-allocating capital and labor.

This paper contributes to the rich literature on how political frictions affect public savings and investment. Particularly related are the studies of Tabellini and Alesina (1990), who argue that turnover motivates excess deficits, and Glazer (1989), who argues that anticipated turnover motivates excess investment as incumbents attempt to constrain their successors.[3] The framework I construct encompasses these models as special cases in terms of production technology; the former is equivalent to a setting where production requires labor only, the latter implicitly assumes perfect substitutability between capital and labor.[4] I conclude differently, because I allow for a degree of capital-labor complementarity that aligns with macro evidence such as Klump et al. (2007). Several other studies are also relevant. These include (Peletier et al., 1999; Besley and Coate, 1998; Bassetto and Sargent, 2006; Battaglini and Coate, 2007; Azzimonti, 2012; Bai and Lagunoff, 2011), who all study politico-economic determinants of investment. However, none of these consider heterogenous capital over which politicians have opposing preferences. Beetsma and van der Ploeg (2007) consider such heterogeneity, but because they assume that capital does not require future inputs in order to yield returns, turnover causes excess deficitsand overinvestment for the same reasons as in Glazer (1989). To my knowledge, the only other analysis which emphasizes how complementarity ties together policy over time is given by Watkins and Bohn (2011), who analyze how precommitted spending programs, such as health insurance, can be used to influence the future size of government.[5]

One way to evaluate the relevance of the complementarity mechanism I emphasize, is to consider the impact of re-election probability on investment. Three empirical papers shed light on this effect. Darby et al. (2004) find that across countries, investment is lower when turnover is higher. Azzimonti (2012) shows that across US states, investment is higher in states where electoral advantage is stronger. Using a panel of Norwegian municipalities, Fiva and Natvik (in press) find that when re-election probabilities increase, investment falls. These findings favor the predictions under capital-labor complementarity, rather than models that implicitly assume substitutability. Moreover, the extensive literature on privatization, summarized by Megginson and Netter (2001), indicates that production is less labor intensive when in the hands of the private rather than the public sector. Particularly convincing evidence is provided by Azmat et al. (2012), Dewenter and Malatesta (2001) and La Porta and López-de-Silanes (1999).[6] This pattern fits well with my study's prediction that government production will be excessively labor intensive.

While the listed evidence is consistent with my model, the mechanism I emphasize is not the only one that can explain it. In particular, models where turnover reduces incumbents' valuation of future public wealth and infrastructure raises the tax base, as in Besley and Coate (1998) and Azzimonti (2011), also imply that turnover reduces investment. My model, where capital raises the productivity of public labor, should be seen as a complementary explanation of why turnover reduces public investment. Which of the two mechanisms is the more relevant will depend on the type of capital one has in mind. My study relates to the considerable share of public capital which requires publicly financed labor and other current expenditures to yield returns. Examples here are national defense and public health care.[7] For infrastructure investment like roads, my model might be less relevant.

Regarding public debt, my model contrasts with that of Tabellini and Alesina (1990) and other studies where turnover raises discounting. These predict that turnover will cause deficits, while my framework predicts very timid effects on deficits, and potentially even that turnover will cause surpluses. Hence, my model cannot explain the common perception that governments excessively accumulate debt. However, while explaining high government debt is desirable, it should be

[2] 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.

[3] These arguments are also referred to in economic textbooks, such as Romer (2001) and Persson and Tabellini (2000). Furthermore, strategic debt accumulation due to turnover has been embedded in theoretical frameworks to investigate related economic topics such as sovereign debt repayment, as considered by Amador (2009). Another classical model here is Persson and Svensson (1989) who argue that conservatives might strategically increase debt, whereas liberals will reduce it.

[4] Glazer (1989) considers the choice of purchasing durable or non-durable public goods, which my production model captures as the special case where capital and labor are perfect substitutes. Tabellini and Alesina (1990) consider only purchases of non-durable public goods, which is equivalent to the special case where labor is the only input to government production.

[5] Strategic investments also feature in the political business cycle literature, where it has been hypothesized that investments are particularly visible to voters, and therefore will be increased in order to raise support before elections (Drazen and Eslava, 2010; Rogo, 1990). Again the prediction is overinvestment.

[6] Azmat et al. (2012) find that privatization reduced labor intensity of the network industries in the OECD. Dewenter and Malatesta (2001) find a positive association between government ownership an labor share using both an international cross-section of privately and government owned firms, and a time series of firms that privatize. La Porta and López-de-Silanes (1999) document massive reductions in employment, and large increases in investment relative to employment, following privatizations in Mexico.

[7] For instance, capital in military defense is arguably best considered as an input to the provision of national security services, rather than as a good in itself. Over the past 30 years, direct investments in defense have constituted about two thirds of major physical capital outlays, and around 1% of GDP, in the United States, according to the US Government Printing Office (www.gpo.orgHistorical Table 9.3).

noted that the mechanism where turnover drives up debt is questioned by evidence. Crain and Tollison (1993) give the perhaps most supportive conclusion for the deficit bias, based on the finding that budget surpluses are more volatile in those U.S. states where majority change in state legislature is more likely. However, this finding might equally well come from a positive effect of turnover on savings as a negative effect. Cross-country studies such as Franzese (2001) and Grilli et al. (1991) typically do not find effects of turnover on debt. Lambertini (2003) uses U.S. and OECD data to estimate the impact of re-election probability on deficits, and finds no effect. Petterson-Lidbom (2001) studies Swedish municipalities, and finds that while anticipated turnover raises deficits chosen by right-leaning incumbents, it reduces deficits under left-leaning ones.

The rest of this paper is organized as follows. Section 2 presents the model. Section 3 describes its equilibrium. Section 4 considers two special cases for which the model may be solved analytically. The main results, obtained numerically to permit 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

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

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", $(\alpha^i g_t^{(\phi-1)/\phi} + (1-\alpha^i) f_t^{(\phi-1)/\phi})^{\phi/(\phi-1)}$. Households differ in terms of $\alpha^i \in \langle 0,1 \rangle$.

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

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

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.

