The dynamics of public investment under persistent electoral advantage.*

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Abstract

This paper studies the effects of asymmetries in re-election probabilities across parties on public policy and its subsequent propagation to the economy. The struggle between groups that disagree on targeted public spending results in governments being endogenously short-sighted: Systematic underinvestment in infrastructure and overspending on public goods arise, beyond what is observed in symmetric environments. Because the party enjoying an electoral advantage is less short-sighted, it devotes a larger proportion of revenues to productive investment. Hence, political turnover induces economic fluctuations in an otherwise deterministic environment. I characterize analytically the long-run distribution of allocations, and show that output increases with electoral advantage, despite the fact that governments expand. Volatility is non-monotonic in electoral advantage and is an additional source of inefficiency. Using panel data from US States I confirm these findings.

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1 Introduction

A central issue in dynamic political economy is to understand how political frictions affect fiscal policy and economic performance over time. The recent literature has focused almost exclusively on characterizing symmetric equilibria in which parties behave identically. [1] A main result is that re-election uncertainty introduces a wedge in intertemporal decisions when governments lack commitment. This wedge distorts economic allocations; thereby reducing long-run output and consumption. This paper contributes to the literature by considering the implications of asymmetries in political turnover between competing parties. Additional distortions emerge when incumbents face different re-election prospects, since the politically disadvantaged party leans toward more short-sighted policies than it would if political turnover were symmetric. Even though parties have identical preferences over the size of the government, alternating

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[1] Recent examples are Amador (2008), Azzimonti (2011), Battaglini and Coate (2007), and Debortoli and Nunes (2010).

power induces economic fluctuations via changes in taxation and spending (in an environment that is otherwise deterministic), furthering the inefficiencies. I find that the resulting volatilities are non-monotonic in the size of the political bias.

Persistent partisan advantage in democratic elections has been extensively documented by political scientists, in particular regarding the voting behavior across US States. Using a multi-component index that combines historical results in gubernatorial, House, and Senate elections, individual States are characterized being under Democratic or Republican control. Brown and Bruce (2002) use a combination of the two most common indices of political competition, the Ranney index and the Holbrook Van Dunk index, to compute trends in political advantage. Their study shows that between 1968 and 2003, Massachusetts, Maryland, and New York exhibit a sizeable and uninterrupted Democratic advantage (both at the state and national levels). New Hampshire, Wyoming, and Indiana, on the other hand, have been exclusively under Republican control. Using the results from State legislative elections I document that partisan advantage can be large and persistent at the State level. Evidence of systematic electoral biases in other countries is further illustrated by the recent experiences of Japan and Mexico. Despite the body of research showing that partisan advantage is fairly common and empirically relevant, the possibility of asymmetries in election prospects has been ignored in dynamic political economy models.[2] Understanding its implications is a main objective of this work.

Building on the work of Alesina and Tabellini (1990) and Besley and Coate (1998), I present a theoretical model in which partisan electoral advantage is explicitly considered. There are two groups of citizens in the economy that would like to target spending to themselves (through the provision of local public goods) but have common interests regarding the accumulation of public capital, which enhances output. Groups are represented by parties that alternate in power via a democratic process. A key feature is that a representative of only one of the groups is in power at each point in time and suffers from limited commitment. I characterize time-consistent policies as Markov-perfect equilibria. Because election outcomes are uncertain, parties are endogenously short-sighted relative to the groups they represent. Thus, despite the fact that financing instruments are non-distortionary (i.e., taxes are lump-sum), an intertemporal wedge arises. As in the symmetric case, policymakers tend to overspend in public consumption and underinvest on productive public capital, which reduces output and private consumption relative to the efficient allocations.

The asymmetry arises because one of the parties is assumed to enjoy persistent political advantage, which is formalized as a higher probability of winning an election. Because the two decision-makers have different de facto discount factors, interesting strategic interactions arise. In particular, the disadvantaged party is endogenously more short-sighted and thus under-saves (relative to a world in which its rival had the same effective short-sightedness), while the advantaged party is less short-sighted and thus over-saves (relative to a world in which its rival had the same effective short-sightedness). Political uncertainty is propagated throughout the economy via volatility in policies, and economic cycles endogenously arise. This is the case even though there is no source of uncertainty other than the identity of the policymaker. Welfare is lower relative to the first best not only because of a dynamic inefficiency (investment is too low), but also because volatility in macroeconomic variables (output, employment, and consumption) is introduced.

[2] Battaglini (2010) considers an environment in which expected ideological biases are persistent across groups in the population. However, due to the assumption that there is no ex ante bias in favor of or against any candidate, his equilibrium is symmetric. Therefore, there are no fluctuations in macroeconomic variables generated by switches of power (other than those resulting from productivity shocks).

Increases in political advantage widen the gap between the policies chosen by the two parties, as well as their probabilities of being elected. Despite the fact that the size of the government (total expenditures to output) increases with the political bias, long-run average output rises. The reason is that, on average, a larger proportion of revenues is devoted to productive public investment. I find that the size of the cycles induced by changes in political advantage is non-monotonic because it is affected by changes in policy and probabilities in opposite directions. Economies in which the political advantage is low exhibit rapid turnover but small fluctuations in policy, as the difference in investment shares is small. This happens because both parties have similar election prospects and are thus equally short-sighted. At the other extreme, when the biases are large, so are the differences in policy. But the most popular party is in power more often, and hence, fluctuations are small. Volatility is largest for intermediate values of the political bias.

I construct a proxy for partisan advantage for each State during the period 1970-2000 using elections' data in State legislatures. I document that partisan advantage is generally sizable and persistent within a given State over the sample period. I then test the main predictions of the model combining these series with the State economic and fiscal policy data from the US Census. In line with the theory, I find that employment, government consumption, and public investment are procyclical over the cycle. The share of public investment to GSP is increasing in electoral advantage. This is consistent with Fiva and Natvik's (2009) finding that higher re-election probabilities are associated with higher public investment in Norwegian local governments. As predicted by the model, I show that States where parties enjoy a larger advantage exhibit a lower share of targeted public spending in GSP. Finally, using a panel constructed with 10-year rolling variances of filtered data, I test the functional relationship between volatility and electoral advantage. The outcome of fixed effects regressions confirms that, for the medium term cycle, there is an inverted U-shape relation between electoral advantage and the variance of public investment. This also holds for public consumption, even after the industry composition at the State level is controlled for. To the best of my knowledge, this is the first paper documenting the relationship between of fiscal policy variables and persistent electoral advantage for US States.

The organization of the paper is as follows. A discussion of the existing literature is presented next. The benchmark model is described in Section 2. The Markov-perfect equilibrium is defined in Section 3 and characterized in Section 4. Section 5 provides empirical support for several implications of the theory. Section 6 concludes.

Related Literature

This paper contributes to the literature that analyzes the dynamic efficiency of policy choices in representative democracies. It builds on the work by Besley and Coate (1998) and Alesina and Tabellini (1990), who present the first theories of political failure. In Alesina and Tabellini (1990), parties choose to overspend on public goods and to create an excessive level of debt when the outcome of elections is uncertain. In Besley and Coate (1998) parties fail to undertake public investments that are Pareto improving due to lack of commitment in a two-period model. My work extends some of their insights to a dynamic infinite-horizon political economy model, particularly relevant for assessing the long-run effects of government policy.

Amador (2008) and Azzimonti (2011) also analyze the inefficiencies generated by a common pool problem in a fully dynamic infinite-horizon model. Their basic mechanism, like the one in this paper, is based on the trade-offs described in Alesina and Tabellini (1990). Amador finds that politicians are too impatient, behaving as hyperbolic consumers, which results in inefficient

overspending and excessive deficit creation.[3] In Azzimonti, overspending results in equilibrium due to political turnover but in an environment in which the government distorts private investment in order to finance group-specific public goods. In both papers, taxation is deterministic, and so are output and consumption. Moreover, neither considers public investment. Battaglini and Coate (2007) introduce durable public goods financed by the government. Distortions arise due to the assumption of proportional taxation on labor income, while I assume those away by focusing on lump-sum taxes. In my paper distortions arise because public capital affects the productivity of labor. In contrast, durable goods and labor productivity are completely independent in Battaglini and Coate's setup. [4]

This paper also contributes to the literature on inefficiencies resulting from the government's lack of commitment. Sleet and Yeltekin (2008) and Farhi and Werning (2008) analyze how political frictions, through binding implementability constraints, affect the actual discount factor of the policymaker and deviate allocations away form the first best. Re-election uncertainty acts similarly here, but the asymmetry creates additional inefficiencies through optimal manipulation of public investment. While several existing models find strategic interactions between successive policymakers, most of them must rely on numerical methods to characterize the Markov-perfect equilibrium (e.g. Krusell and Rios-Rull 1999 or Bachman and Bai, 2010). I derive a closed-form solution instead. An exception is Hassler, Storesletten, and Zilibotti (2007) who compute analytical solutions in an overlapping generations setup in which policy is decided by majority voting, but assume away political uncertainty. Like here, they find that expenditures on a consumable public good can be inefficient. Unlike in their work, governments devote part of the expenditures to productive investment in my model, which allows me to analyze the effects of electoral advantage on economic development.

A common feature of all the papers discussed above is that they restrict attention to symmetric environments, so there are no fluctuations in macroeconomic variables induced by changes in power. The analysis of cycles in policy and economic allocations generated by electoral advantage is a main contribution relative to their work.

There exists a body of research where economic cycles can result from political frictions, but through alternative mechanisms to the one presented in my paper. One strand of the literature, the 'political budget cycles' (or political business cycles), argues that policymakers can engage in rent-seeking activities and may choose inefficient policies in order to increase their probability of re-election, so as to get continued access to these office rents. Incumbents' incentives to induce good economic outcomes just before an election produces fluctuations in fiscal policies, and these create volatility in economic variables (see for example Rogoff and Sibert, 1988, more recently Martinez, 2009 or Drazen, 2000b for a survey). Informational asymmetries between voters and policymakers are at the core of their results. In my paper, there is no disagreement between politicians' objectives and their constituency's. In that sense, my work is more related to the second strand of the literature, the 'partisan cycles', in which political turnover between groups gives rise to economic fluctuations. The main difference with previous models in this literature (such as Milesi-Ferretti and Spolaore, 1994, Persson and Svensson, 1989 or more recently Song, 2012 and Azzimonti and Talbert, 2011) is that heterogeneity does not arise from differences

[3] Caballero and Yared (2010), Cuadra and Sapriza (2008), Debortoli and Nunes (2008, 2010), Devereux and Wen (1998), Kumhof and Yakadina (2007) and Ilzetzki (2011) also analyze environments in which exogenous political turnover introduces inefficiencies in debt accumulation and the level of taxation in Markov-switching models. See Lagunoff and Bai (2011) for an interesting case in which the probabilities of re-election are exogenous but depend on the aggregate state of the economy.

[4] Besley, Ilzetzki, and Persson (2010) study the effects of exogenous political instability on fiscal capacity (a durable public good) in a similar environment.

in preferences over the size of public expenditures. Parties have the same ex-ante utility over the size of spending on public goods and on the level of investment. In equilibrium, one of the parties spends more and invests less just because it loses more often as a result of an electoral disadvantage. The advantage of this approach is that it can be tested since we do observe asymmetries in electoral advantage. In addition, the paper presents a full characterization of long run outcomes. Many existing papers abstract from it by focusing in two-period models. An important exception is Acemoglu, Golosov, and Tsyvinski (2011). The authors find that—as long as the discount factor is small enough—power alternation results in inefficient allocations where distortions (and hence labor) fluctuate over time. Because they abstract from any form of capital, the dynamic strategic link between current and future governments is abstracted from in their analysis. The dynamics of public investment is instead the main focus of my paper. In addition, since I restrict equilibria to be Markov-perfect (while they characterize sustainable equilibria) distortions do not disappear when the discount factor increases, while they vanish in their environment. My results are thus highlighting the detrimental effects of institutional failures under re-election asymmetries.

2 The benchmark model

In this section I describe the economic environment and define a competitive equilibrium given policy. Conditions satisfied by Pareto optimal allocations are presented to be used as a benchmark when discussing inefficiencies arising from political uncertainty in the following sections.

2.1 Economic environment

Consider an infinite-horizon economy populated by agents of equal measure who live in one of two regions, A and B (normalizing total population to 1). While they have identical income and identical preferences over private consumption, they disagree on the composition of public expenditures, since public goods can be region-specific (e.g. environmental protection, public television, education subsidies, assistance programs etc.). The instantaneous utility of agent j in region J is

$$u(c_j, n_j) + v(g^J) \tag{1}$$

where c_j denotes the consumption of private goods, n_j denotes labor, and g^J is the level of discretionary spending on local goods in region J. Notice that an agent living in region A derives no utility from the provision of a good in region B (and vice versa). In principle there will be disagreement in the population over the desired composition of public expenditures but not on its size, since both types have the same marginal rate of substitution between private and public goods. Throughout the text, I will assume that preferences over consumption are of the GHH form

$$u(c, n) = \log\left(c - \frac{n^{1+\frac{1}{\epsilon}}}{1+\epsilon}\right)$$

where ϵ is the elasticity of labor, and preferences over the provision of public goods are logarithmic

$$v(g^J) = \log(g^J + G).$$

The constant G is introduced for technical reasons, in order to ensure that utility is bounded when the public good is not provided to the region, $g^J = 0$. Agents discount the future at rate $\beta \in (0, 1)$.

There are infinitely many competitive firms that produce a single consumption good and hire labor each period so as to maximize profits, which are distributed back to consumers who own shares of these firms. Firms have access to a Cobb-Douglas technology

$$F(K_g, n) = AK_g^{\theta} n^{1-\theta},$$

where n is the aggregate labor supply and K_g is the stock of public capital. Its level is determined by government investments and acts as an externality in production. The idea behind this specification is that the better the infrastructure (roads, harbors, bridges, etc.), the healthier and more educated the population, and the stronger the protection of property rights, the higher the productivity of the private sector. We assume that K_g depreciates fully after being used in production. In equilibrium, workers are paid the wage w and firms distribute profits

$$\Pi = F(K_g, n) - wn$$

as dividends to individual shareholders.

The government raises revenues via lump-sum taxes τ which are chosen every period, so private consumption is

$$c_j = wn_j + \Pi - \tau.$$

Taxes are used to finance the provision of consumable public goods (g^A and g^B) and investments in productive public capital ($I = K_g'$). The cost of producing $g > 0$ units of a local public good is linear $x(g) = g + G$, with $x(0) = G$. This assumption allows us to characterize the solution analytically, but all results hold as $G \to 0$. Assuming that there is no debt, the government must balance its budget every period. Its budget constraint is

$$x(g^A) + x(g^B) + K_g' = \tau,$$

where primes denote next period variables. The assumption of lump-sum taxes is made in order to highlight the fact that inefficiencies in production may arise due to political frictions even when the government has access to non-distortionary financing instruments.

