

Something's Got to Give: The Political Economy of State Budget Trade-offs *

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ABSTRACT.

Because the American states operate under balanced budget requirements, increases in spending in one area typically entail equal and opposite budget cuts in other programs. Yet the literature analyzing the correlates of state spending by policy area has so far ignored these tradeoffs inherent to the budgeting process, and thus fails to address one of the most politically interesting and important dimensions of fiscal policy. Borrowing from the statistical literature on compositional data, we present more appropriate and efficient methods that explicitly incorporate the budget constraint into models of spending by budget category. We apply these methods to eight categories of spending from the 50 states over the years 1984–2005. Our findings show that partisan governments, political institutions, and economic conditions all influence who wins and who loses in the scramble for government spending in the states.

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*Politics is who gets what,
when, where, and how.*

HAROLD LASSWELL

1 Introduction

The American states fund myriad policies which impact the lives of their citizens (Gray and Hanson, 2004; Morehouse and Jewell, 2004). Because they operate under strict rules against deficit spending, states are forced to make tough choices across different public policy priorities. Indeed, if spending on hospital or highways could be raised without recourse to new taxes or budget cuts elsewhere—if actual spending on public goods were as cheap as talk supporting them—there might be little controversy in state budget making. In the real world of balanced budgets, every state spending decision bears an opportunity cost thereby creating a highly controversial process. Thus every year, state legislators and governors must face the tradeoffs across budget priorities, tradeoffs that we believe form the heart of state budget politics.

We are unaware of any study in the large literature on state budgets which uses appropriate methods to examine how increases in one budget area are offset by cuts in others.¹ Instead, analysts treat budget categories in isolation, potentially missing the tradeoffs which impact every category of public spending. The aim of this paper is to illustrate the statistical and substantive advantages of treating the state budget as a composition of many categories. Accordingly, we propose a statistical model for time series cross-sectional compositional budget data, and use that model to uncover the influence of political and economic variables on spending within, and tradeoffs across, all the components of the state budget.

Specifically, we apply this model to annual data from the 50 states over the years 1984 to 2005, parcelling each annual budget into spending on education, welfare, highways, medicine, natural resources, police, and corrections. Our results show which budget categories Democratic and Republican governments favor with extra spending, and which parts of the budget they raid to pay for their policy priorities. Additionally, we uncover how different budgetary rules advantage or disadvantage certain spending items, which policy areas suffer hardest during recessions and which are protected, how states reorder their budget priorities as they grow richer, and how the remaining differences in spending priorities vary across regions of the country once our political and economic variables are taken into account.

The paper unfolds in six parts. Section 2 reviews the literature on the political economy of state spending, suggesting a set of covariates likely to shape the trade-offs across budget priorities. Section 3 describes the budget data and covariates. Section 4 presents our method for compositional data analysis and Section 5 reviews the results of our analysis. Section 6 concludes.

¹Much of the literature (e.g. see Hendrick and Garand (1991); Nicholson-Crotty, Theobald and Wood (2006)) at best follow some of the recommendations for studying federal budget trade-offs provided by Berry and Lowery (1990).

2 Theoretical explanations of state budget priorities

The literature on state budget decisions is both vast and deep. One major avenue of inquiry, about which we will say little, focuses on the specific motivations of budgeting officials and the ‘nuts and bolts’ of the budget process (Rubin, 1997; Thurmaier and Willoughby, 2001; Wildavsky, 1964). Another stream of literature, to which this study contributes, looks instead to the broader political, institutional, and economic forces shaping the budget (Alt and Lowry, 1994, 2000; Barrilleaux and Berkman, 2003; Gilligan and Matsusaka, 2001; Husted and Kenny, 1997; Jacoby and Schneider, 2001; Painter and Bae, 2001; Primo, 2006). The best known of these works examine variations only in the total amount of state spending; however, some recent works study variation in select spending categories (Barrilleaux and Berkman, 2003, e.g.).

As our primary goal in this paper is to advance a new method for analyzing state budget compositions, we rely heavily on the existing literature for theoretical insights into which political and economic variables are likely to influence the allocation of state spending. In particular, we identify from this literature three sets of variables—partisanship, budget institutions, and economic conditions—which we expect to have systematic effects on the composition of the budget. But even in borrowing from this literature we face two challenges. First, because our data cover each component of the budget, we must consider many more relationships than a study of a single policy area. Second, because we consider each budget category as part of the whole, rather than as an independent sum of money, some variables commonly employed in studies of spending may have unexpected effects. As a result, our hypotheses are mostly tentative, and our analysis exploratory.

2.1 Partisan effects

More than any other political variable, government partisanship features prominently in the discussion of “who gets what” at the state level (Alt and Lowry, 1994; Dye, 1984; Garand, 1985; Gilligan and Matsusaka, 2001; Brown, 1995) as well as in cross-national studies (Huber and Stephens, 2001). Alt and Lowry (1994, 2000) show that unified partisan governments—those in which the same party holds the governorship and a majority of House and Senate—are dramatically quicker and better able to adjust state budget outcomes in the to match their preferences. Dye (1984) and Barrilleaux (2000) similarly find that Democratically controlled legislatures produce policies that are more liberal and more consistent with constituent interests. In particular, Husted and Kenny (1997) find that Democratic governments generally spend more on welfare programs, consistent with their constituents’ higher demand for redistribution and social insurance.

The literature devotes less attention to the role of parties in other budget areas. We expect partisan effects on the share of the budget going to education, for example, to be negligible, given broad support in the electorate for strong schools and universities. On the other hand, spending on highways and natural resources benefits suburban and rural voters more than urban constituents, suggesting Republican support may be higher for these areas.

If Democrats shift state resources towards redistributive programs, those resources will not be available for other state priorities. Focusing on budget compositions brings into sharp relief the

notion that parties affect not just levels of particular budgets, but trade-offs among them. Even if a party promises to support all areas of public policy—and, for good measure, to keep taxes low—any effort to raise spending in one area must be complemented with sacrifices elsewhere. How parties target those cuts says just as much about their agenda as which budgets they increase. Our expectation is that Republicans and Democrats will raid the preferred policies of their opponents for funds to support their own agendas, while preserving universally popular areas like education from cutbacks.

Much of the literature on partisanship in state spending focuses on the question of measurement. Here we follow Alt and Lowry (1994, 2000) and contrast three types of governments: those in which Democrats have control of the statehouse and majorities in both legislatures, those in which the Republicans have unified control, and all other governments, which we term divided. This classification highlights the central importance of the legislative median voters and governor in setting budget policy; moreover, if unified partisan governments fail to differ in policy priorities, it seems unlikely that partisan effects are strong. However, there are other measures of partisan control worth considering. These measures include those which take into account the effects of partisan supermajorities and electoral competitiveness on the parties’s ability to pursue an agenda that benefits their own constituents, rather than one which primarily satisfies the state’s median voter (Barrilleaux, Holbrook and Langer, 2002). We leave investigation of such measures to ensuing work.

2.2 Institutional influences

Among the many political institutions influencing the budget process, we focus on two which are highlighted by the public budgeting literature: gubernatorial powers and budgetary rules (Poterba, 1996; Poterba and von Hagen, 1999).

Gubernatorial Powers. Governors, the single most powerful actors in state government, draw much of their influence over the budget process from their constitutionally defined authority to set the budget agenda and veto budgets passed by the legislature (Wildavsky, 1986; ?; Beyle, 1996). At one extreme, governors exercise hegemony over the budget agenda, constructing budgets by themselves or with committees appointed at the governor’s discretion. At the other, governors draw up budgets in collaboration with agency officials and legislators not of his or her choosing. Governors’ powers to veto a passed budget also vary, from a simple blanket veto that can be overridden by simple majorities of the legislature, to a line-item veto, or, in most states, a line-item veto which can be overridden only by a two-thirds legislative majority.

We expect governors to use these powers to advance their budget priorities at the expense of spending in budget categories they either oppose outright, or favor less strongly. While we expect individual legislators to favor spending on local public goods, and to participate in log-rolls with other legislators to fund such pork barrel spending, we expect governors, who answer to a statewide constituency, to be less supportive of such funding, and more interested in providing statewide public goods (Weingast, Shepsle and Johnsen, 1981). Thus under strong governors, we expect spending on highways and natural resources—prototypical local public goods—to shrink. Cutting local public goods provision gives also governors a chance to raise spending on statewide public goods like education and public health and hospitals; hence these categories should gain

under strong governors.