The gross interest rate is exogenous and set to one for simplicity. In period one the government chooses $\{n_1^g, n_1^f, k_2^g, k_2^f, b\}$, subject to the budget constraint

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

where δ is the depreciation rate of physical capital, which is identical in the two public production activities. In period two the government chooses $\{n_2^g, n_2^f\}$ 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 over public goods have the same form as voters', given in Eq. (1), with preference weights α^D and α^R, for party D and R respectively. Each party's discount factor is set to one, to equal the inverse of the gross interest rate. For expositional convenience, I will assume that the office-holder in period 1 comes from party R.

Before period 2 there is an election, which party R wins with probability p_R and party D wins with probability $1-p_R$.[8] 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 in the parties' relative popularity along dimensions of politics that are independent of which goods government provides.[9]

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 government must use labor and predetermined capital to produce goods.[10]

[8] 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.

[9] The results obtained in this paper with exogenous re-election probabilities can also be reached in a model 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. $\alpha^i = \{\alpha^R, \alpha^D\}$), and in addition have a random preference, "ideology", for having a given party in office. Details of an analysis showing this are available upon request.

Intratemporal separability is encompassed as the special case where $\sigma = \phi$, while a constant unit cost of public goods is encompassed as the special case where $\gamma = 1$.

3. Political equilibrium

The equilibrium objects are $\{n_1^g, n_1^f, k_2^g, k_2^f, b\}$ and $\{n_2^g, n_2^f\}$. Since first period choices are contingent on second period reactions, the model is solved by backward induction. It will be important to keep track of the policymaker's identity in each period. To this end, I use u^J to denote utility of a politician from party J, and define h_t^J and n_t^{hJ} as the production and labor choices for good h made by a politician of type J in period t. For partial derivatives the notation $h_{n_t^h}^J \equiv h_n(n_t^{hJ}, k_t^h)$ and $h_{k_t^h}^J \equiv h_k(n_t^{hJ}, k_t^h)$ will be used.

3.1. The second period

In period two the office-holder of type J decides how much labor to assign to the production of each good. His problem is

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

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

$$u_g^J(g_2^J, f_2^J) g_{n_2^g}^J = u_f^J(g_2^J, f_2^J) f_{n_2^f}^J. \tag{5}$$

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

$$n_2^{gJ*} = G(\alpha_2^J, b, k_2^g, k_2^f), \tag{6}$$

$$n_2^{fJ*} = F(\alpha_2^J, b, k_2^g, k_2^f). \tag{7}$$

For notational convenience I will hereafter refer to $G(\alpha_2^J, b, k_2^g, k_2^f)$ as G^J and $F(\alpha_2^J, b, k_2^g, k_2^f)$ as F^J. With the utility and production functions in (1) and (2), the reaction functions have the intuitive properties $G_{\alpha_2^J}^J = -F_{\alpha_2^J}^J > 0$ and $G_b^J = -1 - F_b^J \in [-1, 0]$, as long as $\varepsilon > 0$ and $k_2^h > 0$.

A novelty of this framework is that labor choices depend on purpose-specific capital (k_2^g and k_2^f). I denote the marginal effect of capital on labor choice by $G_{k_2^h}^J$ and $F_{k_2^h}^J$. With the utility and production functions displayed in Eqs. (1) and (2), $G_{k_2^g}^J$ can be expressed as

$$G_{k_2^g}^J = \frac{g_{k_2^g}^J}{g_2^J \Lambda} \left[\frac{1}{\varepsilon} - \frac{1}{\phi} \right], \tag{8}$$

where $\Lambda \equiv (g_{n_2^g}^J / g_2^J + f_{n_2^f}^J / f_2^J)/\phi - g_{n_2^g n_2^g}^J / g_{n_2^g}^J - f_{n_2^f n_2^f} / f_{n_2^f}$. A similar expression applies for $F_{k_2^h}^J$. Because $\Lambda > 0$, we see 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). Likewise, $G_{k_g}^J < 0$ if $\phi < \varepsilon$, and $G_{k_2^g}^J = 0$ if $\phi = \varepsilon$. 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 good g 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 g-production. 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 utility (ϕ).[11]

[10] Another, but less important difference, is that I assume there are two fixed candidates, which makes the political environment similar to Alesina and Tabellini (1990).

[11] The partial derivatives of the reaction functions, are treated in more detail and for more general functional forms in the working paper version of this study, Natvik (2009). The result that n_2^h increases with k_2^h if and only if the elasticity of substitution in production is smaller than the intratemporal elasticity of substitution in the utility function, is there proved to hold for any utility function that is homogenous, and any production function that is homogenous of degree one.

3.2. The first period

In the first period, the incumbent who is assumed to represent party R, solves the following problem:

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

subject to the production technology (2), the budget constraint (3) and the reaction functions as given by (6) and (7). Thus, the incumbent acknowledges how his investment choices will influence second period outcomes. The first-order conditions for this problem are then

$$u_g^R(g_1^R,f_1^R)g_{n_1^g}^R = u_f^R(g_1^R,f_1^R)f_{n_1^f}^R, \quad (9)$$

$$u_g^R(g_1^R,f_1^R)g_{n_1^g}^R = p_R u_g^R(g_2^R,f_2^R)g_{n_2^g}^R-(1-p_R)[u_g^R(g_2^D,f_2^D)g_{n_2^g}^D G_b^D+u_f^R(g_2^D,f_2^D)f_{n_2^f}^D F_b^D], \quad (10)$$

$$u_g^R(g_1^R,f_1^R)g_{n_1^g}^R = p_R u_g^R(g_2^R,f_2^R)g_{k_2^g}^R+(1-p_R)u_g^R(g_2^D,f_2^D)g_{k_2^g}^D+(1-p_R)[u_g^R(g_2^D,f_2^D)g_{n_2^g}^D G_{k_2^g}^D+u_f^R(g_2^D,f_2^D)f_{n_2^f}^D F_{k_2^g}^D], \quad (11)$$

$$u_g^R(g_1^R,f_1^R)g_{n_1^g}^R = p_R u_f^R(g_2^R,f_2^R)f_{k_2^f}^R+(1-p_R)u_f^R(g_2^D,f_2^D)f_{k_2^f}^D+(1-p_R)[u_g^R(g_2^D,f_2^D)g_{n_2^g}^D G_{k_2^f}^D+u_f^R(g_2^D,f_2^D)f_{n_2^f}^D F_{k_2^f}^D], \quad (12)$$

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. Analytical results

While the model in general cannot be solved analytically, its main mechanisms can be illuminated by imposing assumptions that allow analytical solutions. In this section, I will therefore use the following assumptions:

Assumption 1. $u^J(g_t,f_t)=[\alpha^J g_t+(1-\alpha^J)f_t]^{1-1/\sigma}/1-1/\sigma$, and $\alpha^R<1/2<\alpha^D$.