2.2 Competitive equilibrium given policy

Firms decide how much labor to hire given wages and distribute profits back in the form of dividends to agents, who own shares of these firms. Agents choose consumption and leisure, taking wages and government policy (public spending and investment) as given. A competitive equilibrium given policy is defined below (I omit the stock of public capital K_g from all functions to simplify notation).

Definition 2.1 *A competitive equilibrium given government policy $\Upsilon = \{g^A, g^B, K_g'\}$ is a set of allocations, $\{c_j(\Upsilon), n_j(\Upsilon), \Pi(\Upsilon)\}$, prices $w(\Upsilon)$, and taxes $\tau(\Upsilon)$ such that:*

(i). Agents maximize utility subject to their budget constraint. Agent j's labor supply satisfies

$$u_1(c_j(\Upsilon), n_j(\Upsilon))w(\Upsilon) + u_2(c_j(\Upsilon), n_j(\Upsilon)) = 0,$$

where

$$c_j(\Upsilon) = w(\Upsilon)n_j(\Upsilon) + \Pi(\Upsilon) - \tau(\Upsilon).$$

(ii). Firms maximize profits, so $w(\Upsilon) = F_2(K_g, n(\Upsilon))$ and $\Pi(\Upsilon) = F(K_g, n(\Upsilon)) - w(\Upsilon)n(\Upsilon)$.

(iii). Markets clear $n(\Upsilon) = \int_j n_j(\Upsilon)$.

(iv). The government budget constraint is satisfied.

$$\tau(\Upsilon) = x(g^A) + x(g^B) + K_g'.$$

The static nature of firms' and workers' economic decisions simplifies the characterization of the competitive equilibrium to a great extent. Moreover, from condition (i) we can see that agents' decisions are independent of their type j, which results from the additive separability of the utility derived from the provision of public goods. Hence, there is aggregation and we can think of the competitive equilibrium as characterized by the decisions of a representative agent with $n_j(\Upsilon) = n(\Upsilon)$ and $c_j(\Upsilon) = c(\Upsilon)$.[5]

Replacing the firm's optimal decisions and the government budget constraint into the agent's budget constraint we obtain consumption as a function of policy,

$$c(\Upsilon) = F(K_g, n(\Upsilon)) - x(g^A) - x(g^B) - K_g', \tag{2}$$

with aggregate labor $n(\Upsilon)$ satisfying

$$u_1(c(\Upsilon), n(\Upsilon))F_2(K_g, n(\Upsilon)) + u_2(c(\Upsilon), n(\Upsilon)) = 0. \tag{3}$$

2.3 Planning solutions

Before describing the outcome under political competition (where different parties alternate in power), it is useful to characterize the optimal allocation chosen by a benevolent social planner. The planner chooses $\{c, n, K_g', g^A, g^B\}$ so as to maximize a weighted sum of utilities, where the weight on type J agents is $\lambda^J \in [0, 1]$ (with $\lambda^A + \lambda^B = 1$). The planner's maximization problem is

$$V^*(K_g) = \max \sum_{J=A,B} \lambda^J [u(c, n) + v(g^J)] + \beta V^*(K_g'),$$

subject to the resource constraint:

$$c + x(g^A) + x(g^B) + K_g' = F(K_g, n).$$

As long as the planner gives a positive weight to each agent, the optimal allocation of public good J will be such that its marginal utility is proportional to the marginal utility of private consumption.[6]

Departures from this condition represent a wedge Δ_g in the optimal provision of g^J

$$\Delta_g = -u_1(c, n)x_g(g^J) + \lambda^J v_g(g^J). \tag{4}$$

By varying λ^J between 0 and 1 it is possible to trace the Pareto frontier that characterizes the optimal provision of public goods. Concavity of v implies that if type A agents have a higher weight in the social welfare function, more of their desired public good will be provided (at the expense of type B agents).

[5] This result holds for any pair of concave functions $u(c, n)$ and $v(g)$, not just the particular ones assumed in the text.

[6] If the planner only cares about the well-being of, say, agent A, it will set $g_t^B = 0 \, \forall t$ and g_t^A so as to equate the marginal rate of substitution between private and public goods to the marginal cost of providing the goods $x_g(g)$.

The second optimality condition refers to the optimal labor supply. Under this condition, the planner equates the marginal disutility of working to the marginal increase in the utility of consumption generated by additional production. Departures from this equation define a *labor wedge*

$$\Delta_n = u_1(c,n)F_2(K_g,n) - u_2(c,n). \tag{5}$$

Finally, the planner chooses the level of public capital that equates the marginal costs in terms of foregone consumption to the discounted marginal benefits of investment. Departures from this condition define an *investment wedge*

$$\Delta_k = -u_1(c,n) + \beta u_1(c',n')F_1(K_g',n'). \tag{6}$$

The planner's Euler equation is completely independent of the choice of the social welfare function: Changes in λ^J do not affect this margin. The result follows from assuming that both agents have the same trade-off between private and public consumption (i.e., u and v are equal for all agents). [7]

3 Politico-economic equilibrium

The role of the government in this economy is to provide public goods and productive public capital. Given the disagreement between groups over which public good should be provided, political parties will endogenously arise in a democratic environment. I analyze a stylized case in which there are two parties, A and B, representing each group in the population and competing for office every period. They alternate in power according to an exogenous election probability p_i, $i \in \{A, B\}$. The asymmetry arises because one of the groups has greater political power than the other. In particular, I assume that type-B candidates are more likely to be elected

$$p_B = 0.5 + \xi, \text{ with } \xi \in \left[0, \frac{1}{2}\right],$$

and $p_A = 0.5 - \xi$. We can interpret ξ as measuring B's *electoral advantage*. This specification can be micro-founded using a traditional Lindbeck-Weibull probabilistic voting model augmented to allow for an ideology bias in the population towards party B and assuming no commitment to platforms (see Appendix 8 for its derivation). I abstract from incumbency advantage in this paper to ease notation, but the results hold for the case where p_i represents the probability of re-election with $p_i > 0.5\,\forall i$ as long as $p_B > p_A$. Details are available upon request.

The elected party chooses the tax rate and the allocation of government resources between the different types of spending and investment so as to maximize the utility of its own type.[8]

3.1 Markov-perfect equilibrium

There is no commitment technology, so promises made by any party before elections are not credible unless they are optimal ex-post. The party in power plays a game against the opposition

[7] It is important to note that the planner is constrained to offer all households the same consumption allocation (that is, $c^A = c^B$). This condition is imposed in order to capture the constraint faced by the government in the political equilibrium (where parties cannot tax agents at different rates).

[8] In that sense this is a *partisan model*. A politician from party j is just like any other agent in that group, so he wants to maximize his type's utility. In contrast, other models in the literature assume that politicians can extract rents from being in power, so their objective is to maximize the probability of winning the next election. See Drazen (2000) or Persson and Tabellini (2000) for a discussion of *opportunistic models*.

taking their policy as given. Alternative realizations of history (defined by the sequence of policies up to time t) may result in different current policies. In principle, this dynamic game allows for multiple subgame-perfect equilibria that can be constructed using reputation mechanisms. I will rule out such mechanisms and focus instead on Markov-perfect equilibria (MPE), defined as a set of strategies that depend only on the current, payoff relevant, state of the economy. Given the sequence of events the only payoff-relevant state variable—besides the identity of the party in power—is the stock of public capital. In a Markov-perfect equilibrium, policy rules are functions of this state.

The equilibrium objects we are interested in are policy functions, allocations, and value functions. There are three policy functions: The investment rule of incumbent i, $h_i(K_g)$, and expenditures in each region-specific good $g_i^A(K_g)$ and $g_i^B(K_g)$. The labor supply $n_i(K_g)$ and consumption $c_i(K_g)$ under incumbent i's policies summarize the allocations. The value function of agent type J when his group is in power will be denoted by $V_J(K_g)$ and when his group is out of power by $W_J(K_g)$.

The incumbent must decide on the optimal policy, knowing that he will be replaced by a different policymaker with probability p_i. Suppose that B is the elected party. Given the stock of public capital K_g, his objective function today is:

$$\max_{g^A, g^B, K_g' \geq 0} u(c, n) + v(g^B) + \beta\{p_B V_B(K_g') + p_A W_B(K_g')\} \tag{7}$$

where consumption and labor satisfy equations (2) and (3).

Since g^A and g^B affect only today's utility, tomorrow's decisions are independent of the composition of expenditures. If party i is in power, it will choose $g_i^J = 0$, for $J \neq i$, which further simplifies the problem. Slightly abusing notation, we use $g_i(K_g)$ to denote the equilibrium amount spent by incumbent i on the local public good i. The description of the problem is completed by defining the functions $V_B(K_g)$ and $W_B(K_g)$:

$$V_B(K_g) = u\left(c_B(K_g), n_B(K_g)\right) + v(g_B(K_g)) + \beta\{p_B V_B(h_B(K_g)) + p_A W_B(h_B(K_g))\} \tag{8}$$

and

$$W_B(K_g) = u\left(c_A(K_g), n_A(K_g)\right) + \beta\{p_B V_B(h_A(K_g)) + p_A W_B(h_A(K_g))\}, \tag{9}$$

where $\Upsilon_i(K_g) = \{g_i^A(K_g), g_i^B(K_g), h_i(K_g)\}$ denotes the equilibrium policy functions chosen by incumbent type i, and where $c_i(K_g) = c(\Upsilon_i(K_g))$ and $n_i(K_g) = n(\Upsilon_i(K_g))$ are the competitive equilibrium values of consumption and labor under the political equilibrium policies.

We can now define a Markov-perfect equilibrium, which just imposes consistency between private agents and the government's decisions.

Definition 3.1 *A Markov-perfect equilibrium with exogenous political turnover is a set of value and policy functions such that:*

i. Given the re-election probabilities and CE allocations and prices, the functions $h_i(K_g)$, $g_i^B(K_g)$, $g_i^A(K_g)$, $V_i(K_g)$, and $W_i(K_g)$solve incumbent i's maximization problem, (7), (8), and (9).

ii. Given the re-election probabilities and government policy, the functions $c_i(K_g)$ and $n_i(K_g)$ satisfy equations (2) and (3).

3.2 Differentiable Markov-perfect equilibrium (DMPE)

In order to further characterize the trade-offs faced by an incumbent when choosing investment, I will focus on *differentiable* policy functions. Klein, Krusell, and Rios-Rull (2008) made this assumption (in a different context), arguing that there could be in principle an infinitely large number of Markov equilibria. By assuming differentiability, the problem delivers a solution that is the limit to the finite-horizon problem. Moreover, it allows us to derive the government optimality condition even though the envelope theorem doesn't hold.

The choice of expenditures is a static one, affecting only the *intratemporal* margin. At the optimum, the government chooses g so that the marginal cost of providing the good in terms of consumption equals its marginal benefit:

$$u_1(c_B(K_g), n_B(K_g))x_g(g) = v_g(g). \tag{10}$$

We can see that government spending in the MPE is sub-optimal from the standpoint of a social planner—which gave positive weight to both types—since $\Delta_g \neq 0$ (see eq. 4). Sub-optimality arises for two reasons. First, the group out of power gets no provision of their preferred good. Second, there is overspending in the sense that the marginal rate of private consumption is too low when compared to that of the utilitarian optimum (or any level associated with positive weights $\lambda^J > 0$). Even the group in power would prefer a *lower* level of g if the difference was invested in productive capital and subsequently used in the provision of its preferred good instead.

The investment decision affects the *intertemporal* margin; the costs of increasing public capital are paid today, while the benefits are received in the future. The government chooses K'_g so that the marginal cost in terms of foregone consumption equals *expected* marginal benefits:

$$u_1(c_B(K_g), n_B(K_g)) = \beta\{p_B V_{B1}(K'_g) + p_A W_{B1}(K'_g)\}$$

As in the planner's first-order condition, the cost of an extra unit of investment in public capital is given by a reduction in current utility via a decrease in consumption $-u_1(c, n)$. The benefits, on the other hand, now depend on the identity of the party that wins the next election. When K'_g increases, expected future utility rises from the expansion of resources. Type B agents enjoy an increase of $V_{B1}(K_g) = \frac{\partial V_B(K'_g)}{\partial K'_g}$ utils if they win the next election (which occurs with probability p_B) and $W_{B1}(K_g) = \frac{\partial W_B(K'_g)}{\partial K'_g}$ otherwise (which occurs with probability $p_A = 1 - p_B$).

The politico-economic equilibrium studied here implies several distortions relative to the first best as shown in Proposition 3.1.

Proposition 3.1 *The investment wedge in incumbent B's first-order condition is given by*

$$\Delta_k = \beta p_A\{DE + MB + ID\} \tag{11}$$

where

$$MB = u_1\left(c_A(K'_g), n_A(K'_g)\right) F_1(K'_g, n_A(K'_g)) - u_1\left(c_B(K'_g), n_B(K'_g)\right) F_1(K'_g, n_B(K'_g))$$
$$DE = -x_g(g_A(K'_g))g_{A1}(K'_g)u_1\left(c_A(K'_g), n_A(K'_g)\right),$$
$$ID = h_{A1}(K'_g)[-u_1(c_A(K'_g), n_A(K'_g)) + u_1(c_A(\tilde{K}'_g), n_A(\tilde{K}'_g))], \text{ where } \tilde{K}'_g = h_B^{-1}(h_A(K'_g)).$$

Proof See Appendix 7.1.

If $p_A = 0$, B would remain in office forever. In such a case, the incumbent would invest exactly as a benevolent planner and the investment wedge would be zero. This cannot be interpreted as implying that allocations are equivalent, because $g^A = 0$. Growth implications are the same (since efficiency is achieved), but at the expense of some proportion of the population enjoying lower utility as one type of public good is never provided.

When $p_A > 0$, there is a positive likelihood $(1 - p_B)$ that the group in office loses power next period, which introduces a wedge in the investment optimality condition. This wedge is composed of three terms.

The first term, DE (disagreement effect), captures the cost of disagreement in terms of the provision of public goods. When the incumbent is not re-elected (which happens with probability p_A), a marginal increase on public capital today changes the opposition's spending in public goods tomorrow by $g_{A1}(K'_g)$. This results in a cost in terms of foregone consumption next period with no utility benefit, since the incumbent derives no utility from that public good. From today's perspective it is optimal, then, to decrease investment with respect to the certainty case: The current incumbent wants to 'tie the hands' of its successor in order to restrict its spending. The disagreement over the composition of public goods, together with the political uncertainty, deters public investment.[9]

If parties had the same political power ($p_A = p_B$), the composition of expenditures would be the only source of disagreement. The center of the conflict would be *what* to spend the budget on, instead of *how much* to spend (as analyzed in detail in Azzimonti, 2011). All distortions would be summarized by the DE. Under asymmetry, there is also disagreement on the *levels* of spending and investment, as seen from the two additional effects described next.

