Estimating a Dynamic Game of U.S. State Fiscal Policies: Adjustment Costs and Balanced Budgets*

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Abstract

We develop and estimate a new dynamic game of state fiscal policies under partisan governments to study differences in preferences among parties and the importance of adjustment costs, which generate policy inertia. We consider the case in which a state government faces a binding ex-ante balanced budget constraint. Hence, taxes are a function of expenditures as well as the business cycle. Adjustment costs arise due to the constraints in the budget process. Our estimation approach exploits first-order conditions that optimal expenditures must satisfy along the equilibrium path. It also exploits a forward simulation algorithm to compute the value functions and their derivatives based on the estimated policy functions. We estimate the model using a panel of 45 states during the past three decades. Our empirical results provide new insights into the systematic effects of partisan government on state fiscal policies. Our results suggest that adjustment costs are large and primarily reflect institutional and legal constraints on the budget process. It takes up to eight years to adjust expenditures from one party's bliss point to the other party's bliss point. Our policy counterfactuals suggest that adjustment costs may dampen the impact of increased polarization on the volatility of expenditures.

Keywords: State Fiscal Policies, Balanced Budget Requirements, Rainy Day Funds, Polarization, Adjustment Costs, Estimation of Dynamic Games, Forward Iteration Algorithm.

1 Introduction

Partisan control of government systematically shapes both tax and expenditure policies. This observation raises critical questions: if voters seek to alter the size of the government by changing the ruling party, how significant can the resulting fiscal changes be? The answer to this question primarily depends on how far the parties are apart. To measure the differences in bliss points among parties, two challenges need to be overcome. First, there are significant adjustment costs; policies do not adjust instantaneously. Second, there are important legal or constitutional constraints that shape fiscal rules and regulate the budget process. These budget rules impose severe constraints on policymakers. As a consequence, the current policy may not fully reflect the bliss point of the party that is in control of the budget process. This observation then raises another set of empirical questions. What is the speed with which policy adjusts, or, to put it more succinctly, how quickly do the parties get what they want? Despite substantial theoretical research on the relationship between partisan government and policy inertia, these empirical questions remain insufficiently understood. To address these research questions, we develop and estimate a new dynamic model of fiscal policies under partisan governments, using data from U.S. states.

An emerging theoretical literature has studied the causes and implications of policy inertia, focusing primarily on the mechanisms that generate adjustment costs. New government programs are difficult to establish, since there are significant set-up costs. Once programs are established, they tend to persist over time, i.e., policy tends to be "sticky." Adjustment costs can arise from at least four sources. First, there are political frictions that arise, for example, from a divided or split government. More generally, there is political gridlock.[1] Second, these adjustment costs partially reflect

[1]Influential lobbying groups and other beneficiaries of government programs may also contribute to policy inertia.

institutional features of the budget process. Third, there are legal constraints, such as labor laws, which make it difficult to hire, fire, and reassign public employees, who tend to be unionized. Finally, new programs take time to implement, since they may require investments in new infrastructure and capital. Hence, time-to-build considerations need to be taken into account. In this paper, we show how to estimate adjustment costs within a new dynamic model of state fiscal policies, which captures these political, institutional, legal, and economic constraints.

Partisan agendas unfold within a constitutional or institutional framework that imposes strict constraints on fiscal policy. Nearly all states in the U.S. operate under a balanced budget requirement (BBR), which prohibits expenditures from exceeding revenues in the general fund.[2] Most states also require that a share of revenues be deposited into a rainy day fund, further limiting fiscal discretion. These fiscal rules occupy a central place in contemporary policy debates. From an empirical perspective, these rules are helpful to measure polarization between parties and the speed of policy adjustment. By severely limiting the opportunity to finance (general fund) expenditures via debt, BBRs allow us to measure preferences for fiscal policies without the confounding factor of preferences for the timing and magnitude of debt. Specifically, we show in this paper that BBRs also allow us to estimate the differences in bliss points and the magnitude of adjustment costs solely based on observed expenditure policies.[3]

We develop a new dynamic game that considers an economy in which policymakers with different preferences alternate in office as a result of competitive elections. Preferences over taxes and expenditures systematically vary by party affiliation and

[2] In a U.S. state budget, the general fund is the primary operating account that finances most of a state's ongoing activities. Balanced budget requirements may be prospective (at the start of the fiscal year) or retrospective (at the end of the year). We refer to these as ex-ante and ex-post constraints, respectively.

[3] This simplification also rests on the assumption that tax revenues are proportional to income.

are subject to random shocks, which reflect differences in preferences over fiscal policies within a party. Policy makers are rational and forward-looking and understand that future policy makers may have different preferences from themselves. As a consequence, policy choices are not only driven by the desire to implement policies that are close to the ideal point of the policy-maker, but also reflect a strategic desire to influence the policies of future policy-makers.

Our model incorporates five important features of the budget process. First, we assume that the state government faces an ex-ante balanced budget constraint. We abstract from commitment problems and assume that the BBR is binding, as it has been for all U.S. states in our sample. Second, there is a one-period lag in the budget process, i.e., the budget passed this period determines taxes and expenditures in the next period. These two assumptions imply that taxes and spending have to be set in advance, before economic shocks are realized. With an ex-ante balanced budget requirement, tax rates are a function of budgeted expenditures and the (expected) state of the economy, reflecting the one-period policy lag. Since budgets are not necessarily balanced ex-post, the state government needs to operate a rainy day fund. Third, we assume that each government faces adjustment costs, which are a function of previous policies and may depend on the institutional and political environment. Each government cannot easily implement its bliss point as a fiscal policy since adjustment costs matter. As a consequence, the current policymakers' decisions are constrained by the policies of previous governments. Hence, the evolution of fiscal policies is sluggish, which gives rise to policy inertia. Fourth, we explicitly model the four periods in each term of an administration. Hence, parties face different incentives in election years than in non-election years. In election years, budgets need to be passed before the outcome of the election is known. This feature of the model allows us to endogenously generate a political business cycle for expenditures. Political business cycles may also arise since expenditure policies influence the incumbent's reelection probability. Finally, there is a disagreement between current and future policymakers. Hence, electoral changes imply volatility in fiscal policies. Moreover, adjustment costs imply that current expenditures are strategically used by each government to influence the choices of its successors.[4] Disagreement amongst alternating policymakers and uncertainty about who will be appointed in the future prevent the current government from implementing its preferred policies. Instead, the model inherently generates an overshooting mechanism in which policymakers tend to prefer policies that are more extreme than their bliss points.

Since the objective of the paper is quantitative analysis, we show how to estimate the model. It is well-known that estimating dynamic games can be rather challenging. To our knowledge, this is the first paper that has estimated a dynamic game to study policy inertia. We show that a flexible specification of the model can be estimated based on moment conditions, which can be derived from the optimality conditions that expenditures have to satisfy in equilibrium.[5] The error of the model can be interpreted as a preference shock that temporarily shifts the bliss point of the current policymaker. Since parties are forward-looking in our model, one key econometric challenge arises because the first-order conditions depend on the level and the derivative of the value functions of policymakers from both parties. A full solution nested fixed-point algorithm – in the spirit of Rust (1987) – is computationally challenging.[6] Hence, we follow Bajari, Benkard, and Levin (2007) and use a forward-simulation approach to compute the value functions and their derivatives.[7] This approach ul-

[4]This strategic component of policy also arises in models of debt policy, where debt may be used to tie the hands of future governments.

[5]The estimation of a dynamic non-linear model based on first order conditions is due to Hansen and Singleton (1982). It was extended to the context of dynamic games by Berry and Pakes (2000).

[6]Doraszelski and Pakes (2007) for a survey on how to solve dynamic games.

[7]Hotz, Miller, Sanders, and Smith (1994) proposed a forward simulation estimator for dynamic discrete choice models.

timately rests on our ability to estimate the policy functions of both parties before estimating the parameters of the structural model.

We estimate the model using expenditure data from 45 U.S. states for the period 1990-2018.[8] One problem encountered in matching the model to the data is that our dynamic game is stationary while the data exhibit significant stochastic growth. Hence, we need to detrend that data, a problem that is commonly encountered in macroeconomic business cycle analysis. Here, we follow the quantitative literature in time series econometrics and use the Hodrick and Prescott (1981) filter to detrend the state-level data.[9] Alternatively, we can use a double fixed effect model that controls for both time and state fixed effects. This model has been popularized in empirical studies in political economy by Besley and Case (1995). We estimate the decision rules of the parties and the parameters of our model using both approaches.

Our empirical results confirm that tax and expenditure policies are shaped by the political conflict between the two parties in the U.S. In particular, we find that differences in bliss points among parties are statistically significant and economically meaningful. Our estimates suggest that the differences in bliss points range between \$46 and \$125 per capita. Expenditure policies appear to be less polarized at the state than the federal level of government. This finding may be due to the fact that state programs primarily finance less controversial programs such as transportation, infrastructure, health, and education. In addition, balanced budget requirements force both parties to pay for expenditures on a pay-as-you-go basis. State governments, in contrast to the federal government, are severely limited in their ability to pass the tax burden to future generations by issuing debt. Our findings also confirm the

[8] This period follows the realignment of the two major parties in the U.S. that followed the passage of the civil rights legislation.

[9] Alternatively, we also explored a detrending algorithm proposed by Hamilton (2018) and found that the results are robust to these changes.

hypothesis that policymakers' preferences are decreasing in tax rates, which reflects voters' aversion to taxation. An increase in expenditures, holding economic conditions fixed, needs to be financed by an increase in tax rates. Our empirical results suggest that these tax increases impose significant costs on policymakers from both parties. Party-specific preference shocks are large. These reflect variations in policy over time that cannot be explained by economic shocks. These shocks partially reflect differences in preferences among administrations or governors of the same party.

Our most important finding is that there are substantial adjustment costs. The adjustment costs are primarily identified by the autocorrelation coefficient in the parties' optimal policy functions. Our estimates suggest that these autocorrelation coefficients are statistically significant and range between 0.57 and 0.85. A relatively small fraction of these autocorrelation parameters can be explained by differences in government composition, i.e., unified, split, or divided governments. We thus conclude that the adjustment costs primarily reflect economic and institutional costs associated with setting up and terminating programs, and are less driven by political differences in government types. The estimates of the adjustment are economically meaningful. To illustrate this result, we investigate how fast policies adjust to new partisan fiscal targets after changes in party control. We find that adjustments are quite sizable. It takes up to eight years to adjust expenditures from one party's bliss point to the other party's bliss point.

We find some compelling evidence that expenditures are larger in election years, which can be rationalized by assuming that reelection probabilities depend on the budgeted expenditures. Voters reward incumbents for higher expenditures, which provides some incentives to the party in power to increase expenditures in election years, thus generating a political business cycle. Overall, we find that these political business cycle effects are statistically significant and moderate in magnitude.

Finally, we study the relationship between partisanship and the volatility of policies. It is well understood that increases in polarization among the parties yield more volatile policies, which may not be in the interest of the mean voter. Our model suggests that the higher the adjustment costs, the lower the volatility of expenditures. Broadly speaking, our policy counterfactuals, therefore, suggest that the impact of increased polarization on the volatility of expenditures may be dampened by political, institutional, legal, or economic constraints that lead to high adjustment costs. As such, policy inertia can be desirable in the presence of rising polarization.

The rest of the paper is organized as follows. Section 2 presents a brief literature review. Section 3 introduces the new dynamic game that guides our empirical investigation. Section 4 discusses identification and estimation. Section 5 provides details about the data and the detrending algorithms used in this paper. Section 6 discusses the estimation of the policy functions. Section 7 provides the key empirical results. Section 8 focuses on policy analysis. Section 9 concludes and discusses future research. The appendices provide additional detail about the computational and estimation approach taken in this paper.

2 Literature Review

Our paper contributes to at least four strands of the literature. First, it relates to the growing body of work on dynamic games in political economy.[10] In particular, our work contributes to a growing literature in political economy on policy inertia. In the "endogenous status quo" framework, inertia arises in dynamic legislative-bargaining models (Eraslan and Piazza, 2025), where disagreement defaults to the previous period's policy. Policy changes entail heterogeneous costs across parties, and polariza-

[10]See Duggan and Martinelli (2017) for a survey of earlier contributions.

tion introduces additional frictions. Efficiency in these models requires moderate policies without reversals. Loeper and Dziuda (2024) show that voters may favor divided government to mitigate the costs of policy change. Another strand of the literature emphasizes inertia outside of bargaining models but still with costly adjustments. Piguillem and Riboni (2024), for example, analyze "sticky" spending rules that bind governments to maintain part of past expenditures. Gersbach, Jackson, Müller, and Tejada (2023) similarly model costly policy changes, with costs increasing in the magnitude of the shift, which induces caution among parties. In contrast, our framework generates an overshooting mechanism.

This study is also related to a recent literature in political economy that studies policy inertia. In the "endogenous status quo" literature, policy inertia arises endogenously in a dynamic legislative-bargaining model (Eraslan and Piazza, 2025). The key assumption is that the default option in case of disagreement coincides with the previous period's policy, which is the status quo. Changing policy incurs costs that may differ for the parties, and ideological polarization creates another tension. They show that efficiency requires no policy reversals and moderate policies. Loeper and Dziuda (2024) study the electoral choice between unified and divided governments and show that the voters choose divided governments to avoid the cost of policy change. Another strand of the political-economy literature studies policy inertia in models without bargaining but with a cost of changing policy. For example, Piguillem and Riboni (2023) develop a political-economy model with "sticky" spending, where the current government must maintain a fraction of past spending. Gersbach, Jackson, Muller, and Tejada, (2023) also assume that policy changes are costly: changing from the current policy has costs, and these costs grow with how large the shift is. They find that higher costs make parties more cautious about big shifts. In contrast, our model gives rise to an overshooting mechanism.