Budget Rules. In contrast to the federal government, all states except Vermont are constitutionally required to maintain a balanced budget (Wildavsky, 1986). As a result, in times of budgetary shortfall, politicians must make spending cuts to keep in line with the budgetary restrictions placed on them. Cuts made to satisfy the balanced budget rule need not fall equally across budget categories. We expect entitlement programs, which predominate in the welfare and education categories, to be especially resistant to the budget axe; indeed, automatic increases in entitlement programs may be the source of budget pressures. Instead, we expect discretionary programs, such as spending on public health, highways, police, corrections, and natural resources, to bear the brunt of fiscal adjustment.²

While most states have very strict balanced budget amendments, some states enjoy a limited ability to deficit spend or carryover past debts. These states should be able to weather budgetary crises with fewer budget cuts, and hence should reallocate fewer resources from discretionary to entitlement programs. On average, states with strict balanced budget rules should devote a higher proportion of their budgets to entitlements than states with more flexible rules.

2.3 Economic factors

The literature on the federal budget suggests economic conditions should have a strong impact on the outcomes of the budget process (Kamlet and Mowery, 1987; Su, Kamlet and Mowery, 1993). Here, we focus on three commonly examined economic variables: the state unemployment rate, state per capita income, and the state population growth rate.

Unemployment. The unemployment rate provides the clearest signal of a state's macroeconomic well-being. Fluctuations in unemployment over the business cycle also trigger automatic spending, especially on welfare programs, and so should strongly impact the proportion of the budget devoted to this area. But state governments must also decide what spending to curtail during a recession, and which budget priorities to protect, even as more resources flow into entitlements.

Income. If unemployment proxies short-run economic conditions, per capita income contrasts states at different levels of long-run economic development. Because we are focused not on the size of government but on how relative demand for different types of policy depends on income, it helps to borrow the language of microeconomics, which identifies three ways demand for a good can respond to changes in income. Demand for some goods rises in proportion to income. If everyone, rich or poor, spends roughly the same proportion of their income on a good such as housing, then housing is said to be a normal good. Goods on which the rich spend a greater share of their income than the poor, like international travel, are luxury good. Finally, inferior goods or necessities are those goods, like food, which take up a greater share of the budgets of the poor than the rich.

A long standing claim (known as Wagner's Law) holds that economic development is the primary determinant of the size of government. According to the welfare state literature, as an economy grows, government spending will account not only for a growing absolute amount of

²Kousser (2002) suggests that discretionary portions of the Medicaid budget are more subject to change than entitlement portions.

real dollars, but a growing share of the gross domestic product (Wilensky, 1975; Cameron, 1978; Garand, 1988; Painter and Bae, 2001). Because Wagner’s Law focuses on redistributive policy as the main element of the expanding state, we draw from it the hypothesis that welfare spending in particular is a luxury good, and should grow as a percentage of the state budget as per capita income rises.

The existence of a luxury good in the state budget—and in a large category of spending—would logically require that some other portions of the budget shrink as income rises. The most likely candidates for inferior goods in the budget are programs favored by states seeking to develop lagging economies. This could include programs with heavy public investment components, such as highways, natural resources, hospitals, and prisons. By the same token, we expect economically developed states to have already made extensive public investments in these areas, and thus can afford to shrink spending in these categories.

Population Growth. Because we treat the budget as shares of a whole, rather than as dollar amounts, total state population should have little or no effect spending by category. However, the rate of growth of the population may matter for the pattern of spending across categories. It is useful to distinguish here between capital and non-capital spending. A growing population will demand more services from the state, but will also provide the tax revenue to fund those services, so for service-heavy budget categories like welfare or police, population growth should have no net effect on the composition of the budget—the overall budget and the budget for services should increase in rough proportion. However, a growing population may strain existing infrastructure, requiring the state to devote a greater share of resources to one-time investments in physical capital. Thus, we expect population growth to be associated with a shift in resources to capital-heavy policy areas, such as health and hospitals, highways, corrections, and education.

3 Data

The data we examine comprise yearly state expenditures in eight programmatic categories over the 50 states and the years 1984–2005, and are constructed using publicly available data from State Government Finances. Ranked from largest to smallest average share of state budgets, these categories are *Education*, *Welfare*, *Miscellaneous*, *Highways*, *Medical*, *Corrections*, *Natural Resources*, and *Police*.³ The key programs within each category are summarized in Table 1. The categorizations are for the most part intuitive, but it is worth highlighting the treatment of some borderline policy areas. First, Medicaid expenditures are grouped with other Welfare spending, and not in the Medical category, which focuses on state investments in public health. Second, mass transit subsidies are grouped with Miscellaneous spending, rather than with Highways. Both of these categorizations help focus our budget areas on politically relevant distinctions among programs.

Figure 1 summarizes the variation in spending within these categories across states and years. Education spending is the largest component of the state budget’ welfare the second largest, and

³State Government Finances provides 11 budget categories. We collapse three of these categories: government administration, parks, and “other” spending into our category “Miscellaneous”. We also combine their categories for Hospital and Health spending into a single category “Medical”, due to concerns about the consistent delineation of these two categories across states.

Budget category	Spending falling within this category
Education	Spending on elementary, secondary, and post-secondary education; schools for the blind and vocational schools.
Welfare	Cash assistance programs (SSI, TANF); vendor payments for medical care (Medicaid); emergency relief; welfare administration costs.
Miscellaneous	Government administration; judicial and legal expenditures; central staff services; public building costs; mass transit subsidies; parks; scientific and cultural facilities; stadiums.
Highways	Construction and maintenance of roads and highways; ferries.
Medical	Construction and maintenance of state hospitals, university hospitals, and mental health facilities; subsidies to private hospitals; health inspections; regulation of air and water quality; environmental cleanup.
Corrections	Construction and maintenance of prisons and jails; funding for inmate rehabilitation programs; salary for prison workers and probation officers.
Natural Resources	Fish and game expenditures; state administration of forests.
Police	State police; sheriffs; state highway patrol; training academies; crime labs; vehicle inspection.

Table 1: Description of state budget categories.

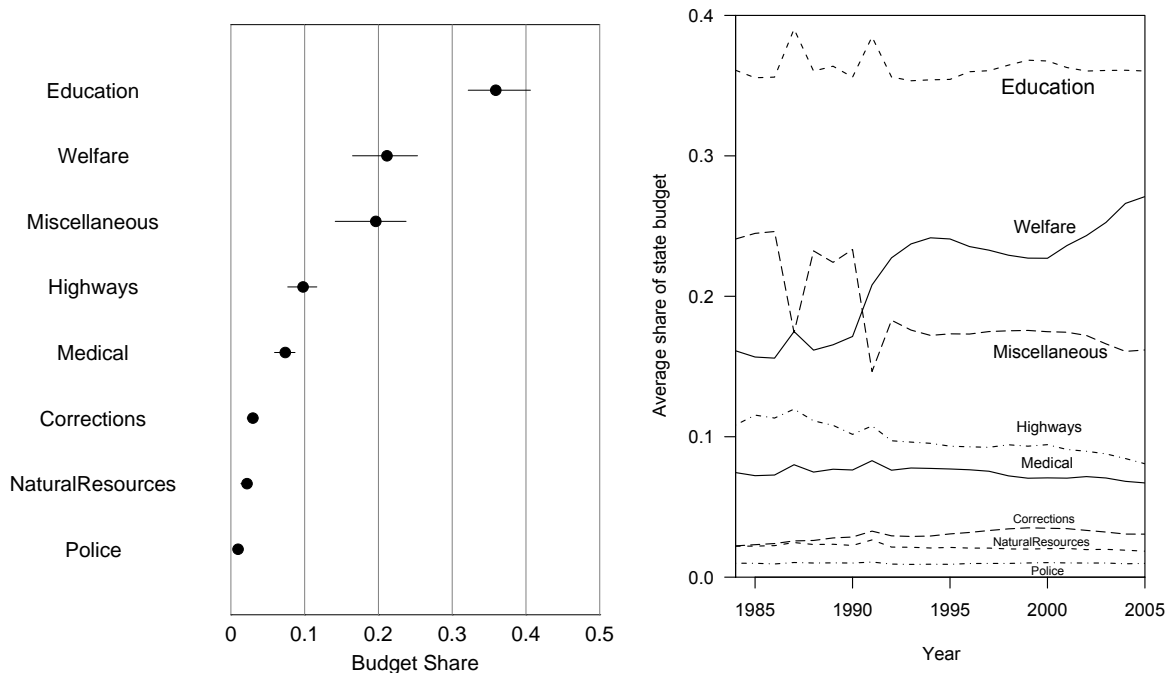


Figure 1: Variation in state spending by budget category, 1984–2005. The left plot shows the mean and interquartile ranges for spending by category for all states over the 1984–2005 period. The right plot shows the average spending by year for each category.

together these categories comprise more than half of the average state’s spending. Highways and Medical spending account for ten percent or less of the typical state’s budget, while Corrections, Natural Resources, and Police, though all essential and distinct state functions, each constitute no more than three percent of the average budget. Although states differ in the shares they devote to each category, the tight inter-quartile ranges suggest that most state budgets are variations on a common theme. As a result, our task is to illustrate the factors associated with quantitative trade-offs among the categories, rather than to delineate qualitatively different spending regimes.