Because parties' constituencies differ, the reaction of the opposition to a change in K'_g will be sub-optimal from the standpoint of party B (since both groups value the future differently). The second term, MB (marginal benefits), corresponds to the difference in the marginal benefit of investment received when tomorrow's government policy is chosen by the opposition and the one obtained if party B remained in power.

The last term in the optimality condition, ID (investment disagreement), captures the investment disagreement resulting from the fact that parties would invest differently if in power. Because B's likelihood of staying in power is larger, the expected marginal benefits of investing one more dollar in public capital are higher than for party A, which would increase investment next period only by $h_{Ak}(K'_g)$. This distorts future investment costs differentially for both parties, introducing an additional distortion.

Since specific functional forms for utility and production were not used to derive equation 11, this equation describes more generally the optimal behavior of an incumbent in a political equilibrium with re-election uncertainty.

4 Characterization

It is instructive to analyze the Pareto optimal allocations first, obtained by solving the planner's problem presented in Section 2.3. Under the assumptions above, the economy collapses to a traditional neoclassical economy and thus the standard results apply. There exists a unique

[9] This effect is similar to that observed in Persson and Svensson (1989). Besley and Coate (1998) find that disagreements over redistribution policies can result in inefficient levels of investment. Milesi-Ferretti and Spolaore (1994) also obtain strategic manipulation but for an alternative environment. For an infinite-horizon economy with symmetric shocks that also exhibits a disagreement effect, see Azzimonti (2011).

equilibrium in which the labor supply takes a simple form,

$$n(K_g) = [\epsilon A(1-\theta)K_g^{\theta}]^{\frac{\epsilon}{1+\epsilon\theta}}, \tag{12}$$

and the level of production is given by

$$F(K_g, n(K_g)) = \bar{A}K_g^{\bar{\theta}} \quad \text{where} \quad \bar{A} = A[\epsilon A(1-\theta)]^{\frac{\epsilon(1-\theta)}{1+\epsilon\theta}} \quad \text{and} \quad \bar{\theta} = \frac{\theta(1+\epsilon)}{1+\epsilon\theta}.$$

Public capital evolves according to

$$K_g' = s^* \tilde{A} K_g^{\bar{\theta}}, \quad \text{with} \quad \tilde{A} = \bar{A} - \frac{[\epsilon A(1-\theta)]^{\frac{1+\epsilon}{1+\epsilon\theta}}}{1+\epsilon},$$

where $\tilde{A}K_g^{\bar{\theta}}$ equals the total amount of resources net of the disutility of labor, and we can think of it as 'labor-adjusted' production. A benevolent planner invests a constant proportion $s^* = \beta\bar{\theta}$ of labor-adjusted resources, independently of the Pareto weights attached to each group (these weights affect the composition of region-specific public goods but not the total amount of resources devoted to them). Since $\bar{\theta} < 1$, public capital converges *deterministically* to a steady-state level $K_g^* = [\beta\bar{\theta}\tilde{A}]^{\frac{1}{1-\theta}}$.

4.1 Dynamic inefficiencies in the MPE

The competitive equilibrium given policy determines consumption and labor as functions of government spending and investment. Because taxes are lump sum and there are no income effects under the GHH formulation, the labor supply follows eq. (12). Consumption satisfies

$$c_i(K_g) = \bar{A}K_g^{\bar{\theta}} - g_i(K_g) - G - h_i(K_g).$$

Proposition 4.1 fully characterizes government policy.

Proposition 4.1 *There exists a differentiable Markov equilibrium where incumbent i chooses:*

$$g_i(K_g) = \frac{1}{2}(1-s_i)\tilde{A}K_g^{\bar{\theta}} - G, \quad h_i(K_g) = s_i\tilde{A}K_g^{\bar{\theta}}, \quad \textit{and} \quad \tau_i = \frac{1}{2}(1+s_i)\tilde{A}K_g^{\bar{\theta}}$$

and the propensity s_i satisfies

$$s_i = \bar{\theta}\beta\left[\frac{1+p_i}{2-\bar{\theta}\beta\,(1-p_i)}\right]. \tag{13}$$

Proof See Appendix 7.2.

An incumbent of type i invests a constant proportion of labor-adjusted resources, with the propensity to invest being an increasing function of the probability of reelection. Differentiation of equation 32 yields

$$\frac{\partial s_i}{\partial p_i} = \frac{2\bar{\theta}\beta(1-\bar{\theta}\beta)}{(2-\bar{\theta}\beta(1-p_i))^2} > 0. \tag{14}$$

The benefits from an extra unit of investment are not fully internalized, which causes the incumbent to behave *myopically* and overspend today on unproductive public goods (and under-invest in public capital). The effect is stronger, the lower the probability of remaining in power. The next corollary summarizes the distortionary effects of political uncertainty on government policy.

Corollary 4.1 *The Markov-perfect equilibrium is Pareto efficient if and only if $p_i = 1$. When $p_i < 1$ there is underinvestment in public capital $s_i < s^*$, so the MPE is inefficient.*

Proof Let $p_i = 1$, then $s_i = s^*$ from eq. (32). Let $p_i < 1$, then $s_i < s^*$ by eq. (14).

The intuition behind this result can be understood by looking at the trade-offs faced by the group in power. An incumbent who believes that he will be replaced with high probability does not have strong incentives to abstain from consumption today in order to invest in public capital. Knowing that it is very likely that tomorrow's policymaker would prefer a different composition of spending, the incumbent tries to manipulate next period's policy through the choice of the state variable. He ties the hands of his successor by decreasing the amount of available resources (i.e., investing a small amount today), which shrinks the tax base tomorrow. It is then reasonable to expect the propensity to invest under political uncertainty to be lower than that chosen by a planner. Finally, note that while the equilibrium is Pareto optimal when $p_i = 1$, the allocations do not coincide with those chosen under a utilitarian planner because one of the groups never receives its preferred public good.

4.2 Politico-driven economic fluctuations

An interesting feature of this model is that it delivers endogenous cycles in economic variables generated by parties' alternation of power. Even though there are no exogenous productivity shocks, output, investment, consumption, labor, and taxes fluctuate in the long run.

From the government's maximization problem, the evolution of public capital follows

$$K_g' = s_i \tilde{A} K_g^{\bar{\theta}} \tag{15}$$

where $s_i \in \{s_A, s_B\}$ depends on the identity of the incumbent. Since $p_B > 0.5$, eq. 32 implies

$$s_A < s_B.$$

Consider an economy with $0 < K_{g0} < K_{gA}^{ss}$. If party i were in power long enough, capital would converge to the steady-state value K_{gi}^{ss}, as shown in the following lemma.

Lemma 4.1 *Fix i, let $p_i = 1$ and $K_{g0} > 0 \Rightarrow \exists$ a unique stationary point $h_i(K_{gi}^{ss}) = K_{gi}^{ss}$ given by $K_{gi}^{ss} = (s_i \tilde{A})^{\frac{1}{1-\bar{\theta}}}$.*

Proof Existence is trivial from $h_i(K_g) = s_i \tilde{A} K_g^{\bar{\theta}}$. Uniqueness follows from the properties of the policy function: (i) it is strictly increasing, $h_i'(K_g) = s_i \tilde{A} \bar{\theta} K_g^{\bar{\theta}-1} > 0$ since $s_i \in [0, 1]$ and $\bar{\theta} < 1$, (ii) strictly concave $h_i''(K_g) = s_i(\bar{\theta} - 1)\tilde{A}\bar{\theta} K_g^{\bar{\theta}-2} < 0$, and (iii) it crosses the 45° line from above $h_i'(K_{gi}^{ss}) = \bar{\theta} < 1$.

Suppose that the government always followed B's optimal investment rule. Then K_g would evolve according to the upper line in Figure 1, converging eventually to K_{gB}^{ss} (where B's policy function intersects the 45° line). If A's rule was followed instead, not only would the steady state be lower ($K_{gA}^{ss} < K_{gB}^{ss}$) but convergence would take place at a slower pace. This follows from the fact that the speed of convergence under B is larger, $h_B'(K_g) > h_A'(K_g)$. When parties alternate in power, public investment fluctuates following the political cycle and the evolution of capital is stochastic. A possible path is represented by the arrows in Figure 1.

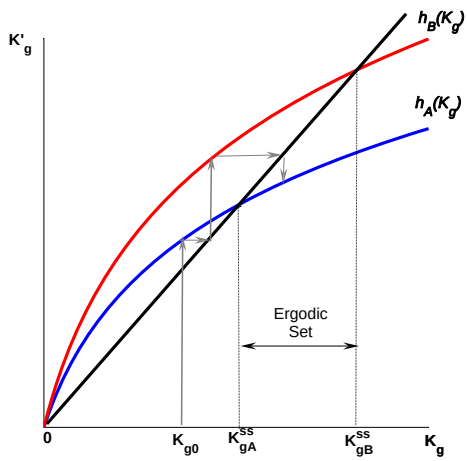

Figure 1: Evolution of capital: Policy functions

Eventually, the economy reaches an 'ergodic set' in which public capital only takes values belonging to the interval $\left[K_{gA}^{ss}, K_{gB}^{ss}\right]$. Since public capital affects the productivity of the private sector, other macroeconomic variables (such as labor, output, and consumption) also fluctuate, with political shocks propagating into the real economy. The following proposition formally characterizes the evolution of capital over time.

Proposition 4.2 *Let* $0 < K_{g0} < K_{gA}^{ss}$. *Then* $\exists T < \infty$ *such that* $\{K_{gt}\}_{t=0}^{T}$ *is an increasing sequence and* $\{K_{gt}\}_{t=T}^{\infty} \in [K_{gA}^{ss}, K_{gB}^{ss}]$.

Proof See Appendix 7.3

The proposition states that starting from a value of capital outside of the ergodic set, the sequence of K_{gt} is increasing and reaches the set in finite time.

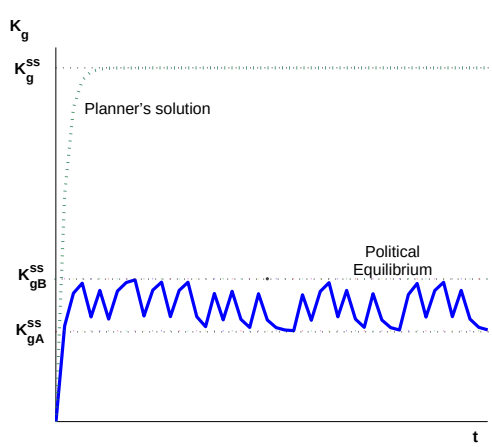

Figure 2: Evolution of capital: Simulation

This is illustrated in Figure 2, which plots a series of investment for a simulation of this economy (the parameters used in this numerical example are described in detail in Appendix 7.8). It also shows the evolution of capital that would be followed by a benevolent planner. We can see that a planner reaches a significantly higher steady state as described in Corollary 4.1.

Public capital exhibits an increasing trend until it reaches the ergodic set at which point it fluctuates around a constant mean. It is possible to show theoretically that this process is in general stationary. In order to do so, it is useful to work with the logarithm of our variables of interest. Let $\hat{x} \equiv \log(x)$, we can show:

Lemma 4.2 *Define $\bar{\epsilon} = p_A \hat{s}_A + p_B \hat{s}_B$. Then $\hat{K}_{gt+1}$ follows an AR(1) process,*

$$\hat{K}_{gt+1} = q + \bar{\theta}\hat{K}_{gt} + \epsilon_t$$

where $\epsilon_t = \hat{s}_t - \bar{\epsilon}$ and $q = \log(\tilde{A}) + \bar{\epsilon}$. The shocks ϵ_t are i.i.d and white noise with zero mean and variance

$$\sigma^2 = p_A p_B (\hat{s}_A - \hat{s}_B)^2.$$

The long-run distribution of $\hat{K}_{gt+1}$ has the following properties.

i. The mean is $E(\hat{K}_{gt+1}) = \frac{q}{1-\bar{\theta}} \equiv \mu$.

ii. The variance is $Var(\hat{K}_{gt+1}) = \frac{\sigma^2}{1-\bar{\theta}^2} \equiv \gamma_0$.

iii. The auto-covariances and auto-correlations satisfy

$$Cov(\hat{K}_{gt+1}, \hat{K}_{gt+1-j}) = \frac{\bar{\theta}^j}{1-\bar{\theta}^2}\sigma^2 \equiv \gamma_j \quad \textit{and} \quad \rho_j = \frac{\gamma_j}{\gamma_0}.$$

Proof Take logs in equation (15) to obtain $\hat{K}_{gt+1} = \log \tilde{A} + \bar{\theta}\hat{K}_{gt} + \hat{s}_t$. Since $\hat{s}_t$ is a two-state iid stochastic process that equals $\hat{s}_i$ with probability p_i, its expected value is $E(\hat{s}_t) = p_A \hat{s}_A + p_B \hat{s}_B = \bar{\epsilon}$. By adding and subtracting $\bar{\epsilon}$ from the equation, its transformed error term ϵ_t has a zero mean. The variance is obtained by computing $Var(\epsilon_t) = E(\epsilon_t^2) - [E(\epsilon_t)]^2$ and using the fact that $p_A = 1 - p_B$. Stationarity follows from the fact that $\bar{\theta} < 1$. For the computation of long-run moments, see Hamilton (1994).

Figure 3 depicts the evolution of investment and spending in region-specific goods for a period of time, once the economy has reached its ergodic set.

The economy experiences booms when B is in office and short periods of recession after party A wins an election. For example, consider what happens after t=7, when group B takes office. There is an immediate jump in investment and a contraction of spending on public goods. This results in larger levels of public capital and hence more production (i.e., a 'boom' in the economy). Government investment grows over time (periods 7 to 13), and as public capital becomes larger, the amount provided of the public good also increases. Group A gets into power in period 14, at which time expenditures on public goods have a boost accompanied by a contraction in investment.