Our paper is also related to recent literature on balanced budget requirements, which builds on the earlier research on strategic debt in macro-political economy.[11] The central result from the strategic debt literature is that political turnover and polarization generate a debt bias: politicians who face uncertain re-election prospects tend to overspend in the present and issue debt to constrain future policymakers. Battaglini and Coate (2008) consider a dynamic legislative bargaining environment, where members of the minimum winning coalition do not fully internalize the tax costs of spending, and therefore approve targeted transfers to their districts. Anticipating exclusion from future coalitions, legislators also have incentives to shift resources from the future to the present, leading to excessive debt accumulation. An early paper in the dynamic analysis of fiscal rules is Azzimonti, Battaglini, and Coate (2016), who extend Battaglini and Coate's model to study the effects of budget balance rules in a calibrated version of this model, showing that fiscal rules impose a trade-off between the rigidity of shock responses and the discipline of reduced debt accumulation.[12] Piguillem and Riboni (2021) also note that fiscal rules can be overridden by consensus, and treat fiscal rules as default options within a legislative bargaining framework. They show that under some conditions, the political bargaining mitigates the debt accumulation problem.

Our model focuses on a binding ex-ante balanced budget requirement—the most prominent fiscal rule in U.S. states, which are the focal point of our analysis. Since many U.S. states adopted their BBRs as part of their founding constitutions, they have been in effect for a long time, and it is unlikely they will be abandoned soon. This historical fact allows us to abstract from commitment problems. Ex-ante balanced

[11]Some important contributions include Persson and Svensson (1989), Alesina and Tabellini (1990), Besley and Coate (1998), Klein, Krusell and Rios-Rull (2008), and Song, Storesletten and Zilibotti (2012).

[12]Dovis and Kirpalani (2020) analyze fiscal rules in federal systems with limited commitment, finding that local rules can accelerate the revelation of a lax central government's type and, paradoxically, exacerbate local over-borrowing.

budget requirements may lead to ex-post deficits and thus force the government to accumulate some debt. We show that even a relatively small rainy-day fund is needed to prevent unintended debt accumulation in the long run. In contrast to the previous literature, our analysis focuses on the interaction between fiscal rules and adjustment costs as the main friction in the economy. We also show that under certain conditions, adjustment costs can be an effective tool in reducing volatility in environments with higher levels of polarization. Otherwise, our framework remains simpler than those in the papers discussed above, reflecting our primary focus on estimation and empirical implementation.

Second, our paper is related to the recent methodological literature on the identification and estimation of dynamic games. Some notable recent papers include Bajari, Benkard, and Levin (2007), Aguirregabiria and Mira (2007), Pesendorfer and Schmidt (2008), Merlo and Tang (2012), Hu and Shum (2013), and Aguirregabiria and Magesan (2020). We show that a flexible specification of the model can be estimated based on moment conditions, which can be derived from the optimality conditions that expenditures have to satisfy in equilibrium. To evaluate these orthogonality conditions, we need to characterize the derivatives of value functions. Our approach, therefore, combines the techniques of Hansen and Singleton (1982) with a forward simulation estimator proposed by Hotz, Miller, Sanders, and Smith (1994) and Bajari, Benkard, and Levin (2007).

Third, our paper is related to the literature on estimating dynamic games in political economy. The pioneering paper is by Merlo (1997), who estimated a dynamic bargaining model of government formation.[13] Diermeier, Eraslan, and Merlo (2003) extended that framework and provided additional evidence in support of the bar-

[13]Sieg (2000) estimated a dynamic bargaining model with asymmetric information to study dispute resolution in U.S. courts.

gaining approach using data from a variety of European countries.[14] More recently, there have been several papers that study how political competition among partisan governors shapes economic outcomes. Sieg and Yoon (2017) estimate a dynamic retention model with pure adverse selection, in which politicians differ by ideology and ability, using data on U.S. gubernatorial elections. Similarly, Aruoba, Drazen, and Vlaicu (2018) study the reelection of governors using a dynamic moral hazard model with imperfect monitoring.[15] Here, we abstract from asymmetric information and focus on the importance of adjustment costs and fiscal rules. We thus study how institutional and fiscal rules affect the dynamics of government spending behavior of partisan policymakers.

Finally, our paper is related to the existing empirical literature on fiscal rules. Much of this work investigates whether balanced budget requirements used in practice have measurable effects. Scholars have examined, for instance, whether fiscal rules reduce deficits and public spending, and whether they moderate the influence of electoral incentives and government ideology on fiscal outcomes. Seminal early contributions include von Hagen (1991), Alt and Lowry (1994), Poterba (1994), and Bohn and Inman (1996).[16] This literature shows that partisan control of government is shaped by fiscal rules. In particular, BBRs restrict debt accumulation—an observation that motivates our key simplifying assumption that the ex-ante balanced budget

[14]Some other important recent papers that have estimated dynamic models in political economy are Knight and Schiff (2010) who estimate a dynamic model of social learning in presidential primaries. Lim (2013) studies the impact of two selection systems for public officials, appointment and election, on policy outcomes focusing on state court judges and their criminal sentencing decisions. Silveira (2017) estimates a bargaining model with asymmetric information to study plea bargains. Lim and Yurukoglu (2018) consider the regulation of a natural monopoly within a dynamic game, focusing on how the political environment influences regulators; behavior. Avis, Ferraz, and Finan (2018) and Finan and Mazzocco (2025) develop and estimate a dynamic model to study corruption in Brazil. Iaryczower, López-Moctezuma, and Meirowitz (2024) study career concerns and accountability of U.S. Senators within a dynamic reelection model.

[15]Sieg and Yoon (2022) study the optimal retention of mayors in a dynamic rent-seeking model with imperfect monitoring.

[16]For a recent overview, see Potrafke (2025).

constraint is binding. As a result, strategic debt considerations play no role in our framework, although we do model the evolution of a rainy-day fund that accounts for ex-post deficits. Our analysis, therefore, does not focus on whether fiscal rules matter, but rather on how ex-ante balanced budget requirements and rainy day funds affect policy volatility in a partisan setting. From an empirical perspective, our main contribution is that we show that adjustment costs are statistically significant and economically meaningful. As such, they should not be ignored in the study of state expenditures.

3 A Dynamic Game of Fiscal Policies

We consider a dynamic game of state government spending and taxation under a balanced budget rule. Two parties have conflicting preferences over expenditures and taxes and compete in competitive elections. The party in power implements fiscal policies facing a balanced budget constraint. Parties are forward-looking and infinitely lived, and understand that future policy-makers may have different objectives. We assume that each government faces adjustment costs, which are a function of previous policies and may depend on the institutional environment. Disagreement amongst parties and uncertainty about which party will hold office in the future prevent the current government from implementing its preferred policies.

3.1 Parties and Elections

We consider a stationary dynamic game with two infinitely lived players (parties), denoted by Republicans R and Democrats D. Time is discrete $t = 1, 2, ..., \infty$. Elections are held every four years, while fiscal policies (taxes and expenditures) are determined annually. Let Δ_t denote the time left until the next general election. Note that $\Delta_t \in \{3, 2, 1, 0\}$ and that $\Delta_t = 0$ denotes election years, while $\Delta_t \neq 0$ denotes non-election years. Let P_D (P_R) denote the reelection probability, i.e., the probability that a Democratic (Republican) administration wins reelection.[17] Define the state of the political world $\omega_t \in \{D, R\}$, which indicates which party is in power at time t.

3.2 The Budget Process

Each period, the party that is in power controls the government and determines the budgeted spending level s_t and a proportional income tax rate τ_t. There is a one-period lag in the budgeting process. The budgeted spending in t determines the expenditures in $t + 1$.

To incorporate business cycle shocks, let us assume that income y_t follows a first-order Markov Process. In our application, we assume income follows an AR(1) process:

$$y_t = \alpha_y + \rho_y y_{t-1} + \epsilon_y \tag{1}$$

where ρ is the autocorrelation parameter.[18]

We consider the case of a soft or ex-ante balanced budget requirement. Recall that budget decisions in t determine fiscal policies implemented in $t+1$. Income y_{t+1} is realized at the beginning of $t+1$. As a consequence, there may be an ex-post deficit or a surplus at the end of the budget period. To deal with the problem of ex-post deficits and surpluses, we assume that the government operates a rainy day fund.[19]

[17] In the first period of the model, the election outcome is determined by an unconditional election probability.

[18] Note that $E[y_t] = \frac{\alpha_y}{1-\rho_y}$, $Var[y_t] = \frac{\sigma_y^2}{1-\rho_y^2}$, $E[y_t|y_{t-1}] = \alpha_y + \rho_y y_{t-1}$.

[19] Rainy day funds are also used in practice to cover unforeseen expenditures that are not explicitly modeled here.

The rainy day fund is financed by an income tax surcharge denoted by δ_τ. This fund is then used to account for any unexpected surpluses or deficits at the end of the period.

Incorporating the rainy day fund into the budget process, expenditures and taxes need to satisfy the following ex-ante balanced budget constraint:

$$s_t \;=\; \tau_t \, E[(1-\delta_\tau)\; y_{t+1}|y_t] \tag{2}$$

which implies that the balanced-budget tax rates are given by:

$$\tau_t(s_t, , y_t) \;=\; \frac{s_t}{E[(1-\delta_\tau)\; y_{t+1}|y_t]} \tag{3}$$

Thus, taxes are given by a function of expenditures that is strictly monotonically increasing, conditional on the expected state of the economy.

The management of the rainy day fund is completely passive in our model.[20] Let a_{t+1} be the stock of assets at the end of $t+1$ in the rainy day fund, i.e., after y_{t+1} has been realized. The interest rate is constant and given by r. The ex-post deficit/surplus is given by $\tau_t\,(1-\delta_\tau)(y_{t+1}-E[y_{t+1}|y_t])$. Hence, the law of motion for the balance of the rainy fund is given by

$$a_{t+1} \;=\; (1+r)\;a_t + \tau_t\;(1-\delta_\tau)(y_{t+1}-E[y_{t+1}|y_t]) \;+\delta_\tau y_{t+1} \tag{4}$$

Note that the rainy day fund is primarily affected by ex-post surpluses and deficits. If there is a positive shock ($y_{t+1}-E[y_{t+1}|y_t]>0$) and hence an ex-post surplus, then the government saves and accumulates assets in the rainy day fund. If there is a negative shock ($y_{t+1}-E[y_{t+1}|y_t]<0$) and an ex-post-deficit, the government decreases the

[20]Hence, while a_t is a state variable, it does not affect the decisions of the parties.

amount of assets in the rainy day fund. If assets are negative, the government is in debt.[21] In our model, the governor thus deliberately runs a small ex-ante surplus to ensure the viability of the rainy-day fund.[22]

3.3 Flow Utilities and Adjustment Costs

We assume that each party has preferences defined over spending s_t and the income tax rate τ_t. We adopt a spatial model and assume that each party j has a bliss point denoted by s_{jt}. The bliss points of both parties are not constant but are subject to idiosyncratic shocks. Hence, we adopt the following specification:

$$s_{jt} \;\; = \;\; s_j \; + \; \epsilon_{jt}, \tag{5}$$

Note that ϵ_{jt} is an i.i.d. shock.[23] It is plausible to conjecture that $s_D > s_R$. Hence, there is a partisan conflict over expenditure and tax policies.

Define $\tilde{\tau}_t$ to be the tax rate that finances the expenditures s_t in steady state, i.e. $\tilde{\tau}^s_t$ is given by:

$$\tilde{\tau}_t(s_t) \;\; = \;\; \frac{s_t}{E[(1-\delta_\tau)\; y_{t+1}]} \tag{6}$$

We can think of $\tilde{\tau}_t$ as the balanced-budget tax rate in the absence of economic shocks, i.e., as the tax rate that decentralizes expenditures if income in the economy is at the

[21]Our model, thus, allows for debt to exist in the rainy day fund. However, our numerical simulations suggest that a very small value of δ_τ is sufficient for the government not to accumulate any debt in the long run.

[22]An interesting extension of the model allows the governor to deliberately set taxes and spending to run a surplus to build up the rainy day fund. Then the amount in the rainy-day fund becomes part of the policy choice. Such a model could then be used to study, for example, the optimal design of rainy-day funds.

[23]In the empirical model, we assume that the shocks are normally distributed with zero mean and constant party-specific variance.

mean. The gap between actual and steady-state tax rates is denoted by $\tau_t - \tilde{\tau}_t$. This gap captures the costs (benefits) associated with financing the preferred expenditures due to higher (lower) than expected tax rates.

We assume that preferences are quadratic in the gap between expenditures and the bliss point and linear in the gap between actual and steady state tax rates. Hence, preferences can be written as:

$$\tilde{B}_j(s_t, \tau_t, \tilde{\tau}_t, \epsilon_{jt}) = -\frac{1}{2}\left(s_t \; - \; s_{jt}\right)^2 \; - \; \eta_j \left(\tau_t \; - \; \tilde{\tau}_t\right) \tag{7}$$

where $\eta_j > 0$ reflects the aversion of party j (and taxpayers) to higher levels of taxation.