Assumption 2. For both goods $h=g,f$, either: (a) $h_t=\gamma n_t^h+(1-\gamma)k_t^h$, or (b) $h_t=n_t^{h^\gamma}k_t^{h^{(1-\gamma)}}$.

Assumption 3. $k_1^h=0$.

Note that the only role of Assumption 3 is to ease exposition by ensuring that $b=0$ in the absence of turnover. We can now describe the impact of turnover when capital and labor do not complement each other.

Proposition 1. *Under Assumptions*1, 2 (*a*), *and* 3, *where intratemporal utility is linear and capital and labor are separable in production*, *anticipated turnover affects public savings as follows*:

1. *When partisan gains exceed efficiency costs of overinvestment*, *anticipated turnover causes excess accumulation of debt and physical capital*: *If* $1-\alpha^R>\gamma>1/2$, *investments* $(k_2^f+k_2^g)$ *are increased from zero to* $2(1-\gamma)^{\sigma-1}/((1-\gamma)^{\sigma-1}+\gamma^{\sigma-1})$, *and deficits* ($b$) *are increased from zero to*1. *Total savings* $(k_2^f+k_2^g-b)$ *are reduced if* $\sigma>1$, *increased if* $\sigma<1$, *and are unaffected if* $\sigma=1$.
2. *When efficiency costs exceed partisan gains of overinvestment*, *anticipated turnover may affect accumulation of debt*, *but not accumulation of physical capital*: *If* $1/2<1-\alpha^R<\gamma$, *investments* $(k_2^f+k_2^g)$ *are unaffected while deficits* (b) *are changed from zero to* $((1-\alpha^R)^{\sigma-1}-\alpha^{R\sigma-1})/(\alpha^{R\sigma-1}+(1-\alpha^R)^{\sigma-1})$. *Hence*, *deficits are increased if* $\sigma>1$, *reduced 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. *When it is efficient to use only capital in production*, *that is 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 1 of Proposition 1, where the incumbent finds the effect of investment on increased production of f-goods worth 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 1 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.[12]

Proposition 1 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 1, as anticipated turnover stimulates investment. Furthermore, Tabellini and Alesina (1990) assume that public goods are purchased at fixed prices, which is encompassed as the special case where labor is the only input to production ($\gamma = 1$). Consequently, their main result regarding debt bias is captured in part 2 of Proposition 1.[13]

Perfect substitutability between capital and labor rules out that current investments may affect the marginal product of labor in the future. The following proposition illuminates how input complementarity enables incumbents to affect future spending:

Proposition 2. *Under Assumptions 1 and 2(b), where intratemporal utility is linear and capital and labor are complements in production, anticipated turnover will not affect policy.*

Proof. See Appendix.

The reason why anticipated turnover does not affect policy here, is that labor 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. Hence, the incumbent, who always prefers good *f* over good *g* (due to the intratemporally linear utility function), is able to implement his favored future intratemporal resource allocation by investing only in the project he prefers.

5. Numerical results

Propositions 1 and 2 rest on extreme parameterizations of the utility and production functions to facilitate analytical solutions. In order to shed light on the theoretical mechanisms for more plausible parameter values, this section instead solves the model numerically. To this end a benchmark parametrization, reported in Table 1, is used.

The benchmark value of ε is motivated by estimates of macroeconomic production functions. Two recent examples using U.S. time series are Klump et al. (2007), who estimate that the elasticity of substitution between capital and labor lies 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 reasonable starting point is to assume that capital-labor substitutability is similar in the public sector. The distribution parameter γ is set to be consistent with a labor share of 70% if government were minimizing costs.[14] Hence, whenever ε is varied in the analysis that follows, γ is updated so that the labor share does not change. This parametrization is motivated by the evidence for US government expenditure in Cavallo (2005).[15] One period in the model is 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%, which is within the range that Blanchard and Giavazzi (2004) and Kamps (2004) argue is empirically reasonable for public capital.[16]

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), because policy choices then are not influenced by political turnover in their model, which leaves the effects from the public sector production technology particularly clear in this case. Initial capital stocks $\{k_1^g, k_1^f\}$ are set to the levels that the incumbent would choose to maintain if re-election were

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

[13] 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 $\sigma = 1$.

[14] 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 (for e.g. in Arrow et al., 1961; Klump et al., 2007).

[15] Cavallo shows that the post-war wage expenditure has accounted for 63% of total government spending on consumption and investment, while investment has accounted for 16%. The remaining 21% has been purchases of privately produced goods and services. It is unclear whether this last component is best categorized as capital or labor in my model, most likely it contains items of both input types.

[16] Blanchard and Giavazzi (2004) argue that a 5% 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% in 1960 to 4% in 2001.

Table 1
Parametrization.

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

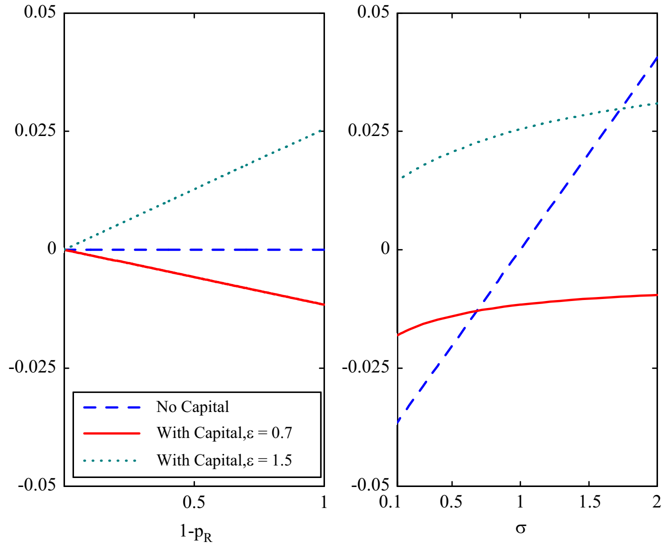

Fig. 1. Deficit bias. *Note*: The left panel plots the deficit for different re-election probabilities p_R, minus the deficit when $p_R=1$. The right panel plots deficit when $p_R=0$ minus the deficit when $p_R=1$. Dashed curves are computed with labor as only input to production, while solid and dotted curves are computed with a 70% labor share.

certain.[17] This choice is made for analytical convenience, and is unimportant for results, as explained in the sensitivity analysis below.