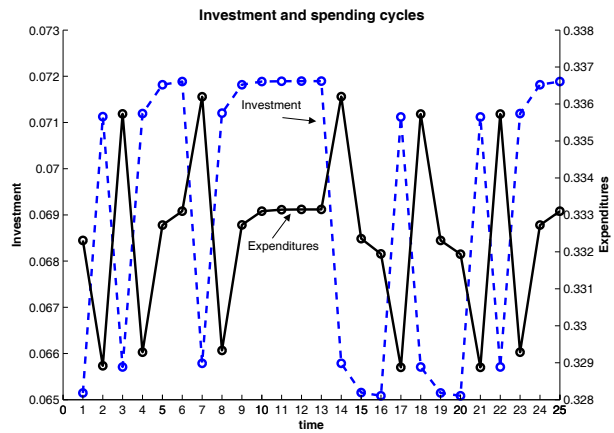

Figure 3: Understanding the cycle

An empirical implication from this analysis is that we should observe a jump in public consumption when a party that doesn't often win takes power, together with a sudden decrease in investment. Total expenditures increase when the party enjoying an electoral advantage is in office, since

$$e_{it} = x(g_{it}) + h_i(K_{gt}) = \frac{1}{2}(1 + s_i)\tilde{A}K_{gt}^{\bar{\theta}}$$

rises right after B takes control of the government.

Notice that the nature of the economic cycle is intrinsically different from the one found in traditional partisan cycle models, in which one of the parties is assumed to derive higher utility from public goods than the other. In such models, switches in power that are associated with increases in total expenditures should also result in higher public consumption. In this model, however, increases in total spending right after a switch in government would be associated with *decreases* in public consumption.

Because output, consumption, and expenditures are proportional to capital, their processes are also stationary. The following lemma provides some insights into the propagation mechanism of political shocks.

Lemma 4.3

$$Var(\hat{n}_t) < Var(\hat{y}_t) < Var(\hat{K}_{gt+1}) \quad and$$
$$Var(\hat{c}_t) = Var(\hat{x}(g_t)) > Var(\hat{y}_t).$$

Proof See Appendix 7.4.

Private consumption reacts immediately to the change in taxes that occurs after a political switch. The labor supply, on the other hand, is unaffected by the resulting income effects due to the GHH preference assumption. Since the current stock of capital is fixed, output does not change either. This implies that consumption variability is larger than output variability in this model. Public consumption reacts in the same way to shocks than private consumption as a result of separability and the fact that both are assumed to have the same intertemporal elasticity of substitution. Power switches also affect investment, and this creates changes in output and labor, but with a lag. Hence, investment is more volatile than these two variables,

as shown in the lemma above. It is worth mentioning at this point that since we are abstracting from productivity shocks, these implications are not to be taken as general results regarding relative volatilities at the business cycle frequency, but instead as illustrating how economic variables react to *medium-term political shocks* associated with switches in the ideology of the policymaker.

Lemma 4.4 *Government policy and allocations are procyclical*

$$0 < Corr(\hat{x}(g), \hat{y}) = Corr(\hat{c}, \hat{y}) < Corr(\hat{n}, \hat{y}) = 1 \quad and \quad Corr(\hat{I}, \hat{y}) > 0.$$

Proof See Appendix 7.5.

Private and public consumption are less correlated with output than the labor supply is.[10] It is not possible to establish theoretically whether private investment is more correlated to output than consumption is, but this has been verified in our numerical example (details upon request). The reason is that investment is proportional to output but it exhibits a much higher variability.

4.3 The effect of party advantage

The probability of party B's re-election increases when its electoral advantage ξ rises. If the incumbent belongs to the advantaged group, he is more likely to be succeeded by a candidate of his own type and has incentives to invest more resources in productive activities (see equation 14). If A was in power instead, a higher value of ξ would decrease this party's probability of staying in power. So the short-sightedness would be strengthened, resulting in a propensity to invest even further away from the first best. Despite the decrease in A's propensity to invest, long-run capital increases as B's electoral advantage goes up, as shown in Lemma 4.5.

Lemma 4.5 *The long-run average of the capital stock increases with political advantage*

$$\frac{\partial E(\hat{K}_g)}{\partial \xi} > 0.$$

Proof See Appendix 7.6.

Because $\hat{y}$ and $\hat{n}$ are increasing functions of $\hat{K}_g$, output and the labor supply will also increase in the long run as ξ increases.

This model also provides implications for the relationship between political stability and the size of governments. The degree of political stability is closely related to the variable ξ. Political turnover is highest when $\xi = 0$, since each party's probability of winning an election equals 0.5. As B's advantage increases, power switches become more infrequent, and political stability goes up. The size of governments is usually measured as the ratio of total government expenditures to GDP in the empirical literature, which given our assumptions equals

$$\frac{e_i}{y} = \frac{1}{2}(1 + s_i).$$

The long-run average of this variable is just $E(e/y) = p_A e_A + p_B e_B$, and can be shown to be increasing in ξ following steps similar to those in Appendix 7.6 (proof available upon

[10] Bachman and Bai (2010) also find that government consumption is procyclical in a political economy model, but their channel arises from the correlation between political wealth bias and productivity shocks.

request). Hence, the model predicts that countries (or States) with larger political advantage—and low political turnover—should exhibit overall larger governments. Finally, long-run public consumption as a fraction of output is decreasing in this variable, since $E(\frac{x(g)}{y}) = \frac{1}{2} - E(e/y)$. More concisely, as the advantage of B increases, a larger percentage of expenditures is devoted to productive investment and away from public consumption. This implies the following:

Lemma 4.6 *The long-run share of public investment to output increases with political advantage, while the share of public consumption decreases with it*

$$\frac{\partial E\left(\frac{K_g}{Y}\right)}{\partial \xi} > 0 \quad \textit{and} \quad \frac{\partial E\left(\frac{x(g)}{Y}\right)}{\partial \xi} < 0.$$

Additionally, the long-run share of public investment to total spending also increases with political advantage, while the share of public consumption decreases with it.

The volatility of political and economic variables can be shown to be non-monotonic in the electoral advantage ξ.

Proposition 4.3 *There exists a unique value ξ^* such that $\forall \xi < \xi^*$ we have $\frac{\partial Var(\hat{K}_g)}{\partial \xi} > 0$ and $\forall \xi > \xi^*$ we have $\frac{\partial Var(\hat{K}_g)}{\partial \xi} < 0$.*

Proof See Appendix 7.7.

The reason is that there are two opposing forces driving these volatilities. One is given by the gap between each party's propensities to save, which increases the volatility of policy and allocations. The other force is political stability, which reduces it. When $\xi = 0$, both parties are completely symmetric. Even though political turnover reaches its maximum value (with $p_A = p_B = 0.5$), the gap is zero (since $s_A = s_B$). So there are no fluctuations in policy or economic variables, and $\sigma^2(\xi) = 0$, implying $\text{Var}(\hat{K}_g) = 0$. As ξ increases, the marginal propensity to invest of type A falls below the symmetric level, while that of type B lies above that value. Hence, the gap in the marginal propensities to invest is widened and volatility rises. For small deviations from symmetry, this effect dominates that of political stability. Eventually, ξ becomes large enough that even though the gap between s_A and s_B is large, political turnover is very infrequent. Since B is in power most of the time, policy remains stable and volatility goes down. At an extreme, when $\xi = 0.5$ party B wins elections with probability one. So there is no variability in policy or allocations.

We can see this graphically in Figure 4 for the set of parameters described in Appendix 7.8. As shown in Lemma 4.3, output is more volatile than labor but exhibits less volatility than public and private consumption. The variance of public investment is much larger than that of all other variables because the estimated elasticity of public capital is quite small in this example ($\theta = 0.039$). Therefore, it has been omitted to make the figure more readable.

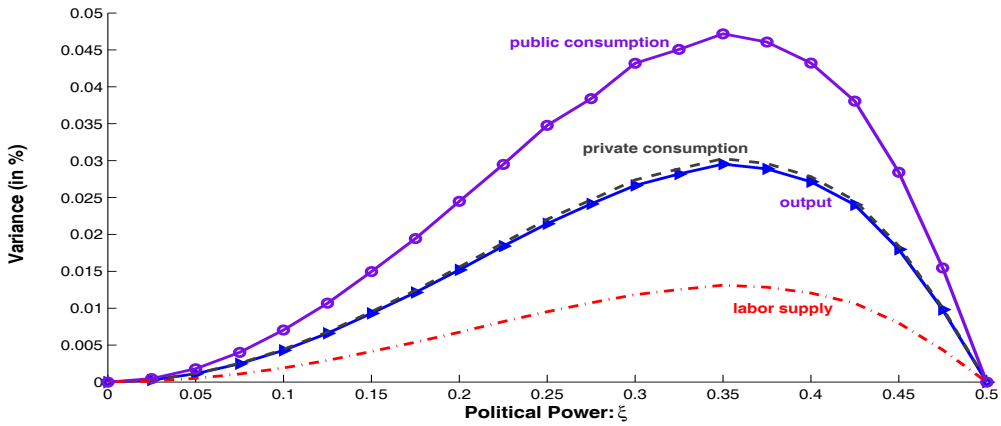

Figure 4: Volatility of policy and allocations, measured by the variance of log-variables

This result provides a testable implication of the model. Countries (or States) in which parties are very symmetric (i.e., there is almost no popularity advantage for any of them) will exhibit frequent turnover but little volatility in policy variables. We should also expect low variability in countries (or States) in which turnover is infrequent. Fluctuations are largest for those with intermediate levels of political advantage.

5 Empirical support

The objective of this section is to test relevant implications of the model. We want to assess whether the effects of partisan advantage on fiscal policy and allocations are consistent with the theory developed in previous sections.

The unit of analysis is a State. US States provide an ideal sample, since they share the same institutional features (as well as aggregate economic conditions), but are heterogeneous in terms of their citizens' political preferences. The analysis proceeds in two ways. One emphasizes the cross-sectional variation in economic and political variables across States. The other takes advantage of the over-time variation in variables within States, using panel data analysis. The sample consists of 47 States (Alaska, Hawaii, DC, and Nebraska are excluded due data unavailability), over the period 1970 - 2000 which is the largest span of data for fiscal variables I had access to. For fiscal and economic series, I employ annual data. Political series are only available at a bi-annual frequency, so I interpolate intermediate values to generate annual observations.

5.1 Political Data

Electoral advantage ξ is proxied by the average margin of victory of the winning party in State legislatures, also referred to as 'party strength'. It measures the degree to which a given party dominates electoral politics in a particular State. [11]

Let $sh_{jt}(i) = \frac{i_{jt}}{D_{jt}+R_{jt}}$ denote the share of seats obtained by party $i \in \{R, D\}$ in the Upper and Lower houses of the legislature of State j. Data on the number of seats controlled by each party is obtained from 'Composition of State Legislatures by Political Party Affiliation' at the US Census Bureau. The solid line in Figure 5 represents the share of seats controlled by the

[11] See Brown and Bruce (2002) for a measure that also includes results from national and gubernatorial elections.

Democratic party in both houses at the State legislature over time. Clearly, Democrats enjoyed a persistent political advantage over the Republican party, since they controlled more than 50% of the seats for most of our sample. The surface closer to the figure's origin (i.e. the blue shaded area) measures the percentage of States under D control in both houses (i.e. those where the share is larger than 0.5), while the medium surface (red area) is the equivalent measure for party R.

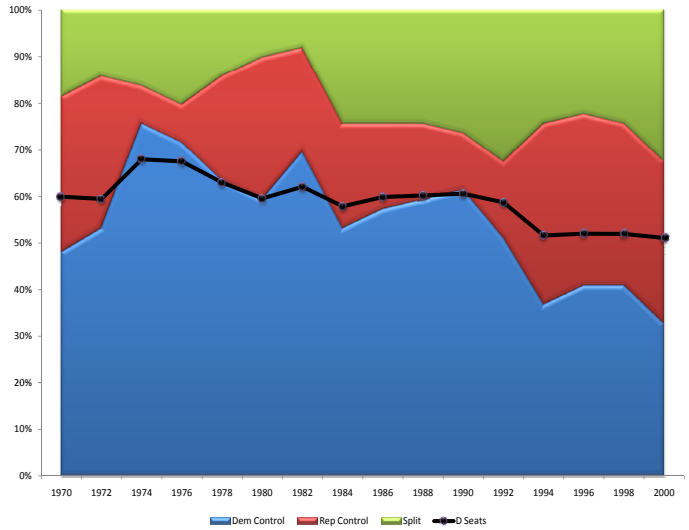

Figure 5: The persistence of partisan advantage.

'Split' denotes the percentage of States under a divided government (i.e. where each party controls only one house, represented by the green upper surface in the graph). While the number of States under a divided government has increased over time, its proportion is relatively small for most of the sample. Therefore, I will focus on the total share of seats across both houses for the reminder of the analysis.

Following the political science literature, the party strength PS in State j at year t is defined as

$$PS_{jt} = |sh_{jt}(D) - sh_{jt}(R)|,$$

that is, as the margin of victory of the winning party in State elections. It is the empirical counterpart of $|p_A - p_B|$ in the model. Using the definition of p_i derived in the theoretical section of the paper, electoral advantage ξ_{jt} can thus be proxied by $\frac{1}{2}PS_{jt}$.

The average value per state over the sample period, ξ_j, is depicted in Figure 6. Blue States denote parties where Democrats enjoyed an electoral advantage (i.e. $sh_j(D) > sh_j(R)$), while red States correspond to Republican ones (i.e. $sh_j(D) < sh_j(R)$, numbers in parenthesis). Clearly, some States exhibited a large electoral advantage over our sample period, such as Arkansas where ξ averaged 0.4 (recall that the maximum value ξ can take is 0.5). We can also observe a large degree of heterogeneity in the sample, since the standard deviation of ξ_j is 0.1 while its mean is 0.16. This evidence suggests that electoral advantage—in a given State—is sizable and persistent, as assumed in the theoretical model.

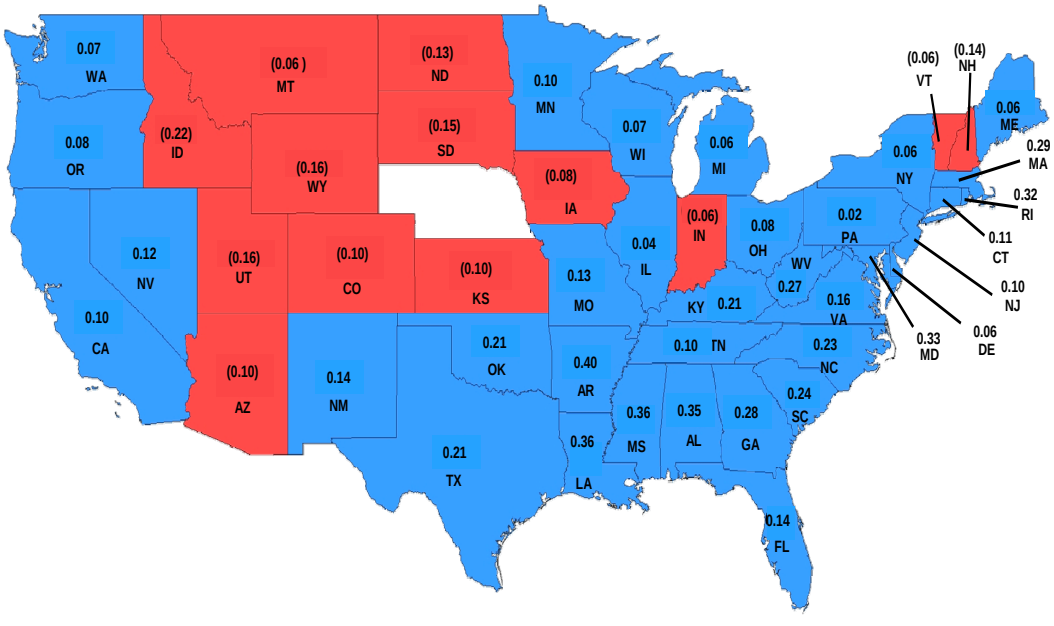

Figure 6: Electoral advantage (Republican in parenthesis).