Substituting the budget constraint and the definition of the balanced budget tax rates into the flow utility function, we obtain the balanced-budget preferences:

$$\begin{aligned} B_j(s_t, y_t, \epsilon_{jt}) &= \tilde{B}_j(s_t, \tau_t(s_t, y_t), \tilde{\tau}_t(s_t), \epsilon_{jt}) \\ &= -\frac{1}{2}\left(s_t - s_{jt}\right)^2 \; - \; \eta_j \left(\frac{s_t}{E[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{s_t}{E[(1-\delta_\tau)y_{t+1}]}\right) \end{aligned} \tag{8}$$

Note that the balanced budget preferences only depend on s_t, y_t, and ϵ_t since the tax rates are completely determined by equation (3). Balanced budget preferences vary over the business cycle. Holding expenditures fixed, preferences increase in boom periods and a decrease in recessions. This reflects the fact that, holding expenditure fixed, tax rates have to be higher in a recession and lower in an expansion, as implied by equation (3). Also note that s_j maximizes the flow utility of party j if $\epsilon_{jt} = 0$ and income is at the mean. In that sense, s_j is the bliss point of party j.[24]

[24] Alternatively, we could define preferences over public and private expenditures assuming that the two parties value public services differently. We could then derive preferences over tax and expenditure policies from a general equilibrium model. This is the approach taken, for example, in Alesina and Tabellini (1999) and Azzimonti, Battaglini, and Coate (2016). Our approach avoids this

Another key feature of the model is that adjustments to spending are sluggish and subject to costs. Without adjustment costs, each party would implement its bliss point each period. The costs may arise because policymakers need to convince constituents, lobbyists, or interest groups when changing expenditures. Similarly, they may reflect the effort that has to be devoted to having policy changes approved by the legislature. Finally, many states have tax and expenditure rules and limits that the policymaker needs to take into consideration. These budget rules cause additional frictions in the adjustment of both spending and tax policies. In the spirit of Alt and Loury (2000), we assume that the magnitude of these adjustment costs is party-specific. Let us denote this cost function by:

$$C_j(s_t, s_{t-1}) \quad = \quad \frac{\alpha_j}{2}\,(s_t - s_{t-1})^2 \tag{9}$$

where α_D and α_R measure the magnitude of the adjustment costs.[25]

We assume that the adjustment costs are only borne by the party in power. Hence, the flow-utility of party j is given by:

$$U_j(\omega_t, s_t, s_{t-1}, y_t, \epsilon_{jt}) \quad = \quad B_j(s_t, y_t, \epsilon_{jt}) \; + \; 1\{\omega_t = j\}\;(\kappa \; - \; C_j(s_t, s_{t-1})) \tag{10}$$

where κ denotes the benefits of holding office. We assume that the benefits of holding office are sufficiently high to compensate for the party in power for the adjustment costs.

Parties are forward-looking, maximizing expected lifetime utility with a constant

complication, which makes the approach more tractable for estimation since it reduces the number of parameters that need to be estimated. A more general model would require us to also estimate households' preferences and firms' technologies.

[25]We can also account for differences in adjustment costs that result from differences between unified and divided government. See Alesina and Rosenthal (1996), for a formal analysis of divided government.

discount factor β.

3.4 The Timing of Decisions and Equilibrium

To close the model, we assume that the budget decision is made before the election. The timing of decisions within any period t is then as follows:

1. Income y_t and preference shocks $(\epsilon_{Dt}, \epsilon_{Rt})$ are realized.
2. The party that is power determines s_t.
3. If $\Delta_t = 0$, an election is held which determines ω_{t+1}.
   If $\Delta_t > 0$, the ruling party stays in power, and hence $\omega_{t+1} = \omega_t$.

We restrict attention to a Markov Perfect Equilibrium in pure strategies. Let $\mu_j(s_{t-1}, y_t, \epsilon_{jt}, \Delta_t = i)$ denote the equilibrium strategy of party $j \in \{D, R\}$ and $i \in \{0, 1, 2, 3\}$.

3.5 Optimal Decisions in Equilibrium

Next, we characterize the decision problems faced by the parties and derive the first-order conditions that hold in equilibrium. To accomplish this task, it is useful to solve the model starting in the last period of the term, i.e., $\Delta_t = 0$. Assume for the sake of concreteness that a Democratic administration is in power $\omega_t = D$. (The case of a Republican administration is symmetric.) Note that the budget decision s_t is made before the election outcome is known. We can, therefore, express the optimization problem recursively as:

$$
\begin{aligned}
V_D(D, s_{t-1}, y_t, \epsilon_{Dt}, \Delta_t = 0) &= \max_{s_t} \Bigg\{ B_D(s_t, y_t, \epsilon_{Dt}) - C_D(s_t, s_{t-1}) + \kappa \\
&+ \beta \Big[P_D \; E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)] \\
&+ (1 - P_D) E_t[V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)] \Big] \Bigg\}
\end{aligned} \tag{11}
$$

where $s_{t+1} = \mu_R(s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta = 3)$. Expectations are with respect to future income y_{t+1} and future preference shocks ϵ_{Dt+1} and ϵ_{Rt+1}. All expectations are conditional on t. The expected value functions are therefore given by

$$
\begin{aligned}
E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)] &= \int V_D(D, s_t, y_t, \epsilon_{Dt+1}, \Delta_{t+1} = 3) \\
& \quad f(y_{t+1}|y_t) \; f(\epsilon_{Dt+1}) \; dy_{t+1} \; d\epsilon_{Dt+1} \\
E_t[V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)] &= \int V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) \\
& \quad f(y_{t+1}|y_t) f(\epsilon_{Rt+1}) \; f(\epsilon_{Dt+1}) \; dy_{t+1} \; d\epsilon_{Rt+1} \; d\epsilon_{Dt+1}
\end{aligned} \tag{12}
$$

Since the Democrats are in power, the Republicans are in opposition and, therefore, do not make any decisions with respect to the government spending in this period. The value function of the Republicans can be recursively defined as:

$$
\begin{aligned}
V_R(D, s_t, y_t, \epsilon_{Rt}, \Delta_t = 0) &= B_R(s_t, y_t, \epsilon_{Rt}) \; + \; \beta \Big[P_D \; E_t[V_R(D, s_{t+1}, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)] \\
& + (1 - P_D) \; E_t[V_R(R, s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)] \Big]
\end{aligned} \tag{13}
$$

where $s_{t+1} = \mu_D(s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_t = 3)$. Again, the expectations can be written as

$$\begin{aligned} E_t[V_R(R, s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)] &= \int V_R(R, s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)\; f(y_{t+1}|y_t) \\ &\quad f(\epsilon_{Rt+1})\; dy_{t+1}\; d\epsilon_{Rt+1} \\ E_t[V_R(D, s_{t+1}, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)] &= \int V_R(D, s_{t+1}, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3) f(y_{t+1}|y_t) \\ &\quad f(\epsilon_{Dt+1})\; f(\epsilon_{Rt+1})\; dy_{t+1}\; d\epsilon_{Dt+1}\; d\epsilon_{Rt+1} \qquad (14) \end{aligned}$$

The first-order condition for optimal spending of the Democrats is given by:

$$\begin{aligned} 0 \;=\; & -(s_t - s_D - \epsilon_{Dt}) \;-\; \eta_D \left(\frac{1}{E[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{1}{E[(1-\delta_\tau)y_{t+1}]} \right) \;-\; \alpha_D\; (s_t - s_{t-1}) \\ & + \beta \left\{ P_D\; E_t \left[\frac{\partial V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_t} \right] \right. \qquad (15) \\ & \left. + (1 - P_D)\; E_t \left[\frac{\partial V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_{t+1}} \frac{\partial s_{t+1}}{\partial s_t} \right] \right\} \end{aligned}$$

where

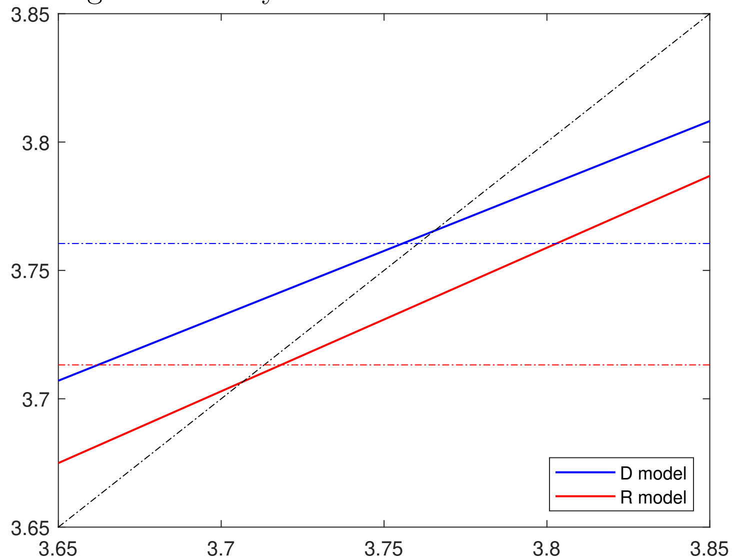
$$\frac{\partial s_{t+1}}{\partial s_t} = \frac{\mu_R(s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)}{\partial s_t} \qquad (16)$$

Note that the previous equation captures the effect that a Democratic administration can tie the hands of future Republican administrations by increasing spending. Because of the adjustment costs, the future Republican administration will have to incur costs to undo the spending increases implemented by the previous Democratic administration. This effect thus captures the strategic interaction and competition among the parties.

Figure 1 illustrates the policy functions in our model during an election period.[26]

[26]We use the estimated parameters from Column I of Table 4.

Figure 1: Policy Function in an Election Year



from o The two functions are given by the blue and red solid lines. The dashed line represents the bliss point of the party (assuming that the idiosyncratic shock is zero and income is at the mean.) The black line indicates the 45-degree line. Without any strategic aspects, the policy functions would intersect the 45-degree line at the bliss points. However, Figure 1 shows that this is not the case. Instead, the strategic aspect of decision-making implies an overshooting mechanism: Democrats tend to favor expenditures exceeding their bliss point in election years, while Republicans prefer policies below their bliss point. This overshooting arises because policies are set before the election outcome is known. Each party, anticipating the possibility of losing the election, rationally adopts slightly more extreme policies to constrain the next government's actions. Notably, this overshooting effect becomes more pronounced when adjustment costs are high, as our estimation results demonstrate (discussed further below).

Next, we consider decisions in non-election years. Hence, we know that $\Delta_t = i > 0$ (i.e. $i = 1, 2, 3$). Since there are no elections during this period, there is no uncertainty regarding the party that will be in power next period. Again, we can express the optimization problem of the Democrats recursively as:

$$\begin{aligned} V_D(D, s_{t-1}, y_t, \epsilon_{Dt}, \Delta_t = i) &= \max_{s_t} \Big\{ B_D(s_t, y_t, \epsilon_{Dt}) - C_D(s_t, s_{t-1}) + \kappa \\ &+ \beta\ E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = i-1)] \Big\} \end{aligned} \tag{17}$$

The first-order condition for the Democratic Party is now given by:

$$\begin{aligned} 0 &= -(s_t - s_D - \epsilon_{Dt}) - \eta_D \left(\frac{1}{E[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{1}{E[(1-\delta_\tau)y_{t+1}]} \right) - \alpha_D\ (s_t - s_{t-1}) \\ &+ \beta\ \ E_t \left[\frac{\partial V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = i-1)}{\partial s_t} \right] \end{aligned} \tag{18}$$

The main difference between equation (18) and equation (15) is that there are only two instead of three terms in the first-order condition. The Democrats know that they will be in power for the next period. The Republican Party is again in opposition and passive. Hence, we have:

$$\begin{aligned} V_R(D, s_t, y_t, \epsilon_{Rt}, \Delta_t = i) &= B_R(s_t, y_t, \epsilon_{Rt}) \\ &+ \beta\ E_t[V_R(D, s_{t+1}, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i-1)] \end{aligned} \tag{19}$$

where $s_{t+1} = \mu_D(s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_t = i-1)$.

3.6 Endogenous Reelection Probabilities

We have seen that our model generates an overshooting mechanism in election years. We can also generate a political business cycle by assuming that the reelection probability is endogenous and depends on the budgeted spending chosen by the administration. To illustrate let $P_D(s_t)$ denote the probability that the democratic party will be re-elected in the next election. Thus, the election probability is endogenous and depends on the policy choices at the beginning of the period. In our application, we assume the following functional form for each party $j \in \{D, R\}$:

$$P_j(s_t) = \frac{\exp(\lambda_{0j} + \lambda_{1j} s_t)}{1 + \exp(\lambda_{0D} + \lambda_{1D} s_t)} \tag{20}$$

If $\lambda_{1j} > 0$ voters reward the party in power for high expenditures. In this case, the overshooting and the reelection effect go in the same direction for Democrats and in opposite directions for Republicans. If $\lambda_{1j} < 0$, voters punish the party in power for high expenditures. In that case, the overshooting and the reelection effects go in opposite directions for Democrats and in the same direction for Republicans.

