THE LONG-TERM CONSEQUENCES OF STATE BUDGET BALANCING DECISIONS

John Dooley Stavick

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Doctor of Philosophy
in the Paul H. O'Neill School of Public and Environmental Affairs,
Indiana University
May 2023

Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Doctoral Committee

_____
Justin M. Ross, PhD

_____
Craig L. Johnson, PhD

_____
Robert S. Kravchuk, PhD

_____
Katherine G. Willoughby, PhD

_____
Coady Wing, PhD

April 26, 2023

For Chantel and Marie

Acknowledgements

First, I wish to thank the public servants in 45 states that provided the administrative state employee payroll data that made much of the research in this dissertation possible.

It is said that one of the strongest predictors of success in a PhD program is the degree of supportiveness a student receives from his or her mentor or adviser. Much of my success in completing the program is attributable to mine, Dr. Justin Ross. Despite all his other responsibilities, he invested a significant amount of time and effort in my scholarly development, which I believe is reflected in the pages that follow. Justin isn't just a supportive adviser – you never know when he will show up at the door offering his signature smoked salmon. I am also grateful to my research committee, including Dr. Craig Johnson, Dr. Katherine Willoughby, Dr. Coady Wing, and Dr. Robert Kravchuk, all of whom graciously offered valuable academic and personal support over the years. Other Indiana University O'Neill School faculty members, such as Dr. Amanda Rutherford, Dr. Denvil Duncan, Dr. Kosali Simon, and Dr. Sergio Fernandez, were also supportive and influential to me.

Dr. David Sjoquist and Dr. Laura Wheeler of Georgia State University's Fiscal Research Center provided me with my earliest experiences with public finance research and many years of support long after I completed my studies at GSU. My career in public finance can be traced all the way back to my work with them that began two decades ago. I also express my gratitude to past and present members of the Nebraska Department of Revenue staff, specifically Dr. Dave Dearmont, Dr. HoaPhu Tran, Len Sloup, Curt Embree, and Kim Conroy, in whose company I learned a great deal about state tax administration and revenue estimation. The staff of the OpenSky Policy Institute presented me with many challenging policy debates about state budget balancing decisions which inspired the research questions pursued in this dissertation.

During my six years in the O'Neill School Public Affairs doctoral program, I met numerous colleagues who offered the camaraderie that is crucial for perseverance in a doctoral program, especially Dr. Taha Hameduddin; Dr. Felipe Rojas Lozano; Dr. Ruth Winecoff, whose advice about everything was vital to me; my cohort members, including Dr. Patrick Hibbard and Laura Helmke-Long; and upcoming PhDs Megdalynn Fisher, Shannon Conley, Andrey Yushkov, Pat Carlin, Laura Montenovo, Ashley Bradford, and Luis Navarro, who became my close confidants as well. I also want to acknowledge some close friends that I first met long before I ever thought of embarking on a PhD, including Sherri and Colin Tonner, Mohammed Nagda, Bess Perret, and Abby K. Ferraro.

I am grateful for the love and support of my mother, Dr. Joyce E. D. Stavick, of James Tonner, their birds, and of my father, Dr. Lloyd C. Stavick. Much "spirit of the wolf" love to my sister, Rebecca Stavick, who is the only Stavick without a doctoral degree; to my brother-in-law, Adam Stahlecker; and to my niece, Diana Stavick Stahlecker. I am also grateful for my relationship with my in-laws Mike and Carolyn Mullaney, as well as the vast Mullaney empire in eastern South Dakota.

Most of all, I wish to express my love and gratitude to my wife and "project manager," Chantel Stavick, who was my most significant pillar of support during our six years in Bloomington. Along the way, we welcomed Marie Claire Stavick into the world, our beautiful daughter and "native-born Hoosier." It is impossible to imagine completing this milestone without them. I am incredibly lucky to have Chantel and Marie in my life.

John Dooley Stavick

THE LONG-TERM CONSEQUENCES OF STATE BUDGET BALANCING DECISIONS

The theme of the research questions investigated in the following pages relates to the challenges state policy makers face in complying with balanced budget requirements amid periods of fiscal imbalance. If a certain budget balancing tactic is pursued, such as a budget maneuver, reduced appropriations for snap back agencies, or employee furloughs, what result should policy makers expect in subsequent years other than a current-period balanced budget?

Conventional wisdom suggests budget maneuvers threaten long-term structural balance because they transfer resources from the future to the present by non-transparent means. However, the incidence of maneuver use remains poorly understood due in part to their difficulty to observe. The research presented in Chapter 1 draws from a uniquely collected dataset of budget maneuvers implemented by states during the Great Recession. Drawing on the regional economic resiliency literature, the findings do not show a significant relationship between post-Great Recession budget outcomes and maneuver use. The results also indicate that states pursuing targeted or across-the-board cuts to balance their recession-era budgets were relatively more likely to realize post-recession budget growth than states whose post-recession budget growth stagnated.

The research presented in Chapter 2 tests the relationship between state health department employee turnover, retention, and performance in response to an emergency: the COVID vaccination campaign of 2021. Results show that recent health department turnover rates are a more substantive predictor than retention of experienced employees. Estimates indicate a one percentage point increase in employee turnover rates reduce the two-dose adult vaccine take-up

rate by about 0.5 percentage points, a result largely driven by high vaccination rates among senior citizens.

How sensitive are public employees to an exogenous wage shock? In the third chapter, I implement a novel dataset containing the employee records of all California state employees from 1998-2021 to investigate how state employees responded to its mandatory furlough program implemented in 2009. Furloughed employees are about five percent more likely to quit their jobs after exposure to the furlough. Further, the same-year separation elasticity for public employees is about 0.35, an estimate that implies some degree of monopsony power over public sector workers. Therefore, furloughs may be a sensible short-run tactic to reduce expenditures during a budgetary crisis.

_____

Justin M. Ross, PhD

_____

Craig L. Johnson, PhD

_____

Robert S. Kravchuk, PhD

_____

Katherine G. Willoughby, PhD

_____

Coady Wing, PhD

Table of Contents

Chapter 1

Do Budget Maneuvers Reduce Future Budget Resiliency? Evidence from States Following the Great Recession

1.1 Introduction

Public budgeting scholars, fiscal policy analysts, and bond rating organizations caution policy makers against the use of accounting maneuvers and one-time revenue sources in their budget balancing decisions because such actions are theorized to result in long-term fiscal imbalance by non-transparent means. Not only does the use of these tactics enable policy makers to temporarily avoid fully addressing the size and extent of structural fiscal problems, but they also compromise transparency to the public in the budget process. For instance, a common concern is that the initial use of a budget maneuver in one budget period commits the government down a path of repeated use of the maneuver in subsequent budget periods, akin to an addiction that eventually results in an overdose. The Great Recession represented a significant test of U.S. state governments' resolve on budget balancing strategies due to its historic severity and duration. Did the use of budget maneuvers and one-time revenues to balance budgets during the Great Recession crowd out state expenditures in the post-recession era?

The goal of this research is to answer calls from public budgeting scholars for a long-term analysis of the consequences of cutback budgeting decisions. This research investigates the effect of budget maneuver use on state budget resiliency. The decade of state expenditure observations since the Great Recession presents an opportunity to evaluate whether states that implemented budget maneuvers more intensively than tax and budget changes found themselves mired in long-term structural imbalances.

The data collection effort for this paper includes an original tally of budget maneuvers implemented by states during the Great Recession. Although NASBO's *Fiscal Survey of States* publishes some information about maneuver use during that period in the report's footnotes, and while the Volcker Alliance investigated maneuver use by states during FY 2015-19, this discussion of maneuvers includes more complete detail and context of their use by states during the Great Recession. Aside from case studies of specific states, public budgeting scholarship has not empirically addressed whether the use of budget maneuvers resulted in long-term budgetary consequences for states in the years since the Great Recession.

Using multinomial logit regression, I find some evidence which suggests that states that rely on cash fund sweeps are more likely to see stagnant post-recession budget growth relative to states that grew more robustly after the Great Recession. The results suggest that states that used targeted or across-the-board expenditure cuts to balance their recession-era budgets were more likely to realize more robust post-recession budget growth and less likely to see their budget growth stagnate after the Great Recession. Ultimately, I conclude that these maneuvers are likely not major contributors to long term fiscal problems, though are rightly criticized for other concerns related to transparency and performance.

In the following sections, the evolution of the cutback budgeting literature and the emergence of recent research on the use of budget maneuvers in state budget decisions is discussed. How maneuvers can be used to "close" budget deficits and prominent examples of their use in various states during the Great Recession are discussed. Next, the data sources are presented, and multinomial logit regressions are used to estimate the relationship between budget deficit closing strategies and subsequent state budget growth. The paper concludes with limitations, interpretation of the results, and comparisons with similar papers.