5.2 Economic Data

Gross State Product GSP is obtained from the National Economic Accounts at the Bureau of Economic Analysis (BEA). Fiscal data and population per state come from the Bureau of the Census (BOC), historical series. Public investment is denoted by I and corresponds to 'capital outlays' in the Census data. Our proxy for targeted spending G, also referred to as public consumption throughout the paper, is given by the total amount spent on educational subsidies and assistance. This is one of the items over which state and local governments have the largest degree of discretion in terms of government spending. An alternative measure for g could be 'total government consumption'. In States' budgets however, this category includes expenditures related to the development of public capital (such as public employees' salaries in education and infrastructure) which is clearly non-targeted spending. Educational subsidies and assistance are intrinsically a local (and targeted) public good, and hence chosen as a proxy for our theoretical variable. Finally, total spending TS corresponds to 'total expenditure'. The GSP, G, and I series are measured in 2000 constant prices (using the GDP deflator), and converted in per capita terms.

State governments spend on average 11% of GSP on consumption, operations, and investment per-year (Total Spending, TS), as seen in the third line of Table 7 (Total Spending / GSP). Over 10% of this amount corresponds to public investment, whose share of GSP is approximately 1.1%. Targeted spending represents 0.8% of total spending.

Table 7: Targeted spending and public investment shares.

Variable	Average	Std. Dev.	Max	Min
Pub Investment / GSP	1.07	0.33	1.95	0.46
Targeted Spending / GSP	0.09	0.04	0.22	0.03
Total Spending / GSP	10.72	1.86	14.89	6.87
Pub Investment / Tot Spend	10.15	2.39	16.64	4.34
Targeted Spending / Tot Spend	0.80	0.32	2.12	0.31

Notes: Each observation represents the average share of targeted spending or public investment per state. The first three rows are expressed as percentages of GSP, while the last two rows are percentages of total spending.

5.3 Tests

Because most of the individual series are non-stationary, the logged data will be de-trended using a band-pass filter. The advantage of following this approach relative to the HP-filter is that, by being a two-sided moving average filter, we can isolate data for different frequencies. This is particularly important when analyzing the effect of political variables on economic outcomes, because the frequency of political shocks (i.e. turnover between parties) is smaller, and hence more persistent, than that of the business cycle. Following Comin and Gertler (2006) I will focus on the 'medium term cycle', where frequencies range between 2 and 50 years. The high frequency component, between 2 and 8 years, coincides with the standard definition for the real business cycle. The medium term frequency component, between 8 and 50 years, captures the medium term frequency component (note that 2-50 reflects cycles of about a decade in the time domain). The resulting statistics for the high frequency component (2 to 8) are in line with those computed with an HP-filter parameter of $w = 6.25$, while those for the medium term cycle (2 to 50) are similar to an HP filer with parameter $w = 100$. Results using the HP-filter are available upon request.

5.3.1 Ranking of Volatilities, Lemma 4.3

Table 8 summarizes the average State volatility of our economic and fiscal variables during the medium-term cycle. As in previous studies, we see that employment is less volatile than output at all frequencies. Public investment, on the other hand, is more than three times more volatile than output, and the volatility of targeted transfers is even larger.

Table 8: Volatilities during the medium term cycle.

Variables	Medium Term Cycle 2-50	High Frequency Component 2-8	Medium Term Component 8-50
GSP	5.42%	2.13%	4.86%
Employment	4.11%	1.41%	3.75%
Targeted Spending	22.25%	12.55%	17.39%
Public Investment	19.89%	10.54%	16.08%

Notes: Average standard deviation of the natural logarithms of real (2000 constant dollars) per-capita variables, de-trended using a Band-pass filter at different frequencies.

Consistently with Comin and Gertler's findings for the aggregate US economy, the average standard deviation of per-capita output over the medium term is about twice as large that of the high-frequency component (5.42% vs 2.13%). This also holds for fiscal policy, since the standard deviations of both public consumption and investment are larger in the medium term than over the business cycle. The volatilities of public consumption and investment per State for the medium term cycle (2 to 50) are depicted in Figure 9, which shows a large degree of variability across states.

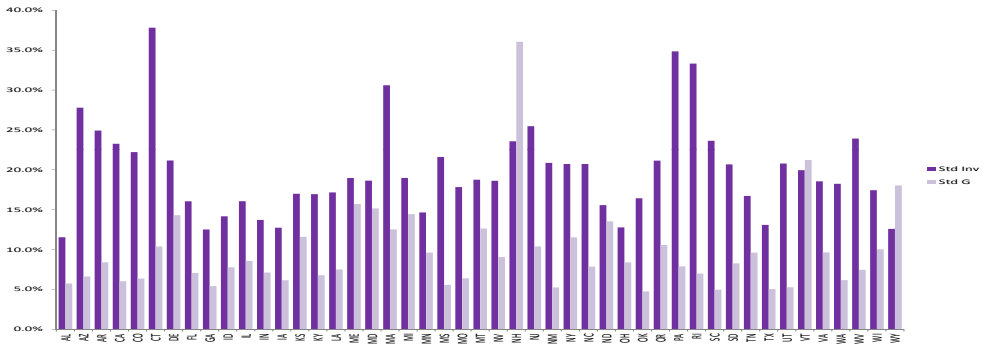

Figure 9: Standard deviation of GSP and G during the medium term cycle, per State.

Consistent with Lemma 4.3, the volatility of targeted spending is larger than the volatility of output for every State in our sample. Public investment is more volatile than output for every state with the exception of Wyoming. Finally, employment is less volatile than output in 87% of the States, consistent with the theoretical prediction of $Var(\hat{n}) < Var(\hat{y})$.

5.3.2 Cyclicality of fiscal policy, Lemma 4.4

Lemma 4.4 establishes that G, L, and I are procyclical, that is, that they co-move with output. While targeted transfers are only mildly procyclical, the average sample correlations (across States) of public investment and employment are consistent with this finding:

i. $Corr(G, GSP) = 0.09$,

ii. $Corr(L, GSP) = 0.64$,

iii. $Corr(I, GSP) = 0.26$.

Moreover, i. and ii. imply that employment is more strongly correlated to GSP than public consumption is, as predicted by the Lemma. Finally, $Corr(L, GSP) < 1$ while this equals 1 in the model, mainly because the theory abstracts from TFP shocks.

5.3.3 Composition of fiscal policy and electoral advantage, Lemma 4.6

Lemma 4.6 is one of the most important results of this paper. While the cyclicality of expenditures and the ranking of volatilities could be caused by other factors (such as productivity shocks), the relationship between fiscal variables and party advantage is a distinctive prediction of this model. The results follow from the effects of a specific type of political shock: political turnover, under asymmetric re-election uncertainty. According to Lemma 4.6, the long-run share of public investment to total spending is increasing in party advantage, while the share of public consumption is decreasing in it. The intuition is that as the advantage of a party increases, its likelihood of staying in power goes up. This reduces the short-sightedness induced by re-election uncertainty, shifting expenditures away from consumption and into investment. Figure 10 shows that States where a party enjoys a larger electoral advantage also tend to exhibit a higher share of (unfiltered) public investment to total spending (Panel A) and a lower share of public consumption (Panel B).

The first column of table 11 presents the estimated coefficients of a simple linear regression of the natural logarithm of public investment shares of total spending on (the natural logarithm of) electoral advantage. Consistent with the Lemma, the coefficient of ξ_j is positive and significant at the 1% level.

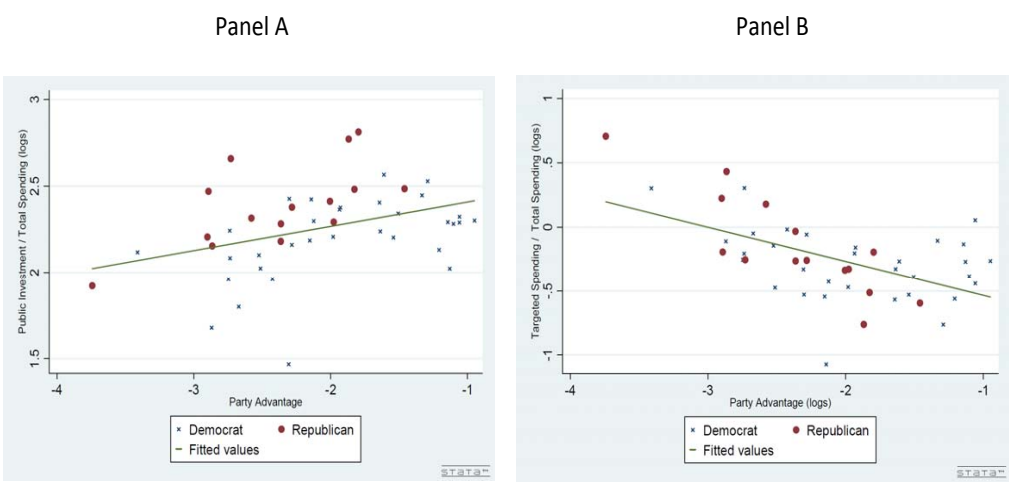

Figure 10: Public investment (Panel A) and targeted spending (Panel B) shares of total spending, and party advantage (in logs).

In specification (2) the model is augmented to include a dummy variable, Democrat, which equals 1 if the State has been—on average throughout the sample period—under democratic control. We find that States that have been under democratic control exhibit lower ratios of investment to total public expenditures than those under republican control. The variable is significant at the 1% level, and the fit of the model increases significantly when this dummy

is introduced. The theoretical model assumed away any differences in preferences over public investment (other than those endogenously derived from differences in electoral advantage). The results from this empirical exercise suggest that an interesting extension to the theoretical model should include both types of heterogeneity: in electoral advantage and political preferences.

Table 11: Regression results. The dependent variable in the first two columns is the natural logarithm of public investment shares of total spending and in the 3rd and 4th columns it is natural logarithm of targeted spending shares of total spending. The last four columns consider the variables as percentages of GSP instead. Electoral advantage is the natural logarithm of the average value per state.

Independent vars	Share of Total Spending				Share of GSP			
	Public Investment		*Targeted Spending*		*Public Investment*		*Targeted Spending*	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Electoral advantage	0.136 ***	0.206 ***	-0.306 ***	-0.295 ***	0.153 ***	0.233 ***	-0.279 ***	-0.262 ***
	(0.045)	(0.046)	(0 .074)	(0.074)	(0.053)	(0.046)	(0 .085)	(0.083)
Democrat		-0.294 ***		-0.040		-0.338 ***		-0.070
		(0.068)		(0.085)		(0.084)		(0.1)
Constant	2.567 ***	2.910 ***	-0.923 ***	-0.873 ***	0.337 ***	0.732 ***	-3.107 ***	-3.020 ***
	(0.09)	(0.12)	(0.16)	(0.17)	(0.11)	(0.13)	(0.18)	(0.19)
R-squared	0.126	0.384	0.344	0.347	0.12	0.37	0.22	0.23
N	47	47	47	47	47	47	47	47

Notes: The sample period is 1970-2000. The independent variable in specifications (1) and (3) is electoral advantage. Specifications (2) and (4) also include a dummy variable 'Democrat', which equals 1 if the State has been on average under democratic control throughout the sample period. Robust standard errors are in parenthesis. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Specification (3) tests whether public consumption decreases with electoral advantage. We see that the coefficient of ξ_j is indeed negative and statistically significant at the 1% level. Interestingly, the introduction of the Democrat variable does not improve the fit of the model: we cannot reject the hypothesis that its coefficient is zero. This implies that the choice of targeted transfers is, beyond its electoral advantage, independent of the identity of the party in power.

For robustness, the same regressions were computed using as dependent variables the natural logarithm of the shares of public investment and targeted spending to output (that is G/Y and I/Y). The results are qualitatively similar to the ones found using shares of total expenditures, and are thus in line with Lemma 4.6.

5.3.4 Variance non-monotonicity, Lemma 4.3

Lemma 4.3 another important result of this paper. The non-monotonicity of volatility in variables as party advantage increases is a distinctive prediction of this model. This prediction is, however, more difficult to test with a small sample.

As can be seen in Figure 12, ξ has changed significantly over time in some States. We can thus take advantage of the extra information provided by the variability observed within a State, in addition to the cross-sectional differences. To test the hypothesis, I regress the volatility of fiscal variables on a quadratic function of party advantage and State-specific fixed effects. The dependent variables are the 10-year rolling variances of the filtered public investment and targeted spending series per State. The focus is again on the medium term cycle, so the Band

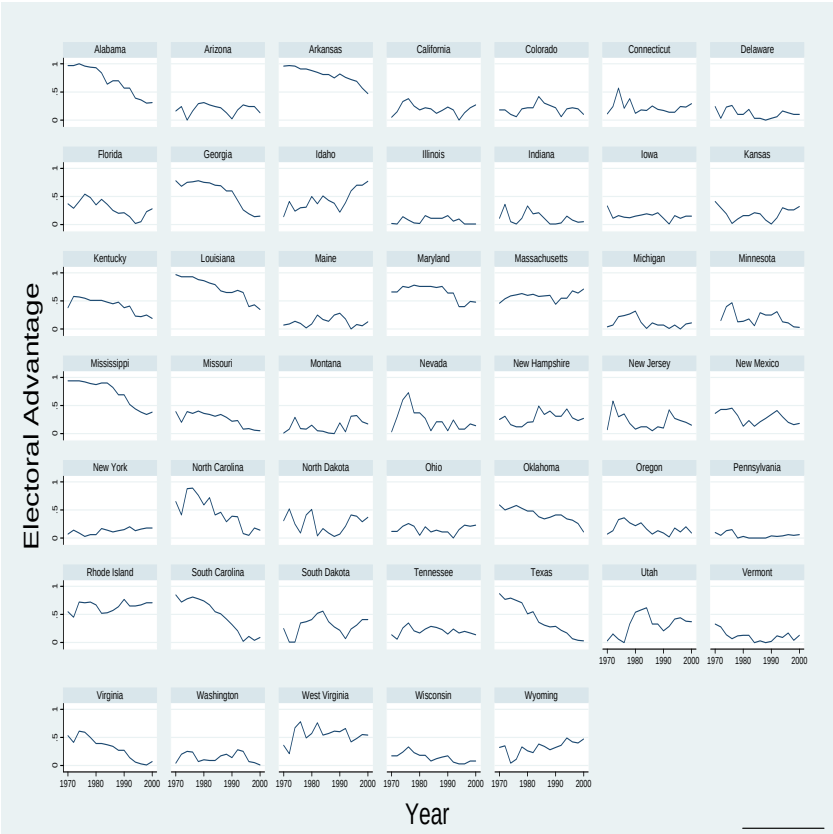

Figure 12: Electoral advantage over time.