Assuming an interior solution, the first-order condition that characterizes optimal spending for Democrats is given by:

$$\begin{aligned} 0 \;=\; & -(s_t - s_D - \epsilon_{Dt}) \;-\; \eta_D \left(\frac{1}{E[(1-\delta_\tau) y_{t+1} | y_t]} - \frac{1}{E[(1-\delta_\tau) y_{t+1}]} \right) \;-\; \alpha_D \, (s_t - s_{t-1}) \\ & + \beta \left\{ P_D \; E_t \left[\frac{\partial V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_t} \right] \right. \\ & \quad + (1 - P_D) \; E_t \left[\frac{\partial V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_{t+1}} \frac{\partial s_{t+1}}{\partial s_t} \right] \Bigg\} \\ & \left. + \frac{\partial P_D(s_t)}{\partial s_t} E_t \Big[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) - V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) \Big] \right\} \end{aligned} \tag{21}$$

The first three terms are as in the baseline model above. The fourth and last term captures the strategic incentives that are generated by the endogenous reelection probability.

3.7 Computation of Equilibria

In general, the equilibria of this model can only be computed numerically. The detailed procedure for computing equilibrium strategies is provided in Appendix A. It is worth noting that exact solutions are possible for some versions of the model, particularly when the value functions are quadratic in the state variables, resulting in linear policy functions. For more complex cases, our algorithm can be used to approximate equilibria. With this framework established, we now turn to the estimation of the model parameters.

4 Estimation

The structural parameters of the model are the parameters of the AR(1) process for income, the variances of the preference shocks (σ_D^2 and σ_R^2), the parameters of the preferences ($s_D, s_R, \alpha_D, \alpha_R, \eta_D, \eta_R, \kappa$), and the parameters of the reelection probabilities, ($\lambda_{D0}, \lambda_{D1}, \lambda_{R0}, \lambda_{R1}$). Note that the parameters of the income process and the parameters of the reelection probabilities can be estimated outside the model. We can estimate the remaining structural parameters of the model based on the orthogonality conditions that are derived from the first-order conditions that optimal spending needs to be satisfied in equilibrium. Consider our extended model. Rearranging terms, we can rewrite the optimality condition for the last term ($\Delta_t = 3$) of a Democratic administration as:

$$
\begin{aligned}
\epsilon_{Dt} \quad = \quad & (s_t - s_D) \; + \; \eta_D \; \left(\frac{1}{E[(1-\delta_\tau) y_{t+1} | y_t]} - \frac{1}{E[(1-\delta_\tau) y_{t+1}]} \right) \; + \; \alpha_D \; (s_t - s_{t-1}) \\
& -\beta \left\{ P_D(s_t) \; E_t \left[\frac{\partial V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_t} \right] \right. \\
& \quad + (1 - P_D(s_t)) \; E_t \left[\frac{\partial V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_{t+1}} \frac{\partial s_{t+1}}{\partial s_t} \right] \\
& \left. + \frac{\partial P_D(s_t)}{\partial s_t} E_t \Big[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) - V_D(R, s_{t+1}, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) \Big] \right\}
\end{aligned} \tag{22}
$$

Recall that parties are forward-looking and recognize that future policy-makers may have different preferences than they have. As a consequence, the first-order conditions depend on the levels and derivatives of the value functions of policymakers from both parties.

We assume that preference shocks satisfy the following standard conditional moment assumption:

$$
E[\epsilon_{jt} | s_{t-1}, y_t, \Delta_t] \quad = \quad 0 \quad j = D, R \tag{23}
$$

Preference shocks are purely idiosyncratic and uncorrelated with lagged spending and current income. They are i.i.d. across time and parties. We also account for the fact that each administration serves four terms, which produces slightly different orthogonality conditions.

It is well-known that it is difficult to construct an efficient IV estimator for non-linear models (Newey, 1990). As a consequence, we convert the conditional moment restrictions into a sufficiently large number of unconditional moment restrictions. The details of this procedure are discussed in Appendix C. Hence, the parameters of the model are identified and can be estimated with a GMM estimator if the value functions and their derivatives can be computed by the econometrician.

The natural starting point to construct a feasible estimator is to use a full-solution nested fixed-point algorithm in the spirit of Rust (1987). However, this approach is computationally challenging since three continuous state variables enter each party's value functions.[27] As such, it is desirable to adopt an estimation approach that is computationally less demanding. The basic idea here is that we can estimate the policy functions based on the observed data. We then use a forward simulation algorithm suggested by Bajari, Benkard, and Levin (2007) to compute the value functions and their derivatives. We find that this approach works well for our model specifications and that the approximations of the value functions and their derivatives are accurate. For details about the forward simulation algorithm, see Appendix B.

To implement the forward simulation strategy, we need to overcome one additional identification problem. To illustrate this problem, let us, for simplicity, ignore the fact that the policy functions depend on the term i. Moreover, let us conjecture that the policy function of each party is approximately linear. Our computational analysis suggests that this is a reasonable conjecture for many specifications of our model. Hence, the policy function of Democrats can be written as:

$$s_t \;=\; \mu_D(s_{t-1}, y_t, \epsilon_{Dt}) \;\;=\;\; c_{D0} + c_{D1}\, s_{t-1} + c_{D2}\, y_t + c_{D3}\, \epsilon_{Dt} \tag{24}$$

and a similar equation holds for Republicans. It should be clear that the coefficient c_{D3} and the variance of the error term σ_D^2 are not separately identified in the reduced-form regression model above, since the variance of the regression model is $\sigma_D^2 c_{D3}^2$. Hence, we can only identify the product of the two parameters from the regression model (24). To separately identify both parameters, note that σ_D^2 is also identified from

[27]For a discussion of how to solve dynamic games, see, for example, Pakes and Doraszelski (2007) and Aguirregabiria, Collard-Wexler, and Ryan (2021).

the conditional variance of the first-order condition in the equation (22). We can, therefore threat c_{D3} and c_{R3} as nuisance parameters during the structural estimation algorithm. Given values of σ_D^2 and σ_R^2, the slope parameter of the policy functions c_{D3} and c_{R3} are identified from the residual variance regression model in equation (24). We, therefore, need to add some orthogonality conditions to our GMM objective functions that are based on the residual variances of the first-order conditions.

We offer two additional observations. First, we only match the unconditional reelection probabilities when we apply the estimator to our data. We could also match the conditional reelection probabilities. However, we find that our reduced-form estimates of the marginal effects are noisy. As a consequence, we just verify ex-post that the structural estimates of the marginal effects are with a 95 percent confidence interval of the reduced-form estimates. Instead, we could impose these conditions ex-ante by adding two moment inequalities to the objective function. This procedure then makes sure that the parameters λ_{j1} are estimated based on the reduced form election probabilities and are consistent with the political business cycle of the expenditures observed in the data.

Second, the benefits of holding office, denoted by κ, need to be large enough so that each party prefers to be in office, i.e., the benefits of holding office have to be larger than the adjustment costs along the full equilibrium path. There is some scope for identifying κ in the extended model with endogenous reelection probabilities since the first-order conditions for optimal spending depend on the difference of the levels of the value functions, and hence on κ. In theory, we could estimate κ. In practice, it is easier to calibrate κ so that the 95th percentile of adjustment costs is smaller than κ. We also estimated the model using other reasonable values for κ. All findings reported in this paper are robust to reasonable changes in κ.

In summary, we have shown that we can estimate the parameters of our dynamic game using a sequential estimator. First, we estimate the reduced-form policy functions in equation (24). Our estimation approach, therefore, conditions on the equilibrium that generated the data. Thus, our estimator does not rely on the fact that the equilibria have to be unique for our model. Second, we construct a GMM estimator (Hansen,1982) for the structural parameters of the model that is based on moment conditions, which can be derived from the optimality conditions that expenditures have to satisfy in equilibrium. For computational tractability, we adopt a forward-simulation approach to compute the value functions and their derivatives. This approach exploits the fact that the estimated policy functions are known (up to a normalization) to the econometrician.[28]

5 Data

All U.S. states have constitutional or statutory limitations restricting their ability to run deficits in the state's general fund. Balanced budget limitations may be either prospective (beginning-of-the-year) requirements or retrospective (end-of-the-year) requirements. Importantly, the state limits apply only to the general fund, leaving other funds (capital, pensions, social insurance) as potential sources for deficit financing.[29] We, therefore, focus on general fund expenditures in this paper

[28] Results from a Monte Carlo exercise available upon request from the authors.

[29] According to Potrafke (2025), only one US state, Vermont has no balanced budget rule. The rules in the U.S. states have different stages of requirements. The weakest form of balanced budget rules is that the governor needs to submit a balanced budget. This rule is in place in 44 US states. A more stringent form of balanced budget rule is that the legislature (State House and State Senate) needs to enact a balanced budget. This rule is in place in 37 US states. Those balanced budget rules may still give rise to budget deficits in individual years when actual revenues and expenditures deviate from expectations (forecasts). The question then arises whether state governments are allowed to carry over deficits to future years. The strictest form of a balanced budget rule prohibits this carry-over. 24 of the 37 US states that require the legislature to enact balanced budgets do not allow for carry-over budgets. The rules in the individual states also differ regarding the type of individual state spending that is covered (Poterba, 1995). Most states apply these rules to general

Our dataset is based on all gubernatorial elections between 1990 and 2018 in the United States. Our sample is based on the 45 states excluding Alaska, Nebraska (which has a unicameral legislature), New Hampshire, Vermont, and Rhode Island (which adopted different election cycles at least in some periods between 1990 and 2018). We thus have a sample size equal to $N \quad T = 45 \quad 29 = 1305$ observations. 16 administrations were headed by an independent governor and, as a consequence, our final sample is 1289. Data on the election cycle, party affiliation, and incumbency status of candidates in gubernatorial elections are based on a website called www.ourcampaigns.com. Total general expenditures, from the U.S. Census of Governments. Data on state personal income is obtained from the Bureau of Economic Analysis. We convert all variables into constant dollars using the CPI with base year 2000. Table 1 provides some descriptive statistics for our sample.

Table 1: Descriptive Statistics

	Obs	Mean	Std.	Min	Max
Expenditures	1289	3.665	0.855	1.827	7.116
Income	1289	31.204	5.308	17.606	50.523
Democrats	1289	0.423	0.495	0	1
Election Year	1289	0.242	0.428	0	1
Change in Administration	313	0.335	0.473	0	1

Income and expenditures are measured in $1000.

A key challenge in matching the model to the data is that our dynamic game is stationary, whereas the data exhibit substantial stochastic growth. This issue is common in macroeconomic business cycle analysis, and it requires detrending the data. Following standard practice in time-series econometrics, we consider multiple filtering approaches.

One approach is a two-way fixed-effect model that controls for both state and time

fund expenditures and may exclude some capital expenditures.

effects, which has been widely used in political economy (Besley and Case, 1995). We use this model to estimate both the parties' decision rules and the structural parameters of our model. Alternatively, we apply the HP filter to remove state-specific trends in per capita expenditures and personal income.[30] In implementing the HP filter, we consider four smoothing parameters (25, 100, 400, and 1600) and compute separate trends for each state, allowing for heterogeneity in economic trends over the sample period. Qualitative business cycle patterns are similar across different smoothing parameters, although the magnitude of fluctuations varies with the parameter choice.[31] For our analysis, we adopt a smoothing parameter of 400, an intermediate value. Robustness checks confirm that the main results are largely insensitive to alternative choices of the smoothing parameter.

6 Empirical Results: Policy Functions

In this section, we present estimates of the policy functions using the two detrending algorithms discussed above. We first consider two-way, fixed-effect panel data models, popularized in political economy by Besley and Case (1995).[32] Five specifications are estimated. Column I includes only party dummies, capturing unconditional differences in spending across parties. Column II adds election-year dummies. Column III incorporates lagged expenditures, while Column IV further controls for income, thus including all state variables. Column V adds dummies and interaction terms for divided government, following Alt and Lowry (2000). The results are summarized in Table 2.

[30] We also experimented with Hamilton's (2018) filter and obtained similar results.

[31] Figures 6 and 7 in Appendix E display weighted averages of the detrended expenditure and income data.

[32] See, for example, Sieg and Yoon (2017) for a recent survey of this literature.