5.1. Debt accumulation

Fig. 1 displays the deficit bias induced by anticipated turnover. The left panel plots the deficit bias as a function of turnover probability, $1-p_R$. The bias is here defined as the gap between the deficit chosen by an incumbent from party R who expects to be re-elected with probability p_R, and the deficit he would choose if re-election were certain ($p_R=1$). The right panel plots the deficit bias as a function of σ. The bias is here defined as the deficit of an R-incumbent who is certain to be replaced ($p_R=0$), minus the deficit he would choose if he were certain to be re-elected ($p_R=1$). Both panels display three cases which are distinguished only by production technology. The magnitudes can be interpreted as shares of government income per period.

Along the dashed curves public goods are produced with labor as the only input ($\gamma=1$). The left panel shows that in this scenario the probability of turnover does not influence the deficit. The right panel illustrates that this occurs because we are considering the knife edge case where the intertemporal elasticity of substitution is one. If instead $\sigma>1$, which is the scenario emphasized by Tabellini and Alesina (1990) and most of the literature on strategic debt accumulation, the incumbent is willing to sacrifice intertemporal smoothing, and reduces savings so as to get a better intratemporal allocation between g and f. If $\sigma<1$, the incumbent has a strong desire to smooth consumption of public goods over time, and therefore saves more if re-election is unlikely.[18]

The solid curves in Fig. 1 show how the introduction of a production function with a an empirically plausible capital share and a moderate elasticity of substitution between inputs (ε) alters the incentive for debt accumulation. The left panel shows that a higher likelihood of turnover now motivates a moderate increase in financial savings. The right panel shows that the effect does not depend heavily on politicians' willingness to shift consumption between periods (σ), and that the quantitative effect of turnover on debt accumulation always remains rather muted.

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[17] More precisely, $\{k_1^g, k_1^f\}$ are set so that if $p_R=1$ it is optimal to choose $k_2^h=k_1^h$ for $h=g,f$.

[18] 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.

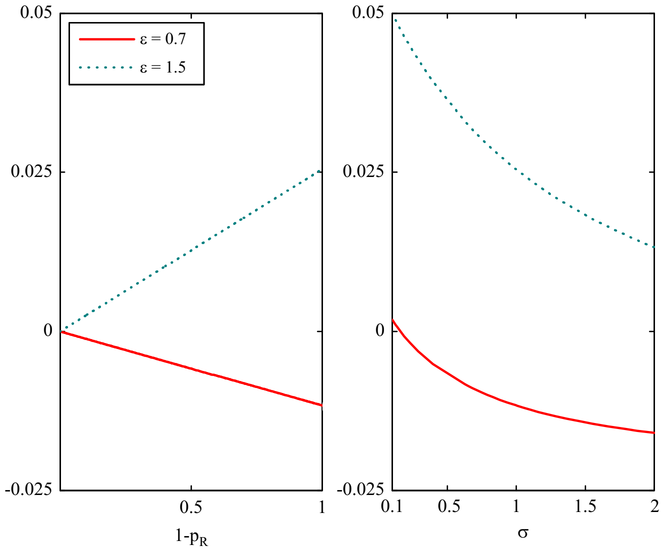

Fig. 2. Investment bias. *Note*: The left panel plots investment for re-election probabilities p_R, minus investment when $p_R = 1$. The right panel plots investment when $p_R = 0$ minus investment when $p_R = 1$.

Complementarity between capital and labor is important for how the presence of production capital affects the deficit bias. To illustrate this, the dotted curves in Fig. 1 plots the deficit bias with a relatively high degree of substitutability between capital and labor ($\varepsilon = 1.5$). We see that now turnover tends to motivate excess deficits. The left panel shows that deficits increase with turnover probability, and the right panel shows that this holds also for low values of σ. This is reminiscent of part 1 of Proposition 1, where inputs are perfectly substitutable, and debt financed investments pins down future production.

Intuitively, complementarity counteracts the deficit bias because it makes capital a powerful tool to influence how public funds are utilized in period 2, as was evident in Eq. (8). Furthermore, because the current capital stock is fixed, complementarity makes the marginal cost of current production increasing, in terms of future production foregone. 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. Therefore, 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

Fig. 2 illustrates how anticipated turnover affects investment, in the same way as Fig. 1 did for deficits. In the left panel, the solid curve shows that with $\varepsilon = 0.7$, a lower re-election probability reduces the accumulation of physical capital. In the right panel, we see that this tendency increases in voters' willingness to substitute public consumption between periods. Comparing Fig. 2 to Fig. 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, as shown by the dotted curves in the two panels.

The intuition why complementarity induces a negative link between investment and the turnover probability 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 1 and Glazer (1989). Instead, when ε is small, the incumbent's valuation of physical capital available for future public production is reduced by expected turnover.

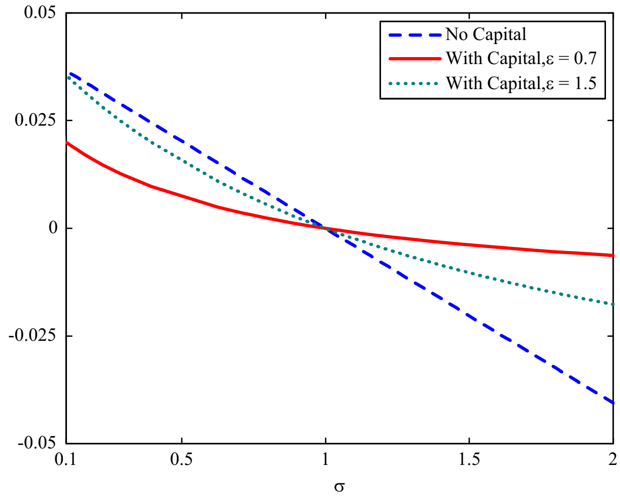

Fig. 3. Excess total saving. *Note*: Total savings is defined as the sum of physical and financial capital accumulation. Each plot gives total savings under certain turnover minus total savings under certain re-election.

