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

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Motivation: Partisanship & Inertia

- **Premise**
  Partisan control systematically influences expenditure and tax policies.

- **Key Empirical Questions**
  - **Magnitude:** If voters change the ruling party, how significant are the fiscal changes? (i.e., *How far apart are the parties?*)
  - **Speed:** How quickly does policy adjust? (i.e., *How quickly do parties get what they want?*)

- **The Gap**
  Despite substantial theoretical research, these empirical magnitudes remain insufficiently understood.

Empirical Challenges

- **The Identification Problem**
  We aim to measure the differences in "bliss points" (ideal policies) among parties, but observed policies are distorted by:

  1. **Adjustment Costs:** Policies cannot change instantaneously.
  2. **Institutional Constraints:** Fiscal rules regulate the budget process.

- **Consequence**
  Current policy $\neq$ The controlling party's bliss point.

- **Our Approach**
  We address this by estimating a **dynamic model of state fiscal policies** using U.S. data, which explicitly separates structural frictions from partisan preferences.

Adjustment Costs & Policy Inertia

- **Nature of Frictions**
  - Set-up Costs: Barriers to establishing new programs.
  - Policy Stickiness: Programs tend to persist once established.
- **Four Sources of Adjustment Costs**
  1. Political: Gridlock or divided government.
  2. Institutional: Features of the budget process.
  3. Legal: Labor laws constraining hiring and firing.
  4. Economic: Time-to-build restrictions on investment.
- **Estimation Goal**
  We estimate these costs within a dynamic model that explicitly captures these constraints.

Fiscal Rules & Identification

- **Institutional Constraints**
  - Almost all U.S. states enforce *Balanced Budget Requirements (BBRs)*, prohibiting deficit spending.
  - Most states also mandate contributions to *Rainy Day Funds*.
- **Implications for the Model**
  - BBRs strictly limit the ability to finance expenditures via debt.
  - This isolates fiscal policy preferences from debt management preferences.
- **Conclusion**

  BBRs allow us to estimate the model based on **expenditure policies alone**.

Model Setup and Assumptions

- **Dynamic Partisan Game**
  - Two forward-looking, infinitely lived parties with conflicting preferences compete in elections.
  - The ruling party implements fiscal policies; the opposition is passive.
- **Institutional Constraints**
  - **Balanced Budget Requirement:** Policymakers face a BBR with a one-period implementation lag.
  - **Election Cycle:** We explicitly model four-period terms, capturing distinct incentives in election vs. non-election years.
- **Frictions**
  - **Adjustment Costs:** A function of previous policies and the institutional environment.
  - These costs, combined with electoral uncertainty, prevent the current government from immediately implementing its preferred policies.

Estimation Strategy

- **Framework:**
  - Estimation based on moment conditions derived from equilibrium optimality conditions.
  - The model error is interpreted as a temporary preference shock shifting the current policy-maker's bliss point.
- **Computational Challenge:**
  - Since parties are forward-looking, FOCs depend on value functions and their derivatives.
  - A full solution nested fixed-point algorithm (e.g., Rust 1987) is computationally challenging.
- **Solution:**
  - We use a **forward-simulation approach** (Hotz et al. 1994; Bajari et al. 2007) to compute value functions.
  - This relies on estimating the policy functions of both parties *before* estimating the structural parameters.

Preview of Key Findings

1. **Polarization & Preferences**
   - Magnitude: Differences in bliss points are significant, but smaller than expected.
   - Implication: Less polarization at the state level than often assumed.
   - Heterogeneity: Idiosyncratic preference shocks are quantitatively important.
2. **Adjustment Costs (Frictions)**
   - Significance: Costs are statistically and economically meaningful.
   - It can takes up to 8 years to adjust expenditures after the economy experiences large economic shock.
   - Stability: High adjustment costs reduce policy volatility.

Related Literature

1. **Dynamic Games in Political Economy**
   - *Strategic Debt:* Persson & Svensson (1989); Alesina & Tabellini (1990); Besley & Coate (1998); Song et al. (2012).
   - *Fiscal Rules:* Battaglini & Coate (2008); Azzimonti et al. (2016); Dovis & Kirpalani (2020).

2. **Policy Inertia and Adjustment Costs**
   - *Costly Adjustment:* Gersbach et al. (2023); Piguillem & Riboni (2024); Eraslan & Piazza (2025); Loeper & Dziuda (2024).