The right panel of Figure 1 reveals that some categories of spending have waxed or waned over the twenty years studied. State spending on Welfare rose sharply in the early 1990s, and has not declined since. Welfare grew at the expense of Miscellaneous spending, which fell by the same degree, and has not recovered. Spending on prisons has risen considerably, in comparison to its original level, while spending on highways has fallen. Education, Medical, Natural Resources, and Police spending have been mostly constant over time.

We gather covariates from a variety of sources (see Appendix for summary statistics). Most of these data are measured over states and years, though some variables, particularly those measuring institutions, tend to be static in many states. Using data from Hoover and Pecorino (2005), we identify observations with *Unified Democratic Control* of the legislature and executive (24 percent of cases), and those under *Unified Republican Control* (18 percent). We measure the stringency of balanced budget requirements across states and years using the American Council

on Intergovernmental Relations’ (ACIR) time-invariant 0 to 10 scale (cite). *Budget Stringency* is strongly skewed: most states score the maximum ten points on this scale, indicating the strongest budget rules. Next, we construct an index of *Governor Power* by summing Beyle’s (1996, 2003) time-varying 5-point scales of governor’s veto and budget agenda powers.⁴ High scores indicate exclusive gubernatorial control over the proposed budget and restrictions on the legislature’s power to amend the governor’s budget. Finally, we obtain state unemployment rates and population growth from Hoover and Pecorino (2005), and per capita state income (in tens of thousands of constant dollars) from the Bureau of Economic Advisors.

4 Methods

For any government, spending in different policy areas must sum to a constraint, which is simply the overall budget. For the American states, all but one of which is constitutionally compelled to produce a balanced budget, this constraint is binding indeed. Any revision of the budget to expand spending in one area entails an equal and opposite combination of budget cuts and tax increases elsewhere. This linkage across budget areas implies that the political economy of state spending is largely one of trade-offs. However, quantitative analyses of state budgets in political economy generally study budget categories in isolation, or when studying multiple categories at once, implicitly assumes independence by estimating separate regressions for each category. These inappropriate models not only make implausible assumptions about the data, but also edit out the trade-offs that form the essence of the political process.

4.1 State budgets as compositional data

By treating state budgets as compositional data, we can simultaneously improve our assumptions about the process generating these data, and hone our models to address better the political substance of budget politics. Denote as w_{kit} the spending in budget category k by state i in year t , where there are K budget categories, I states, and T years in total. For convenience and without loss of generality, we will normalize all budgets to sum to 1. The unit of analysis is a single observed budget composition, defined as a collection of w_{kit} that collectively fulfill the budget constraint:

$$w_{1it} + \dots + w_{kit} + \dots + w_{Kit} = 1, \quad 0 \leq w_{kit} \leq 1 \quad (1)$$

Data that obey these constraints are said to be compositional (Aitchison, 1986). Existing work on state budgets ignores the methodological implications of the compositional constraint, and in so doing estimate inefficient models with potentially misleading conclusions. It is easiest to see this by considering two commonly employed approaches that fail to take the constraints on w_{kit} into account.

Dangers posed by ignoring the budget constraint in single equation models. Although simple linear regression is the most commonly used method for analyzing state budget

⁴Beyle reports veto and budget agenda scores for 1980, 1988, 1994, 1998, 2000, 2001, 2004, and 2005; we interpolate the missing years. Departing from Beyle, we code North Carolina as a zero on the veto scale prior to 1996, as the governor had no veto whatsoever.

categories, this workhorse model fails because it makes several assumptions about the compositional nature of budget data. Consider a linear regression model for a single category $k = j$, so that our response variable is w_{jit} . Linear regression assumes that w_{jit} can potentially take any value from negative to positive infinity. However, for budget data, w_{jit} is bounded by $[0, 1]$ —a state cannot spend negative dollars on a policy, nor can it spend more than its entire budget on any one budget category. Though linear regression will produce unbiased results when applied to bounded continuous data, it will often produce impossible fitted values (i.e., budget shares less than 0 percent, or greater than 100 percent), suggesting a basic mismatch between data and model.⁵

There is a deeper problem with analyzing a budget category outside the context of the complete budget composition. For concreteness, imagine that states can only spend money on welfare, highways, and education, so that the budget for any state and year has three components— $\{\text{Welfare}_{it}, \text{Highways}_{it}, \text{Education}_{it}\}$ —which, because of the budget constraint, sum to 1. Suppose that as data analysts we ignore the second and third components and fit the following linear regression:

$$\text{Welfare}_{it} = \alpha_0 + \alpha_1 \text{Unified Democratic Control}_{i,t-1} + \varepsilon_{it}$$

If we estimate $\hat{\alpha}_1 > 0$, we might be tempted to conclude that Democratic governments support increased welfare spending. However, substituting from the budget accounting identity $\text{Welfare}_{it} = 1 - (\text{Highways}_{it} + \text{Education}_{it})$, reveals an alternative interpretation of the estimated model:

$$\begin{aligned} 1 - (\text{Highways}_{it} + \text{Education}_{it}) &= \alpha_0 + \alpha_1 \text{Unified Democratic Control}_{i,t-1} + \varepsilon_{it} \\ \text{Highways}_{it} + \text{Education}_{it} &= (1 - \alpha_0) - \alpha_1 \text{Unified Democratic Control}_{i,t-1} - \varepsilon_{it} \end{aligned}$$

This version of the model seems to support a rival interpretation of $\hat{\alpha}_1 > 0$: Democrats oppose spending on (the sum of) Education and Highways. Mathematically identical, these interpretations appear at first to have very different substantive implications. Both reflect, though neither fully expresses, the finding that Democrats trade-off Welfare spending against Highways and Education. Unfortunately, because we have modelled only a single budget component, we do not know where specifically the budget cuts fall—they could come entirely from Education, entirely from Highways, or from a combination of the two.

Dangers posed by ignoring the budget constraint in multi-equation models. An obvious (but flawed) fix is to run a separate regression for each category. For our three component

⁵These problems are closely analogous to those which arise when one uses linear regression to model a dichotomous variable. In that case too, linear regression produces unbiased estimates; however, those estimates are usually logically impossible. The solution, of course, is to estimate a model, such as logit or probit, derived from appropriate assumptions about the data generating process. In the same fashion, it is better to derive appropriate models for compositional data, rather than to strain the interpretation of inappropriate ones.

example, we would estimate three linear regressions:

$$\begin{aligned} \text{Welfare}_{it} &= \alpha_0 + \alpha_1 \text{Unified Democratic Control}_{i,t-1} + \varepsilon_{it} \\ \text{Education}_{it} &= \theta_0 + \theta_1 \text{Unified Democratic Control}_{i,t-1} + \nu_{it} \\ \text{Highways}_{it} &= \lambda_0 + \lambda_1 \text{Unified Democratic Control}_{i,t-1} + \eta_{it} \end{aligned}$$

Note that this equation-by-equation approach assumes that the components are independent; i.e., that $\text{corr}(\varepsilon_{it}, \nu_{it}) = \text{corr}(\nu_{it}, \eta_{it}) = \text{corr}(\varepsilon_{it}, \eta_{it}) = 0$. In contrast, the budget constraint requires that if one component goes up, some combination of the others must go down. In general, the components of a budget tend to be negatively correlated, violating the assumption of independence. By ignoring the negative correlations across budget categories, the equation-by-equation approach fails to exploit all of the information in the data and is inefficient (Aitchison, 1982). (One symptom of this inefficiency is the unnecessary estimation of a K th equation, even though a K -part composition has only $K - 1$ degrees of freedom.) A model that incorporated the information provided by the budget constraint would produce more precise estimates of the quantities of interest.

The equation-by-equation approach also regularly makes impossible predictions—and not just for individual categories, but for the composition as a whole. Because nothing in the equation-by-equation model constrains the components to sum to the overall budget, the expected budget for any hypothetical values of the covariates will rarely if ever satisfy that constraint. Instead of capturing the actual trade-offs across the budget categories, then, the model often predicts a “budget constraint” which impossibly expands or shrinks to accommodate changes in spending by category.