Pass filter used is 2 - 50 years (as before, we filter the logarithm of per-capita real variables). The main independent variable is a series of 10-year rolling averages of electoral advantage.

The regression equation is displayed below.

$$\tilde{V}ar(Z_j)_t = \alpha + \beta_1 \tilde{\xi}_{tj} + \beta_2 \tilde{\xi}_{tj}^2 + \beta_3 Year_t + \sum_{j=1}^{47} \gamma_j S_j + \epsilon_t,$$

where tildes denote the fact that we are using rolling means and variances (with t being the end-date of the window), ϵ_t is the error term, $Z \in \{I, G\}$, and S_j is a State dummy. The quadratic term is included in order to capture the curvature of the function characterized in the Lemma. A time trend (denoted 'year') is introduced in order to account for the effect of aggregate factors that are independent of the change in electoral advantage, but might be affecting volatilities.

The regression outcomes for each dependent variable in the benchmark specification are summarized in Table 13 (fixed effect terms are omitted, to ease readability). Reported standard errors are robust, to control for heteroscedasticity. The coefficients on electoral advantage, reported under the column labeled (1), are significant and imply an inverted U-shape relation with public investment. This simple model explains around 45% of the variability in the dependent variables. The quadratic term is, on the other hand, statistically insignificant for the case of targeted spending.

Table 13: Fixed-effects regression results to test the non-monotonicity of variances.

Independent Variables	Dependent Variable			
	Var(Pub Investment)		*Var(Targeted Spending)*	
	(1)	(2)	(1)	(2)
ξ	0.060 *	0.060 *	0.233 **	0.330 ***
	(0.03)	(0.03)	(0.11)	(0.122)
ξ^2	-0.122 *	-0.110 *	-0.205	-0.400 **
	(0.06)	(0.06)	(0.17)	(0.19)
Year	-0.001 ***	-0.001 ***	0.001 **	-0.003 ***
	(0.0001)	(0.0002)	(0.0005)	(0.0006)
Public		-0.448 ***		-1.200 ***
		(0.12)		(0.28)
Manufacturing		0.256 ***		-0.814 ***
		(0.06)		(0.18)
Adj R^2	0.45	0.48	0.37	0.39
F	33.9	34.0	1.6	7.2
Prob > F	0.00	0.00	0.18	0.00

Notes: Dependent variables are the 10-year rolling variances of deflated, per capita, logged, and filtered (band-pass 2-50) series of public investment and targeted transfers. Independent variables are 10-year rolling means of electoral advantage (ξ_j), and the 10-year rolling means of the labor share in the public ('Public') and manufacturing sectors ('Manufacturing'). The sample period is 1970-2000, and there are 1034 observations in each regression. Fixed effect terms are omitted. Robust standard errors are in parenthesis. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Changes in the State industrial composition may affect the variability of fiscal variables, biasing the estimated coefficients of electoral advantage. In order to control for this, I constructed two additional variables: Manufacturing and Public. They measure the (10-year rolling mean) share of employment in these industries relative to total employment in all industries, as reported by the Bureau of Economic Analysis [12]. The reason for including them is that States have experienced important changes in the structure of production during this period. In particular, some an increase in the share of the manufacturing sector in production. Outcomes are reported under Model (2) in Table 13. The relationship between electoral advantage and fiscal variables is, consistently with previous results, increasing for small values of ξ and then decreasing. The coefficients of ξ and ξ^2, are now statistically significant for both public investment and public consumption, and in line with the theoretical predictions of the model.

The regressions are intended to show that some of the correlations predicted by the model do hold in the data. Causality is however more difficult to claim, since there might be an erogeneity problem due to reverse causation. In particular, it is possible that public policy does affect the margin of victory, which is the proxy used to capture party advantage.

6 Concluding Remarks

I presented a model in which disagreements about the composition of spending results in implementation of myopic policies by the government: Investment in infrastructure is too low while

[12] Data is obtained from the table Annual State Personal Income and Employment. I use 'Total full-time and part-time employment by industry (SA25, SA25N)'. The industrial classification is SIC (Standard Industry Classification)

spending on public goods is too high. Groups with conflicting interests try to gain power in order to implement their preferred fiscal plan. Since there is a chance of being replaced by the opposition, strategic manipulation of the level of investment is optimal.

I considered a case in which one of the groups enjoys an advantage in the political arena, captured by a higher probability of being in power. As a result, the politico-economic equilibrium is asymmetric and public investment is not only inefficiently low but it also fluctuates. The group with the advantage wins elections more often, becoming less impatient. Therefore, it chooses a share of investment to GDP closer to the first best. Even though both groups have symmetric preferences over the size of spending and investment, in equilibrium the group with the disadvantage tends to spend more and invest less. Since different policies are implemented as parties alternate in power, the political cycle is propagated throughout the real economy. In equilibrium, macroeconomic variables fluctuate even in the absence of economic shocks. Moreover, consumption, employment and output are distorted despite the fact that the government has access to lump-sum taxation. Increases in electoral advantage induce increases in the share of public investment to total expenditures by the advantaged party. Finally, volatility is non-monotonic in the degree of electoral advantage. Economies with intermediate values of this variable are expected to exhibit the largest volatility in fiscal and economic variables.

I test the main hypotheses of this model using data from US States over the period 1970-2000, since they exhibit a large and persistent electoral advantage towards a party. I find evidence of a positive relationship between public investment as a share of total spending (or output) and the political bias. There is also evidence of a negative relationship between the share of targeted spending on total expenditures (or output) and party advantage. Using a fixed effects regression, I show that there exists an inverted U-shape relation between the electoral advantage and the volatility of public investment and government consumption.

This paper abstracts from several important dimensions related to public investment that would be interesting to incorporate in future research. One of them is private savings. By distorting production through public capital, the government would introduce a wedge in private investment decisions. This would act similarly to distortionary taxation on capital income. Another interesting extension would be to relax the balanced budget assumption. States are unable to issue debt to finance discretionary expenditures, but they are allowed to borrow to finance infrastructure. Debt would make such investments cheaper from the standpoint of an incumbent which could potentially decrease the inefficiencies highlighted in this paper. Finally, analyzing the case where agents disagree on public investment rather than on public spending could complement the analysis.

7 Appendix

7.1 Proof of Proposition 3.1

The FOC with respect to K_g' is:

$$u_1(c_B(K_g), n_B(K_g)) = \beta\{p_B V_{B1}(K_g') + p_A W_{B1}(K_g') \tag{16}$$

Denote the rule that solves this functional equation by $h_B(K_g) \equiv K_B$. Define $h_A(K_g) \equiv K_A$ analogously.

Focus on the problem of party B (and abstract from the subindexes in its value function). Obtain $V_1(K_g)$ by differentiating equation 8 and simplifying:

$$V_1(K_g) = u_1(c_B(K_g), n_B(K_g))F_1(K_g, n_B(K_g)). \tag{17}$$

To find $W_1(K_g)$ differentiate equation (9):

$$W_1(K_g) = u_1(c_A(K_g), n_A(K_g))c_{A1}(K_g) + \beta h_{A1}(K_g)\left\{p_B V_1(K_A) + p_A W_1(K_A)\right\}, \tag{18}$$

where $c_{A1}(K_g) = F_1(K_g, n_A(K_g)) - x_g(g_A(K_g))g_{A1}(K_g) - h_{A1}(K_g)$. Notice that allocations are evaluated given party A's policy, because we are considering the value function of a type B agent when his group is out of power.

Use eq. (16) to solve for $W_1(h_B(K_g))$:

$$W_1(K_B) = \frac{1}{p_A}\left\{\frac{1}{\beta}u_1(c_B(K_g), n_B(K_g)) - p_B V_1(K_B)\right. \tag{19}$$

In order to replace the equation above in eq. (18) we need the value function to be evaluated in the investment choice of government A, $W_1(K_A)$. Assuming that the functions h_i are invertible, we can achieve this by evaluating eq. (19) at $\tilde{K_g} = h_B^{-1}(h_A(K_g))$,

$$W_1(K_A) = \frac{1}{p_A}\left\{\frac{1}{\beta}u_c(c_B(\tilde{K_g}), n_B(\tilde{K_g})) - p_B V_1(K_A)\right. \tag{20}$$

Replace eq. (20) into eq. (18) and simplify:

$$\begin{aligned} W_1(K_g) = {} & u_1(c_A(K_g), n_A(K_g))[F_1(K_g, n_A(K_g)) - x_g(g_A(K_g))g_{A1}(K_g)] \\ & -h_{A1}(K_g)[u_1(c_A(K_g), n_A(K_g)) - u_c(c_B(\tilde{K_g})), n_B(\tilde{K_g}))]. \end{aligned} \tag{21}$$

Update eq.(21) by substituting K_g with $K_g' = h_B(K_g)$ and replace in eq.(16). After some manipulations, we obtain

$$\begin{aligned} u_1(c_B(K_g), n_B(K_g)) = \beta \Bigg\{ & \sum_{i=A,B} p_i u_1(c_i(K_g'), n_i(K_g'))F_1(K_g', n_i(K_g')) \\ & -p_A x_g(g_A(K_g'))g_{A1}(K_g')u_1(c_A(K_g'), n_A(K_g')) \\ & -h_{A1}(K_g')p_A[u_1(c_A(K_g'), n_A(K_g')) - u_c(c_B(\tilde{K_g}')), n_B(\tilde{K_g}'))]\Bigg\}. \end{aligned} \tag{22}$$

7.2 Proof of Proposition 4.1

Guess a constant investment share $h_i(K_g) = s_i \tilde{A} K_g^{\bar{\theta}}$. Eq. (10) implies:

$$g_B(K_g) = \hat{c}_B(K_g) = \frac{1}{2}(1 - s_B)\tilde{A}K_g^{\bar{\theta}},$$

with $\hat{c}_B(K_g) = c_B(K_g) - \frac{n_B(K_g)^{1+\epsilon}}{1+\epsilon}$. Equation (11) simplifies to:

$$\begin{aligned} \frac{1}{\hat{c}_B(K_g)} = \beta \Bigg\{ & p_B \frac{f_K(K_g')}{\hat{c}_B(K_g')} + (1 - p_B)\frac{[f_K(K_g') - g_{AK}(K_g)]}{\hat{c}_A(K_g')} + \\ & (1 - p_B)h_{AK}(K_g')\left[-\frac{1}{\hat{c}_A(K_g')} + \frac{1}{\tilde{c}_B(K_g')}\right]\Bigg\}. \end{aligned}$$

where $K_g' = h_B(K_g) = s_B \tilde{A} K_g^{\bar{\theta}}$ and $\tilde{c}_B(K_g') = \frac{1}{2}\frac{1-s_B}{s_B} s_A \tilde{A} K_g'^{\bar{\theta}}$.

Replacing the guess into the equation above and simplifying,

$$s_B = \frac{\beta\bar{\theta}(1 + p_B)}{2 - \beta\bar{\theta}(1 - p_B)}. \tag{23}$$

7.3 Proof of Proposition 4.2

Let $N = [K_{gA}^{ss}, K_{gB}^{ss}]$ define the ergodic set. We will prove the proposition in two steps: first, by showing that any sequence starting outside of the set necessarily converges to a point inside the set; second, by showing that any sequence starting inside N necessarily stays in N.

Step 1. Let $0 < K_{g0} < K_{gA}^{ss}$. Define the sets $M_i = [0, K_{gi}^{ss}]$ and $Q_i = [K_{gi}^{ss}, \infty) \Rightarrow \forall K_g \in int(M_i)$, $h_i'(K_g) > 1$ and $\forall K_g \in int(Q_i)$, $h_i'(K_g) < 1$. Let $K_g \in M_A \cap M_B \equiv M$, then we know that $K_g' > h_i(K_g)$ from Lemma 4.1 for $i \in \{A, B\}$. Hence, if $K_{g0} \in M$ the sequence $\{K_{gt}\}_t$ is increasing. Moreover, $\exists T < \infty$ such that $K_{gT} > K_{gA}^{ss}$. Suppose not. Since M is bounded and $\{K_{gt}\}_t$ is increasing, then the series must converge to the upper bound K_{gA}^{ss}. But $h_B(K_{gA}^{ss}) > K_{gA}^{ss}$ from Lemma 4.1 and the fact that $s_B > s_A$. Contradiction.

Now let $K_g \in Q_A \cap Q_B \equiv Q$, then we know that $K_g' < h_i(K_g)$ from Lemma 4.1 for $i \in \{A, B\}$. Hence, if $K_{g0} \in Q$ the sequence $\{K_{gt}\}_t$ is decreasing. Moreover, $\exists T' < \infty$ such that $K_{gT'} < K_{gB}^{ss}$. Suppose not. Since Q is bounded below and $\{K_{gt}\}_t$ is decreasing, then the series must converge to the lower bound K_{gB}^{ss}. But $h_A(K_{gB}^{ss}) > K_{gB}^{ss}$ from Lemma 4.1 and the fact that $s_B > s_A$. Contradiction.

Step 2. Let $K_{gt} \in N$, then there are two possibilities. Either $i = A$, in which case $K_{gt+1} = h_A(K_{gt}) \geq K_{gA}^{ss}$ from Lemma 4.1, so $K_{gt+1} \in N$. Alternatively, if $i = B$, then $K_{gt+1} = h_B(K_{gt}) \leq K_{gB}^{ss}$ from Lemma 4.1, so $K_{gt+1} \in N$.

7.4 Proof of Lemma 4.3

In parts.