Table 2: Policy Function Estimates based on the HP Filter

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Expenditure	Expenditure	Expenditure	Expenditure	Expenditure
Dem	0.125***	0.124***	0.0480***	0.0368***	0.0548***
	(0.0129)	(0.0149)	(0.00820)	(0.00806)	(0.0106)
Rep Election		0.00607	0.00596	0.00437	0.00175
		(0.0199)	(0.0108)	(0.0105)	(0.0104)
Dem Election		0.00703	0.00896	0.0125	0.0127
		(0.0228)	(0.0124)	(0.0120)	(0.0120)
Lagged Exp			0.845***	0.785***	0.825***
			(0.0205)	(0.0221)	(0.0294)
Lagged Exp x Dem			0.00304	0.00441	-0.0106
			(0.0307)	(0.0326)	(0.0423)
Income				0.0278***	0.0266***
				(0.00442)	(0.00441)
Income x Dem				0.00486	0.00620
				(0.00670)	(0.00668)
Rep Divided					0.0227**
					(0.00911)
Dem Divided					-0.0153
					(0.0105)
Lagged Exp x Rep Divided					-0.0897**
					(0.0400)
Lagged Exp x Dem Divided					-0.0609
					(0.0446)
Constant	-0.0570***	-0.0585***	-0.0233***	-0.0189***	-0.0298***
	(0.00848)	(0.00973)	(0.00535)	(0.00524)	(0.00706)
Observations	1,289	1,289	1,289	1,289	1,289
R-squared	0.067	0.067	0.725	0.742	0.745

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Columns I and II indicate an unconditional difference in spending of \$125 per capita. Columns III–V suggest autocorrelation parameters between 0.79 and 0.85, highlighting the importance of policy inertia and adjustment costs. Columns IV and V show that the income coefficient is both statistically significant and economically meaningful, with a positive sign consistent with increased spending during expansions and reduced spending in recessions. Column V provides modest evidence that divided government affects adjustment costs.[33]

We next estimate the same five specifications using data detrended with the HP filter. Results are summarized in Table 3. Column I shows unconditional differences in spending of \$46 per capita. Columns II–V indicate higher spending in election years, providing evidence of a political business cycle. Columns III–V confirm the relevance of adjustment costs, with autocorrelation estimates around 0.57, lower than in the BC specification. Columns IV and V demonstrate that the income coefficient is both statistically and economically significant and suggest that Democrats may respond more strongly to income changes than Republicans. Column V provides moderate evidence that divided government affects adjustment costs. Overall, the findings are, therefore, similar to those reported in Table 2. The main differences are a smaller variation in bliss-points and lower autocorrelation estimates under the HP filter.

In summary, average unconditional differences in expenditures range from \$46 to \$125, indicating meaningful variation in party preferences. Autocorrelation estimates between 0.57 and 0.85 suggest significant adjustment costs. The income coefficient is consistently significant, implying that policy preferences vary with the business cycle. There is also some support for the hypotheses that: (i) Democrats respond more

[33] Alt and Lowry (2000) examine expenditures from 1952 to 1995, whereas our sample spans 1990–2019; differences in periods may explain variations in findings.

Table 3: Policy Function Estimates based on the HP Filter

	(1) Expenditure	(2) Expenditure	(3) Expenditure	(4) Expenditure	(5) Expenditure
Dem	0.0462***	0.0417***	0.0308***	0.0330***	0.0381***
	(0.00829)	(0.00950)	(0.00791)	(0.00772)	(0.0101)
Rep Election		0.0180	0.0304***	0.0270***	0.0268***
		(0.0127)	(0.0106)	(0.0103)	(0.0103)
Dem Election		0.0359**	0.0383***	0.0395***	0.0394***
		(0.0146)	(0.0121)	(0.0118)	(0.0118)
Lagged Exp			0.567***	0.564***	0.576***
			(0.0325)	(0.0317)	(0.0473)
Lagged Exp x Dem			-0.0256	-0.0530	-0.0193
			(0.0461)	(0.0452)	(0.0616)
Income				0.0256***	0.0257***
				(0.00516)	(0.00517)
Income x Dem				0.0154*	0.0139*
				(0.00800)	(0.00805)
Rep Divided					0.00152
					(0.00884)
Dem Divided					-0.00863
					(0.0102)
Lagged Exp x Rep Divided					-0.0218
					(0.0637)
Lagged Exp x Dem Divided					-0.136**
					(0.0684)
Constant	-0.0195***	-0.0238***	-0.0204***	-0.0198***	-0.0205***
	(0.00543)	(0.00622)	(0.00517)	(0.00504)	(0.00672)
Observations	1,289	1,289	1,289	1,289	1,289
R-squared	0.024	0.030	0.332	0.366	0.368

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

strongly to income changes than Republicans; (ii) Republicans respond more strongly to election-year effects than Democrats; and (iii) divided government moderately influences adjustment costs.

7 Parameter Estimates and Model Fit

Tables 4 report the estimates and standard errors of the structural parameters for two specifications of our model. Columns I and II are based on data detrended using a BC two-way fixed-effects regression, while Columns III and IV employ the HP filter. Columns I and III present the baseline model with exogenous reelection probabilities, whereas Columns II and IV relax this assumption, allowing for endogenous reelection probabilities. Standard errors are obtained via a bootstrap procedure that accounts for the sequential estimation of the income process and policy functions. All specifications build on the policy functions reported in Column IV of Tables 2 and 3.

Using the BC (HP) detrending algorithm, estimated bliss points differ between parties by \$119 (\$48) per capita in the baseline model and \$118 (\$44) in the model with endogenous reelection probabilities. By comparison, the detrended mean expenditures in our sample are \$3,710. Differences in bliss points vary over the business cycle: estimates of η_D and η_R indicate that both parties' spending responds to economic conditions, consistent with the policy function results reported in the previous section. Specifically, differences in preferred spending increase during booms and narrow during recessions. An increase in expected income of \$1,000 raises preferred spending for Democrats by \$151 (\$129) and for Republicans by \$136 (\$99) in the baseline model, and by \$160 (\$136) and \$134 (\$100), respectively, in the endogenous reelection model.

Estimated adjustment costs are substantial, with Republicans exhibiting higher

Table 4: Structural Parameter Estimates

		BC Filtered		HP Filtered	
		I	II	III	IV
bliss	s_D	3.781	3.768	3.761	3.729
		()	()	(0.019)	(0.019)
points	s_R	3.662	3.650	3.713	3.685
		()	()	(0.012)	(0.011)
tax	η_D	151	160	129	136
		()	()	(37)	(41)
effect	η_R	136	134	99	100
		()	()	(32)	(34)
	α_D^e	10.268	13.433	1.700	1.958
adjustment		()	()	(0.721)	(0.879)
costs	α_R^e	12.2123	13.0195	2.285	2.644
		()	()	(0.603)	(0.755)
standard deviation	σ_D	1.772	2.220	0.461	0.504
		()	()	(0.122)	(0.149)
preference shocks	σ_R	1.782	1.881	0.464	0.509
		()	()	(0.079)	(0.097)
	λ_D^0	0.432	-1.863	0.477	-2.636
		()	()	(0.249)	(1.226)
reelection	λ_D^1	0	0.624	0	0.831
		(—)	()	(—)	(0.323)
probability	λ_R^0	0.863	-0.832	0.864	-2.765
		()	()	(0.244)	(1.028)
	λ_R^1	0	0.461	0	0.979
		(—)	()	(—)	(0.266)
marginal effects (λ_j^1)	D		0.145		0.194
			()		(0.073)
	R		0.096		0.204
			()		(0.057)

BC income process: $\alpha_y = 1.387$, $\rho_y = 0.953$, $\sigma_y = 0.440$.
HP income process: $\alpha_y = 9.350(1.028)$, $\rho_y = 0.623(0.035)$, $\sigma_y = 0.619(0.024)$.

costs than Democrats. This aligns with the larger autocorrelation parameters for Republicans reported in Tables 2 and 3. Adjustment costs are also considerably larger under the BC detrending algorithm than under the HP filter, reflecting the higher autocorrelation estimates in the BC case.

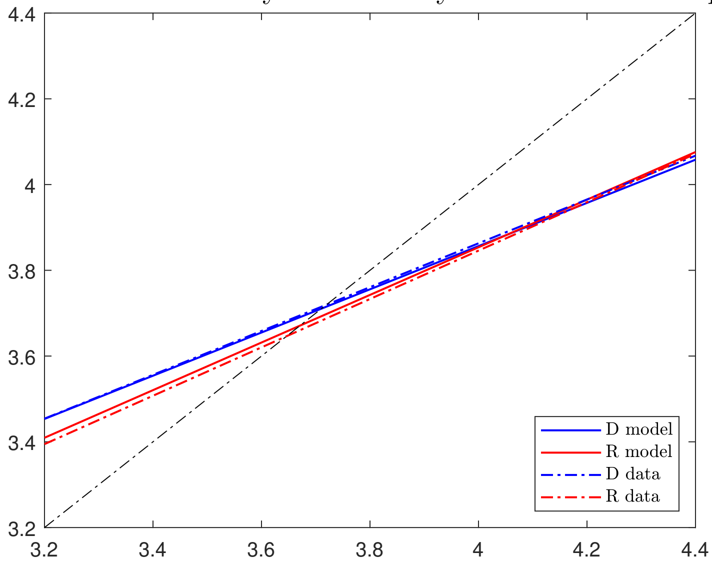
Comparing Columns II (IV) with I (III) provides some evidence supporting the endogeneity of reelection probabilities. The estimated slopes of the reelection probability are 0.62 (0.83) for Democrats and 0.46 (0.98) for Republicans, implying that a \$100 increase in spending raises the reelection probability by roughly 1 to 2 percentage points. These findings are broadly consistent with the reduced-form estimates reported in Appendix D.

Finally, the estimated standard deviations of the preference shocks indicate substantial idiosyncratic variation in bliss points, often amounting to several hundred dollars. Such shocks likely reflect changes in gubernatorial identity and, more generally, heterogeneity within parties. This finding is consistent with prior evidence of significant ideological variation across state-level party governors (Sieg and Yoon, 2017).

The model fit can be assessed by the difference between the estimated and predicted policy functions. Figure 2 plots the policy functions using the HP model during the last term of an administration as a function of the lagged expenditures, holding income at the median. The blue line is for a Democratic administration, while the red line is for a Republican administration. The dotted lines indicate the bliss points for both parties. We find that the fit of the model is quite excellent. The differences between the policy functions generated by our model and those estimated in the previous section are small.

The slope of both policy functions reflects the magnitude of the adjustment costs.

Figure 2: Model Fit: Policy Function by Previous Period Spending

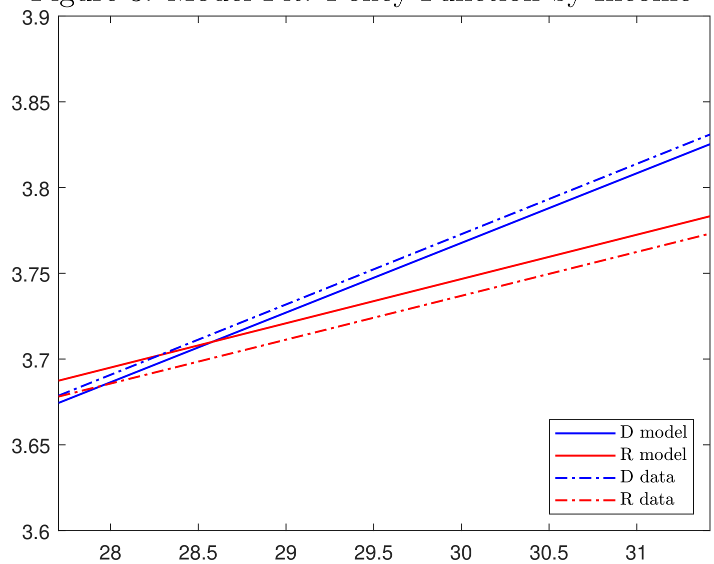


The larger the slope, the larger the adjustment costs. Table 4 indicates that Republicans face larger adjustment costs than Democrats, which then generates a steeper policy function. Thus, differences in party behavior are larger the smaller the expenditures in the previous period.

Figure 3 repeats the exercise and shows the policy functions as a function of income. Again, we find that policy functions generated by our model closely match those estimated in the previous section. The slope of the policy function is determined by the parameter η_j. As we have seen above, Democrats have a larger coefficient than Republicans. As a consequence, the slope of the Democratic policy function is larger than that of the Republicans. This finding then implies that differences in preferred spending increase during boom periods and decrease during recessions. This result may also help to explain why we observe more polarization between parties in richer states than in poorer states. The model fit is similar for the specification that uses the BC algorithm to detrend the data.

We have seen above that there are three types of shocks in our model that gener-

Figure 3: Model Fit: Policy Function by Income



ate volatility in expenditures. The first shock is an income shock, which captures the impact of the economic business cycle on expenditures. The second shock is a preference shock, which reflects idiosyncratic heterogeneity in preferences within parties and across time. Finally, there is a political shock which is due to the uncertainty of elections. We assess the relative importance of the three different types of shocks in our model. To accomplish this goal, we can simulate the model shutting down the different shocks. Again, we can measure the volatility of expenditures using the average standard deviation of expenditures.[34] Table 5 summarizes our findings for the BC and HP model with endogenous reelection probabilities.

We find that idiosyncratic preference shocks account for the largest fraction of the volatility. Income shocks are the second most important shocks that determine expenditures, in particular when we detrend the data using the BC algorithm. Changes in the political environment only account for approximately 15 percent of the volatility.

[34]We simulate 1,000 paths over 1,000 years. The first 100 years serve as a burn-in period. I begin with the median income and expenditure, assuming the Democrats are the ruling party with $\Delta = 3$.

Table 5: Decomposition of the Volatility of Expenditures

	bliss point shocks	income shocks	political shocks	all shocks
	BC filtered			
mean	3.67	3.68	3.73	3.74
volatility	0.176	0.150	0.048	0.250
	HP filtered			
mean	3.71	3.71	3.73	3.73
volatility	0.131	0.040	0.022	0.151

Means and volatility are measured in $1000.

We thus find that idiosyncratic shocks account for a larger fraction of the volatility than income or political shocks.

In summary, we conclude that our model parameter estimates are quite plausible, and the fit of the model is excellent. We, therefore, turn to counterfactual policy analysis to illustrate some of the important properties of our model.