These are not merely methodological quibbles: the inefficiency and impossible predictions of standard models of budgets point to a deep mismatch between the political process that generates budgets and the assumptions of the simple linear regressions commonly used to model them. Trade-offs are the essence of budgetary politics, and ignoring them makes neither political nor statistical sense. A covariate can no more affect only a single budget category than a state government can raise welfare spending without taking that money from some other priority.

4.2 Estimation and specification

A good model of state budgets jointly estimates the budget categories and respects the unit constraint across them. Fortunately, appropriate models for compositional data are easy to estimate and are widely employed throughout statistics, geology, and other fields. Surprisingly, despite the ubiquity of compositional data in politics—examples include party vote shares in multiparty elections (Katz and King, 1999), the proportion of space devoted to particular issues on the public agenda or in political speech, the time budgets of bureaucrats (Brehm, Gates and Gomez, 2003)—models of compositional data have received only sporadic attention from political scientists. Most surprising, we are unaware of any applications of these methods to government budgets.

The most celebrated methods for compositional data analysis are due to Aitchison (1986), whose central insight is that while compositional data are jointly dependent and bounded by

zero and one, the logarithms of their ratios are independent and unbounded, and thus can be jointly modeled using standard multivariate methods for continuous data. Formally, let \mathbf{w}_{it} be a K -vector containing the budget shares for a single observation. Then stack all observed compositions into a single $IT \times K$ matrix \mathbf{W} , which contains one row for each observation and one column for each component. Select one of the columns of \mathbf{W} to serve as the reference component. The results do not depend on which column we choose, so for convenience and without loss of generality, let the last component, K , be the reference. Then apply Aitchison’s additive logratio transformation to the budget components, which turns the $IT \times K$ matrix \mathbf{W} into an $IT \times K - 1$ matrix \mathbf{Y} such that

$$y_{kit} = \ln(w_{kit}/w_{Kit}) \tag{2}$$

The columns of \mathbf{Y} are independently distributed, yet the new matrix retains all the ratio information in \mathbf{W} . This means that the original composition \mathbf{W} can be exactly reconstructed from \mathbf{Y} , up to the budget constraint. Thus if we estimate a regression model on the logratio scale, we can easily recover conditional expectations of the original K components for any counterfactual we care to consider (Aitchison, 1986).

Our data have not only compositional but also time series cross-sectional properties. While regression models of compositional time series have received some attention in statistics (Grunwald, Raftery and Guttorp, 1993; Ravishanker, Dey and Iyengar, 2004; Larrosa, 2005) and political methodology (Brandt, Monroe and Williams, 1999), most proposed models are for a single time series and do not easily lend themselves to panel applications. However, Smith and Brundson (1989) show simple time series models provide consistent estimates of compositions that are invariant to the choice of reference category. Provided we are willing to make pooling assumptions common in the political economy literature (e.g., common dynamic parameters across our units), this model easily extends to pooled time series cross-section data. After transforming the state budget data, we pool the logratios across time and states, and estimate the following $K - 1$ equation time series cross-section compositional data model by seemingly unrelated regressions:

$$y_{kit} = \sum_{p=1}^P \phi_{pk} y_{k,i,t-p} + \mathbf{x}_{it} \boldsymbol{\beta}_k + \mathbf{z}_{i,t-1} \boldsymbol{\gamma}_k + \varepsilon_{kit} \tag{3}$$

For each logratio y_{kit} , we specify an equation regressing y_{kit} on one or more of its lagged values, as well as a vector of contemporaneous economic variables \mathbf{x}_{it} , a vector of lagged political variables $\mathbf{z}_{i,t-1}$, and a set of regional dummies. We estimate the system of $K - 1$ equations by seemingly unrelated regressions, which allows non-zero correlations across the error terms for a given state and period (Zellner, 1962).

Our preferred specification regresses seven logratios, formed from the full eight-part budget composition, on four political variables—*Unified Democratic Control*, *Unified Republican Control*, *Budget Stringency*, and *Governor Power*, each lagged one year—and three economic variables—*Unemployment Rate*, *Income per capita*, and *Population Growth*, each measured contemporaneously. We also control for the state’s region—*Northeast*, *Midwest*, *South*, or *West*. We have experimented with different lag structures for the response variable, and found little substantive

or statistical difference among models with one, two, or three lags. We thus settled on a model with a single lag to minimize loss of data. As is typical for time series models of budget data, the model fits the data well, and R^2 for the system of equations was 0.90.

However, there are several potential sources of bias to bear in mind as we report our results. Because some of our variables are time invariant (Budget Stringency, and in some states, partisan control), we could not estimate a model with state fixed effects. Thus there is a danger that our results reflect or are biased by omitted features of states, whether institutional, demographic, geographic, or cultural. Including regional effects mitigates but does not eliminate this threat.

Second, budgets not only react to political economic variables, but influence them as well. Voters may choose parties in response to existing budget allocations. Governments may change institutions with the aim of reshaping existing budget priorities. And the spending priorities of the government may influence either long or short run economic growth. Endogeneity is thus another potential source of bias, but here there are mitigating factors as well. Economic measures such as state unemployment reflect both state-level and national economic conditions, and the latter are not under the state’s influence. By lagging our partisan variables one year to reflect the budget process, we also reduce the risk of conflating political effects on the budget with voters’ reactions to the budget. On the other hand, institutional variables pose perhaps the greatest risk of reverse causation or spurious correlation, as both they and the budget are slow to change, and are under the influence of the same political actors.

4.3 Interpretation and presentation

Because trade-offs under the budget constraint link all budget categories together, discussions of the relationship between covariates and isolated budget categories typically obscure the tradeoffs across budget categories. In contrast, our model and presentation of results focuses on the reallocation among all our budget categories expected when one of the covariates changes. To show these tradeoffs clearly, we must overcome two interpretative challenges: translating estimates from the scale of estimation to the scale of the budget shares, and accounting for the dynamics of our model to show how changes in our covariates influence sticky budgets over a period of years.

Translating estimates back to budget shares. Because they relate directly to the logratios of components, and only indirectly to the underlying budget categories, the parameters of an additive logratio model do not allow easy interpretation in the manner of most regression coefficients. However, the estimated parameters ϕ_k , β_k , and γ_k allow us to calculate the expected logratios for any observed or hypothetical values of the covariates. We can easily translate these fitted logratios back to the composition space by inverting the logratio, which lets us present the expected budget allocation under the model for any particular scenario of interest.⁶

⁶Specifically, we can undo the additive logratio transformation using its inverse,

$$\begin{aligned}
 w_{kit} &= \frac{\exp y_{kit}}{1 + \sum_{\ell=1}^{K-1} \exp y_{\ell it}} && \text{for } k = 1, \dots, K - 1 \\
 w_{Kit} &= \frac{1}{1 + \sum_{\ell=1}^{K-1} \exp y_{\ell it}} && \text{for } k = K.
 \end{aligned}$$

Accounting for time. Because this is a dynamic model with a lagged dependent variable, and because budget allocations tend to persist over time, the effects of our covariates on the composition of the budget accumulate slowly over time. As a result, the clearest way to understand the implications of the model is to consider the response of the composition over time to a change in a covariate, that is, to examine the impulse-response function. However, given the large number of components and covariates in our model, plotting and describing here each complete impulse response function is impractical. Instead, we summarize the results by calculating the response in each budget category for the fifth year after a permanent change in each covariate. We also present 90 percent confidence intervals for these quantities, obtained by stochastic simulation of the iterated response variable (King, Tomz and Wittenberg, 2000).

Finally, there are several choices for presenting the degree of change in a budget category resulting from a change in a covariate. The first and simplest option is to report the expected share of the budget falling into each category, given a set of hypothetical political and economic conditions. This option yields easily interpreted values; for example, we find that under Unified Democratic Control, a state devotes 24.52 percent of the budget to welfare, while the average state devotes only 23.45 percent. However, because the average share of the state budget varies widely by category, from the education behemoth to the comparatively puny share spent on police and law enforcement, comparing expected shares may unintentionally exaggerate the size of changes in large budget categories while minimizing changes in smaller policy areas.

To facilitate clear comparisons, we instead focus on the percent change in budget shares associated with changes in our political economic covariates. For our welfare example, we would report that the election of a unified Democratic government foretells a 4.5 percentage increase in the education budget ($24.51/23.45 \approx 4.5$).⁷ The figures and discussion in the main text focus on the percentage change in each budget category, while the expected budget shares are presented in the Appendix.