1.2 **Evolution of Cutback Budgeting Scholarship**

This section traces the history of the scholarship on cutback management in public budgeting. This scholarship has sought directly to advance normative theories of how cutback management should be conducted and provide positive evidence on how cutback management has occurred. Three important points are demonstrated in this review: First, the normative literature has emphasized the importance of considering long term implications resulting from the cutback strategy selected. Second, the positive investigative literature has generally determined that guidance from normative theory has not been followed such that unwise budget "gimmicks" and "maneuvers" are used to balance budgets. Finally, these works are heavily concentrated in the wakes of recession or other severe financial circumstances where interest in the subject is high, but there is little actual follow-up on longer term impacts. Case studies which have followed the longer-term impacts tend to start with the case of a current crisis and then trace it back to earlier decisions made, a research strategy that is at risk of the fallacy of reversing the conditional, as it is unclear whether these strategies commonly result in crises when they are pursued. This contextualizes the contribution of this paper, which looks at all deficit-closing strategies employed in all states during the Great Recession.

1.2.1 Emergence of the "Era of Limits," Cutback Budgeting, and Criticism of Incrementalism

Although it seemed a satisfying and intuitive theory of budgeting, shifting attitudes about public expenditure in the last quarter of the 20th century threatened incrementalism as the dominant theory of budgeting. As the public sector faced numerous headwinds in the late 1970s, such as stagflation and contractionary monetary policy, as well as increased support for legal limits on state and local governments' authority to tax and spend, the "era of bounty" for government

expenditure abated. Government at all levels no longer had the political support to "do anything at any cost" (McTighe 1979).

Recognition of this new "era of limits" resulted in the emergence of a new thread of budgeting literature. Levine (1978) pioneered the scholarship of cutback budgeting by categorizing the causes of public organization decline, believing the emerging field was in "desperate need of theoretical direction" (Pandey 2010). Without a developed theory of cutback budgeting or management, most of the earliest cutback management scholarship consisted of a series of discussion papers in *Public Administration Review* that provided advice to public managers in leading their organizations to meet their missions amid the constraints of retrenchment. This was followed by early cutback management literature that offers further normative recommendations and strategic advice to public managers (Behn 1980; Biller 1980; Greenhalgh and McKersie 1980; Levine 1979; Lewis and Logalbo 1980; McTighe 1979) and anecdotal evidence of how public managers and leaders in large cities responded to a reduction in resources (Levine, Rubin, and Wolohojian 1981; McCaffery 1981).

Jick and Murray (1982) urged budgeting scholars to move on from normative strategy prescriptions for managers and begin building models of cutback budgeting "from which actions can be logically derived or linked." This cutback management and budgeting literature evolved in the early 1980s with the proposal of new ideas in a series of theoretical discussion papers and early empirical investigations upon which it became possible to build and test new models of cutback budgeting. Among the most important questions raised by budgeting scholars during this period include: Does the theory of incrementalism retain explanatory power in periods of retrenchment? Is "decrementalism" simply the mirror image of incrementalism? Can a "budget cutting algorithm" be specified as a model for decrementalism?

Among the most influential critiques of incrementalism in the age of retrenchment is Schick (1983), who argues that incrementalism is a "fluid concept" that describes budget phenomena, but not how decisions are made, which renders it an incomplete theory of budgeting. Decrementalism, he argues, is "redistributive, conflict-ridden, and unstable." Lewis (1984), however, finds that expenditure patterns among municipal governments facing retrenchment are not significantly different than those facing expansion, thus concluding, "incrementalism prevails."

Some early challenges in establishing a new theory of budgeting in the era of decrementalism is found in Downs and Rocke (1984), who sought to test the theories of bureaucratic process and interest group politics by testing models of those theories against budgetary data from the late 1970s cutback periods in Pittsburgh and San Diego. They find "little evidence of any budget-cutting algorithm based on stable account priorities" and weak evidence of across-the-board cuts resulting from their interest group politics model. All told, decremental budgeting "will never be routine" because each round of cutbacks is "fundamentally different" (Behn 1985).

1.2.2 Ebbs and Flows in Cutback Budgeting Research After the Early 1980s

After the mid-1980s and until the Great Recession, scholarly interest in cutback budgeting and management waned, a phenomenon that Bozeman (2010) attributes to the upswing in the business cycle. However, scholarly activity in cutback budgeting was not completely dormant after the mid-1980s given that some cutback-related investigations were published in the intervening period, both empirical and descriptive. One example is Berne and Stiefel (1993), who find that reduced expenditures persist many years after cutbacks were pursued during the

mid-1970s in the New York City school system, especially among capital expenditures. Also in New York, Bartle (1996) finds in his investigation of municipal cutbacks after a reduction in state aid substantial variation in the budget cutting tactics employed across cities, further casting doubt on the predictive power of a "budget cutting algorithm."

1.2.3 Budget Scholars Advocate a Long-Term Perspective in Cutback Budgeting Research

Many budget scholars are vocal about the importance of taking the long view when it comes to studying the consequences of cutback budgeting decisions. Levine (1978, 323) made this clear from the beginning: If public organizations must begin to reorient themselves to survive with fewer resources, "we will have to have a confrontation with our propensity for wishful thinking that denies that some declines are permanent." In their review of the consequences of Florida's cutback decisions during the late 1980s, Grizzle and Trogen (1994) warn that Florida's decision to focus on short-term budget fixes in the late 1980s left the state in a fiscally weakened position, vulnerable to long-term spells of fiscal stress.

As the Great Recession inflicted fiscal stress upon state and local governments, budgeting scholars began to call for a new era of renewed focus on cutback budgeting. Bozeman (2010, 561) notes that "only a handful of new contributions on decline" had been made since the 1980s. He calls for an "intellectual transformation" of the cutback budgeting literature and advocates "resilient, long-term managerial strategies" that depart from the "episodic basis" of the earlier literature: "Studies that are historically informed, longitudinal, and strategically oriented have the potential to give us information not revealed when focusing on an isolated episode."

Pandey (2010, 568) argues against the use of "reductionist," short-sighted measures to balance budgets during times of retrenchment while setting aside "considerations of managing

for the long term" such that "wielding the budget axe to effect cutbacks is likely to cause long term damage." In short, he writes, "Cutback management needs to be about the long term." Scorsone and Plerhoples (2010, 177) note the lack of long-term analysis in the cutback literature: "Questions must be answered as to whether this new method [of balancing budgets relying heavily on budget cuts and not new revenue] is detrimental to long-term growth." Recognizing "the lack of a time element in the discussions of both strategies implemented and strategy effectiveness" in the literature as a major gap, they argue that it is "unclear…whether organizational cutbacks are to be permanent…or short-term responses to a budget problem that is only temporary in nature" (Scorsone and Plerhoples 2010, 186). The long-term consequences of budget balancing decisions frequently appear in the literature as an important research question, but few research investigations have directly addressed the question. Berne and Stiefel (1993) provide some evidence that budget cutbacks may persist through time well after a fiscal crisis abates, while Ammons, Smith, and Stenberg (2012) predict that the Great Recession would not result in a permanent impact on budgeting at the municipal level.

1.2.4 State of the Literature on Budget Maneuvers

Empirical studies that focus on maneuvers as a potential tool to balance state budgets in the cutback budgeting literature are few in number, possibly because the incidence of their use is difficult to observe. Bifulco, et al. (2012) note that the extent to which states borrow against future resources to balance their budgets, including using maneuvers, is poorly understood. The use of traditional budget cutting tactics, such as across-the-board and targeted cuts, reductions in labor force, etc., are tabulated in NASBO's *Fiscal Survey of States*, a biannual survey administered to state budget officials, and is often used as a data source in the cutback budgeting literature. However, NASBO did not include maneuver-type budget management strategies as a

category in its survey, such as cash fund sweeps and payment deferrals, until the Spring 2018 edition. In earlier surveys, state budget officials could account for the use of budget maneuvers as an "other" strategy with detail provided in a footnote.[1]

The most complete tally of more recent state budget maneuver use was compiled by the Volcker Alliance (2021) in tandem with its *Truth and Integrity in State Budgeting* initiative. In partnership with principal investigators at several public affairs schools, they graded each state according to its avoidance of various maneuvers in budget balancing actions taken during the FY 2015-19 period. The principal investigators were responsible for identifying cases of budget maneuver use, exposure to legacy costs, revenue estimation practices, and measurement of budget transparency according to a list of criteria developed by the Volcker Alliance. The basis for the grades is whether a certain maneuver was used in a given year (Hendrick and Hu 2020). The grades do not account for the proportion of a budget deficit to which various maneuvers are applied. The Volcker Alliance does not publish details on all specific instances of budget maneuvers identified, only the grades they assigned to states. To date, no tally of budget maneuvers implemented by each state to balance their budgets during the Great Recession period has been undertaken.