3. **Methodological: Estimation of Dynamic Games**
   - *Forward Simulation:* Hotz et al. (1994); Bajari, Benkard, & Levin (2007); Aguirregabiria & Mira (2007); Pesendorfer & Schmidt (2008).

4. **Empirical Political Economy & Fiscal Rules**
   - *Structural Estimation:* Merlo (1997); Diermeier et al. (2003); Sieg & Yoon (2017); Aruoba et al. (2018).
   - *BBR Evidence:* Poterba (1994); Bohn & Inman (1996); Alt & Lowry (1994).

Institutional Setting and Budget Constraint

Environment

- Two parties (D, R), annual policy, elections every 4 years $(\Delta_t \in \{0, .., 3\})$.
- Budget decisions made (by party in power) in t determine fiscal policies in year $t+1$
- Income y_t is Markov; soft balanced budget requirement.

Balanced Budget Rule

- Given the timing of decisions, the annual budget needs to be balanced in expectations:

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

Rainy Day Fund (Passive)

- Handles ex-post deficits/surpluses using surcharge δ_τ.
- Law of motion for assets a_{t+1}:

$$a_{t+1} = (1+r)a_t + \tau_t(1-\delta_\tau)(y_{t+1} - E_t[y_{t+1}]) + \delta_\tau y_{t+1}$$

Preferences

Spatial Preferences

- Bliss point with idiosyncratic shock: $s_{jt} = s_j + \epsilon_{jt}$.
- Flow utility (quadratic in spending, linear in tax gap):

$$\tilde{B}_j = -\frac{1}{2}(s_t - s_{jt})^2 - \eta_j(\tau_t - \tilde{\tau}_t)$$

- $\eta_j > 0$ implies incentive to smooth taxes (spend more in booms).

Balanced-Budget Preferences

- Substituting the budget constraint yields $B_j(s_t, y_t, \epsilon_{jt})$:

$$B_j(\cdot) = -\frac{1}{2}(s_t - s_{jt})^2 - \eta_j \left(\frac{s_t}{E_t[(1-\delta_\tau)y_{t+1}|y_t]} - \frac{s_t}{E[(1-\delta_\tau)y_{t+1}]} \right)$$

Adjustment Costs and Timing

Frictions

- Sluggish spending adjustment modeled as party-specific cost:

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

- **Total Flow Utility** (including office benefit κ):

$$U_j(\cdot) = B_j(s_t, y_t, \epsilon_{jt}) + \mathbf{1}\{\omega_t = j\}(\kappa - C_j(s_t, s_{t-1}))$$

Timing of Events

1. Shocks realized: Income y_t and preferences ϵ_{jt}.
2. Ruling party chooses spending s_t.
3. If election year ($\Delta_t = 0$), election determines ω_{t+1}; otherwise $\omega_{t+1} = \omega_t$.

The Decision Problem of the Party in Power

- We can express the optimization problem recursively as:

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

- Expectations are with respect to **future income** y_{t+1} and **future preference shocks** ϵ_{Dt+1} and ϵ_{Rt+1}.

Optimal Decisions and Strategic Effects

First-Order Condition

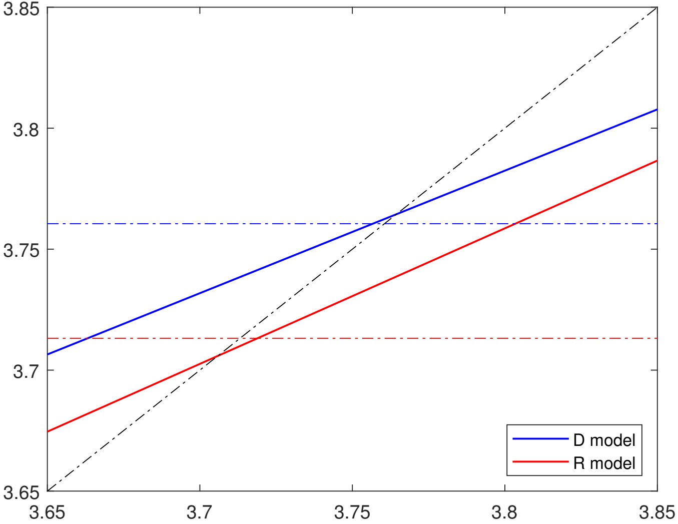
$$0 = \underbrace{-(s_t - s_D - \epsilon_{Dt})}_{\text{Marginal Utility}} - \underbrace{\eta_D(\dots)}_{\text{Tax Smoothing}} - \underbrace{\alpha_D(s_t - s_{t-1})}_{\text{Marginal Adj. Cost}}$$

$$+ \beta \left\{ P_D E_t \left[\frac{\partial V_D(D)}{\partial s_t} \right] + (1 - P_D) E_t \left[\underbrace{\frac{\partial V_D(R)}{\partial s_t}}_{\text{Strategic Effect}} \right] \right\}$$

Strategic "Tie-the-hands" Effect

- The last term represents the strategic motive.
- Incumbents influence future opposition governments because undoing spending changes requires incurring adjustment costs ($\alpha_R > 0$).