5 Results

Table 3 (in the Appendix) collects the estimated parameters from the compositional data model. As noted above, these coefficients resist direct interpretation; they reflect shifts in logratios of budget shares, rather than the budget shares themselves. Instead, we calculate the expected percentage change resulting (after five years) from a change in each of our covariates. With 8 budget categories and 11 covariates, this produces 88 estimated effects. To keep our discussion manageable, we plot these estimates and their confidence intervals in eight dotplots, one for each budget category (Figures 2 and 3). Each row of the dotplots shows the effect of a change in the listed covariate on all of the budget categories, holding constant all other variables.⁸

Looking at each plot gives an overall impression of how weakly or strongly that budget category is influenced by our covariates. Education spending is largely impervious to the political,

⁷Percentage changes are calculated from the expected budget shares implied by the estimated Model 1, and involve no additional estimation.

⁸Where it is logically impossible to hold other variables constant, e.g., if Unified Democratic Control = 1, it is logically required that Unified Republican Control = 0, we make the required changes to the counterfactual.

economic, and institutional forces we consider, unlike the remaining categories. Nor will we have much to say about the Miscellaneous category, for which we found few statistically significant associations—indeed, it would have been surprising if this residual category composed of disparate programs had been strongly related to any of our covariates. Most of our discussion revolves around tradeoffs among the remaining six categories—welfare, highways, natural resources, medicine, police, and corrections—which comprise 44 percent of the average state budget. We now turn to those trade-offs, examining the effect of each covariate in turn.

5.1 Partisan effects

Democrats and Republicans appear to set distinct budget priorities when they hold majorities in both legislative chambers and control the statehouse, as comparison across plots of the first two rows in Figures 2 and 3 shows. Democrats favor welfare spending, increasing welfare spending by 4.4 percent over five years when compared to other governments, with a ninety percent confidence interval of 0.4 to 8.6 percent. To pay for this increase in welfare spending, Democrats must make cuts elsewhere, and appear to target highway spending, which shrinks by 6.7 percent [90% CI: -11.1, -2.3]. Democrats may also cut the police budget by 4.9 percent [90% CI: -10.6, 1.0] and reduce corrections spending by 4.2 percent [90% CI: -9.6, 1.5], though neither result reaches statistical significance in our sample. On the other hand, when Republicans control the levers of power, they elevate highway spending by 8.6 percent [90% CI: 2.7, 14.6] and natural resources spending by 9.5 percent [90% CI: 0.6, 14.6]. They may also raise spending on corrections by about 4.8 percent, though this result is not quite significant [90% CI: -2.1, 12.1]. Notably, there are no partisan differences in the share of the budget devoted to education or miscellaneous spending, and only the slightest hint of greater Democratic favor for medical spending.

These results suggest that both parties find ways to funnel a greater share of state resources to their constituents, with Democrats spending more on social welfare programs to benefit lower income citizens, and the Republicans shifting those resources into investment in highways and natural resources—a transfer to the rural and suburban base of the GOP. But by focusing on the composition of the whole budget, rather than on isolated categories, we see not only what the parties devote resources to, but also the trade-offs they are willing to make, and those they are unwilling to consider. Democrats' preference for welfare spending leads them to cut into resources that would otherwise flow to police and prisons under Republican rule—yet neither party seems willing to pillage education, the largest budget category, to finance their priorities.

5.2 Institutional effects

We turn now to the relationship between political institutions and budget priorities, beginning with governor powers (row 3 of Figures 2 and 3). States which grant their governors extensive budget and veto powers can expect to see substantial cuts in welfare [-4.8 percent after 5 years; 90% CI: -7.8, -1.7] and large gains in the share of state resources devoted to public health and hospitals [7.6 percent; 90 % CI: 3.1, 12.1], but no significant changes in other categories. More powerful governors do not appear to fight harder to contain spending on highways or natural resources. Overall, these results do not appear to support our expectation that relative to legislatures, governors will favor statewide public goods and oppose local spending. One

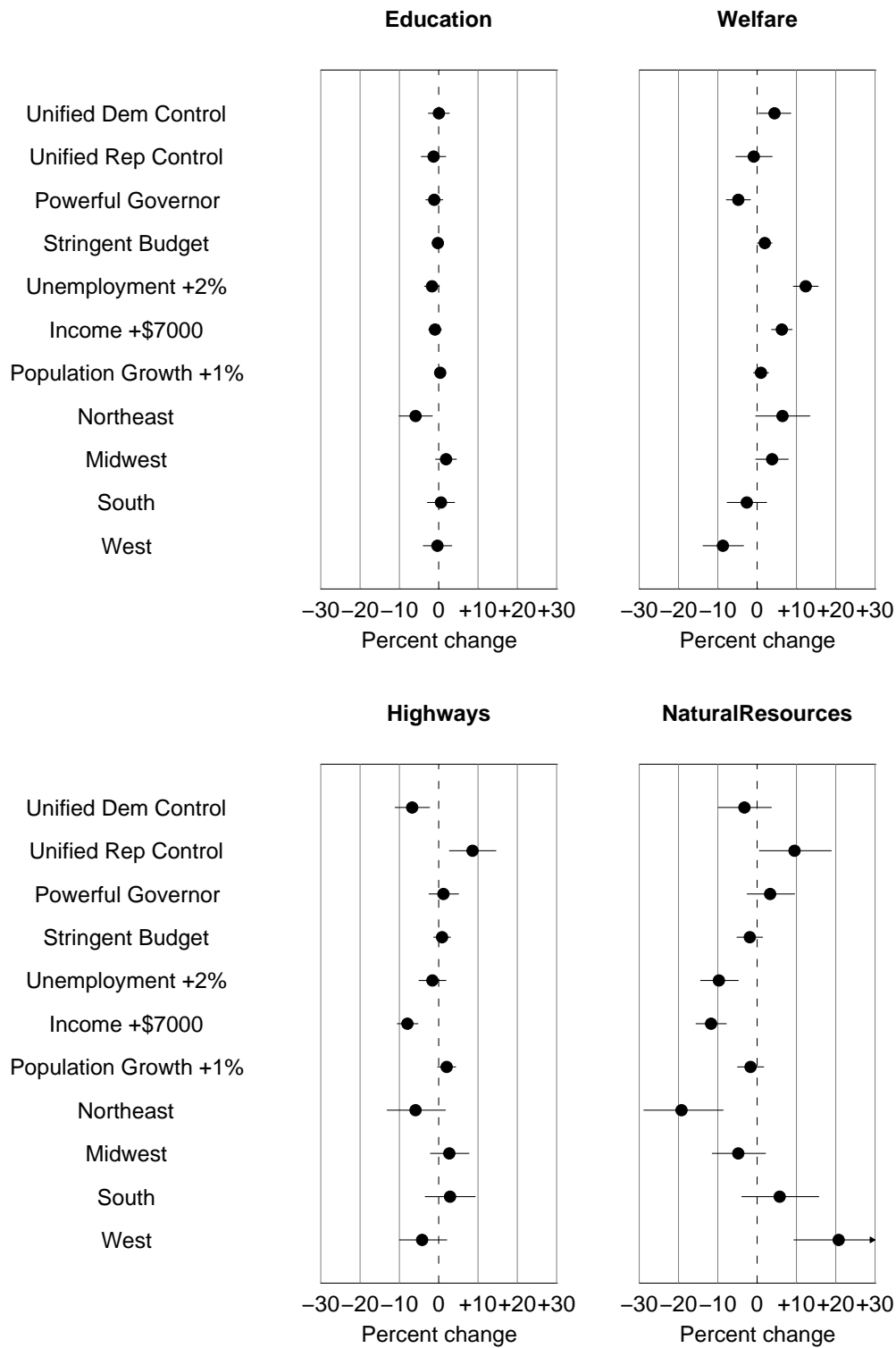


Figure 2: Estimated percent change in budget shares after 5 years, part A. Plots show the expected percentage change in spending by budget category after five years under the counterfactuals listed at the right, in comparison to the budget shares estimated for the average state. Each row represents a different counterfactual, and each column a different budget category. For each counterfactual, all other covariates are held at their sample means. Horizontal lines mark 90 percent confidence intervals.