Much of the budget maneuver literature consists of case studies of their use in certain states, how their use may be influenced by state fiscal rules, and how and why state legislatures use them to "close" their budget deficits. Gold (1995) presents case studies of how six states closed their budget deficits during the early 1990s recession, emphasizing the unique political

[1] The "other" category in the *Fiscal Survey of States'* budget management strategies tables does not consistently provide a full accounting of state budget maneuver use. For example, Louisiana's Annual Financial Reports indicate that fund sweeps were used to close budget deficits each fiscal year between 2008 and 2011, but these sweeps are not indicated in the survey as an "other" budget management strategy.

dynamics in each state that shape the options state legislators and governors pursue in restoring their budgets to fiscal balance, sometimes leading them to rely on maneuvers. Briffault (1996) describes the menu of accounting gimmicks pursued by state legislators while critical of efficacy of balanced budget requirements, arguing that such requirements hasten the use of accounting gimmicks. On the other hand, Mou and Lozano Man Hing (2021, 57) argue that stringent balanced budget and transparency rules force budget officials to use more legitimate accounting methods and discourage the use of "creative accounting" to artificially achieve budgetary balance.

Writing in the aftermath of the early 2000s recession, Petersen (2003) offers a similar discussion of means by which states close their budget deficits, arguing that their use among states amid structural budget problems "compounds fiscal stress over time." He calls the accounting tactics employed by states "aggressive," putting state budgets on "flimsy footing," "acts of a skillful financial artifice worthy of an Enron" (Petersen 2003, 563). Sheffrin (2004) notes a sharp increase in the use of maneuvers in California during the early 2000s relative to the early 1990s recession where tax and budget changes constituted 82 percent of budget balancing actions. During the boom years of the late 1990s, the state expanded programs funded in part by the state's disproportionate exposure to income tax revenue arising from capital gains realizations – an uptick in revenue that proved during the dot-com crash of 2000-2001 to be a temporary windfall but was perceived as permanent. California's budget crisis, including a $38 billion deficit estimated for FY 2004, contributed to the recall ouster of Governor Gray Davis in September 2003.

Budget scholars had little further to say about budget maneuvers or cutback budgeting until after the Great Recession. Bifulco, et al. (2012) propose a more general definition of state

borrowing to include the underfunding of state employee pensions, lease purchase agreements of state-owned capital assets, deferral of payments to local government and pensions to later fiscal years – actions that "free up resources to cover current operating expenditures in exchange for taking on future resource commitments" (Bifulco et al. 2012, 659). They present case studies of the debt-increasing budget actions in Connecticut, New York, and Illinois and the fiscal circumstances that preceded their use. Further published case studies involve budgeting decisions and the use of maneuvers in Washington (Holland and Benjamin 2012), Connecticut (Robbins and Simonsen 2019) and Illinois (Bunch, Byrnes, and Schneider 2019).

Empirical research that investigates the effect of budget maneuvers on state budget outcomes is scarce. Hudspeth et al. (2015) find that increases in fiscal stress decreases the proportion of state spending debited from the general fund, implying the shifting of expenditures from general to cash funds, a tactic that increases state budget complexity. Other empirical research on state budget decisions in periods of fiscal stress use data from *Fiscal Survey of States*, which as noted earlier, did not account for maneuvers until 2018. Klase (2018) uses this data from FY 2002-13 to estimate the relationship between fiscal stress severity and budget deficit closing strategies implemented by states, finding that the "response severity" increases in tandem with fiscal stress. Bourdeaux (2018) notes the use of "shifting costs to the future" and "intergovernmental strategies" among the options available to state legislators in her case study of Georgia's response to deficits that arose during the Great Recession. She incorporates them into a budget decision matrix categorizing how legislators make decisions to mitigate perceived loss associated with budget cuts.

In a paper that directly makes empirical use of observed budget maneuvers, Hendrick and Hu (2020) use the Volcker Alliance's grading of the states as the dependent variable in

estimating the relationship between a state's grade and a host of political, fiscal, and economic controls. The grades assigned to states range from A to D- depending on the proportion of questions listed in Table 1.2 received a "yes" according to the extent of budget maneuver use observed by public budgeting faculty members and students who partnered with the Volcker Alliance. They conclude that states with the weakest financial condition make the most frequent use of budget maneuvers, while those with strong reserve funds and revenue forecasting practices are less likely to resort to maneuvers. The period under investigation in their study (FY 2015-18) was one of generally moderate growth, with tepid growth in some states, and the absence of major fiscal shocks.

Rubin and Willoughby (2021) compare the state budget responses to the Great Recession to those observed during the COVID-19 pandemic. Among the most important comparisons is the variation among states in terms of the severity of both crises and the speed at which certain budget balancing tools can provide results. While the Great Recession unfolded slowly, starting in some regions of the country earlier than others, such as in the Southwestern states, the COVID-19 pandemic resulted in immediate shutdowns of entire sectors of the economy which necessitated quick action to keep general funds solvent. They find that during the pandemic, states were more likely to pursue budget deficit remedies such as accessing prior year fund balances, cash fund sweeps, and tapping rainy-day funds relative to the Great Recession, which are best suited to provide immediate budget relief.

1.3 **The Use of Budget Maneuvers During the Great Recession**

The budget maneuver categories below are influenced by discussion from Briffault (1996), Petersen (2003), Bifulco, et al. (2012), Mikesell (2017), Hathaway and Lightbourne (2018), and

the Volcker Alliance (2021). The criteria they use to define various budget maneuvers influence which budget actions are included below. Although detailed discussion of these tactics can be found in those sources, I briefly review each below in tandem with prominent examples of their use during the Great Recession.

The use of budget maneuvers in some cases is analogous to the first dose of an addictive "gateway drug." Once a state adopts a maneuver that shifts to the present resources from the future, it is more likely to be repeated each year until the state is prepared to make a commensurate sacrifice in "quitting the addiction." Two major sources were used to identify state use of budget maneuvers to close deficits during the Great Recession. First, articles published in *The Bond Buyer* between July 1, 2007, to June 30, 2011, were searched for general obligation bond use amid budget deficits. Although the Great Recession officially ended in July 2009, state fiscal stress often lags the national business cycle by 12 to 18 months (Petersen 2003). Second, the Letters of Transmittal and Management Discussion and Analysis of each state's Annual Comprehensive Financial Reports for FY 2008-2011 were examined for discussion of budget deficit closing actions. Inclusion of the ACFRs as a source enables a broader opportunity to capture budget maneuver use by states who may be less likely to receive attention from *The Bond Buyer*.

Other sources, such as municipal bond official statements, newspaper articles, and state budget documents were consulted for additional context about specific cases of maneuver use. Although this research may not have identified every instance of maneuver use for every state during the Great Recession, each maneuver discussed below accompanies examples that animate how some states used them to reduce budget pressure on the general fund for a given budget period.

1.3.1 Deficit/Cash Flow Bonds

Though the practice is uncommon and not widely permitted, some states sold bonds whose proceeds served the sole purpose of closing budget deficits. This practice presents concerns about intergenerational equity and the potential for increased interest and debt service costs that may crowd out state spending on current operations and services (Hathaway and Lightbourne 2018).

On March 2, 2004, California voters approved Proposition 57, which authorized the state to issue up to $15 billion in “Economic Recovery Bonds” (ERBs) backed by a quarter cent of the state’s sales tax. The state sold $10.896 billion in ERBs in May and June of 2004, resulting in a general fund deposit totaling $11.254 billion. The state sold an additional $3.179 billion in ERBs in February 2008. Due to substantial decreases in sales tax revenues during the Great Recession, California struggled to service the bonds. The state responded by issuing $3.435 billion in refunding bonds in November 2009 to reduce debt service costs (State of California 2009). California’s FY 2015 budget appropriated funds to retire all debt related to the ERBs (Taylor 2018). Similarly, the Connecticut General Assembly authorized the issuance of “Economic Recovery Notes” (ERNs) in a 2009 special session as a last resort to close a deficit due to a legislative stalemate. The bonds issued totaled $923 million, which were fully repaid in early 2018, including $166 million in interest (State of Connecticut Governor's Office 2018).

Also in 2004, Michigan issued about $1.3 billion in general obligation cash flow notes that matured the following fiscal year. According to the official statement, “Proceeds of the Notes will be applied to meet cash flow requirements of the State resulting from cash disbursements that are scheduled to be made before moneys are available to the State as cash

receipts" (State of Michigan 2004). The state was unable to escape from the annual borrow-repay-borrow cycle until after the Great Recession. Table 1.1 summarizes these actions. No further short-term borrowing for cash flow purposes was performed in Michigan after 2011 (State of Michigan 2020).