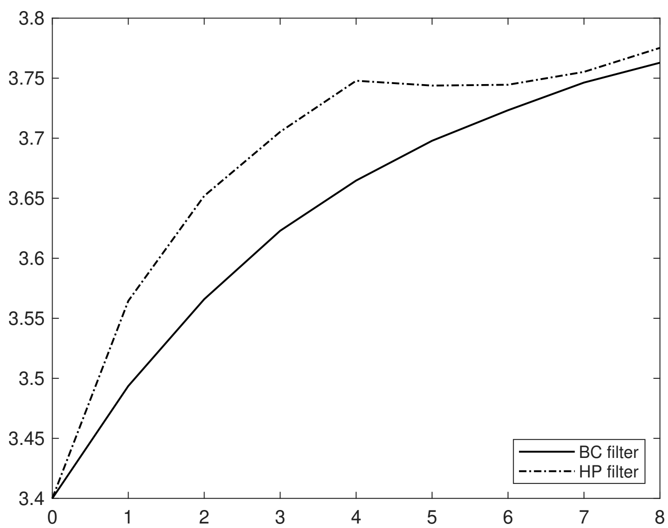
8 Policy Analysis

We have seen above that adjustment costs are statistically significant and economically meaningful. To illustrate the importance of adjustment costs, we show in this section how they affect the speed of adjustment and the political business cycle. They also partially offset the effects of polarization.

8.1 The Speed of Policy Adjustment

Adjustment costs can arise from at least four sources. First, political frictions—such as those associated with divided or split governments—may slow policy changes, although our results suggest they account for only a small fraction of the observed autocorrelation in expenditures. Second, institutional features of the budget process, including formal fiscal constraints, restrictions on rolling over deficits, and line-item veto powers for governors, contribute to expenditure inertia. Recent expansions of revenue restrictions in many states may further reinforce this effect. Third, legal constraints, such as labor regulations, limit the ability to hire, fire, or reassign public employees, many of whom are unionized. Finally, the implementation of new programs often requires investments in infrastructure and capital, introducing time-to-build delays.[35] While our analysis does not permit disentangling the relative contributions of these mechanisms, it is plausible that all play a role in generating adjustment costs.

Figure 4: The Speed of Adjustment



To illustrate the impact of adjustment costs on the speed of convergence, we consider the model with endogenous reelection probabilities as shown in Column II and IV of Table 4. Suppose a new Democratic administration is elected and the previous expenditures are far away from the bliss point of the new Democratic administration (because the economy was in a recession). Figure 4 illustrates the

[35]Adjustment costs to the capital stock of firms play a large role in Lucas and Prescott (1971) as well as Prescott and Kydland (1982).

expenditure path taken by the economy for the two models. The path associated with the BC (HP) specification is illustrated by the solid (dashed) line in Figure 4.[36]

We find that it takes the new Democratic administration 4 or 1 full term, based on the HP specification. Using the BC specification, it takes up to 8 years to reach a level of expenditures that is approximately equal to the average bliss point.

8.2 The Political Business Cycle

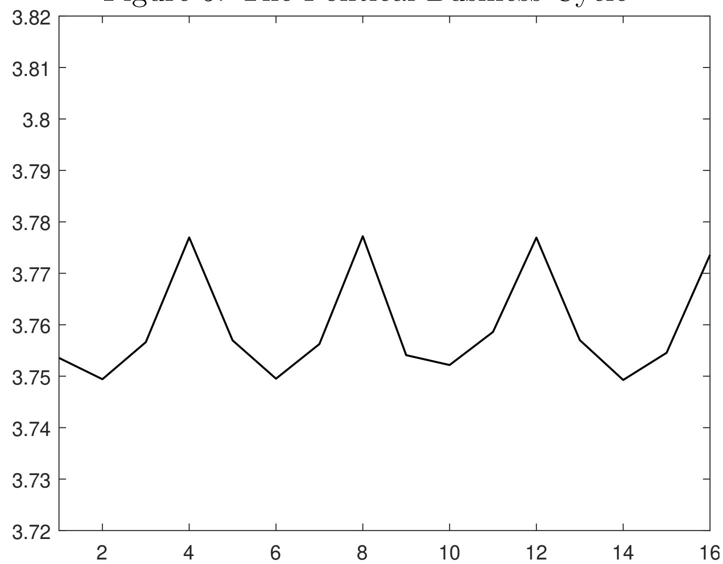
Using the HP specification, we find some evidence in support of the hypothesis that both parties want higher spending levels in election years than in non-election years. Our baseline model cannot generate this pattern observed in the data. However, our extended model with endogenous reelection probabilities is consistent with this observation. This feature of the extended model is illustrated in Figure 5. Here, we simulate the expenditure path of a Democratic administration in a steady state.

We find that our model generates a political business cycle. Expenditures are systematically higher in election years than in non-election years. Using the estimates in Column II of Table 4, we find that the magnitude of the political business cycle is approximately \$30. An increase in \$30 spending implies an increase in the reelection probability of less than 1 percentage point.

Moreover, the magnitude of the fluctuations crucially depends on the adjustment costs. High adjustment costs tend to dampen the political business cycle. We conclude that the magnitude of the political business cycle depends on the slopes of the reelection probabilities and the magnitude of the adjustment costs.

[36] We generate 10,000 simulation paths for eight years or two terms. We plot the average impulse response.

Figure 5: The Political Business Cycle



8.3 Polarization and Adjustment Costs

Our model helps us to understand the impact of political polarization on expenditure policies. We can measure polarization by the difference in bliss points. To illustrate the relationship between polarization and gridlock, we consider nine different regimes that differ by polarization and adjustment costs. The first bliss point regime is the baseline economy. The second (third) case reflects an increase in polarization by \$100 (\$150). Similarly, we have three cases of adjustment costs: low, baseline, and high. We consider a sequence in which a one-term Democratic administration is followed by a one-term Republican administration. The simulations are based on Columns II and IV in Table 4. Table 6 summarizes our main findings from our simulations.

Note that the baseline volatility is approximately \$150 when we use HP filters and \$250 when we use the BC algorithm. Not surprisingly, an increase in polarization leads to significant increases in volatility in all scenarios. Moreover, higher adjustment costs tend to partially offset the increase in polarization and, thus, lead to less volatile

Table 6: Polarization and Adjustment Costs

		Polarization		
		baseline	\$100	\$150
BC filtered				
adjustment costs	low (50%)	0.2986	0.3034	0.3066
	baseline	0.2500	0.2591	0.2652
	high (150%)	0.2290	0.2403	0.2479
HP filtered				
adjustment costs	low (50%)	0.2083	0.2176	0.2253
	baseline	0.1508	0.1642	0.1750
	high (150%)	0.1226	0.1386	0.1513

The volatility is measured in \$1000.

expenditures in a polarized world. We thus conclude that adjustment costs may be an effective tool in reducing volatility in environments with higher levels of polarization.

9 Conclusions

We have developed and estimated a dynamic game of state fiscal policies under partisan governments to quantify differences in party preferences and the speed of policy adjustment. Our results reveal statistically significant and economically meaningful differences in bliss points between the two major U.S. parties, ranging from \$46 to \$125 in steady state. Adjustment costs are substantial and contribute to significant policy inertia, with expenditures taking up to two full terms—or eight years—to adjust from one party's bliss point to the other. These costs also serve to smooth expenditures in a polarized political environment. Policy counterfactuals suggest that high adjustment costs can dampen the effects of increasing polarization. Overall, state fiscal policies depend not only on political polarization but also on the magnitude of adjustment costs and institutional constraints, such as fiscal rules, that shape government flexibility.

Our findings open several avenues for future research. One natural extension would allow for asymmetric adjustment costs, recognizing that it may be easier to increase than decrease expenditures, or to decrease rather than increase taxes. While our analysis focuses on four-year gubernatorial terms, legislators typically serve two-year terms; modeling the interplay between executive and legislative power, including uncertainty from the midterm elections, would enrich the framework. Another promising direction is to incorporate intergovernmental grants and distinguish between own-source and transfer revenues, although doing so would expand the state space considerably. Finally, building on Alesina and Tabellini (1990), a multidimensional model could examine conflicts over the composition of spending, not just its level. Such extensions are computationally demanding, but they are important for a fuller understanding of how institutional features, adjustment costs, and political polarization jointly shape tax and expenditure policies.

References

Aguirregabiria, V., Collard-Wexler, A., and S. Ryan (2021). Dynamic games in empirical industrial organization. Handbook of Industrial Organization, Chapter 4, Volume 4, Issue 1, 225-343.

Aguirregabiria, V. and A. Magesan (2020). Identification and Estimation of Dynamic Games When Players' Beliefs Are Not in Equilibrium, The Review of Economic Studies, 87(2), 582-625.

Aguirregabiria, V. and Mira, P. (2007). Sequential Estimation of Dynamic Discrete Games. Econometrica, 75, 1–54.

Alesina, A. and H. Rosenthal (1996). A Theory of Divided Government. Econometrica, Vol. 64 (6). 1311-1341.

Alesina, A. and G. Tabellini (1990). A Positive Theory of Fiscal Deficits and Government Debt. The Review of Economic Studies, 57 (3), 403-414.

Alt, J. and R. Lowry (1994). Divided Government, Fiscal Institutions and Budget Deficits: Evidence from the States. The American Political Science Review, 88 (4), 811-828.

Alt, J. and R. Lowry. (2000) A Dynamic Theory of State Budget Outcomes Under Divided Partisan Government. The Journal of Politics, 62 (4) 1035-69.

Avis, E., Ferraz, C., and Finan, F. (2018). Do government audits reduce corruption? Estimating the impacts of exposing corrupt politicians. Journal of Political Economy, 126(5), 1912-1964.

Azzimonti, M., Battaglini, M., and Coate, S. (2016). The Costs and Benefits of Balanced Budget Rules: Lessons from a political economy model of fiscal policy, Journal of Public Economics, Elsevier, vol. 136(C), 45-61.

Battaglini, M. and S. Coate (2008). A Dynamic Theory of Public Spending, Taxation, and Debt. The American Economic Review, 98 (1), 201-236.

Bajari, P., Benkard, L. and J. Levin (2007). "Estimating Dynamic Models of Imperfect Competition," Econometrica, 75(5), 1331-1370.

Besley, T. and A. Case (1995). Does Electoral Accountability Affect Economic Policy Choices? Evidence from Gubernatorial Term Limits. The Quarterly Journal of Economics, 110 (3), 769-798.

Besley, Timothy, and Stephen Coate (1998). Sources of Inefficiency in a Representative Democracy: A Dynamic Analysis. American Economic Review, 88(1): 139-156.

Bohn, H. and R. Inman (1996). Balanced-budget rules and public deficits: evidence from the states. U.S. Carnegie-Rochester Conference Series on Public Policy 45. 13-76.

Diermeier, D., Eraslan, H., and Merlo, A. (2003). A Structural Model of Government Formation. Econometrica, 71, 27–70.

Doraszelski, U. and A. Pakes (2007). A Framework for Applied Dynamic Analysis in IO. Handbook of Industrial Organization, Volume 3, Chapter 30, 1887-1966.

Dovis, A., and R. Kirpalani (2020). Fiscal Rules, Bailouts, and Reputation in Federal Governments. American Economic Review 110 (3): 860–88.

Duggan, J. and C. Martinelli (2017). The Political Economy of Dynamic Elections: Accountability, Commitment, and Responsiveness. Journal of Economic Literature 2017, 55(3), 916-984.

Eraslan, Hülya and Adriana Piazza (2025). Efficiency with Political Power Dynamics and Costly Policy Change. Working Paper.

Finan, F. and M. Mazzocco (2025). Combating Political Corruption with Policy bundles. Journal of Political Economy. Forthcoming.

Hamilton, J. (2018). Why you should never use the Hodrick-Prescott Filter. The Review of Economics and Statistics, 831-843.

Hansen, L. P. (1982). Large Sample Properties of Generalized Method of Moments Estimators, Econometrica, 50, 1029-1054.

Hansen, L. P., and K. J. Singleton (1982): "Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models," Econometrica, 50, 1269-1286.

Hodrick, R. and E. Prescott (1981). Postwar U.S. business cycles: An empirical investigation. Discussion Paper 451, Northwestern University.

Hotz, VJ; Miller, RA; Sanders, S; Smith, J (1994). A simulation estimator for dynamic models of discrete choice. Review of Economic Studies, 61 (2), 265-289.

Gersbach, Hans, Matthew O. Jackson, Philippe Müller, and Oriol Tejada (2023). Electoral Competition with Costly Policy Changes: A Dynamic Perspective. Journal of Economic Theory 214: 105716.

Iaryczower, M., López-Moctezuma, G., and Meirowitz, A. (2024). Career concerns and the dynamics of electoral accountability. American Journal of Political Science, 68(2), 696–713.

Klein, Paul, Per Krusell, and Jose Victor Rios-Rull (2008). Time-Consistent Public Policy. Review of Economic Studies, 75(3), 789-808.

Knight, B. and Schiff, N. (2010). Momentum and Social Learning in Presidential Primaries. Journal of Political Economy, 118 (6), 1110–1150.

Lim, C. (2013). Preferences and incentives of appointed and elected public officials: Evidence from state trial court judges. American Economic Review, 103(4), 1360–1397.

Lim, C,, and Yurukoglu, A. (2018). Dynamic natural monopoly regulation: Time inconsistency, moral hazard, and political environments. Journal of Political Economy, 126(1), 263–312.