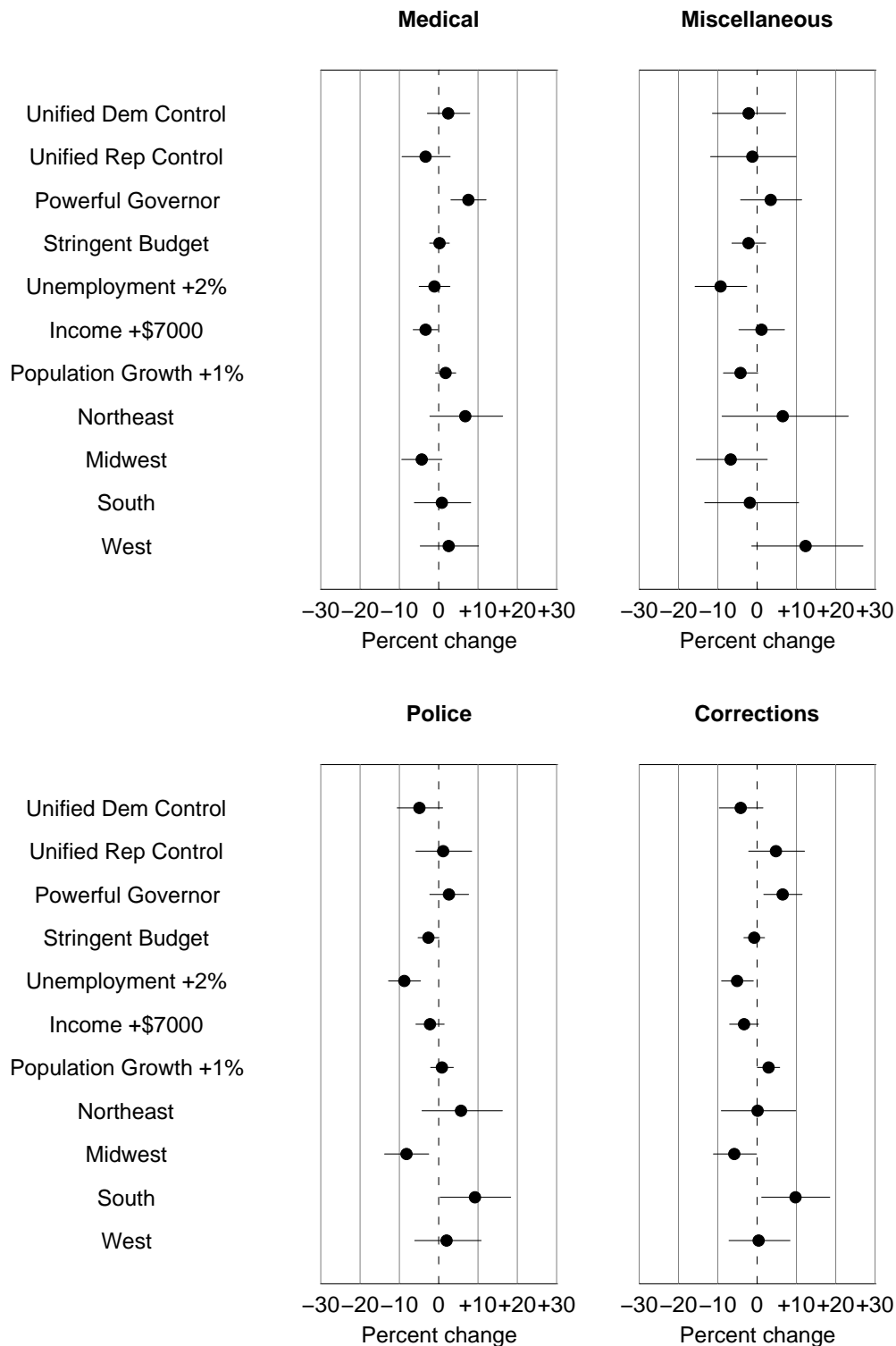


Figure 3: Estimated percent change in budget shares after 5 years, part B. Plots show the expected percentage change in spending by budget category after five years under the counterfactuals listed at the right, in comparison to the budget shares estimated for the average state. Each row represents a different counterfactual, and each column a different budget category. For each counterfactual, all other covariates are held at their sample means. Horizontal lines mark 90 percent confidence intervals.

speculative explanation for these findings is that governors seek to shift resources from a statewide program unpopular and little used by the median voter (welfare) to a different statewide program the median voter is more likely to use and appreciate (public health and hospitals). However, it is not immediately obvious why it should fall to governors to pursue this tradeoff, as the median voter in the legislature should feel similar pressures from the median voter in the electorate.

Perhaps this puzzle can be explained by the fact that governors' powers are merely means to policy ends. Because different governors have different agendas, the net effect of empowering governors is to advance a mixture of their divergent goals.⁹ To follow up on this possibility, we estimate models that interact institutional and partisan variables. For example, having more powerful governors might augment the power of the party holding the statehouse and allow them to shift policy further in their preferred direction. This might be especially true for divided governments with weak governors. Unfortunately, given the limited size of the dataset and the restricted variation in governors' powers, no interactions of partisan regime and institutions was remotely significant.

Returning to our non-interactive model, we consider the effect of budget stringency, which we expected to protect entitlement spending at the expense of discretionary programs (row 4 of Figures 2 and 3). The data offer tentative, if incomplete evidence for this view: strict balanced budget rules are associated with slightly higher welfare spending [1.9 percent after five years; 90% CI: 0.1, 3.8], and perhaps with somewhat lower police spending [-2.6 percent, 90% CI: -5.3, 0.1]. However, these rules had no effect on most categories, even such seemingly discretionary areas as highways and natural resources.

5.3 Economic effects

Economic conditions strongly shape budget priorities as well. When unemployment rises by two points (approximately the standard deviation in unemployment across the sample), state budget priorities shift dramatically. Welfare's share of the budget rises by a whopping 12.4 percent [90% CI: 9.2, 15.5], almost three times the effect associated with a change in the governing party. And unlike parties, who appear to offset increases in spending in favored areas with targeted cuts in less favored categories, rising unemployment is accompanied by largely indiscriminant belt-tightening. Almost every other budget category faces significant relative cuts to compensate for the expansion of welfare: spending on natural resource falls by 9.7 percent [90% CI: -14.4, -7.8], police budgets shrink by 8.7 percent [90% CI: -12.8, -11.6], spending on prisons falls by 5.1 percent [90% CI: -9.0, -1.0], and miscellaneous spending drops by 9.3 percent [90% CI: -15.8, -2.6]. Even education appears to suffer a slight, though not quite significant hit during economic downturns, as its relative budget share is trimmed by 1.7 percent [90% CI: -3.6, 0.2]. Only highway spending appears immune to budget pressure under high unemployment, suggesting states still employ old-fashioned Keynesian fiscal stimuli to counter recessions.

As with our institutional variables, we considered additional models interacting economic conditions with partisan control, to investigate whether governments with different constituencies

⁹Observations in our sample are closely split between Democratic governors (48.8 percent of cases) and Republican governors (50.5 percent), so the uninteracted Governor Powers variable is unlikely to proxy either party more closely than the other.

and ideologies respond differently to economic shocks. However, given the limited size of the dataset, we found no remotely significant results.

If unemployment lets us examine state's responses to short-run economic crises, personal income per capita offers a window to how state budget priorities react to long-term economic development. Our expectation is that rich and growing states would increase spending on welfare state programs (Wagner's Law), while states lagging in economic development would promote growth through higher spending on public infrastructure and investment. Our results bear out this intuition strongly. According to the model, if we raise personal income by \$7000 (approximately one standard deviation), after five years, welfare spending rises 6.3 percent [90% CI: 3.7, 8.9], marking welfare as a luxury good. At the same time, rich states cut back on public investment, marking it as an inferior good or necessity: spending on highways falls by 8.0 percent [90% CI: -10.5, -5.3], spending on Natural Resources plummets 11.7 percent [90% CI: -15.5, -7.8], and spending on public health and hospitals falls by 3.3 percent [90% CI: -6.5, -0.2]. Further, there is at least the suggestion of cuts to Corrections, with the expected spending in this category dropping 3.3 percent [90% CI: -7.0, 0.3]. Education, Police, and Miscellaneous spending remain unchanged. Because they retain a constant share of the budget as states develop economically, these three categories appear to be normal goods.

A last counterfactual considers how state budget priorities change under conditions of rapid population growth. We should be careful in interpreting this variable. Because we normalize the total state budget to unity, we do not expect to see any service demand effects. Rather, if population has any effect, we expect to see temporarily increased investment to recalibrate infrastructure to meet the needs of a larger state. The apparent effects of population growth on budget shares are few and small. Spending on prisons grows by 2.9 percent [90% CI: 0.1, 5.7], the only statistically significant result. There are two borderline cases: highways, which rises by 2.0 percent [90% CI: -0.3, 4.3], and miscellaneous, which drops by 4.2 percent [90% CI: -8.6, 0.2]. The results for highways and prisons are at least suggestive of extra spending on infrastructure, though the absence of a similar effect on health and hospital spending dulls this impression.