$\text{Var}(\hat{y}_t) < \text{Var}(\hat{K}_{gt})$: Since $\hat{y}_t = \log \tilde{A} + \bar{\theta}\hat{K}_{gt} \Rightarrow \text{Var}(\hat{y}_t) = \bar{\theta}^2 \text{Var}(\hat{K}_{gt}) < \text{Var}(\hat{K}_{gt})$.

$\text{Var}(\hat{n}_t) < \text{Var}(\hat{y}_t)$: Take logarithms to equation (12), then $\text{Var}(\hat{n}_t) = \left(\bar{\theta} - \frac{\theta}{1+\theta\epsilon}\right)^2 \text{Var}(\hat{K}_{gt})$.

$\text{Var}(\hat{c}_t) = \text{Var}(\log(g + G))$: Trivial from $\hat{c}_t = \log(0.5\tilde{A}) + \log(1 - s_t) + \bar{\theta}\hat{K}_{gt} = \log(g + G)$.

$\text{Var}(\hat{c}_t) > \text{Var}(\hat{y}_t)$: The variance of $\hat{c}_t$ is

$$\text{Var}(\hat{c}_t) = \text{Var}(\log(1 - s_t)) + \bar{\theta}^2 \text{Var}(\hat{K}_{gt}) + 2\bar{\theta}\text{Cov}(\log(1 - s_t), \log s_{t-1}),$$

from the expression for $\hat{c}_t$ and the definitions of $\hat{K}_{gt}$ and $\hat{\epsilon}_t$. Finally, $\bar{\theta}^2 \text{Var}(\hat{K}_{gt}) = \text{Var}(\hat{y}_t)$ and $\text{Cov}(\log(1 - s_t), \log s_{t-1}) = 0$ because political shocks are *i.i.d.*.

7.5 Proof of Lemma 4.4

Let σ_x denote the standard deviation of variable x. Public investment is proportional to output, $I = sy$. Taking logs, we can compute

$$\rho(\hat{I}_{gt}, \hat{y}_t) = \frac{Cov(\hat{s}_t + \hat{y}_t, \hat{y}_t)}{\sigma_{\hat{y}}\sigma_{\hat{I}}} = \frac{\sigma_{\hat{y}}}{\sigma_{\hat{I}}} > 0$$

since s_t and y_t are uncorrelated.

Consumption is proportional to output, $c = 0.5(1 - s)y$. Taking logs,

$$\rho(\hat{c}_t, \hat{y}_t) = \frac{Cov(\log(0.5[1 - s_t]) + \hat{y}_t, \hat{y}_t)}{\sigma_{\hat{y}}\sigma_{\hat{c}}} = \frac{\sigma_{\hat{y}}}{\sigma_{\hat{c}}} > 0.$$

From the definition of public consumption $\rho(\hat{c}_t, \hat{y}_t) = \rho(\hat{x}(g_t), \hat{y}_t)$. The correlation of labor supply with output can be computed in a similar way.

7.6 Proof of Lemma 4.5

Differentiating condition *i.* in Lemma 4.2 we obtain

$$\frac{\partial E(\hat{K}_g)}{\partial \xi} = \frac{1}{1-\bar{\theta}^2}\left(p_B \frac{\partial s_B}{\partial p_B}\frac{1}{s_B} - p_A \frac{\partial s_A}{\partial p_A}\frac{1}{s_A} + \hat{s}_B - \hat{s}_A\right)$$
$$> p_B \frac{\partial s_B}{\partial p_B}\frac{1}{s_B} - p_A \frac{\partial s_A}{\partial p_A}\frac{1}{s_A}$$

since $\hat{s}_B > \hat{s}_A$. We can use the fact that $\frac{\partial s_A}{\partial p_A} = \frac{\partial s_B}{\partial p_B}\left(\frac{1+p_B}{s_B}\frac{s_A}{1+s_A}\right)^2$ in the right-hand side of the equation and simplify it to

$$RHS = \frac{\partial s_B}{\partial p_B}\frac{1}{s_B^2(1+p_A)^2}[p_B s_B(1+p_A)^2 - p_A s_A(1+p_B)^2]$$
$$> \frac{\partial s_B}{\partial p_B}\frac{1}{s_B^2(1+p_A)^2}\frac{s_A}{s_B^2(1+p_A)^2}(p_B - p_A)(1-p_A p_B) > 0.$$

7.7 Proof of Proposition 4.3

The proof is based on the properties of σ^2 since they determine the shape of $\mathrm{Var}(\hat{K}_g)$, defined in condition *ii.* of Lemma 4.2. We will use the following results.

Lemma 7.1 *The variance of $\bar{\epsilon}$ is non-negative, $\sigma^2(\xi) > 0\,\forall \xi \in [0, 0.5]$ and has only two zeroes: $\sigma^2 = 0$ at $\xi = 0$ and $\xi = 0.5$. At these points, its slope satisfies $\frac{\partial \sigma^2(\xi)}{\partial \xi}|_{\xi=0} = 0$ and $\frac{\partial \sigma^2(\xi)}{\partial \xi}|_{\xi=0.5} < 0$.*

Proof The first property follows by definition: $\sigma^2 = p_A p_B(\hat{s}_A - \hat{s}_B)^2 \geq 0$. When $\xi = 0$, $\hat{s}_A = \hat{s}_B \Rightarrow \sigma^2 = 0$. When $\xi = 0.5$, $p_A = 0 \Rightarrow \sigma^2 = 0$. Let $z = \hat{s}_A - \hat{s}_B$ and note that $p_A p_B = 0.5^2 - \xi^2$. Then

$$\frac{\partial \sigma^2}{\partial \xi} = -2\xi z^2 + p_A p_B 2z \frac{\partial z}{\partial \xi} \tag{24}$$

where $\frac{\partial z}{\partial \xi} = 2(1-\bar{\theta}\beta)[(1+p_B)^{-1}(2-\bar{\theta}p_A)^{-1} + (1+p_A)^{-1}(2-\bar{\theta}p_B)^{-1}]$. When $\xi = 0$, $z = 0 \Rightarrow \frac{\partial \sigma^2}{\partial \xi}|_{\xi=0} = 0$. Since $p_A = 0$ when $\xi = 0.5$, $\frac{\partial \sigma^2}{\partial \xi}|_{\xi=0.5} < 0$ follows.

Lemma 7.2 *Let $\Xi \equiv \left\{\xi \in (0, 0, 5] : \frac{\partial \sigma^2(\xi)}{\partial \xi} = 0\right\} \Rightarrow$ for any $\xi \in \Xi$, we have $\frac{\partial^2 \sigma^2(\xi)}{\partial^2 \xi} < 0$.*

Proof The second derivative of equation (24) is

$$\frac{\partial^2 \sigma^2}{\partial^2 \psi} = -2z^2 - 8z\xi\frac{\partial z}{\partial \xi} + 2p_A p_B\left(\frac{\partial z}{\partial \xi}\right)^2 + 2p_A p_B z\frac{\partial^2 z}{\partial^2 \xi}, \tag{25}$$

with

$$\frac{\partial^2 z}{\partial^2 \xi} = 4(1-\bar{\theta}\beta)\left[\frac{1+\bar{\theta}\beta p_A}{(1+p_A)^2(2-\bar{\theta}\beta p_B)^2} - \frac{1+\bar{\theta}\beta p_B}{(1+p_B)^2(2-\bar{\theta}\beta p_A)^2}\right].$$

Take $\xi^* \in \Xi$. We know that: (i) $z > 0$, since $\xi > 0$ and $s_A = s_B \Leftrightarrow \xi = 0$ and (ii) ξ^* solves $z = \frac{p_A p_B}{\xi}\frac{\partial z}{\partial \xi}$. Evaluating equation 24 at ξ^* we obtain

$$\frac{\partial^2 \sigma^2}{\partial^2 \xi}|_{\xi \in \Xi} = 2\frac{z}{\xi}\left[\xi(0.5^2 - \xi^2)\frac{\partial^2 z}{\partial^2 \xi} - (0.5^2 + \xi^2)\frac{\partial z}{\partial \xi}\right]. \tag{26}$$

Defining $\gamma_i = (1+p_i)(2-\bar{\theta}\beta p_j)$ for $j \neq i$, replacing the expression for $\frac{\partial^2 z}{\partial^2 \psi}$ into equation (26), and using condition (ii) we obtain

$$\frac{\partial^2 \sigma^2}{\partial^2 \xi}|_{\xi \in \Xi} = 4\frac{z}{\xi}(1-\bar{\theta}\beta)\left(\gamma_A^{-2}[2\xi(0.5^2-\xi^2)(1+\bar{\theta}\beta p_A) - (0.5^2+\xi^2)\gamma_A] - \right.$$
$$\left. \gamma_B^{-2}[2\xi(0.5^2-\xi^2)(1+\bar{\theta}\beta p_B) + (0.5^2+\xi^2)\gamma_B]\right)$$

Since the second term is clearly positive (due to $\gamma_i > 0 \, \forall i$),

$$\frac{\partial^2 \sigma^2}{\partial^2 \xi}|_{\xi \in \Xi} < 4\frac{z}{\xi}(1-\bar{\theta}\beta)\gamma_A^{-2}[2\xi(0.5^2-\xi^2)(1+\bar{\theta}\beta p_A) - (0.5^2+\xi^2)\gamma_A]$$
$$< 4\frac{z}{\xi}(1-\bar{\theta}\beta)\gamma_A^{-2}(1+p_A)[2\xi(0.5^2-\xi^2) - (0.5^2+\xi^2)(2-\bar{\theta}\beta p_A)]$$

using the fact that $\bar{\theta}\beta < 1$. Simplifying, we obtain

$$< 4\frac{z}{\xi}(1-\bar{\theta}\beta)\gamma_A^{-2}(1+p_A)[0.5^2(-1.5+\xi) + \xi^2(-2+\bar{\theta}\beta/2) - \xi^3(2+\bar{\theta}\beta) < 0.$$

Claim 7.1 *There exists a unique* $\xi^* \in \Xi$.

Proof Existence by continuity of $\sigma^2(\xi)$ and Lemmas 7.1 and 7.2. The function $\sigma^2(\xi)$ is continuously differentiable and strictly positive in the interval $(0, 0.5)$ and equal to zero at $\xi = 0$ and $\xi = 0.5$. Hence a point in Ξ must exist.

Uniqueness by contradiction. Suppose $\exists$ at least one value $\tilde{\xi} \in \Xi$ such that $\frac{\partial^2 \sigma^2}{\partial^2 \xi} \geq 0$, because the function $\sigma^2(\xi)$ is continuous in ξ and $\sigma^2 = 0$ at the extremes, $\xi = 0.5$ and $\xi = 0$, as shown in Lemma 7.1. But this contradicts Lemma 7.2, which proved that $\sigma^2(\xi)$ is strictly concave around any point where the first derivative is zero.

7.8 Numerical Appendix

A time period represents a year, so the discount factor is $\beta = 0.95$. Following Greenwood, Hercowitz and Huffman (1988) I assume that the elasticity of labor supply ϵ equals 2. The level of productivity A is normalized to one. There are three non-standard parameters in this model: The elasticity of public capital θ, the fixed cost of providing public goods G, and the popularity advantage ξ. I choose the three parameters so that simulated moments at the political equilibrium match three target moments in the data. The first target is mean non-defense public investment as a proportion of GDP in the US for the period 1929-2006 ($GNDI/Y$). The second target is average non-defense public consumption as a proportion of output, for the same time period ($GNDC/Y$). All figures are obtained from the NIPA tables. The third target is computed so that the equilibrium advantage of party B, given by $p_B - p_A$ in the model, matches the average advantage obtained by the Democrats during all congressional elections to the House of Representatives between 1929 and 2006 (AD). The variable is computed as follows. Let $sh_t(i) = \frac{i_t}{D_t+R_t}$ denote the share of seats obtained by party $i \in \{R, D\}$ in the House of Representatives in Congress $t \in \{70^{nt}, ..., 109^{th}\}$ (that is, covering the period 1929-2006). Following Diermeier, Keane and Merlo (2005) the advantage of party D at each period of time is simply $Adv_t = sh_t(D) - sh_t(R)$.

I simulated the political equilibrium for 5000 periods and discarded the first 1000 to eliminate the effects of initial conditions. Table I summarizes the value of the parameters obtained from the calibration, together with the target variables.

Variable	Parameter	Target	Target Value
Elasticity of public investment	$\theta = 0.039$	Public Investment/Output	$GNDI/Y = 2.88$
Fixed cost of public goods	$G = 0.063$	Public Spending/Output	$GNDC/Y = 13.84$
Popularity advantage	$\xi = 0.068$	Democrat advantage	$AD = 0.145$

The value of θ is in line with empirical estimates and close to the estimate used in Baxter and King (1993), who set the elasticity of public capital to 0.05. While they use the same target—public investment as a ratio of output—to calibrate the model, their measure of investment includes defense expenditures, while mine excludes them. If I were to include defense expenditures as well, I would obtain a value closer to Baxter and King's. The parameter G captures expenditures that have not been modeled (such as defense spending). To the extent of my knowledge, this is the first time an attempt to estimate the parameter ξ has been done in a calibrated political economy model. Therefore, there is no counterpart in the literature. As we will see in the next section, assuming a constant value for ξ is clearly a simplification, since its value has fluctuated over the time interval. However, using a stochastic popularity advantage would complicate the solution presented in this paper, and it is left for an extension.[13]

8 Appendix B

In this section, I endogenize the re-election probabilities by adding a voting stage into the model following the probabilistic voting literature.

The two groups will alternate in power based on a political institution in which "ideology" or other non-economic issues play a role. In particular, I use a "probabilistic-voting" setup (see Lindbeck and Weibull (1993)) in order to provide micro-foundations for political turnover: The probability of being in power next period is going to be endogenously determined via an electoral process.

A key departure from the traditional probabilistic voting model is that *parties do not have a commitment to platforms*. Therefore, announcements made during the political campaign will not be credible unless they are optimal ex-post (that is, once the party takes power).

Agents are assumed to differ not only in their preferences over the composition of expenditures but also in another dimension that is orthogonal to economic policy (religious views, charisma of the politician, etc.). Preferences over this *political dimension* imply derived preferences over candidates and will take the form of additive iid preference shocks ω. The instantaneous utility of agent j in region J at a particular point in time is

$$\underbrace{u(c_j, n_j) + v(g^J)}_{\text{economic}} + \underbrace{\omega_j}_{\text{political}}, \tag{27}$$

Timing

Each period will be divided into two stages: the taxation stage and the election stage.

At the taxation stage, the incumbent chooses τ, g^A, g^B, and K_g' knowing the state of the economy (K_g) and the distribution of political shocks but not their realized values. Hence, policy is chosen under uncertainty. The probability of winning the election can be calculated by forecasting how agents vote given different realizations of the shock.