1.3.2 Pension Obligation Bonds

In the perspective of Bifulco, et al. (2012), any state pension contribution below the actuarially determined level is a source of long-term debt for states because reduced payments that pad a budget deficit in the current budget period must eventually be offset with larger contributions in the future. For example, New Jersey skipped a $3 billion pension contribution in 2010 which reduced its pension funding ratio (Kaske 2010). The issuance of pension obligation bonds is costly for the state's taxpayers because the interest is federally taxable, which implies that states must offer higher yields to place the bonds. Illinois, which has a long and fraught history with its state pension obligations, sold $3.5 billion in pension obligation bonds in January 2010 which financed the state's FY 2010 pension contribution (State of Illinois 2010). This issuance follows an earlier pension obligation bond issuance in 2003 which totaled $7.3 billion.

1.3.3 Debt Restructure/Scoop and Toss

Although states may sometimes realize genuine cost savings through bond refunding efforts that reduce the interest costs of previous issuances, states sometimes refinance outstanding debt with extended maturities that reduce or eliminate current period debt service costs, which implies greater debt service costs in net present value terms (Petersen 2003). For example, a restructured bond could offer its first serial maturity five years after the bond proceeds are received. Hathaway and Lightbourne (2018) note that the use of scoop and toss debt refinancing

compromises budget transparency because the bond's official statements may not directly address alleviation of near-term budget pressure as the purpose of the bond.

In April 2009, Michigan issued $280 million in bonds that partly refunded existing debt, with new delayed serial maturities that began in 2015 and 2021. This enabled the state to push debt service costs off the books for FY 2009 and into future years (Devitt 2009; State of Michigan 2009). The official statement for this bond series does not discuss budget relief as the purpose for the bond sale.

In 2011, Missouri realized $20 million in FY 2012 budget relief and $15 million in FY 2013 by issuing refunding bonds whose first maturities occurred after the FY 2013 budget period ended (Shields 2011a). New Jersey restructured $410 million in FY 2011 to reduce debt service costs and further restructured $120 million in debt in FY 2012 which similarly delayed the serial maturities to later fiscal years (Kaske 2010). Also in 2011, Wisconsin issued general obligation refunding debt to erase the burden of debt service from its FY 2011 budget. The debt service payment was amortized to be paid over ten years (Shields 2011b).

1.3.4 Securitizing Assets and Lease-Purchase Agreements

State governors and legislators facing pressure to balance budgets are often tempted to securitize a state-owned capital asset, an action that delivers a large sum of cash that can be used to restore budgetary balance to the general fund. For example, some states engage in lease purchase agreements with the private sector or with authorities created by the legislature that purchase buildings from the state, which leases the facility back over some number of years. In other cases, the state sells a revenue-generating asset in exchange for a lump sum payment and then assigns to the purchaser the rights to the revenue stream over several years, such as a toll road.

The result in either case is an opaque form of borrowing sometimes used to circumvent debt limits (Briffault 1996).

States facing debt limits or restrictions sometimes create semi-autonomous building authorities that issue their own bonds on behalf of the state, whose proceeds are used to purchase state assets and whose encumbrances are independent from that of the state. The building authority then receives the proceeds of state lease payments which it uses to pay debt service. The building authority shields the state from general obligation borrowing against its full faith and credit taxation authority. The sales of assets are often referred to as "one-shot" sources of revenue since the assets can only be securitized once at a time. Among the most widely-used securitization functions taken for budget purposes is the issuance of bonds guaranteed by future payments received from tobacco companies resulting from the 1998 Master Settlement Agreement, which is a series of payments to states lasting in perpetuity (Petersen 2003). Rather than use the funds to support anti-smoking initiatives, some states securitized the payments for use in plugging budget deficits starting in the early 2000s recession.

Municipal bond rating agencies often punish states that pursue "one-time" resources to balance budgets with rating downgrades because such resources fail to provide a sustainable source of general fund support, while increasing future liabilities or forgoing future revenue, thus signaling to bond markets that the state is not taking the appropriate steps necessary to achieve long-term fiscal balance. An analyst with Standard & Poor's specifies: "We're looking for [states] to structurally balance their budget, where ongoing revenues match ongoing spending. If the state continues to use one-time revenues to balance their budget, it could pressure their rating" (Stark 2007).

In 2007, the major bond rating agencies scolded Rhode Island for its dependence on one-time revenues to balance its budgets. A $200 million securitization of tobacco settlement proceeds led Moody's to caution that Rhode Island was continuing to face "financial strain at a time when most states are moving toward structurally balanced budgets," leaving them "in a more vulnerable position should there be a recession" (Stark 2007). In 2008, Moody's and Fitch Ratings similarly placed negative outlooks on Kentucky's debt rating over concern about its dependence of one-time revenue sources to offset declining revenue collections (Sigo 2008). New Jersey State Treasurer Andrew Sidamon-Eristoff argued that the state's decreased reliance on one-time revenues was a "very significant barometer of fiscal stewardship that we believe will be favorably received in the financial community as well" (Kaske 2011).

1.3.5 "Rosy Scenario" Revenue Forecasts

A balanced budget can be enacted using lofty assumptions in the state revenue forecast. Mikesell (2017) writes that "phantom budget balances" such as assumptions about federal payments to states under negotiation but not yet appropriated by Congress, optimistic assumptions about economic activity and increased taxpayer compliance, proceeds from new taxes or fees, or uncertainty related federal income tax changes that affect state income tax bases given their conformity to the Internal Revenue Code are sources of significant budget risks. For example, economic nexus laws arising from the 2018 *South Dakota v. Wayfair, Inc.* U.S. Supreme Court decision may generate new use tax revenue that is difficult to initially estimate. Mikesell (2017) cites the case of California moving to erase $1.4 billion of its FY2011 budget deficit by implementing a more optimistic revenue forecast (Vara 2010).

1.3.6 Cash Fund Transfers/Internal Borrowing

Although most state spending on major functions such as aid to school districts and Medicaid expenses are debited from the general fund, state legislatures create cash funds by statute which specify revenue sources to be credited to the fund and strictures on uses for the balances. For example, user fees paid by campers at state parks are often credited to a state park operations cash fund, the use of whose balances is restricted to funding the expenses of operating the park and campground. Because only the general fund is typically subject to a balanced budget requirement, state legislators and budget officials are often interested in "raiding" cash fund balances to replace a shortfall in tax revenue. State budget documents often justify transfers from cash funds with the rationale that they are carrying "excess balances," but it is difficult to ascertain to what extent the projects supported by cash funds are compromised by such transfers.

In Georgia, a hazardous waste remediation fund was adopted in the early 1990s to receive the proceeds of a new landfill tipping fee whose purpose is to fund the inspection and remediation of unlined landfills. During the Great Recession as the state faced a $2 billion budget deficit, the Georgia General Assembly transferred funds from the hazardous waste fund to the general fund. The result was the Georgia Department of Natural Resources had insufficient funding available to carry out landfill inspections, even though the state continued to collect a fee earmarked to support such projects (Salzer 2011). In 2020, Georgia voters adopted a constitutional amendment to prohibit the diversion of special fees to the general fund (Salzer 2021). Similar actions have been taken by New York: The Environmental Protection Fund (EPF), supported by a real estate transfer tax, has been subject to multiple fund transfers to shore up the state's general fund, which the New York State Comptroller says, "…have constrained the

ability of the EPF to meet critical State and local environmental program demands" (DiNapoli 2010).

1.3.7 Shifting Expenses to Cash Funds

Sweeping the balances of cash funds as a resource for the general fund is one way cash funds are used to shoulder the burden of closing budget deficits. Another way is to offload expenses from the general fund to cash funds, which increases budget complexity and constrains the ability of cash funds to support their intended purposes (DiNapoli 2010). Hudspeth, et al. (2015) find that as fiscal stress increases, the state share of general fund spending decreases as states shift funding obligations from the general fund to cash funds, which escape the scrutiny that the general fund receives during the budget process and are not generally subject to a balanced budget requirement.

In 1991, New York created the Dedicated Highway and Bridge Trust Fund to provide ongoing capital support for transportation infrastructure without the use of bonds, which would save the state bond underwriting and debt service costs over the long run. However, the New York State Assembly gradually amended the statute to broaden the nature of expenses authorized for support from the fund to include transactions well beyond the scope of transportation infrastructure. In 2010, the New York State Comptroller found that the proceeds of the fund began supporting operating expenses for the Departments of Transportation and Motor Vehicles, including bus inspections and snow removal costs. Although the original intention of the fund was to provide ongoing capital support for transportation infrastructure, only 35 percent of the funds were spent for capital purposes. The New York State Comptroller concludes that the fund

was “sabotaged for short-term gain” and that “prior budget tactics have rendered the Trust Fund effectively bankrupt” (DiNapoli 2010).