Finally, we find a number of strong regional differences in budgets that persist when controlling for partisan governments and economic conditions, most of which appear to be unsurprising reflections of geography, demography, and culture. All else equal, western states spend heavily on natural resources, while northeastern states spend little. Southern states devote a larger fraction of their budgets to police and prisons than states in other regions, while midwestern states spend much less. Welfare spending is high in the northeast and midwest, and low in the west. Finally, and perhaps surprisingly, northeastern states devote a smaller share of their budgets to education.

6 Conclusions

While the compositional data approach offers improvements in estimation efficiency and in the sensible prediction of budget shares by category, the main payoff from our methodology is a model that allows us to link political and economic variables to the trade-offs across budget priorities, a move we believe captures more of the essence of distributive politics under a fixed budget constraint than studies which focus on budget categories in isolation. And though our

empirical work here is exploratory, and our model specification tentative, the budget tradeoffs associated with many of our covariates appear both substantively important and theoretically interesting.

We find that partisan governments not only fund policy areas dear to their constituents, but pay for those priorities with targeted cuts to areas of less importance to the party's agenda and electoral prospects. In contrast, we find that economic downturns have broad, almost indiscriminant effects on the budget. Most areas of policy give up resources to pay for increases in welfare spending, with only education, a largely automatic entitlement, and highways, a traditional source of economic stimulation, standing immune. Our results also suggest that as states grow richer, their priorities shift from policies that invest in the state economy towards welfare state programs. Finally, we find hints that states under different budgetary institutions allocate resources differently across entitlements and discretionary programs. It will be interesting to see whether these results hold up as we improve the specification and expand the data to additional budget years.

Looking at general patterns across budget components, our findings offer support for the conclusions of Breunig and Koski (2006), who argue that large differences in the variability of state budget categories over time reflect differences in the vulnerability of budget areas to political and economic forces. As in Breunig and Koski's analysis, education spending is particularly steady and seemingly immune to political and economic change. Education often enjoys large dedicated revenue streams, is predetermined to a considerable degree by guarantees from the state, and much of its spending involves stable wage contracts with organized labor. Moreover, education is a consistent priority of policymakers and citizens, regardless of party or economic conditions. Indeed, any effort to cut this "third rail" of state politics promises an passionate legislative battle.

Welfare, though also an entitlement, appears highly responsive to economic and political conditions. Spending on welfare programs rises in response to unemployment, grows disproportionately as personal income rises, is sharply affected by the partisanship of government, and falls under strong governors. These relationships suggest, in contrast to education spending, welfare spending is both less secure and less popular with the statewide median voter, on whom the governor depends for reelection. And because welfare spending is such a large component of the budget, its fluctuations have large countervailing effects on other categories. Depending on the political or economic factors driving increases in welfare, deep cuts in spending on highways, natural resources, corrections, and police spending occur. Even though education is by far the largest budget category, its immobility makes it much less relevant to budget tradeoffs than the moderately large but highly flexible welfare budget.

Although we find some effects on budget priorities of budget institutions deemed critical by the literature, the magnitude of these relationships falls short of the covariation of budget categories and partisanship or economic change. Budget stringency may protect entitlements at the expense of discretionary spending, and powerful governors may indeed favor some categories over others. But these effects are fairly small, especially for budget stringency. Partly, this reflects a lack of variation in these institutions—almost all states have very strict balanced budget requirements and governors with significant powers of the budget agenda; indeed, the average state scores 8 out of 10 on both of these scales. Perhaps state institutions are so similar that the

variation in their budget priorities reduces to a simple mix of political interests and economic forces. Or perhaps the institutional variation that is present only augments the strength of parties and interest groups, leading to interactive theories of institutional effects—theories that will be hard to test with existing datasets. But there may be key institutional differences so far understudied that will emerge from future study as important not just to overall spending, or the level of a single category, but to the composition of the budget as a whole.

In general, we hope the compositional model of budget allocations will uncover new insights as its use is expanded, and see at least four further ways this model can help us understand budget politics:

First, we should give deeper thought to the variables which influence not just single categories of the budget, or overall levels of spending, but the tradeoffs across budget categories. The specification used in this paper, drawing as it does on a literature which has neglected these tradeoffs, is surely missing key elements of the politics of budget policy—especially, we think, the state-level institutions which shape budget priorities.

Second, while we have chosen to categorize spending by programmatic categories, other decompositions of the budget may yield interesting complementary results. For example, some of the hypotheses investigated here could be more sharply tested using budget compositions which distinguish capital and non-capital spending, or discretionary and entitlement spending. These distinctions could be drawn within our programmatic categories, or even across them.

Third, studies could take a closer look at the composition of specific budget areas, examining, for instance, how funds are allocated to different types of health programs, or how state education resources are allocated to districts with different average incomes. We can use the same compositional methods to gain insights on the politics and tradeoffs within budget areas that we use to understand tradeoffs across them.

Finally, we can take these methods abroad, to study either national or provincial budget priorities not just in the United States, but across countries. This move would give greater scope to institutional explanations, by dramatically increasing the variety of polities in the sample. It would also help move the comparative welfare state literature, a close cousin to the state budgets literature, away from studies of aggregate spending, towards an understanding of the varied composition of that spending, and the tradeoffs wrung from the political conflicts budgets represent.

Appendix

	Min	25th percentile	Median	Mean	75th percentile	Max
Unified Democratic	0	0	0	0.2	0	1
Unified Republican	0	0	0	0.2	0	1
Governor powers	3	7.8	8	8.1	9	10
Budget stringency	0	6	10	8.1	10	10
Unemployment rate	2.2	4.3	5.3	5.5	6.4	15
Income per capita (\$10k)	9.4	17.2	22.1	22.7	27.5	47.5
Population growth	-4.5	0.3	0.8	1.0	1.5	10.9

Table 2: Summary statistics of the covariates.

Covariates	Response variables are logratios: ln(Component k /Miscellaneous)						
	Edu	Welfare	Highway	NatRes	Medical	Police	Correct
Unified Democratic	0.007 (0.021)	0.022 (0.022)	-0.009 (0.022)	0.004 (0.026)	0.013 (0.023)	-0.007 (0.024)	-0.002 (0.023)
Unified Republican	0.002 (0.023)	0.007 (0.024)	0.026 (0.024)	0.031 (0.028)	-0.001 (0.024)	0.004 (0.026)	0.016 (0.024)
Governor powers	-0.005 (0.006)	-0.009 (0.006)	-0.002 (0.006)	-0.000 (0.007)	0.004 (0.006)	-0.000 (0.007)	0.003 (0.006)
Budget stringency	0.002 (0.003)	0.004 (0.003)	0.003 (0.003)	0.000 (0.004)	0.002 (0.004)	-0.000 (0.004)	0.001 (0.004)
Unemployment rate	0.009 (0.006)	0.024 (0.006)	0.010 (0.006)	-0.000 (0.007)	0.009 (0.006)	0.000 (0.006)	0.005 (0.006)
Income per capita (thousands)	-0.000 (0.001)	0.001 (0.001)	-0.003 (0.001)	-0.004 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Population growth	0.010 (0.007)	0.012 (0.008)	0.015 (0.008)	0.006 (0.009)	0.013 (0.008)	0.011 (0.008)	0.017 (0.008)
Lagged logratio	0.928 (0.006)	0.929 (0.007)	0.896 (0.009)	0.901 (0.010)	0.947 (0.007)	0.927 (0.008)	0.915 (0.009)
Northeast	-0.041 (0.029)	-0.020 (0.030)	-0.045 (0.030)	-0.061 (0.035)	-0.004 (0.030)	0.001 (0.032)	-0.014 (0.030)
South	-0.011 (0.025)	-0.020 (0.026)	-0.009 (0.027)	0.009 (0.030)	0.000 (0.027)	0.021 (0.028)	0.018 (0.027)
West	-0.037 (0.026)	-0.057 (0.028)	-0.049 (0.028)	0.010 (0.032)	-0.020 (0.028)	-0.014 (0.029)	-0.022 (0.028)
Constant	0.059 (0.089)	-0.078 (0.094)	-0.047 (0.094)	-0.112 (0.108)	-0.124 (0.095)	-0.184 (0.102)	-0.179 (0.098)
N	1029						
McElroy's R^2	0.90						

Table 3: Additive logratio model of state budget compositions, 1985–2005. Equations estimated simultaneously by seemingly unrelated regressions. Standard errors in parentheses. The data encompass 49 states; Nebraska is omitted due to its non-partisan legislature.