[13]See Battaglini (2010) for en environment in which a party's advantage changes over time in a symmetric environment with commitment.

After production, consumption, and investment take place, ω' is realized. At the election stage, agents vote for the party that gives them higher expected lifetime utility. They need to forecast how the winner of the election chooses policy. The assumptions of rationality and perfect foresight imply that agents' predictions are correct in equilibrium.

The set of equilibrium functions to be determined in a Markov-perfect equilibrium is identical to the ones in the main body of the paper, with the addition of two new functions: The probabilities of re-election $p_i(K_g)$, which are now endogenous objects.

Election Stage

At this stage, agents must decide which party to vote for. The utility derived from political factors, ω_j, has two components: An individual ideology bias (denoted by φ^{jJ}) and an overall popularity bias (ψ). In particular,

$$\omega_i = \left(\psi + \varphi^{jJ}\right) I_i,$$

where I is an indicator function such that $I_B = 1$ and $I_A = 0$, since ψ and the individual specific parameter φ^{jJ} measure voter j 's ideological bias toward the candidate from party B. I will follow Persson and Tabellini (2000) by assuming that the distribution of φ^{jJ} is uniform and group-specific, $\varphi^{jJ} \backsim \left[-\frac{1}{2\phi^J}, \frac{1}{2\phi^J}\right]$, with $J = A, B$.

These shocks are *iid* over time and hence are 'candidate specific.' Each period, a given party presents a candidate and voters form expectations about the candidate's position on certain moral, ethnic or religious issues, orthogonal to the provision of public goods. Examples are attitudes toward crime (gun control or capital punishment), drugs (e.g., whether to legalize the use of marijuana), immigration policies, pro-life or pro-choice positions, same-sex marriage, etc. Since φ^{jJ} can take positive or negative values, there are members in each group who are biased toward both candidates. Therefore, individuals belonging to the same group may vote differently.

The parameter ψ represents a general bias toward party B at each point in time. It measures the average relative popularity of candidates from that party relative to those from party A. While the realization of φ^{jJ} is individual-specific, the value of ψ is the same for all agents. This is the most essential shock, since by being common to all agents, it is the one that affects the election outcome. The role of φ^{jJ} is to ensure the existence of equilibria by ruling out ties and is included mostly for technical reasons. The popularity shock is *iid* over time and can also take positive or negative values. It is distributed according to:

$$\psi \backsim \left[-\frac{1}{2} + \eta, \frac{1}{2} + \eta\right].$$

A positive value for η (the expected value of ψ) implies that candidates from party B have an average popularity advantage over those from the opposition. On the other hand, $\eta = 0$ implies that parties are symmetric, in the sense that their candidates are expected to be equally popular or charismatic. This parameter will be the main driving force behind the electoral advantage.

Finally, agents are assumed to have perfect information about the candidates, so there are no informational asymmetries in this model. At the election stage, voters compare their lifetime utility under the alternative parties. The maximization problem of voter j in group A is given by

$$\max\left\{V_A(K_g'),\, W_A(K_g') + \psi' + \varphi^{jA\prime}\right\},$$

where $V_A(K'_g)$ denotes the welfare of this agent if a candidate representing his group wins the elections, while $W_A(K'_g)$ is the value of his utility if the candidate representing group B is elected. The maximization problem of an agent in group B is analogously defined.

Determination of probabilities

Individual $j \in A$ votes for B whenever the shocks are such that

$$V_A(K'_g) < W_A(K'_g) + \psi' + \varphi^{jA\prime}.$$

We can identify the *swing voter* in group A as the voter whose value of $\varphi^{jA\prime}$ makes him indifferent between the two parties

$$\varphi^A(K'_g) = V_A(K'_g) - W_A(K'_g) - \psi'.$$

Figure 14 illustrates this point (assuming $\psi = 0$ for simplicity). The swing voter is found where the two solid lines intersect. All voters in group A with $\varphi^{jA\prime} > \varphi^A(K'_g)$ also prefer party B as can be seen in the graph.

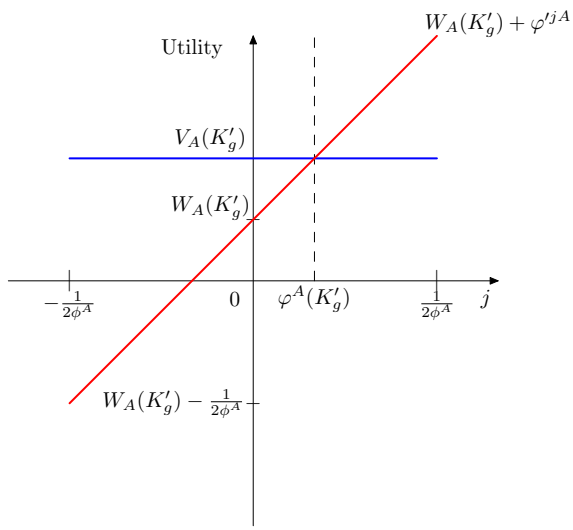

Table 14: Utility as a function of $\varphi^{jA\prime}$

The same type of analysis can be performed for agents in group B, to determine the swing voter in that group.

Given the assumptions about the distributions of φ^{jA} and φ^{jB} the share of votes for party B is:

$$\pi_B = \frac{1}{2}\left[1 - \sum_J \phi^J \varphi^J(K'_g)\right].$$

Under majority voting, party B wins if it can obtain more than half of the electorate; that is, if $\pi_B > \frac{1}{2}$. This occurs whenever its relative popularity is high enough. There exists a threshold

for ψ, denoted by $\psi^*(K_g')$ such that B wins for any realization $\psi > \psi^*(K_g')$. After performing some algebra using the expression above, we find that

$$\psi^*(K_g') = \frac{1}{\phi}\left(\phi^A\left[V_A(K_g') - W_A(K_g')\right] + \phi^B\left[W_B(K_g') - V_B(K_g')\right]\right), \tag{28}$$

where $\phi = \phi^A + \phi^B$.

The threshold is given by a weighted sum of the differences in the utility of the swing voter under each party. The weights depend on the dispersion in the ideology shocks and on the amount of supporters that each party has. The higher the heterogeneity within a constituency (ϕ^J), the bigger the effect these factors have on the election outcomes. Also, the greater the number of individuals belonging to type J, the stronger the group in the determination of the probability. Finally, note that the threshold depends on the level of public capital, though it is not clear in which direction. In principle, this level could increase or decrease with K_g'.

Since $\varphi^J(K_g')$ depends on the realized value of ψ, ex-ante the share of votes for party B (π_B) is a random variable. B's probability of winning the election is given by:

$$p_B(K_g') \quad = \quad P\left(\pi_B > \frac{1}{2}\right) = P(\psi' > \psi^*(K_g')),$$

which is equivalent to:

$$p_B(K_g') = \frac{1}{2} + \left[\eta - \psi^*(K_g')\right]. \tag{29}$$

A's probability of winning the next election is just $p_A(K_g') = 1 - p_B(K_g')$.

Recall that η represents the popularity advantage of candidates from party B over those from party A. So in principle, B's probability increases with η.

The current level of consumption in private and public capital does not affect the voting decision (i.e., no retrospective voting). Voters do not 'punish' politicians/parties for their past behavior but decide instead based on future expected policy choices.

Taxation Stage

The maximization problem looks exactly like the one presented in section 3, with the exception that probabilities now depend on the state variable and utility depends on ideological preference shocks. To fix ideas, consider the problem faced by an incumbent from group B

$$\max_{g^A, g^B, K_g' \geq 0} u(c,n) + v(g^B) + \omega_j + \beta\{p_B(K_g')V_B(K_g') + p_A(K_g')W_B(K_g') + E_B(\omega_j'; K_g')\}$$

where consumption and labor satisfy equations (2) and (3). $E_B(\omega_j', K_g')$ represents the expected value of tomorrow's political shock conditional on B winning the next election (recall that this shock is a relative bias toward a candidate from party B),

$$E_B(\omega_j'; K_g') = \int_{\psi^*(K_g')}^{\frac{1}{2}+\eta} z\partial z,$$

which can be shown to be equal to

$$E_B(\omega_j'; K_g') = p_B(K_g')\left[\frac{1}{2}p_A(K_g') + \eta\right].$$

By changing the stock of public capital the incumbent affects not only the economic dimension but also his probability of winning and the expected value of political shocks.[14]

The functions $V_B(K_g)$ and $W_B(K_g)$ satisfy

$$V_B(K_g) = u\left(c_B(K_g), n_B(K_g)\right) + v(g_B^B(K_g)) + \tag{30}$$
$$\beta\{p_B(h_B(K_g))V_B(h_B(K_g)) + p_A(h_B(K_g))W_B(h_B(K_g)) + E_B(\omega_j'; h_B(K_g))\}$$

and

$$W_B(K_g) = u\left(c_A(K_g), n_A(K_g)\right) + v(g_A^B(K_g)) \tag{31}$$
$$\beta\{p_B(h_A(K_g))V_B(h_A(K_g)) + p_A(h_A(K_g))W_B(h_A(K_g)) + E_B(\omega_j'; h_A(K_g))\},$$

where $\Upsilon_i(K_g) = \{g_i^A(K_g), g_i^B(K_g), h_i(K_g)\}$ denotes the equilibrium policy functions chosen by incumbent type i, and where $c_i(K_g) = c(\Upsilon_i(K_g))$ and $n_i(K_g) = n(\Upsilon_i(K_g))$ are the competitive equilibrium values of consumption and labor under the political equilibrium policies.

Because the choice of expenditures is static, it is identical to the one under exogenous political turnover.

The investment decision, on the other hand, now depends on how public investment affects the probability of re-election

$$u_1(c_B(K_g), n_B(K_g)) = \beta\{p_B(K_g')V_{B1}(K_g') + p_A(K_g')W_{B1}(K_g')$$
$$+p_{B1}(K_g')\left[V_B(K_g') - W_B(K_g')\right] + E_{B2}(\omega_j'; K_g')\},$$

where $p_{B1}(K_g') = \frac{\partial p_B(K_g')}{\partial K_g'}$, and we use the fact that $p_A = 1 - p_B$.

Even though parties represent their constituencies and have no derived value of being in office, they will try to manipulate the probability of being re-elected (which allows them to implement the desired policy in the future).

A change in investment today modifies the problem faced by voters, which in turn affects the probability of being in power next period. A rational incumbent realizes this and thus takes into account the effect of expanding K_g' on its likelihood of winning. It is reasonable to expect that a group is better off while in power, so $V_B(K_g') > W_B(K_g')$. However, the sign of $p_{B1}(K_g')$ is, in principle, ambiguous.

Under our functional assumptions, we can show that $p_{B1}(K_g') = 0$ in a differentiable MPE. Intuitively, if candidate B proposes a higher level of investment, it will create a wedge in the marginal utilites derived from the two candidates. This margin, however, is independent of the stock of public capital in the economy. The reason is that (the natural logarithm of) capital appears additively separably from other arguments in all welfare functions V_i and W_i. Inspection of equation 28 reveals that the threshold value ψ^* is independent of K_g, and so is the re-election probability (see eq. 29). As a result, the probabilities of re-election are constant $p_i(K_g) = p_i$ for $i = A, B$. Marginal utilities, on the other hand, are affected by the marginal propensities to invest. Therefore, the probabilities of re-election are functions of these, as shown in Proposition 8.1.

[14] Other papers in the literature usually ignore political shocks because they study two-period models, once the shock has been realized. Since ω is additive, focusing on net-of-shock welfare is without loss of generality. In this paper, it would not be the case because that elections are held every period.

Proposition 8.1

$$g_i(K_g) = \frac{1}{2}(1-s_i)\tilde{A}K_g^{\bar{\theta}} - G \quad \textit{and} \quad h_i(K_g) = s_i\tilde{A}K_g^{\bar{\theta}},$$

The marginal propensities to invest s_i and the probabilities of re-election p_i are jointly determined by:

$$s_i = \bar{\theta}\beta\left[\frac{1+p_i}{2-\bar{\theta}\beta\,(1-p_i)}\right]. \tag{32}$$

The probabilities of reelection are $p_B = \frac{1}{2} + [\eta - \psi^*]$ and $p_A = 1 - p_B$, where

$$\psi^* = \frac{3}{2}\left[\ln\left(\frac{1-s_A}{1-s_B}\right) + \frac{\bar{\theta}\beta}{1-\bar{\theta}\beta}\ln\frac{s_A}{s_B}\right]. \tag{33}$$

Proof Guess a constant probability $p_i(K_g) = p_i$ and a constant investment share $h_i(K_g) = s_i\tilde{A}K_g^{\bar{\theta}}$. From Proposition 4.1 we verify the guess for $h_i(K_g)$ given a constant p_i, where s_B is defined in equation 23.

To verify that p_i is constant, note that the value functions satisfy

$$V_j(K_g) = \bar{\nu}_j + \nu_j\ \ln(K_g). \tag{34}$$

$$W_j(K_g) = \bar{\omega}_j + \omega_j\ \ln(K_g), \tag{35}$$

where

$$\nu_j = \frac{\bar{\theta}(2-\bar{\theta}\beta p_i)}{1-\bar{\theta}\beta} \quad \text{and} \quad \omega_j = \frac{\bar{\theta}(1+\bar{\theta}\beta p_j)}{1-\bar{\theta}\beta},$$

$$\bar{\nu}_j = \frac{1}{1-\beta}\left\{\beta(1-p_j)\left[\ln\left(\frac{1}{2}(1-s_i)\tilde{A}\right) + \beta[p_j\nu_j + (1-p_j)\omega_j]\ln(s_i\tilde{A})\right.\right.$$
$$\left.\left. +[1-\beta(1-p_j)]\left[2\ln\left(\frac{1}{2}(1-s_j)\tilde{A}\right) + \beta[p_j\nu_j + (1-p_j)\omega_j]\ln(s_j\tilde{A})\right]\right\},$$

$$\bar{\omega}_j = \frac{1}{1-\beta(1-p_j)}\left\{\ln\left(\frac{1}{2}(1-s_i)\tilde{A}\right) + \beta\left[p_j\bar{\nu}_j + [p_j\nu_j + (1-p_j)\omega_j]\ln(s_i\tilde{A})\right]\right\}.$$

Replace eq. (34) and eq. (35) into eq. (28) to obtain the expression that determines $\psi^*(K_g)$.

Finally, we verify that probabilities are constant and that governments choose to invest a proportion of output. Notice that these rules are increasing in capital, differentiable and invertible.

Q.E.D.

From the proposition above, it becomes evident that electoral advantage $\xi = \eta - \psi^*$ is independent of K_g in the politico-economic equilibrium. Therefore, the probabilities of re-election p_i (endogenously derived here) are constant as assumed in the main text.

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