1.3.8 Shifting Current Capital Expenditures to Bonds

State legislatures often appropriate a portion of the general fund for capital construction projects and other ongoing capital maintenance expenditures, such as building renovations, without the use of bond finance. As state budget officials note in their responses to the *Fiscal Survey of States*, these projects are often canceled during periods of fiscal stress. However, some states proceed with the plans by replacing a general fund appropriation for the project with bond financing. As the recession began to depress Nevada’s tax revenues which deteriorated its budget situation in 2008, the state responded by issuing $300 million in general obligation debt to support capital projects, including $115 in projects that originally received a general fund appropriation but will instead be financed with debt (Saskal 2008).

1.3.9 Deferral of Expenses to Future Budget Periods

In addition to shifting expenses to local governments and cash funds, states have shifted expenses into future fiscal years by delaying the date of payment until after the last day of the current fiscal year. California shifted its June 30, 2009, payroll costs into FY 2010 by delaying the payment date by one day, implying that California would then be responsible for 13 months of payroll in FY 2010. Delaying payroll distributions can be a legally dubious maneuver to pursue, although litigation over the use of payroll delays in the early 1990s was not adjudicated until several years later, long after the end of the fiscal period in question (Briffault 1996). Reports from *The Bond Buyer*, *Fiscal Survey of States*, and state Annual Comprehensive

Financial Reports identify delayed payments during the Great Recession in California, Florida, Hawaii, Illinois, Minnesota, Rhode Island, and Wisconsin.

1.3.10 Aid Cuts and Cost Shifts to Local Government

Just as general fund obligations can be shifted to cash funds, some expenses can be shifted to other levels of government. Manipulation of the intergovernmental fiscal relationships between the state, local, and federal levels of government can move the needle in restoring budgetary balance in times of fiscal stress: State support for K-12 education is one of the largest line items in any state's general fund budget. Funding formulas that determine aid levels to school districts can be altered to suit the state's budget situation. Similarly, states may reduce aid transfers to general purpose local governments. While these tactics may bring the state's general fund into balance, they imply higher property tax burden at the local level to replace the lost state aid. State taxpayers are also local taxpayers who must foot the bill for higher local taxes and fees to offset reductions in state support (Volcker Alliance 2021). Payments to local governments may also be delayed into a later fiscal year, creating cash flow headaches for local budget officers.

In 2009, California reduced support for primary education by $6 billion, borrowed $2.1 billion in city and county taxes, and intercepted $1 billion in local motor fuels tax proceeds. The city of Canyon Lake, California pledged its share of the motor fuels tax to secure certificates of participation sold in 1994, and the city's bond rating suffered a downgrade by Moody's after the interception. Because the city promised to service the COPs despite the interception, it needed to find another resource to back its debt service payments (Ward 2009). In 2010, Rhode Island cut its aid to municipalities by about $162 million in mid-year adjustments to balance its FY 2010 budget (Phillips 2010).

1.3.11 Accelerated Tax Filing Deadlines

One maneuver that is easy to adopt but exceptionally difficult to shed is the manipulation of tax filing deadlines that shift revenue into the current budget period at the expense of the next. A state that pursues this option will not bear a cost from this action until it restores the original filing calendar, which implies delaying revenues by one budget period to reverse the filing deadline acceleration. Holland and Benjamin (2012) describe Washington State's experience in pursuing this tactic in 1971 to balance the FY 1973 biennial budget by shifting July 1973 payments into June – effectively 25 months of revenue in a 24-month period. It was not until 1987 that Washington unwound the 1973 revenue shift. Talk of reviving a similar revenue shift arose during the 2011 legislative session but the proposal was soundly rejected by the governor and legislature (Goodman 2011).

Hathaway and Lightbourne (2018) note the case of Virginia's "accelerated sales tax" program which similarly shifted revenue from July to June 2010 by requiring taxpayers who remit sales taxes above a specified threshold to prepay their June remittance in June rather than the previous later deadline in July. As of this writing, the requirement still exists, and retailers with sales tax liability of more than $10 million must prepay June sales taxes (Virginia Department of Taxation 2021).[2] To close its FY 2009 budget deficit, California shifted the due date for quarterly individual and corporate income tax estimated payments from July to June and into FY 2009 (Hill 2008; Ward 2009).

[2] Cole (2021) notes that 17 states have accelerated sales tax payment programs, but it is not clear that these programs exist because of fiscal stress-induced wind-ups. Some "accelerations" refer to more frequent remittances rather than deadline shifts.

1.4 Estimating the Relationship Between Great Recession Budget Management Strategies and Post-Recession Budget Growth

This section describes the empirical approach used to estimate the probability of post-Great Recession budget growth recovery while controlling for budget management strategies and other socioeconomic characteristics of the states.

1.4.1 Dependent Variable: Constructing Categories of Post-Recession Budget Resiliency

The state expenditure data used in this paper is obtained from the Pierson, Hand, and Thompson (2015) Government Finance Database, which is a dataset compiled from the U.S. Census Bureau's Annual Survey of State and Local Government Finances and Census of Government Finance and Employment Data. The variable of interest is FY 2001-2018 real direct general expenditures, from which total insurance trust fund benefits expenditures was deducted and adjusted for inflation.[3]

Each state is coded as experiencing a "recovery type" according to its direct general expenditure growth trend before and after the Great Recession. The motivation for this approach is derived from the literature that analyzes regional recoveries from economic shocks, most directly from Simmie and Martin (2010), who categorize the economic resilience of regions in the United Kingdom according to their employment recovery trends after a shock. They argue that for some regions, such a shock may result in a "state change," such as a realignment of the region's economy that results in a new growth trajectory rather than a return to its previous trend after the shock. The most resilient regions can resist the shock and are flexible in adapting to it.

[3] Categories X11, X12, Y05, Y06, Y14, Y53 includes "Distribution of cash benefits to, or withdrawals by, eligible persons under government administered employee retirement systems covering public employees," "under the cooperative Federal-state unemployment compensation insurance programs," and accident and injury insurance.

Less resilient regions find that the shock sends its economic outcomes into a trajectory of stagnation or decline.

For this paper's interest in budget resiliency, the downstream budget growth outcomes in the years following the Great Recession are stylized as (1) consistent growth through the entire time series; (2) stagnation during Great Recession, followed by resumed growth; (3) stagnation or decline in growth after the Great Recession; or (4) sharp and marked decline after the Great Recession. States with budget growth trends of Type 1 are theorized to be the most resilient to the shock of the Great Recession, and those of Type 4 are the least resilient. These four types are illustrated with the four diagrams in Figure 1.1.

Because categorization of the direct general expenditure trend is key to this analysis, the variable is first passed through the Hodrick and Prescott (1997) filter which separates the trend and seasonal components from the time series. In addition to direct general expenditures, the 20-year expenditure trends of 14 other functional expenditure categories were categorized, such as public health and corrections, resulting in 764 categorization decisions. Each of the 764 categorical decisions was performed independently by the author and two doctoral students, as reviewers, working independently. The name of each state and the category of expenditure was concealed from the reviewer at the time of category assignment, and each reviewer was provided with Figure 1.1 and asked to code each of the 764 data series as belonging to one of the four types. Cross-validation of the assigned categories was performed by comparing how each reviewer categorized each outcome. In cases where the category assignment was clear from a unanimous or a majority vote, the spending trend category is assigned accordingly. A majority or unanimous consensus was reached for all 50 states' direct general expenditure trends that are employed as the dependent variable in this regression analysis, as well as among 98 percent of

the states' fifteen expenditure categories. Figure 1.2 includes a map that displays the degree of budget growth resilience by state as determined by this process.

1.4.2 Multinomial Logit Regression

Do budget management strategies implemented by states during the Great Recession explain the downstream budget growth trajectories depicted above? To answer the question, multinomial logit regression is used to predict the direct general expenditure "recovery type" as the categorical dependent variable.

The goal of using multinomial logit is to estimate whether certain budget maneuvers or other deficit closing strategies used during the recession increased the likelihood of experiencing a certain type of post-recession budget growth. For example, it is hypothesized that states which made widespread use of budget maneuvers effectively choose a "fork in the road," possibly sending themselves down the path of structural imbalance in later years. To characterize this in the language of multinomial logit modeling, it is treated as though each state *i* selects from one of the four types of post-recession budget experiences, and that type provides a certain amount of potential utility. State i receives "utility" from each alternative j during the post-recession period that depends on a vector of individual characteristics (X) as well as a vector of deficit closing strategies employed during the Great Recession (B) such that:

$$U_{ij} = B_i\gamma_j + X_i\alpha_j + e_{ij} \tag{1.1}$$

What is observed in the data on the post-recession period is each state's choice of Type j that yielded the highest utility given the historical choice of budget strategy during the Great Recession. For example, if it is the case that closing the budget deficit with a deficit bond during

the Great Recession meant that future operational expenditures were crowded out, then the post period budget era would be more likely to resemble Type 3 or 4 as illustrated in Figure 1.1. This would be indicated by a corresponding $\gamma>1$ for Types 3 or 4 relative to a baseline of Type 1 or 2.