Loeper, Antoine, and Wioletta Dziuda (2024). “Voters and the Trade-Off between

Policy Stability and Responsiveness." Journal of Public Economics, vol. 232.

Lucas, R. E., Jr., and Prescott, E. C. (1971). Investment under uncertainty. Econometrica, 39(5), 659–681.

Kydland, F. E., and Prescott, E. C. (1982). Time to build and aggregate fluctuations. Econometrica, 50(6), 1345–1370.

Merlo, A. (1997). Bargaining over Governments in a Stochastic Environment. Journal of Political Economy, 105, 101–131.

Merlo, A. and Tang, X. (2012). Identification and Estimation of Stochastic Sequential Bargaining Games. Econometrica, 80, 373–389.

NASBO (2023), Budget Process of the States. National Association of State Budget Officers.

Newey, W. K. (1990): "Efficient Instrumental Variables Estimation of Nonlinear Models," Econometrica, 58, 809–837.

Piguillem, F. and A. Riboni, (2021). "Fiscal Rules as Bargaining Chips [Growth in the Shadow of Expropriation]," The Review of Economic Studies, 88(5), 2439-2478.

Piguillem, Facundo, and Alessandro Riboni (2024). "Sticky Spending, Sequestration, and Government Debt." American Economic Review, 114(11): 3513–3550.

Pesendorfer, M. and Schmidt-Dengler, P. (2008). Asymptotic Least Squares Estimators for Dynamic Games. Review of Economic Studies, 75, 901–28.

Pofrakfke, N. (2025). The Economic Consequences of Fiscal Rules. Journal of International Money and Finance. 152

Poterba, J.M., (1994). State responses to fiscal crises: the effects of budgetary institutions and politics. Journal of Political Economy. 102 (4), 799-821.

Poterba, J.M., (1995). Balanced budget rules and fiscal policy: evidence from the states. National Tax Journal, 48 (3), 329–336.

Ravn, M. and H. Uhlig (2002). On adjusting the Hodrick-Prescott Filter for the frequency of observations. Review of Economics and Statistics 84, 371-380.

Rust, J. (1987). Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher, Econometrica, 55, (5), 999-1033.

Persson, T., and L. Svensson (1989). Why a Stubborn Conservative Would Run a Deficit: Policy With Time-Inconsistent Preferences. Quarterly Journal of Economics, 104, 325-345.

Sieg, H. (2000). Estimating a Bargaining Model with Asymmetric Information: Evidence from Medical Malpractice Disputes. Journal of Political Economy, 108(5), 1006–1021.

Sieg, H. and Yoon, C. (2017). Estimating Dynamic Games of Electoral Competition to Evaluate Term Limits in U.S. Gubernatorial Elections. American Economic Review, 107 (7), 1824-57.

Sieg, H. and C. Yoon (2022). "Electoral Accountability and Control in US Cities," Journal of Political Economy, 130(11), 2985-3023.

Silveira, B. (2017). Bargaining with asymmetric information: An empirical study of plea negotiations. Econometrica, 85(2), 419-452.

Song, Z., Storesletten, K. and F. Ziliboti (2008). Rotten Parents and Disciplined Children: A Politico-Economic Theory of Public Expenditures and Debt. Econometrica, 80 (6), 2785-2803

Von Hagen, J. (1991). A note on the empirical effectiveness of formal fiscal restraints. Journal of Public Economics. 44 (2), 199–210.

A Computation of the Equilibrium Strategies

Here, we illustrate the key issues for the simplified model assuming $\eta_D = 0 = \eta_R$.

We can approximate the value functions by quadratic functions in s_{t-1}, y_t and ϵ_{Dt}:

$$\begin{aligned}
V_D(D, s_{t-1}, y_t, \epsilon_{Dt}, \Delta_t = i) &= a^i_{DD0} + a^i_{DD1}\ s_{t-1} + \frac{1}{2} a^i_{DD2}\ s^2_{t-1} + a^i_{DD3}\ y_t + \frac{1}{2} a^i_{DD4}\ y^2_t + a^i_{DD5}\ \epsilon_{Dt} \\
&+ \frac{1}{2} a^i_{DD6}\ \epsilon^2_{Dt} + a^i_{DD7}\ s_{t-1}\ y_t + a^i_{DD8}\ s_{t-1}\ \epsilon_{Dt} + a^i_{DD9}\ y_t\ \epsilon_{Dt} \\
&+ a^i_{DD10}\ s_{t-1}\ y_t\ \epsilon_{Dt} \\
V_D(R, s_t, y_t, \epsilon_{Dt}, \Delta_t = i) &= a^i_{DR0} + a^i_{DR1}\ s_t + \frac{1}{2} a^i_{DR2}\ s^2_t + a^i_{DR3}\ y_t + \frac{1}{2} a^i_{DR4}\ y^2_t + a^i_{DR5}\ \epsilon_{Dt} \\
&+ \frac{1}{2} a^i_{DR6}\ \epsilon^2_{Dt} + a^i_{DR7}\ s_t\ y_t + a^i_{DR8}\ s_t\ \epsilon_{Dt} + a^i_{DR9}\ y_t\ \epsilon_{Dt} + a^i_{DR10}\ s_t\ y_t\ \epsilon_{Dt}
\end{aligned}$$

Hence, the derivatives have analytical solutions:

$$\begin{aligned}
\frac{\partial V_D(D, s_{t-1}, y_t, \epsilon_{Dt}, \Delta_t = i)}{\partial s_{t-1}} &= a^i_{DD1} + a^i_{DD2}\ s_{t-1} + a^i_{DD7}\ y_t + a^i_{DD8}\ \epsilon_{Dt} + a^i_{DD10}\ y_t\ \epsilon_{Dt} \\
\frac{\partial V_D(R, s_t, y_t, \epsilon_{Dt}, \Delta_t = i)}{\partial s_t} &= a^i_{DR1} + a^i_{DR2}\ s_t + a^i_{DR7}\ y_t + a^i_{DR8}\ \epsilon_{Dt} + a^i_{DR10}\ y_t\ \epsilon_{Dt}
\end{aligned}$$

First, consider period t and assume it is the last term of a Democratic administration, i.e. $\Delta_t = 0$ and $\omega_t = D$. Substituting into the first order condition, we obtain:

$$\begin{aligned}
0 \;=\; & -(s_t - s_D - \epsilon_{Dt}) \;-\; \eta_D \left(\frac{1}{E[(1-\delta_\tau) y_{t+1} | y_t]} - \frac{1}{E[(1-\delta_\tau) y_{t+1}]} \right) \;-\; \alpha_D\ (s_t - s_{t-1}) \\
& + \beta\ P_D\ E_t \left\{ (a^3_{DD1} + a^3_{DD2}\ s_t + a^3_{DD7}\ y_{t+1} + a^3_{DD8}\ \epsilon_{Dt+1} + a^3_{DD10}\ y_{t+1}\ \epsilon_{Dt+1}) \right\} \\
& + \beta (1 - P_D)\ E_t \left\{ (a^3_{DR1} + a^3_{DR2}\ s_{t+1} + a^3_{DR7}\ y_{t+1} + a^3_{DR8}\ \epsilon_{Dt+1} + a^3_{DR10}\ y_{t+1}\ \epsilon_{Dt+1})\ \frac{\partial s_{t+1}}{\partial s_t} \right\}
\end{aligned}$$

Let us conjecture that the policy function of the Republican Party is approximately linear:

$$\mu_R(s_{t-1}, y_t, \epsilon_{Rt}, \Delta_t = i) = c^i_{R0} + c^i_{R1}\ s_{t-1} + c^i_{R2}\ y_t + c^i_{R3}\epsilon_{Rt}$$

and hence:

$$\frac{\partial \mu_R(s_{t-1}, y_t, \epsilon_{Dt}, \Delta_t = i)}{\partial s_{t-1}} = c^i_{R1}$$

Substituting into the FOC:

$$\begin{aligned}
0 &= -(s_t - s_D - \epsilon_{Dt}) - \eta_D \left(\frac{1}{E[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{1}{E[(1-\delta_\tau)y_{t+1}]} \right) - \alpha_D\ (s_t - s_{t-1}) \\
&+ \beta\ P_D\ E_t \left\{ a^3_{DD1} + a^3_{DD2}\ s_t + a_{DD7}\ y_{t+1} + a^3_{DD8}\ \epsilon_{Dt+1} + a^3_{DD10}\ y_{t+1}\ \epsilon_{Dt+1} \right\} \\
&+ \beta(1-P_D)\ E_t \Bigg\{ \Big[a^i_{DR1} + a^3_{DR2}\ (c^3_{R0} + c^3_{R1}\ s_t + c^3_{R2}\ y_{t+1} + c^3_{R3}\epsilon_{Dt+1}) + a^3_{DR7}\ y_{t+1} \\
&+ a^3_{DR8}\ \epsilon_{Dt+1} + a^3_{DR10}\ y_{t+1}\ \epsilon_{Dt+1} \Big]\ c^3_{R1} \Bigg\}
\end{aligned}$$

Hence, the FOC simplifies to

$$\begin{aligned}
0 = &-(s_t - s_D - \epsilon_{Dt}) - \eta_D \left(\frac{1}{E[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{1}{E[(1-\delta_\tau)y_{t+1}]} \right) - \alpha_D\ (s_t - s_{t-1}) \\
&+\beta\ P_D\ \left\{ (a^3_{DD1} + a^3_{DD2}\ s_t + a^3_{DD7}\ E[y_{t+1} \mid y_t]) \right\} \\
&+\beta(1-P_D)\ \left\{ \left[a^3_{DR1} + a^3_{DR2}\ (c^3_{R0} + c^3_{R1}\ s_t + c^3_{R2}\ E[y_{t+1} \mid y_t]) + a_{DR7}\ E[y_{t+1} \mid y_t] \right] c^3_{R1} \right\}
\end{aligned}$$

Second, consider the case when the Democrats are in power at time t, and the time to the next election is $\Delta_t = 1$, i.e. we are in the third term of the administration.

Substituting into the first order condition, we obtain: Hence, the FOC simplifies to

$$\begin{aligned}
0 &= -(s_t - s_D - \epsilon_{Dt}) \; - \; \eta_D \; \left(\frac{1}{E[(1-\delta_\tau) y_{t+1} | y_t]} - \frac{1}{E[(1-\delta_\tau) y_{t+1}]} \right) \; - \; \alpha_D \; (s_t - s_{t-1}) \\
&+ \; \beta \; \left\{ a^0_{DD1} + a^0_{DD2} \; s_t + a^0_{DD7} \; E[y_{t+1} | y_t] \right\}
\end{aligned}$$

Finally, the analysis for $\Delta_t = 2$ and $\Delta_t = 3$ proceeds as in the case when $\Delta_t = 1$.

The expected value functions can be computed as follows:

$$\begin{aligned}
& E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = i)] \\
&= \int V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = i) \; f(y_{t+1} | y_t) \; f(\epsilon_{Dt+1}) \; dy_{t+1} \; d\epsilon_{Dt+1} \\
&= a^i_{DD0} + a^i_{DD1} \; s_t + \frac{1}{2} \; a^i_{DD2} \; s_t^2 + a^i_{DD3} \; E(y_{t+1} | y_t) + \frac{1}{2} a^i_{DD4} \; E((y_{t+1})^2 | y_t) + \frac{1}{2} a^i_{DD6} \; Var(\epsilon_D) \\
&+ \; a^i_{DD7} \; s_t \; E(y_{t+1} | y_t) \\
& E_t[V_D(R, \mu_R(s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i), y_{t+1}, \epsilon_{Dt+1})] \\
&= \int V_D(R, \mu_R(s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i), y_{t+1}, \epsilon_{Dt+1}) f(y_{t+1} | y_t) \; f(\epsilon_{Rt+1}) \; f(\epsilon_{Dt+1}) \; dy_{t+1} \; d\epsilon_{Rt+1} \; d\epsilon_{Dt+1} \\
&= a^i_{DR0} + a^i_{DR1} \; (c^i_{R0} + c^i_{R1} \; s_t) + \frac{1}{2} \; a^i_{DR2} \; (c^i_{R0} + c^i_{R1} \; s_t)^2 + (a_{DR3} + a_{DR1} \; c_{R2}) \; E(y_{t+1} | y_t) \\
&+ \; (\frac{1}{2} \; a^i_{DR4} + \frac{1}{2} \; a^i_{DR2} \; (c^i_{R2})^2 + a^i_{DR7} c^i_{R2}) E((y_{t+1})^2 | y_t) + \frac{1}{2} a^i_{DR6} \; Var(\epsilon_D) + \frac{1}{2} \; a^i_{DR2} \; (c^i_{R3})^2 \; Var(\epsilon_R) \\
&+ \; (a^i_{DR7} + a^i_{DR2} \; c^i_{R2}) \; (c^i_{R0} + c^i_{R1} \; s_t) \; E(y_{t+1} | y_t)
\end{aligned}$$

$$
\begin{aligned}
& E_t[V_R(R, s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i)] \\
= & \int V_R(R, s_t, y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i)\ f(y_{t+1}|y_t)\ f(\epsilon_{Rt+1})\ dy_{t+1}\ d\epsilon_{Rt+1} \\
= & a^i_{RR0} + a^i_{RR1}\ s_t + \frac{1}{2}\ a^i_{RR2}\ s_t^2 + a^i_{RR3}\ E(y_{t+1}|y_t) + \frac{1}{2} a^i_{RR4}\ E((y_{t+1})^2|y_t) + \frac{1}{2} a^i_{RR6}\ Var(\epsilon_R) \\
+ & a^i_{RR7}\ s_t\ E(y_{t+1}|y_t) \\
& E_t[V_R(D, \mu_R(s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = i), y_{t+1}, \epsilon_{Rt+1})] \\
= & \int V_R(D, \mu_R(s_t, y_{t+1}, \epsilon_{Dt+1}), y_{t+1}, \epsilon_{Rt+1}, \Delta_{t+1} = i) f(y_{t+1}|y_t)\ f(\epsilon_{Dt+1})\ f(\epsilon_{Rt+1})\ dy_{t+1}\ d\epsilon_{Dt+1}\ d\epsilon_{Rt+1} \\
= & a^i_{RD0} + a^i_{RD1}\ (c^i_{D0} + c^i_{D1}\ s_t) + \frac{1}{2}\ a^i_{RD2}\ (c^i_{D0} + c^i_{D1}\ s_t)^2 + (a^i_{RD3} + a^i_{RD1}\ c_{D2})\ E(y_{t+1}|y_t) \\
+ & (\frac{1}{2}\ a^i_{RD4} + \frac{1}{2}\ a^i_{RD2}\ (c^i_{D2})^2 + a^i_{RD7} c^i_{D2}) E((y_{t+1})^2|y_t) + \frac{1}{2} a^i_{RD6}\ Var(\epsilon_R) + \frac{1}{2}\ a^i_{RD2}\ (c^i_{R3})^2\ Var(\epsilon_D) \\
+ & (a^i_{RD7} + a^i_{RD2}\ c^i_{D2})\ (c^i_{D0} + c^i_{D1}\ s_t)\ E(y_{t+1}|y_t)
\end{aligned}
$$