Policy Function



Endogenous Election Probabilities

- We treat election probability as **endogenous** (dependent on policy choices).
- Functional form for party $j \in \{D, R\}$:

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

- If $\lambda_{1j} > 0$, voters reward the party in power for high expenditures.

Estimation: First-Order Conditions

- Optimality condition for the last term ($\Delta_t = 0$) if Democrats are in office:

$$
\begin{aligned}
\epsilon_{Dt} &= (s_t - s_D) + \eta_D \ (\dots) + \alpha_D \ (s_t - s_{t-1}) \\
&- \beta \Bigg\{ P_D(s_t) \ E_t \left[\frac{\partial V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3)}{\partial s_t} \right] \\
&+ (1 - P_D(s_t)) \ E_t \left[\frac{\partial V_D(R, s_t, y_{t+1}, \epsilon_{Dt+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3)}{\partial s_t} \right] \\
&+ \frac{\partial P_D(s_t)}{\partial s_t} E_t \Big[V_D(D, s_t, y_{t+1}, \epsilon_{Dt+1}, \Delta_{t+1} = 3) \\
&- V_D(R, s_t, y_{t+1}, \epsilon_{Dt+1}, \epsilon_{Rt+1}, \Delta_{t+1} = 3) \Big] \Bigg\}
\end{aligned}
$$

- Standard assumption for preference shocks:

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

Data and Empirical Strategy

1. Data Construction (1990–2018)

- Sample: 45 U.S. states.
  - Excludes AK, NE (unicameral), NH, VT, RI (election cycles).
- Definition: Party in power is defined by the Governorship.
- Final sample: 1,289 observations (excludes 16 independent administrations).

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2. Matching Model to Data

Challenge: The theoretical model is stationary, but data exhibits growth.

- **A. Fixed-Effect Model**
  - Controls for state and time effects (Besley & Case, 1995).
- **B. HP Filter**
  - Removes state-specific trends from income and expenditures.
  - Baseline $\lambda = 400$; robust to $\lambda \in \{25, 1600\}$.

Policy Function Estimates based on BC Filters

VARIABLES	(1) Expenditure	(2) Expenditure	(3) Expenditure	(4) Expenditure	(5) 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
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Policy Function Estimates based on the HP Filter

VARIABLES	(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
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Structural Parameter Estimates

		I BC Filtered	II HP Filtered	III HP Filtered
bliss	s_D	3.781	3.761	3.729
		(0.111)	(0.019)	(0.019)
points	s_R	3.662	3.713	3.685
		(0.088)	(0.012)	(0.011)
tax	η_D	151	129	136
		(39)	(37)	(41)
effect	η_R	136	99	100
		(28)	(32)	(34)
	α_D^e	10.268	1.700	1.958
adjustment		(6.558)	(0.721)	(0.879)
costs	α_R^e	12.212	2.285	2.644
		(4.345)	(0.603)	(0.755)
standard deviation	σ_D	1.772	0.461	0.504
		(0.850)	(0.122)	(0.149)
preference shocks	σ_R	1.782	0.464	0.509
		(0.527)	(0.079)	(0.097)
	λ_D^0	0.432	0.477	-2.636
		(0.243)	(0.249)	(1.226)
reelection	λ_D^1	0	0	0.831
		(—)	(—)	(0.323)
probability	λ_R^0	0.863	0.864	-2.765
		(0.476)	(0.244)	(1.028)
	λ_R^1	0	0	0.979
		(—)	(—)	(0.266)
marginal effects (λ_j^1)	D			0.194
				(0.073)
	R			0.204
				(0.057)

BC income: $\alpha_y = 1.387(0.526)$, $\rho_y = 0.953(0.018)$, $\sigma_y = 0.440(0.017)$.
HP income: $\alpha_y = 9.350(1.028)$, $\rho_y = 0.623(0.035)$, $\sigma_y = 0.619(0.024)$.
Estimated standard errors are reported in parentheses.