5.3. Total public savings

Fig. 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 certain political turnover. We see that anticipated turnover reduces total savings when $\sigma > 1$, while it increases savings when $\sigma < 1$ as in Proposition 1, irrespective of the production technology. The presence of capital, and the degree of complementarity, will matter only quantitatively. Comparing the solid curve, which is constructed under the benchmark parameter values, to the other curves in the figure, we see that 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 together in the production economy, as the returns to labor depend on investment decisions made in the past while investment returns depend on labor allocations chosen in the future.

5.4. Sensitivity analysis

For expositional purposes, the analysis was conducted only for a limited set of values for the elasticity of substitution between capital and labor (ε), the intratemporal elasticity of substitution (ϕ) and the initial capital stocks. Letting these parameters and the initial capital vary further does not change the substance of the results. I here summarize the main effects of varying ε, ϕ, and the initial capital stocks over a finer grid of values than considered above. Further details are provided in the working paper version of this paper, Natvik (2009).

The effect of ε on the savings bias is non-monotonic, for intuitive reasons. In the Leontief case where $\varepsilon = 0$, investments serve incumbents as a perfect commitment device, and turnover therefore does not bias policy in any direction. When ε increases from zero, turnover starts pushing investment down, and the strength of this effect grows with ε, until the parameter reaches some level where the effect turns. From that point on, increasing ε further dampens the depressing effect of turnover on investment, and when ε is above some threshold, turnover starts raising investments. The upshot is the same qualitative pattern as in with Figs. 1 and 2. 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.

Regarding ϕ, a non-monotonicity is present too. In the polar cases with extremely low or extremely high substitutability between g and f, the biases induced by turnover are negligible.[19] When ϕ is in an intermediate range, the aforementioned effects of anticipated 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.

The composition of the initial capital stocks, k_1^g/k_1^f, does influence results in any way. What matters somewhat is the total stock of public capital, $k_1^g + k_1^f$. A greater stock amplifies any bias that might exist, since a larger stock of capital implies that there are more resources to allocate.

[19] The reason is that when ϕ is close to zero, the composition of public goods provided by the successor is independent of the incumbent's 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.

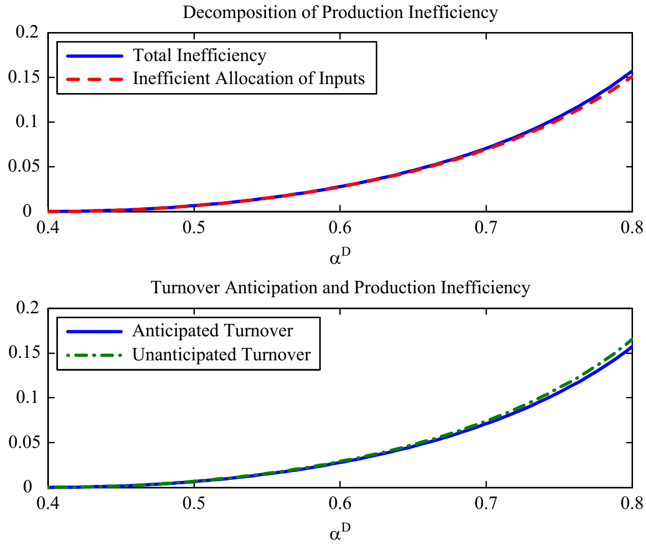

Fig. 4. Production inefficiency. *Note*: The upper panel plots inefficiency measures under certain turnover. The lower panel plots inefficiency in the political equilibrium with certain turnover which is anticipated, and when there is turnover after first period policies mistakenly were conditioned on certain re-election.

6. The costs of political turnover

When government production is homogenous of degree one, as with the specific production functions in (2), the cost minimizing capital-labor ratio is given by $\kappa = k^h/n^h$, $h = f,g$.[20] 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 ($h_{nk}(n_2^h,k_2^h) > 0$), then ex post, after 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. With the CES-functions in (1) and (2), this effect results when $0 < \varepsilon < \infty$ and $\phi < \infty$, while a more general condition for ex ante production inefficiency is that the following assumption holds:

Assumption 4. $0 < h^J_{n_2^h} < \infty, -\infty < h^J_{n_2^h n_2^h} \le 0$, $h^J_{k_2^h n_2^h} > 0$ and $u^J_{hh}(g,f)/u^J_h(g,f) < u^J_{gf}(g,f)/u^J_h(g,f)$, for $h = g,f$.

Using the notation k_2^{hR} to highlight that period two capital is chosen by incumbent R, we have the following proposition:

Proposition 3. *Political turnover will typically bring government production within the ex ante production possibility frontier*: *Under Assumption*4, $g^D_{k_2^{gR}}/g^D_{n_2^g} = f^D_{k_2^{fR}}/f^D_{n_2^f} = 1$ *if and only if* $\alpha^R = \alpha^D$. *When* $\alpha^R < \alpha^D$, $g^D_{k_2^{gR}}/g^D_{n_2^g} > 1 > f^D_{k_2^{fR}}/f^D_{n_2^f}$. *When* $\alpha^R > \alpha^D$, $g^D_{k_2^{gR}}/ g^D_{n_2^g} < 1 < f^D_{k_2^{fR}}/f^D_{n_2^f}$.

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 inputs more could have been produced of either good. I will 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. 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 period two, $(k_2^g + k_2^f)/(n_2^g + n_2^f)$, will generally deviate from its first best level κ. I refer to this as "inefficient composition of savings".

[20] $\kappa = ((1-\gamma)/\gamma)^{\varepsilon}$ with the specific production function in (2).