1.4.3 Budget Strategy Variables

Two categories of budget management variables are used to estimate equation 1.1: Volcker Alliance-defined budget maneuvers and expenditure cuts/revenue changes as reported in the *Fiscal Survey of States*. As noted earlier, the usage of budget maneuvers is thought to send states down the path of long-term fiscal imbalance. The graphs in the preceding section show wide variation across states with respect to post-Great Recession budget growth recovery, with budget growth in 12 states largely flatlining or declining after the shock, and 14 states that experienced a temporary pause in budget growth before an eventual return.

A state by year dummy variable was constructed for each of the Volcker Alliance's questions that are shown in Table 1.2, which its team used to identify the incidence of budget maneuvers between FY 2015-19. Here, the Volcker Alliance questionnaire is used to similarly identify their incidence between FY 2008-11 through searches of *The Bond Buyer* and Management Discussion and Analysis in state Annual Financial Reports, with supplemental context drawn from newspapers, state budget documents, and official statements accompanying general obligation bond issuances.

Because the Great Recession-era budget maneuvers have not been surveyed by NASBO or otherwise compiled by another author, and because they are not readily observable in many state budgets, this research relies in part on the fact that bond rating agencies are sensitive to the use of budget maneuvers because they provide less sustainable solutions to structural budget

problems than expenditure cuts or revenue expansion. Their use involves borrowing resources from the future, either directly or indirectly. *The Bond Buyer* provides intensive multistate coverage of the actions taken by bond rating agencies in response to state budget management decisions and how states use the proceeds of bonds, given that its readership is interested in assessing the credit risks of states in their bond investment decisions. For states that are less active in municipal bond markets, their state Annual Comprehensive Financial Reports often provide information about the budget balancing strategies implemented which may include maneuver use outside of the municipal bond market, such as payment delays, one-time revenue sources, and fund transfers.

If a state is observed implementing a maneuver of a given type as specified below, the state maneuver variable is coded "1" for the given fiscal year the maneuver was implemented. The four fiscal years were then summed to create a frequency count for each state's use of the maneuver during the Great Recession. The same approach was used with the "Strategies used to reduce or eliminate budget gaps" tables from the *Fiscal Survey of States* for the same periods. Next, several of these variables were collapsed into more general variables. This was especially necessary for the Volcker Alliance-defined maneuver variables because they are not widely or frequently utilized. Further, because Connecticut was categorized as the lone member of its "recovery type" resulting in perfect prediction, that state is dropped from the sample. Variables obtained from *Fiscal Survey of States* were similarly condensed into consolidated variables as shown in Table 1.3.

The second set of budget management variables is derived from the Fall editions of *Fiscal Survey of States*. Except for the Fall 2008 edition of the survey which offered fewer pre-defined "Strategies Used to Reduce or Eliminate Budget Gaps" for respondents to select in its

survey, subsequent budget management strategy tables in editions of the survey published between Fall 2009 and Fall 2017 remain consistent. However, only the responses for fiscal years 2008-11 are used since budget management strategies used during the Great Recession are the focus of interest.

1.4.4 Other Controls

In addition to variables related to the decisions made to close budget deficits during the Great Recession, some of the following regressions include other controls that may have some bearing on the budget growth trajectory that states take after a fiscal crisis. Hendrick and Hu (2020) use a legislative professionalism index developed by Squire (2017), suggesting that more professionalized state legislatures are more adept at using budget maneuvers to balance budgets. Squire's 2015 legislative professionalism index is a function of the length of the legislative session, legislator pay, and staff size. Standard and Poor's bond ratings for each state as they existed in 2010 are also included in the model. As discussed earlier, the bond rating agencies are sensitive to the decisions made to balance state budgets, and states may suffer rating downgrades if they rely heavily on one-time revenue sources to obtain budget balance. Therefore, the bond ratings may serve as a proxy for the budget balancing behavior of the state prior to Great Recession. The size of each state's rainy-day fund, measured as a fraction of state expenditures in FY 2010, is included given that an adequately funded rainy day fund may reduce the incidence of states resorting to maneuvers to balance their budgets.[4]

The implicit assumption of these covariates is that they do not represent "bad controls" in the sense that they are plausible alternative dependent variables. For instance, it is assumed that

[4] For more discussion about optimal rainy day fund balances, see Joyce (2001).

2010 bond rating, legislative professionalism in 2015, etc. are not caused using specific budget maneuvers and strategies used by the state during the Great Recession. If that assumption is violated, then the coefficients on budget strategies for the variables *B* will be biased toward zero, as their explanatory power will be soaked up by the controls. By contrast, post-Great Recession budget strategies should not be included as controls because they are often identified as the mechanism through which the earlier choices affect budget resiliency, and therefore are alternative dependent variables. For example, state acceleration of the tax filing deadline to balance the budget during the Great Recession further induces continuous acceleration of the deadline in subsequent years, and this is the mechanism by which that initial decision impacts budget resiliency. Thus, it would be inappropriate to separately include these variables as controls.

Table 1.4 summarizes all controls used in the multinomial logit regressions, their sources, and summary statistics.

1.5 Results and Discussion

To estimate equation (1), type 3 (stagnant growth) was used as the base against which the relative risk ratios would be estimated. Type 4 included only one state, Connecticut, so it was dropped from the analysis leaving only three remaining types. Table 1.5 provides the coefficients and the p-values in parentheses for four different specifications for the likelihood of being type 1 (consistent growth) and for becoming type 2 (growth-pause-growth). Coefficients in Table 1.5 greater than one indicate an increase in the relative risk of experiencing the respective budget type, and less than one implies a decrease.

In Table 1.5, the budget maneuver variables (use of bonds, tax windups, expense shifting) show the weakest relationship with the downstream budget growth outcome of each state in the sense that their p-values are large, often above 0.9. By contrast, the variables representing more traditional budget cutting strategies (user fees, human resource adjustments, budget cuts, organization changes, rainy day funds, cuts in aid) have much smaller p-values than the maneuver-related variables, and therefore will be the focus of most of the exposition here. The results in Table 1.5 indicate that a state which turned to its rainy-day fund to fill a budget deficit was seven to 15 times more likely to experience budget growth relative to the baseline states that saw stagnant post-recession budget growth. These results are statistically significant at the 5 to 10 percent level. States were also more likely to recover when they employed across-the-board and targeted cuts, though this falls below the conventional thresholds for statistical significance. Similarly, using HR-related cuts, such as furloughs and layoffs, increased the risk of budget stagnation among the states that used them, though again, findings fall below conventional thresholds for statistical significance.

To gain a better understanding of the magnitude of the effect sizes, marginal effects are computed and presented for the three main budgeting strategies that were most statistically significant and are presented in Figure 1.3. As shown in Figure 1.3, a one standard deviation increase in the use bond-related maneuvers decreased the probability of realizing the post-recession consistent growth category by -0.14. A one standard deviation increase in cash fund sweep actions increased the probability of being a "gradual decline" state, while a standard deviation increase in expense shifts increased the probability of realizing consistent expenditure growth and reduced the probability of being a gradual decline state. Finally, a standard deviation increase in targeted or across-the-board cuts reduced the probability of a downstream outcome of

gradual post-recession expenditure decline. All marginal effects results reported above are statistically significant at the 10 percent level.

1.5.1 Independence of Irrelevant Alternatives

Multinomial logit models imply the assumption of independence of irrelevant alternatives (IIA). When IIA holds, adding or reducing the number of possible outcomes has no bearing on the risk ratios of remaining outcomes reported by the multinomial logit regression output. The multinomial logit results of all four specifications were compared to the same specifications with one categorical dependent variable omitted. In this case, the "growth/pause/growth" outcome was omitted. Each specification subject to the Hausman test resulted in a p-value greater than 0.99, implying that we cannot reject the assumption of independence of irrelevant alternatives.[5]

1.5.2 Robustness Check 1: Ordinary Least Squares

The models specified for multinomial logit regression were also used in ordinary least squares regression with post-Great Recession direct general expenditure growth as the dependent variable. The results of the OLS regression largely reinforce those of the multinomial logit regression, although the OLS results show a positive and significant relationship ($p < .01$) between the use of expense shifts (across levels of government and budgetary periods) and post-recession budget growth. Although the coefficients on cash fund sweeps and bond-related maneuvers are negative, as theory would suggest, the results are not statistically significant. The OLS results further suggest that states which pursue across-the-board and/or targeted budget cuts

[5] Tests of the assumption of IIA are standard practice when using the multinomial logit model. However, Long and Freese (2014) express skepticism of the usefulness of the test because alternative tests of IIA, such as the Small-Hsiao test, yield results inconsistent with the Hausman test.

to remedy recession-era budget deficits saw relatively more robust post-recession expenditure growth, a result that reinforces the outcome of the multinomial logit regression.