Model Fit

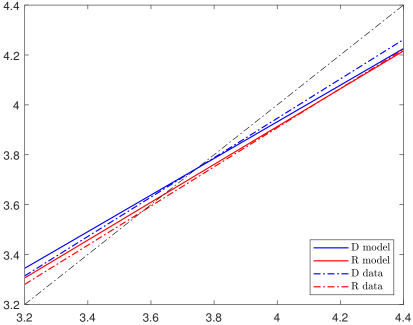


Figure: Policy Function by Previous Period Spending

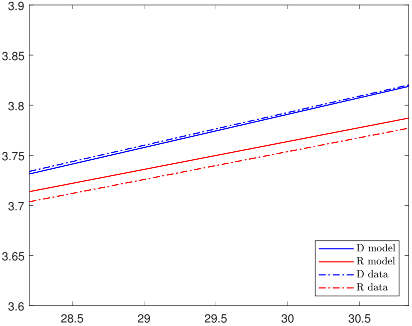


Figure: Policy Function by Income

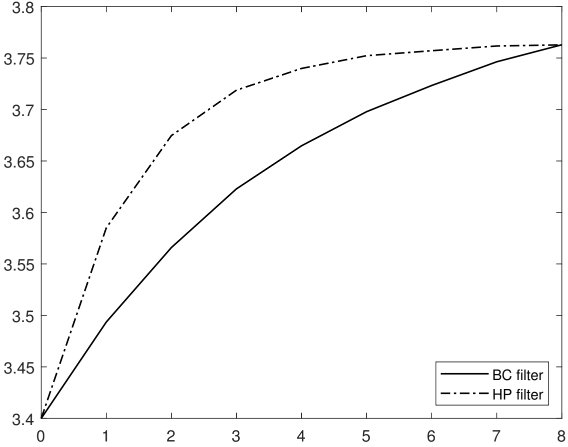
Decomposition of Expenditure Volatility

- Three types of shocks generate volatility:
  1. Income shock (business cycle).
  2. Preference shock (idiosyncratic heterogeneity).
  3. Political shock (election uncertainty).
- Relative importance of each shock:

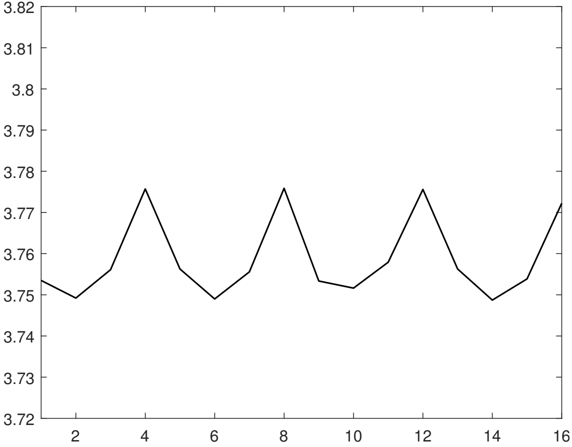
	bliss point shocks	income shocks	political shocks	all shocks
		BC filtered		
mean	3.67	3.67	3.72	3.73
volatility	0.176	0.160	0.043	0.254
		HP filtered		
mean	3.71	3.71	3.73	3.73
volatility	0.131	0.041	0.022	0.150

Means and volatility are measured in $1000.

The Speed of Policy Adjustment



The Political Business Cycle



Polarization and Adjustment Costs

- We consider nine regimes varying by polarization and adjustment costs.
- Baseline bliss point regime vs. polarization increased by \$100 / \$150.
- Adjustment costs: low (50%), baseline, high (150%).

		Polarization		
		baseline	\$100	\$150
BC filtered				
adjustment costs	low (50%)	0.299	0.304	0.306
	baseline	0.253	0.261	0.267
	high (150%)	0.232	0.242	0.249
HP filtered				
adjustment costs	low (50%)	0.206	0.216	0.224
	baseline	0.150	0.164	0.176
	high (150%)	0.122	0.139	0.153

The volatility is measured in \$1000.

Conclusions

- State fiscal policies are subject to large adjustment costs, giving rise to "sticky" policy.
- Costs are driven by institutional/economic constraints (setup/termination), not political gridlock.
- Adjustment costs create strategic incentives, allowing current policy-makers to tie the hands of future ones.
- Strategic election incentives cause expenditure overshooting and a political business cycle.
- Adjustment costs reduce policy volatility, which may benefit voters.

HP vs BC Comparison