The upper panel of Fig. 4 compares the impact of the two inefficiency sources in the political equilibrium when $p_R = 0$. It shows how many more f-goods could have been produced in the second period by re-allocating inputs, but 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 how much the inefficient composition of savings contributes to production inefficiency.[21]

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.[22]

A question that arises here is how information about political turnover affects production efficiency. On the one hand, the incumbent who is aware of his successor's preferences may use this information to invest in a way that facilitates efficiency in future production. On the other hand, the incumbent has an incentive to invest so as to push the composition of second period production toward his own preferences. The bottom panel in Fig. 4 illuminates these opposing forces, by distinguishing between production inefficiency in the political equilibrium where the incumbent anticipates 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 unexpectedly replaced by someone else in the second period. The former is referred to as "anticipated turnover" while the latter is referred to as "unanticipated turnover" 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. The potential efficiency gains from information about the successor's preferences are eliminated by strategic behavior.

7. Conclusion

This paper offers a new perspective on the politico-economic determinants of government debt and investment, by considering government as a producer, using public capital and labor as inputs. The findings highlight how complementarity between inputs determines the effects of anticipated turnover on government saving. Complementarity dampens, and potentially overturns, the incentive for debt accumulation emphasized in the bulk of the literature, but motivates underinvestment instead. While this contrasts with conventional wisdom on how conflict over spending priorities affects government savings, it seems more consistent with existing evidence. Furthermore, although the arguments here are formulated in terms of capital and labor, the complementarity mechanism is of a more general nature. It applies to any setting where government combines state and flow variables to affect outcomes that political agents care about.

A central point in this paper is that political turnover is likely to reduce cost efficiency in the public sector. The potential welfare gains from knowledge about changing preferences for public goods provision do not materialize, as an incumbent about to be replaced uses capital to affect future priorities. While institutional solutions to this problem are not trivial to identify, certain policy implications may be drawn. First, politically induced cost inefficiency is a separate argument, beyond the tax distortions and agency costs that traditionally are emphasized, to limit government production of goods which can be provided in the private market. Second, one should note that in contrast to conventional wisdom, balanced budget rules, or deficit targets in general, are blunt tools to counter the costs of turnover. The stylized numerical examples in this paper indicate that intratemporal inefficiencies are likely to be far costlier than intertemporal ones. Moreover, to the extent that deficit targets are warranted by concerns outside of the model used here, this paper gives a clear rationale to exempt capital expenditure from such restrictions, as in a so-called "golden rule", since investments are likely to be downprioritized even in the absence of deficit restrictions.

Third, for public goods that by nature cannot be efficiently provided in the private market, such as national security or certain types of infrastructure, emphasis should be placed on avoiding inefficient input allocations. Tools to facilitate this could be those that commit future current expenditure to accompany current investment projects, such as long-term procurement contracts. However, such measures are not unproblematic, as they might give too much power to current majorities. Within the model presented here, this is likely to raise the investment incentive too strongly. Such costs must be weighed against the efficiency gains highlighted by this paper. Future research is needed to understand which institutional arrangements can prevent political turnover from causing intratemporal inefficiencies in government production.

Acknowledgments

Views expressed in this paper are those of the author and cannot be attributed to Norges Bank.

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

[22] As is clear from Figs. 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.

the University of Oslo where most of this paper was written. Any errors are my own responsibility. A previous version of this paper was circulated under the title "Voting on Government Production".

Appendix A

Proof of Proposition 1. *Period* 2: $\{n_2^{gJ}, n_2^{fJ}\}$ maximize J's utility subject to inequality constraints $n_2^g > 0$ and $n_2^f > 0$, and the budget constraint (4). The first-order conditions imply $\alpha^J + \frac{1}{\gamma}(\lambda_2^g - \lambda_2^f)(\alpha^J g_2 + (1-\alpha^J) f_2)^{1/\sigma} = (1-\alpha^J)$, where $\lambda_2^g \geq 0$ ($=0$ if $n_2^g > 0$) and $\lambda_2^f \geq 0$ ($=0$ if $n_2^f > 0$). Direct inspection reveals that if $\alpha^J = \alpha^D > 1/2$, then $n_2^f = 0$ and $n_2^g = 1-b$, while if $\alpha^J = \alpha^R < 1/2$, then $n_2^g = 0$ and $n_2^f = 1-b$.

Period 1: $\{n_1^g, n_1^f, k_2^g, k_2^f, b\}$ maximize R's utility subject to $k_2^g \geq 0$, $k_2^f \geq 0$, $n_1^f \geq 0$, $n_1^g \geq 0$ and $b \leq 1$, and (3). The first-order conditions are

$$\alpha^R \gamma + (\lambda_1^g - \mu_1)(\alpha^R g_1 + (1-\alpha^R) f_1)^{1/\sigma} = 0, \tag{13}$$

$$(1-\alpha^R)\gamma + (\lambda_1^f - \mu_1)(\alpha^R g_1 + (1-\alpha^R) f_1)^{1/\sigma} = 0, \tag{14}$$

$$\alpha^R (1-\gamma) + (\omega_1^g - \mu_1)(\alpha^R g_2 + (1-\alpha^R) f_2)^{1/\sigma} = 0, \tag{15}$$

$$(1-\alpha^R)(1-\gamma) + (\omega_1^f - \mu_1)(\alpha^R g_2 + (1-\alpha^R) f_2)^{1/\sigma} = 0, \tag{16}$$

$$\alpha^R \gamma \frac{dn_2^g}{db} + (\mu_1 - \lambda^b)(\alpha^R g_2 + (1-\alpha^R) f_2)^{1/\sigma} = 0. \tag{17}$$