1.5.3 Robustness Check 2: Quantitative Resilience Measure

Regression equation (1) was re-estimated using a resilience measurement proposed by Ringwood, Watson, and Lewin (2019). Both dependent variables used in this research are measurements of the same concept: The extent to which post-Great Recession state expenditure trends follow the growth trends established before the fiscal shock. Theoretically, the most fiscally resilient states were able to absorb the shock, such as with slack resources, and expenditure functions were left relatively undisturbed by the shock. Meanwhile, the measure reveals several states whose expenditure growth trends were "knocked off course" by the Great Recession, whereby expenditure trends became either flat or declined.

Although there is debate among economic resilience scholars as to how the concept is appropriately measured (Sensier, Bristow, and Healy 2016), Ringwood, Watson, and Lewin (2019) (hereinafter "Ringwood") propose a measure of resilience that sums the post-shock differences between expected and actual employment levels in a region after an economic shock. In their research, they construct an expected employment level trend line that fits the pre-shock employment growth trend.[6] Following the theory of economic resilience, a resilient region is one that can absorb the shock and continues a growth trajectory at a similar rate to that observed before the shock. Therefore, regions with the smallest differences between pre- and post-shock employment are theorized as the most economically resilient. Meanwhile, a region lacking resilience in the face of a shock is theorized to display a substantial loss of employment and little

[6] The span of years to be included to define the "pre-shock trend" has reached little consensus in the economic resilience literature. See Sensier, Bristow, and Healy (2016).

capacity to recover it in subsequent years after the shock. As many economic resilience scholars have argued, severe economic shocks can permanently change the employment growth trajectories of regions lacking resilience, such that the industrial composition of such regions becomes permanently reorganized.

In implementing the Ringwood quantitative resilience measure to this analysis, the log transformed direct general expenditure growth trend was measured through simple bivariate regression for years 2004-07, which captures the expenditure growth trend between the trough of the early 2000s recession and the peak before the Great Recession. This simple regression generates a trend line of "expected expenditures" to use for comparison against actual post-recession expenditures. A fiscally resilient state is one whose expenditures are theorized to grow after the fiscal shock at a similar pace observed before the shock. The difference expected and actual post-shock expenditures are summed by calculating the integral of the area between the two curves starting in 2011 through 2018. Figure 1.5 displays an example of this approach as applied to Connecticut. This forms the basis for an alternative dependent variable that measures the total gap between each state's expected and actual post-shock expenditures. This measurement forms the dependent variable used in an OLS regression specified the same way as the multinomial logit regression discussed above, and whose results are discussed below.

Table 1.6 displays the results of the regression specified using the Ringwood resilience measure as the dependent variable, which is measured in thousands of real, log transformed dollars. Like the multinomial logit results, the intensity at which states used bond-related maneuvers and cash fund sweeps to balance recession-era budgets provides little explanatory power for their downstream expenditure outcomes. States that sought to shift expenses across fiscal years and to local government were more resilient, a result that is significant at the 10

percent level in the Ringwood, et al. regression, while the coefficients for this variable approach significance at the 10 percent level.

Among the non-maneuver budget strategy variables, the strongest relationship between recession-era budget closing decisions and downstream budget outcomes rests with the decision to use across-the-board or targeted expenditure cuts. Both sets of results reveal a similar story: The multinomial regression coefficients for the targeted/across-the-board cuts are positive and significant at the five percent level, suggesting that states that used them were more likely to land in one of the two most resilient budget growth categories after the Great Recession. Although the results for same variable are not as robust to multiple specifications using the Ringwood quantitative resilience measure, states that used across-the-board and/or targeted expenditure cuts saw smaller departures from the pre-Recession expenditure trend. Therefore, the quantitative resilience measure lends further support to the conclusion that the use of budget maneuvers during the Great Recession explains little of states' downstream budget outcomes after the recession. However, states that implemented traditional or across-the-board expenditure reductions to manage their recession-era budget deficits were more likely to experience rebounded budget growth during the recovery period after the Great Recession.

1.5.3 Limitations

This research attempted to identify as much information as possible about state budget maneuver use during the Great Recession. This was especially challenging because no centralized tally of budget maneuvers from that era is known to exist. Searching *The Bond Buyer* and state Annual Financial Reports for mentions of state use of budget maneuvers as defined by the Volcker Alliance likely identified many of the most noteworthy cases, such as deficit and/or pension

bonds issued in California, Illinois, and Connecticut; budget balancing tactics through bond refinancing, such as in Missouri, New Jersey, and Wisconsin; and the use of one-time revenues, such as in California, Illinois, Iowa, Kentucky, Rhode Island, and Wisconsin.

An effort was made to include only those plans related to enacted budgets as opposed to intentions announced in the governor's executive budget proposal. However, although actions such as cash fund sweeps may be authorized as a component of the legislature's budget agreement and ultimately enacted, it is possible that they are not executed if fiscal circumstances improve. Further, while one can readily observe the issuance of California's ERBs or Illinois' pension bonds, the case of refunding bonds for scoop and toss purposes or to fund capital projects whose support was originally from the general fund cannot reliably be identified in the bonds' official statements. Therefore, a deeper examination into state flagship newspapers regarding the nature of budget agreements made during the Great Recession and of state budget documents could be undertaken to reach a more complete tally of budget maneuvers undertaken or avoided during that era. Without such an extended search, the estimates presented here may be subject to measurement error.

1.6 Conclusion

This research investigates the impact of different budget deficit reducing strategies implemented by states during the Great Recession on their respective long term budget resiliency. To do this, taxonomies on categorizing budget maneuvers developed by Hendrick and Hu (2020) were adopted and used to create a new dataset of state budget strategies engaged during the Great Recession era of FY 2008-2011. The results provide interesting illustrative cases and descriptions of the prevalence of these different approaches during the most significant period of

fiscal stress in recent decades. This research then draws upon the regional economic resilience literature for inspiration in categorizing budget resiliency into four types for the post-Great Recession era. Early budget balancing strategies are then correlated with the subsequent type of budget experience using a multinomial logit regression.

From the results of the multinomial regression, some evidence is found that states which used across-the-board and targeted budget cuts to manage their recession-era deficits, responses which Klase (2018) considers milder responses to fiscal stress, were more likely to exhibit expenditure growth after the Great Recession. Budget maneuvers, which are frequently criticized as "gimmicks" and draw concerns over transparency, do not appear to generally affect downstream budget resiliency. Figure 1.4, which shows a frequency count of maneuver use by state between FY 2008-11, indicates that a small number of states that made frequent use of budget maneuvers during the Great Recession era.

That budget maneuvers are not major determinants of budget resiliency does not protect them from criticism, but instead raises the profile of the importance of context and institutional setting. For instance, although the use of cash fund sweeps appears to be common during periods of fiscal stress, which conflicts with the original strictures and legislative intent of the funds, such use does not appear to send states down the path of fiscal calamity. Likewise, the data created for this analysis supports NASBO's (2013) assertion that the use of budget maneuvers is uncommon and not a major resource for achieving budget balance. Rubin and Willoughby (2021, 6) observe that during the Great Recession, "…governors kept their budget and policy priorities taut, emphasizing their role as fiscal disciplinarians and offering cautionary advice for navigating forward." They also observe that governors prioritized restoring rainy day fund balances and

structural balance after the recession, while taking a prudential approach to agency budget requests during the Great Recession.

This paper contrasts from the similar work of Hendrick and Hu (2020, 117) such that they estimate the impact of state financial condition and solvency, among other controls, on a state's predicted Volcker Alliance rating. They find, "Looking at the results for the solvency indicators, it is apparent that state governments with worse financial conditions use more budget maneuvers" (p. 117). However, given the results from this research, it appears that poor financial condition does not necessarily preclude budget growth. Illinois, Pennsylvania, New Jersey, and Kansas are cited as states with poor financial condition, yet their growth in direct general expenditures over the past decade was not blunted by the Great Recession.