B Forward Simulation of the Expected Value Functions

To see how this works, let's assume – for simplicity – that the policy functions can be approximately by linear functions (as we do in our application). In that case, we have when Democrats are in power for $j = 0, ..., 3$:

$$
\begin{aligned}
s_t &= \mu_D(s_{t-1}, y_t, \epsilon_t, \Delta_t = j) \\
&= c^j_{D0} + c^j_{D1}\ s_{t-1} + c^j_{D2}\ y_t + c^j_{D3}\ \epsilon_{Dt} \\
&= c^j_{D0} + c^j_{D1}\ s_{t-1} + c^j_{D2}\ y_t + \epsilon^j_{Dt}
\end{aligned}
$$

where $\epsilon^j_{Dt} = c^j_{D3}\ \epsilon_{Dt}$ and hence $\epsilon^j_{Dt} \sim N(0, (c^j_{D3})^2 \sigma^2_D)$. Note that these policy functions can be estimated using OLS. As consequence c^j_{D0}, c^j_{D1} and c^j_{D2} are identified. Moreover, given a value of σ^2_D, the c^j_{D3} are identified from the residual variances.

Similarly, when a Republican administration is in power

$$
\begin{aligned}
s_t &= \mu_R(s_{t-1}, y_t, \epsilon_t, \Delta_t = j) \\
&= c^j_{R0} + c^j_{R1}\ s_{t-1} + c^j_{R2}\ y_t + c^j_{R3}\ \epsilon_{Rt} \\
&= c^j_{R0} + c^j_{R1}\ s_{t-1} + c^j_{R2}\ y_t + \ \epsilon^j_{Rt}
\end{aligned}
$$

where $\epsilon^j_{Rt} = c^j_{R3}\ \epsilon_{Rt}$.

Since we can consistently estimate the parameters of the policy functions, we can, therefore, treat them as known. (For given σ^2_D and σ^2_R, which are estimated in the outer loop. So we can condition on them in the inner loop when we need to evaluate the orthogonality conditions.)

Consider, for example, the problem of simulating $E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 2)]$. The Democrats are in power and we are in state $(s_{t-1}, y_t, \epsilon_t)$ and $j = 3$ at time t.

1. For simulation $h = 1$ to H,

   (a) In period t, $j = 3$. Compute $s^h_t = \mu_D(s_{t-1}, y_t, \epsilon_t, \Delta_t = 3)$. (Note this does not change across simulations.)

   (b) In period $t + 1$, $j = 2$. Simulate y^h_{t+1} by drawing from the AR(1) process conditional on y_t. Simulate ϵ^h_{Dt+1}. Compute $s^h_{t+1} = \mu_D(s^h_t, y^h_{t+1}, \epsilon^h_{Dt+1}, \Delta_t = 2)$. Compute the flow utility:

$$U^h_{t+1} = B_D(s^h_{t+1}, y^h_{t+1}, \epsilon^h_{Dt+1}) - C_D(s^h_{t+1}, s^h_t) + \kappa$$

(c) In period $t+2$, $j=1$. Simulate y^h_{t+2}, ϵ^h_{t+2}, and compute $s^h_{t+2} = \mu_D(s^h_{t+1}, y^h_{t+2}, \epsilon^h_{Dt+2}, \Delta_t = 1)$. Compute the flow utility:

$$U^h_{t+2} = B_D(s^h_{t+2}, y^h_{t+2}, \epsilon^h_{Dt+2}) - C_D(s^h_{t+2}, s^h_{t+1}) + \kappa$$

(d) In period $t+3$, $j=0$. Simulate y^h_{t+3}, ϵ^h_{t+3}, and compute $s^h_{t+3} = \mu_D(s^h_{t+2}, y^h_{t+3}, \epsilon^h_{Dt+3}, \Delta_t = 0)$. Compute the flow utility:

$$U^h_{t+3} = B_D(s^h_{t+3}, y^h_{t+3}, \epsilon^h_{Dt+3}) - C_D(s^h_{t+3}, s^h_{t+2}) + \kappa$$

Since $j=0$ we also need to simulate the election outcome. For that, draw a $U(0,1)$. If the realization is less than P_D, Democrats win, otherwise Republicans win the election.

(e) In period $t+4$, $j=3$. Suppose the simulated election puts the Republicans in power. Simulate y^h_{t+4}, ϵ^h_{Rt+4}, and compute $s^h_{t+4} = \mu_R(s^h_{t+3}, y^h_{t+4}, \epsilon^h_{Rt+4}, \Delta_t = 3)$. Simulate ϵ^h_{DRt+4}, and compute

$$U^h_{t+4} = B_D(s^h_{t+4}, y^h_{t+4}, \epsilon^h_{Dt+4})$$

(f) Continue until the terminal period T.

(g) Compute the realized value function for simulation h

$$V^h_D = \sum_{r=t+1}^{T} \beta^{r-t-1} U^h_r$$

2. Compute the expected value function by averaging over the H simulations:

$$E_t[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)] = \frac{1}{H} \sum_{h=1}^{H} V^h_D$$

Similarly, we can simulate all the other value functions.

C Moment Restrictions

We construct our objective function based on the following conditional moment restriction. For each $j \in \{D, R\}$,

$$E[\epsilon_{jt}|s_{t-1}, y_t, \Delta_t] = 0$$

The conditional moment restrictions above imply the following unconditional moment restrictions:

$$\begin{aligned} E[\epsilon_{jt}|\Delta_t] &= 0 \\ Cor[\epsilon_{jt}, s_{t-1} \mid \Delta_t] &= 0 \\ Cor[\epsilon_{jt}, y_t \mid \Delta_t] &= 0 \end{aligned}$$

We constructed different moment conditions for election years ($\Delta_t = 0, 2$) and non-election years ($\Delta_t = 1, 3$). We also imposed the model restriction that $Std(\epsilon_{jt}) = \sigma_j$ for $j = D, R$. To adjust for the difference in the scale of the moments, we divided the moments by $Std(\epsilon_{jt}) = \sigma_j$. Hence, the objective function of our estimator can be written as:

$$
\begin{aligned}
& Q(\theta_2; \widehat{\theta}_1, \widehat{\mu_D}, \widehat{\mu_R}) \\
= & \sum_{j \in \{D,R\}} \Bigg\{ [E(\epsilon_{jt}(\theta_2) \mid \Delta_t = 0, 2)]^2 + [E(\epsilon_{jt}(\theta_2) \mid \Delta_t = 1, 3)]^2 \\
+ & [Cor(\epsilon_{jt}(\theta_2), s_{t-1} \mid \Delta_t = 0, 2)]^2 + [Cor(\epsilon_{jt}(\theta_2), s_{t-1} \mid \Delta_t = 1, 3)]^2 \\
+ & [Cor(\epsilon_{jt}(\theta_2), y_t \mid \Delta_t = 0, 2)]^2 + [Cor(\epsilon_{jt}(\theta_2), y_t \mid \Delta_t = 1, 3)]^2 \\
+ & [\sigma_j - Std(\epsilon_{jt}(\theta_2)]^2 \Bigg\}
\end{aligned}
$$

D Reduced Form Estimates of the Reelection Probabilities

Here, we report the reduced form estimates of logit models that capture the impact of budgeted policies on general elections in the states in our sample. The following table reports the parameter estimates of the reduced form reelection probabilities. Overall, we find that the slope parameters are estimated imprecisely. The estimate is positive for Republicans and negative for Democrats. Neither estimate is statistically different from zero. When we estimate the structural parameters of the model, we also exploit the variation of expenditures during the different terms of an administration to identify the slope parameters. We find that the structural estimates fall within the 95% confidence band of the reduced form estimates.

Table 7: Reduced Form Estimates of the Reelection Probabilities

	Republican	Democrats
Expenditure	1.088	-1.827
	(1.882)	(1.733)
Constant	-3.175	7.401
	(6.985)	(6.466)
Observations	165	148
Marginal Effects of $1000	0.227	-0.420
	(0.391)	(0.392)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

E Some Robustness Checks

Overall, the qualitative business cycle patterns are similar for different smoothing papers. However, the magnitude of the fluctuations depends on the choice of the smoothing parameter.

Figure 6: Weighted Real State Expenditure Per Capita (Detrended)

Figures 6 and 7 illustrate this finding and show the weighted average of the detrended expenditure and income data. We adopt a bandwidth of 400 for our main analysis, which is an intermediate value of the smoothing parameter.

Next, we show that the main findings are fairly robust to other choices of the smoothing parameter. Table **??** shows the estiamted policy functions using an HP filter with the smoothing parameter set to 1600.

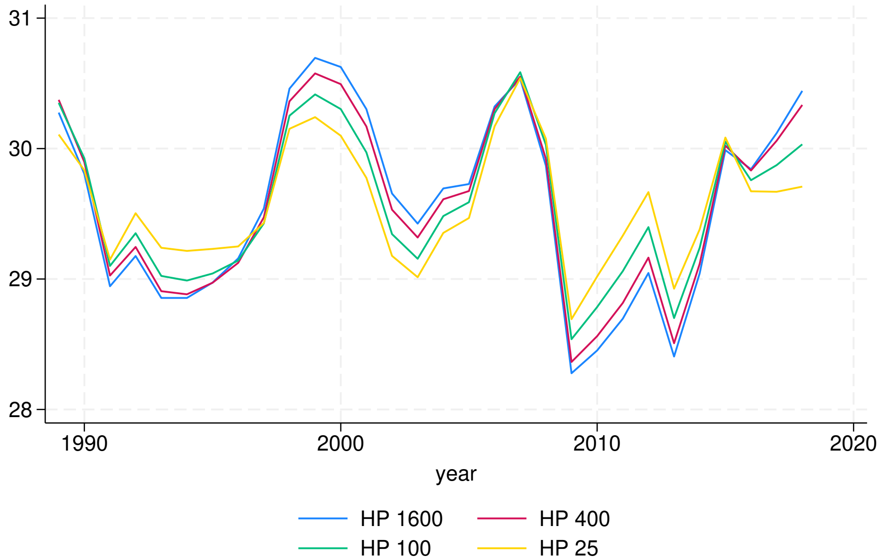
Overall, the findings are similar. If anything, the differences among parties are slightly more pronounced when you use 1600 as the filtering parameter.

Table 8: Policy Function Estimates: Robustness Check

	I	II	III	IV
	Expenditure HP 1600	Expenditure HP 1600	Expenditure HP 1600	Expenditure HP 1600
Constant	3.696***	3.690***	1.288***	0.524***
	(0.00604)	(0.00691)	(0.110)	(0.174)
Dem	0.0516***	0.0482***	0.172	-0.160
	(0.00922)	(0.0106)	(0.160)	(0.251)
Rep Election		0.0222	0.0341***	0.0305***
		(0.0141)	(0.0109)	(0.0106)
Dem Election		0.0357**	0.0382***	0.0401***
		(0.0162)	(0.0125)	(0.0121)
Lagged Exp			0.648***	0.637***
			(0.0297)	(0.0288)
Lagged Exp x Dem			-0.0372	-0.0691*
			(0.0428)	(0.0418)
Income				0.0272***
				(0.00488)
Income x Dem				0.0153**
				(0.00740)
Observations	1,289	1,289	1,289	1,289
R-squared	0.024	0.029	0.421	0.459

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 7: Weighted Real State Income Per Capita (Detrended)



We also experimented with non-linear specifications. However, none of the higher-order terms were significant. We thus conclude that a simple linear specification of the policy function in all the relevant state variables fits the data well.