Here $\mu_1 > 0$ is the multiplier on (3), 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 $b < 1$). Since $\alpha^R < 1/2$, (13) and (14) imply $n_1^g = 0$, while (15) and (16) imply $k_2^g = 0$. Eq. (14) then implies $n_1^f > 0$, and hence $\lambda_1^f = 0$, and thus

$$n_1^f = \frac{[(1-\alpha^R)\gamma]^{\sigma-1}}{\mu_1^\sigma}. \tag{18}$$

Consider R's period 1 policy when $p_R = 0$. Because $n_2^{fD} = 0$, $n_2^{gD} = 1-b$ and $k_2^g = 0$, Eq. (17) implies that either $b < 1$ or $k_2^f > 0$, or both. There are three possibilities to consider. If $b=1$ and $k_2^f > 0$, (16), (18) and the budget constraint $k_2^f + n_1^f = 2$ imply $n_1^f = 2\gamma^{\sigma-1}/((1-\gamma)^{\sigma-1} + \gamma^{\sigma-1})$ and $k_2^f = 2(1-\gamma)^{\sigma-1}/((1-\gamma)^{\sigma-1} + \gamma^{\sigma-1})$, which is consistent with (16) and (17) if and only if $1-\alpha^R \geq \gamma$. If $k_2^f = 0$ and $b < 1$, (17) and (18) and $n_1^f = 1+b$ imply $n_1^f = 2(1-\alpha^R)^{\sigma-1}/((\alpha^R)^{\sigma-1} + (1-\alpha^R)^{\sigma-1})$ and $b = ((1-\alpha^R)^{\sigma-1} - (\alpha^R)^{\sigma-1})/((\alpha^R)^{\sigma-1} + (1-\alpha^R)^{\sigma-1})$, which is consistent with (16) and (17) if and only if $1-\alpha^R \leq \gamma$. Finally, $k_2^f > 0$ and $b < 1$ is consistent with Eqs. (16) and (17) if and only if $1-\alpha_1 = \gamma$, in which case $n_1^f = 2(1-\alpha^R)^{\sigma-1}/((\alpha^R)^{\sigma-1} + (1-\alpha^R)^{\sigma-1})$, $k_2^f \in [0, 2(\alpha^R)^{\sigma-1}/((\alpha^R)^{\sigma-1} + (1-\alpha^R)^{\sigma-1}])$ and $b \in [((1-\alpha^R)^{\sigma-1} - (\alpha^R)^{\sigma-1})/((\alpha^R)^{\sigma-1} + (1-\alpha^R)^{\sigma-1}, 1])$.

Next, consider R's policy when $p_R = 1$. Similar steps as above yield the following. 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 $n_1^f = 2\gamma^{\sigma-1}/((1-\gamma)^{\sigma-1} + \gamma^{\sigma-1})$, $k_2^f = 2(1-\gamma)^{\sigma-1}/((1-\gamma)^{\sigma-1} + \gamma^{\sigma-1})$ 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 the policies under $p_R = 1$ to those under $p_R = 0$, Proposition 1 follows. □

Proof of Proposition 2. Assume first that $p_R = 1$. The R-incumbent chooses $\{n_1^g, n_1^f, n_2^g, n_2^f, k_2^g, k_2^f, b\}$ to maximize W^R, subject to (3) and (4). Optimality requires that $k_2^h = ((1-\gamma)/\gamma) n_2^h$ for $h = g, f$. The production functions then imply $n_2^h = h_2(\gamma/(1-\gamma))^{1-\gamma}$ and $k_2^h = h_2((1-\gamma)/\gamma)^\gamma$, which together with the budget implies $f_2 = \Omega C - g_2$, where $\Omega \equiv [(\gamma/(1-\gamma))^{1-\gamma} + ((1-\gamma)/\gamma)^\gamma]^{-1}$ and $C = 2 + (1-\delta)(k_1^f + k_1^g) - n_1^f - n_2^g$. Using this, we can write $u_2^R = 1/(1-1/\sigma)[(2\alpha^R - 1)g_2 + (1-\alpha_1)\Omega C]^{1-1/\sigma}$. Hence, when $\alpha^R < 1/2$, u_2^R is monotonically decreasing in g_2. Hence, the R-politician sets $\tilde{n}_2^g = \tilde{k}_2^g = 0$, where the tilde denotes that the choice is optimal when $p^R = 1$. From the budget constraints and $k_2^f = ((1-\gamma)/\gamma) n_2^f$, it follows that $\tilde{k}_2^f = (1-\gamma)\tilde{C}$ and $\tilde{n}_2^f = \gamma \tilde{C}$, for some $\tilde{C} = 2 + (1-\delta)(k_1^f + k_1^g) - \tilde{n}_1^f - \tilde{n}_1^g$. Debt follows from (4); $\tilde{b} = 1 - \gamma \tilde{C}$.

Assume next that $p_R = 0$. Then n_2^g and n_2^f will be set to maximize $u^D(g_2, f_2)$ subject to (4). The first-order conditions and (4) imply $n_2^{gD} = (1-b)k_2^g/(k_2^f((1-\alpha^D)/\alpha^D)^{1/(1-\gamma)} + k_2^g)$, and $n_2^{fD} = (1-b)k_2^f/(k_2^f + (\alpha^D/(1-\alpha^D))^{1/(1-\gamma)} k_2^g)$. Thus, if the R-incumbent sets $b = \tilde{b}$ and $k_2^g = \tilde{k}_2^g = 0$, even a D-successor chooses $n_2^g = \tilde{n}_2^g = 0$ and $n_2^f = \tilde{n}_2^f = \gamma \tilde{C}$.

Hence, an incumbent certain to be replaced can implement the same allocation as if he were free to choose the labor allocation in period 2, and thus implement his most preferred policy irrespective of whether he is re-elected or not. It follows that anticipated turnover will not affect policy. □

Proof of Proposition 3. Define $L^J = (u^J_{gg}(g^J_2,f^J_2)/u^J_g(g^J_2,f^J_2) - u^J_{gf}(g^J_2,f^J_2)/u^J_f(g^J_2,f^J_2))g^J_{n^g_2} + g^J_{n^g_2 n^g_2}/g^J_{n^g_2} + (u^J_{ff}(g^J_2,f^J_2)/u^J_f(g^J_2,f^J_2) - u^J_{gf}(g^J_2,f^J_2)/u^J_g(g^J_2,f^J_2))f^J_{n^f_2} + f^J_{n^f_2 n^f_2}/f^J_{n^f_2}$. The assumptions preceding Proposition 3 imply $L^J < 0$. Implicit differentiation of (5) and (11), using (4), yields general expressions for G^J_b and $G^J_{k^g_2}$. By combining these with the first-order conditions (10), (11) and (5), and rearranging, we obtain

$$\frac{g^R_{k^g_2}}{g^R_{n^g_2}} = 1 + \frac{1-p_R}{p_R}N + \left[1 - \frac{g^D_{k^g_2}}{g^D_{n^g_2}}\right]\frac{1-p_R}{p_R}M, \tag{19}$$