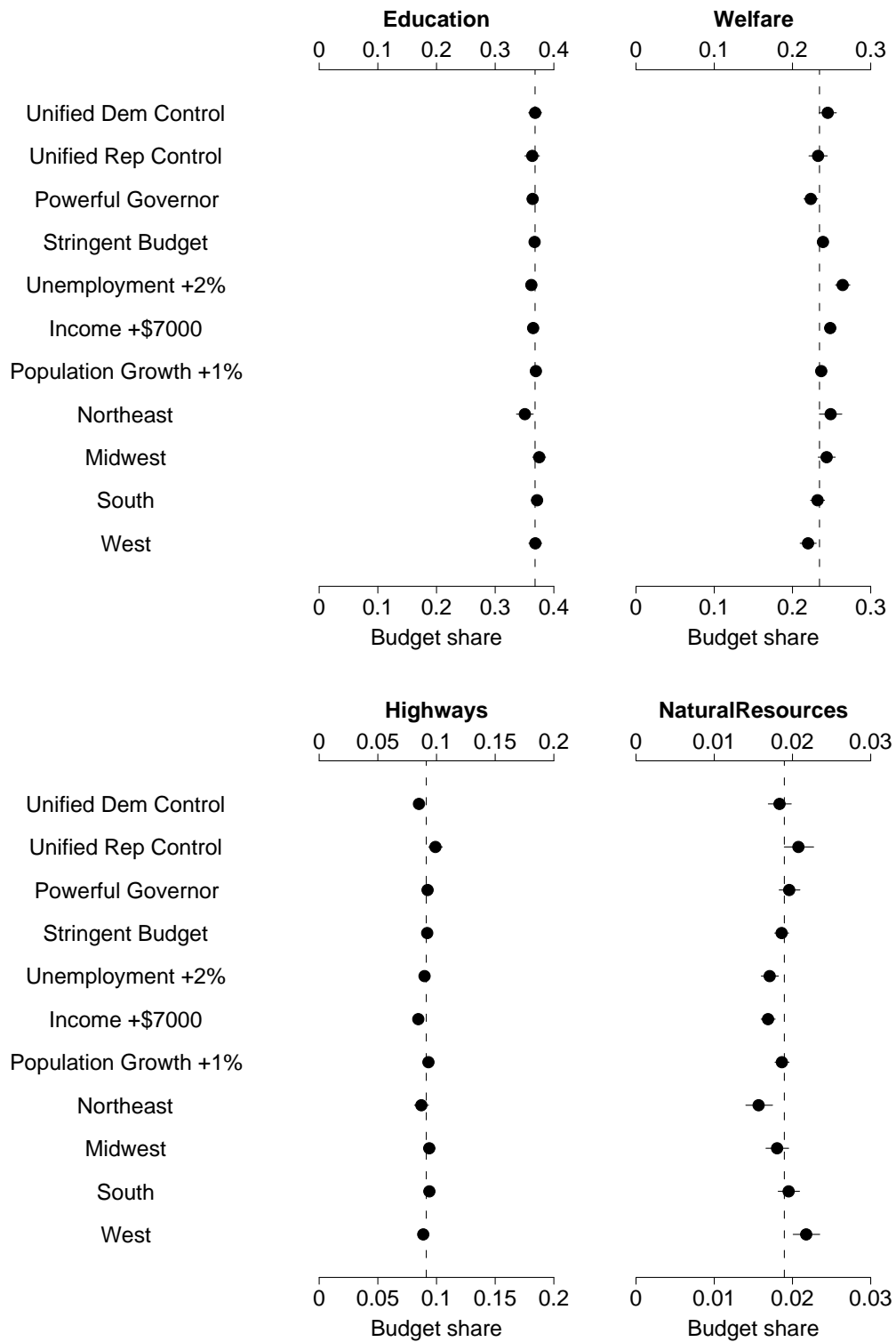


Figure 4: Estimated budget shares after 5 years, part A. Plots show the expected spending by budget category after five years under the counterfactuals listed at the right. Each row represents a different counterfactual, and each column a different budget category. For each counterfactual, all other covariates are held at their sample means. Horizontal lines mark 90 percent confidence intervals. For comparison, the dashed vertical lines show the budget shares estimated after five years for the average state.

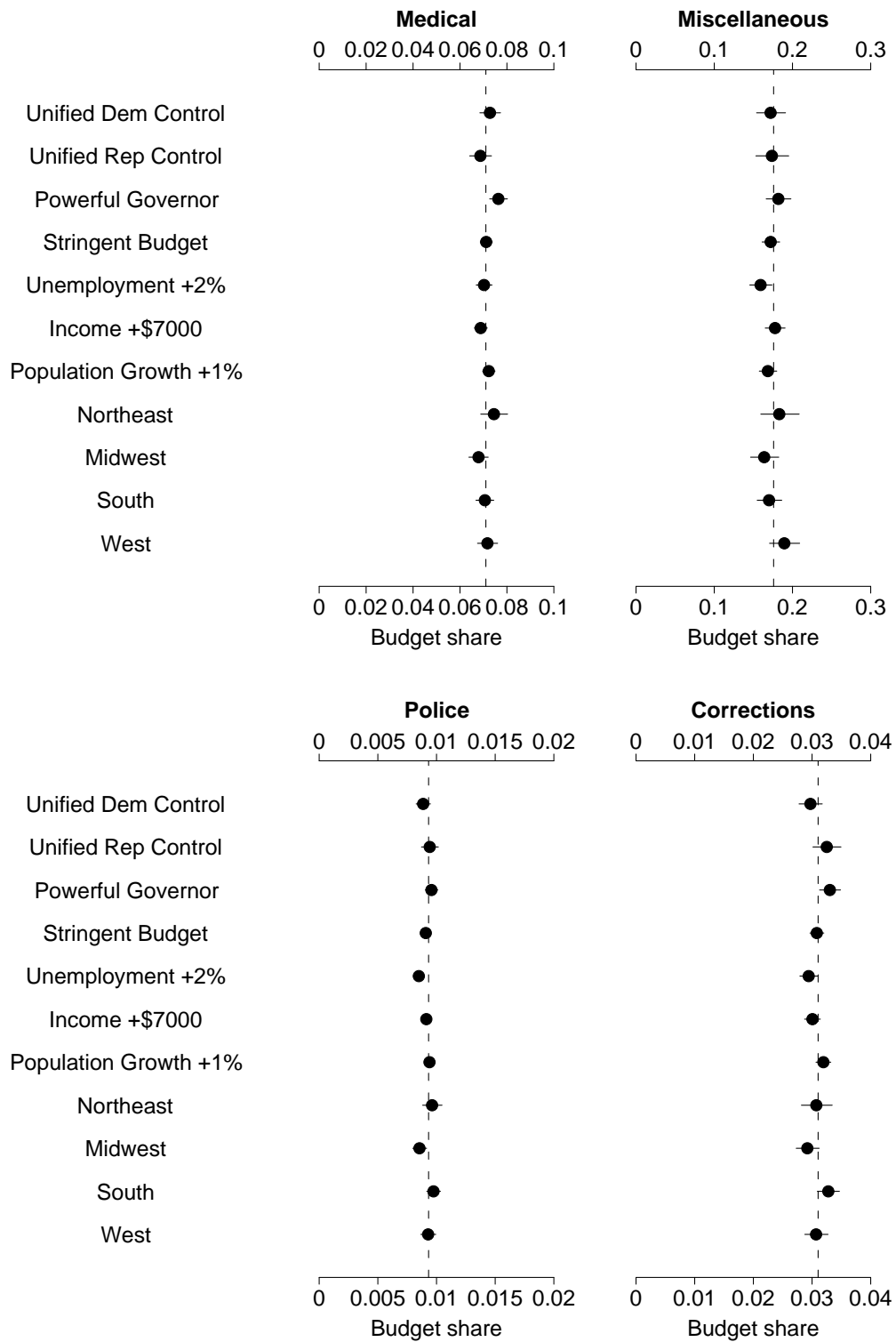


Figure 5: Estimated budget shares after 5 years, part B. Plots show the expected spending by budget category after five years under the counterfactuals listed at the right. Each row represents a different counterfactual, and each column a different budget category. For each counterfactual, all other covariates are held at their sample means. Horizontal lines mark 90 percent confidence intervals. For comparison, the dashed vertical lines show the budget shares estimated after five years for the average state.

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