where $M = (u^R_g(g^D_2,f^D_2)g^D_{n^g_2}/u^R_g(g^R_2,f^R_2)g^R_{n^g_2})[1 + (u^R_f(g^D_2,f^D_2)u^D_g(g^D_2,f^D_2)/u^D_f(g^D_2,f^D_2)u^R_g(g^D_2,f^D_2) - 1)(u^D_{gg}(g^D_2,f^D_2)/u^D_g(g^D_2,f^D_2) - u^D_{gf}(g^D_2,f^D_2)/u^D_f(g^D_2,f^D_2))g^D_{n^g_2}/L^D]$, and $N = (1 - u^R_f(g^D_2,f^D_2)u^D_g(g^D_2,f^D_2)/u^D_f(g^D_2,f^D_2)u^R_g(g^D_2,f^D_2))u^R_g(g^D_2,f^D_2)(g^D_{n^g_2 k^g_2} - g^D_{n^g_2 n^g_2})/u^R_g(g^R_2,f^R_2)g^R_{n^g_2}L^D$, and $N = (1 - u^R_f(g^D_2,f^D_2)u^D_g(g^D_2,f^D_2)/u^D_f(g^D_2,f^D_2)u^R_g(g^D_2,f^D_2))u^R_g(g^D_2,f^D_2)(g^D_{n^g_2 k^g_2} - g^D_{n^g_2 n^g_2})/u^R_g(g^R_2,f^R_2)g^R_{n^g_2}L^D$. Note that because $L^D < 0$, we have that $M > 0$, while $N \gtreqless 0 \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

Next, the assumptions preceding Proposition 3 ensure $G^J_{\alpha^J_2} > 0$, and therefore

$$\frac{g^R_{k^g_2}}{g^R_{n^g_2}} \lesseqgtr \frac{g^D_{k^g_2}}{g^D_{n^g_2}} \;\Leftrightarrow\; \alpha^R \lesseqgtr \alpha^D. \tag{20}$$

Assume $p_R = 1$. (19) then implies $g^R_{k^g_2} = g^R_{n^g_2}$, and thus from (20) $g^D_{k^g_2} \gtreqless g^D_{n^g_2} \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

Assume $\alpha^R < \alpha^D$ and $0 < p_R < 1$. If $g^D_{k^g_2} < g^D_{n^g_2}$, (20) implies $g^R_{k^g_2} < g^R_{n^g_2}$ as well. Hence (19) holds only if $N < 0$. However, $\alpha^R < \alpha^D$ implies $N > 0$, a contradiction. If $g^D_{k^g_2} > g^D_{n^g_2}$, (19) holds with $g^D_{k^g_2}/g^D_{n^g_2} > g^R_{k^g_2}/g^R_{n^g_2}$, which yields no contradiction. Hence, $g^D_{k^g_2} > g^D_{n^g_2}$.

Assume $\alpha^R > \alpha^D$ and $0 < p_R < 1$. If $g^D_{k^g_2} > g^D_{n^g_2}$, (20) implies $g^R_{k^g_2} > g^R_{n^g_2}$ as well. Hence (19) holds only if $N > 0$. However, $\alpha^R > \alpha^D$ implies $N < 0$, a contradiction. If $g^D_{k^g_2} < g^D_{n^g_2}$, (19) holds with $g^D_{k^g_2}/g^D_{n^g_2} < g^R_{k^g_2}/g^R_{n^g_2}$, which yields no contradiction. Hence $g^D_{k^g_2} < g^D_{n^g_2}$.

Consider the situation with $p_R = 0$. Eq. (19) and $N \gtreqless 0 \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$ together imply $g^D_{k^g_2} \gtreqless g^D_{n^g_2} \Leftrightarrow \alpha^R \lesseqgtr \alpha^D$.

In the same way it may be shown that $f^D_{k^f_2} < f^D_{n^f_2}$ when $\alpha^R < \alpha^D$, that $f^D_{k^f_2} > f^D_{n^f_2}$ when $\alpha^R > \alpha^D$, and that $f^D_{k^f_2} = f^D_{n^f_2}$ when $\alpha^R = \alpha^D$. □

The inefficiency measures in Fig. 4. "Inefficient allocation of inputs" is $[f(n^{f*}_2,k^{f*}_2) - f(n^{f,pe}_2,k^{f,pe}_2)]/f(n^{f,pe}_2,k^{f,pe}_2)$, where $\{n^{g*}_2,n^{f*}_2,k^{g*}_2,k^{f*}_2\}$ maximizes f_2, holding $\{n^g_1,n^f_1,b\}$ and g_2 at their political equilibrium levels, denoted by superscript *pe*. Hence, $\{n^{g*}_2,n^{f*}_2,k^{g*}_2,k^{f*}_2\}$ solves

$$(\gamma n_2^{g(\varepsilon-1)/\varepsilon} + (1-\gamma)k_2^{g(\varepsilon-1)/\varepsilon})^{\varepsilon/(\varepsilon-1)} = g^{pe}_2, \tag{21}$$

$$\frac{k^g_2}{n^g_2} = \left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon}, \tag{22}$$

$k^g_2 + k^f_2 = k^{g,pe}_2 + k^{f,pe}_2$ and $n^g_2 + n^f_2 = 1 - b^{pe}$.

"Total inefficiency" is $[f(\widehat{n}^f_2,\widehat{k}^f_2) - f(n^{f,pe}_2,k^{f,pe}_2)]/f(n^{f,pe}_2,k^{f,pe}_2)$, where $\{\widehat{n}^g_2,\widehat{n}^f_2,\widehat{k}^g_2,\widehat{k}^f_2,\widehat{b}\}$ maximize f_2 holding only $\{n^g_1,n^f_1\}$ and g_2 at their political equilibrium levels. Hence, $\{\widehat{n}^g_2,\widehat{n}^f_2,\widehat{k}^g_2,\widehat{k}^f_2,\widehat{b}\}$ satisfies (21), (22), $k^g_2/n^g_2 = k^f_2/n^f_2$, $n^{g,pe}_1 + n^{f,pe}_1 + k^g_2 + k^f_2 = 1 + b + (1-\delta)k^g_1 + (1-\delta)k^f_1$ and $n^g_2 + n^f_2 + b = 1$.

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