Findings presented here do not suggest that budget maneuvers are benign and harmless instruments to achieve budgetary balance in a given fiscal year. Rather, it appears that for most states, some budget maneuvers such as fund sweeps are used as a flexible resource that can provide immediate budget relief, which Rubin and Willoughby (2021) note was especially important during the early months of the COVID-19 pandemic – pursuing tax changes would not restore balance to the general fund without a long delay before increased receipts could be realized. Otherwise, as the National Association of State Budget Officers (2013, 5) argues, short-term budget maneuvers provide "diminishing returns" which limits their usefulness especially amid a sluggish recovery. It also appears that the budget balancing behavior of states is influenced at least in part by the anticipated reaction of the bond rating agencies. As Rubin and Willoughby (2021, 4) note, "…no state will want to engage in any debt strategy that might negatively affect its credit rating."

Although the findings of this paper may generally describe the budget outcomes and balancing strategies of the typical state, and while the budget outcomes in Connecticut are treated as an outlier in this paper, that state's budget situation should serve as a warning in the use of repeated deficit financing and budget gimmicks to muddle through budget deficits. Robbins and Simonsen (2019) write that Connecticut has a history of implementing multiple budget maneuvers over many years and insufficient pension and OPEB contributions while using its own "homegrown" accounting rules and a rainy-day fund that exists only as a "paper fiction." In other words, "The state has 'kicked the can down the road' for pensions, OPEB, and the use of other borrowing and one-time budget fixes, and now those bills are coming due" (Robbins and Simonsen 2019, 11). Unlike California and Illinois, which have had their own experiences with extraordinary budget crises, Connecticut is "a cautionary tale in how difficult it is to forge solutions to large fiscal problems in a small state with a small economy," whose fiscal problems "accumulated over decades of inattention to become real fiscal constraints" (Robbins and Simonsen 2019, 18). The budget situation in Connecticut further underscores the necessity of long-term analysis of maneuver use in cutback budgeting decisions.

The case of Connecticut also raises questions about the most appropriate method of measuring the budgetary resilience of each state. In this research, human reviewers relied on visual judgment of the state's direct general expenditures that clearly show how fiscal imbalance forced the state to dramatically curtain expenditures. However, Connecticut's expenditure reduction began several years after the end of the Great Recession, a non-resilient outcome. Using the Ringwood quantitative resilience measurement, Connecticut's budget growth outpaced the pre-recession trend until 2013. Connecticut produced budgets that were late and unbalanced on a GAAP basis for several years starting in FY 2013 (Robbins and Simonsen 2019). Therefore,

the Ringwood, et al. (2019) measure captures post-Great Recession budget growth that offsets some of the drastic departure from the pre-Recession budget growth trend. See Figure 1.5 for an illustration of the Ringwood approach as applied to Connecticut. Because this research uses 2011 and later years as the cutoff point for measuring the extent to which states departed from the pre-Recession budget growth trend after the recession, a different approach would implement a dynamic "beginning recovery year" for each state, which is what Ringwood, et al. implement in their analysis of the resilience of U.S. County employment in response to the shock of the Great Recession.

This research encourages increased attention to the use of budget maneuvers to balance budgets amid the Great Recession which are difficult to observe, using the definitions of maneuvers well established in the literature. Although most of the results of the multinomial logit regressions were not statistically significant, the evidence related to their use provides anecdotal evidence of the costs that budget maneuvers impose on states which use them, in the form of direct or indirect borrowing and compromised budget transparency. In the future, a deeper search of budget maneuver use is planned that more comprehensively covers state budget documents and flagship news sources to ensure a more complete accounting of state use during the Great Recession, and ideally, create a variable that measures the fraction of a state's budget deficit closed given use of budget maneuvers.

Table 1.1: Michigan's Repeated Use of Short-Term General Obligation Cash Flow Notes, FY 2004-11

Date of issuance	**Amount borrowed**	**Maturity date**
February 4, 2004	$1.292 billion	September 30, 2004
November 22, 2004	$1.261 billion	September 30, 2005
November 22, 2005	$1.287 billion	September 29, 2006
December 13, 2006	$1.300 billion	September 28, 2007
December 20, 2007	$1.350 billion	September 30, 2008
November 13, 2008	$900 million	September 30, 2009
December 17, 2008	$500 million	
December 10, 2009	$1.255 billion	September 30, 2010
November 4, 2010	$1.085 billion	September 30, 2011

Table 1.2: Budget Maneuver Variables

Did the state avoid:	**Number of states observed using maneuver at least once during Great Recession**
Utilizing one-time transfers into the general fund from special funds to pay for recurring expenditures?	37
Deferring recurring expenditures, excluding those for capital projects, into future fiscal year(s) from the current year?	12
Utilizing borrowing proceeds to pay for recurring expenditures?	11
Utilizing proceeds from material, nonrecurring asset sales (excluding routine disposals of surplus or outdated property) to fund recurring expenditures?	10
Utilizing "scoop and toss" refinancing to raise funds for any current expenditures, including debt service?	9
Temporarily shifting costs (to counties, municipalities, school districts, or other governments or agencies), or upstreaming cash from any such entity to the state, that is not part of a regular agreement or process?	8
Diverting bond premiums (or other upfront cash flows generated during sales of bonds or other financial transactions) into the general fund or other general revenue account?	3
Accelerating tax or other revenues from a future year into the current fiscal year to fund recurring expenditures?	3
Utilizing pension bond proceeds to make the annual required or actuarially determined contribution to any pension?	2
Utilizing upfront proceeds or deferral of upfront costs on financial transactions to fund recurring expenditures?	2

Source: Questionnaire for identifying budget maneuvers from Hendrick and Hu (2020). Categorization of state maneuvers during Great Recession performed by author using resources from *The Bond Buyer*, state Annual Comprehensive Financial Reports, Official Statements from Electronic Municipal Market Access, and other miscellaneous state budget reports.

Table 1.3: Variables Obtained from *Fiscal Survey of States* Deficit Closing Strategies

***Fiscal Survey of States* "Strategies Used to Reduce or Eliminate Budget Gaps"**	**States observed using strategy at least once during GR**
Targeted cut	40
Across-the-board cut	39
Rainy day fund	39
Layoff	30
Furlough	26
Local aid cut	23
Reorganize agencies	20
User fees	18
Higher education fees	17
Salary reduction	15
Court fees	13
Business fees	13
Benefit cut	13
Early retirement	12
Privatization	6
Lottery expansion	4
Gaming expansion	2

Table 1.4: Data Sources and Descriptive Statistics

Variable	**Description and source**	**Mean**	**Std. dev**	**Min**	**Max**
Use of bonds	*The Bond Buyer*, EMMA official statements, local news, state budget documents. The variables sum the frequency of each budget maneuvers type observed for each state during FY 2008-11.	0.80	1.641	0	8
Expense shifts to locals or fiscal years, tax windups		0.82	1.624	0	8
Cash fund transfers		1.68	1.300	0	4
Increase user fees	NASBO *Fiscal Survey of States*, Strategies used to reduce or eliminate budget gaps, FY 2008-11, fall editions	2.42	3.429	0	14
HR-related budget cuts		3.70	3.448	0	11
Targeted or across the board cut		3.46	2.012	0	7
Organizational changes		0.70	1.015	0	4
Gaming expansions		0.16	0.468	0	2
Rainy day fund transfer		1.30	0.953	0	3
Reduce aid to local government		1.04	1.307	0	4
Average statewide unemployment rate, 2007-11	Bureau of Labor Statistics, Local Area Unemployment Statistics	6.99	1.559	3.4	10.12
Legislative professionalism, 2015	Squire (2017)	.225	0.105	0.048	0.629
Educational attainment, 2010	U.S. Census Bureau, American Community Survey, Table S.1501	87.114	3.336	80.7	92.3
State bond ratings, 2010	2012 Statistical Abstract of the United States, Table 445	4.56	1.110	1	6
Per capita personal income, 2010	Bureau of Economic Analysis	36112	5364.38	28590	54307
Average rainy day fund balance as percent of state expenditures, FY 2009-11	Fall 2010 *Fiscal Survey of States*, Table 26	7.89	27.412	0	193.7

Table 1.5: Multinomial Logit Regression Results

Specification	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
DV: Budget growth recovery type	**Growth-pause-growth vs stagnation/decline**			**Consistent growth vs. stagnation/decline**		
Bond-related maneuver	-0.250	-0.102	-0.172	-0.608	-0.461	-0.509
	(0.577)	(0.795)	(0.650)	(0.180)	(0.233)	(0.191)
Cash fund sweeps	-1.205	-1.272*	-1.160	-1.103	-1.049	-1.054
	(0.109)	(0.094)	(0.115)	(0.108)	(0.126)	(0.116)
Expense shift	1.260	1.122	1.143	1.434	1.153	1.335*
	(0.152)	(0.131)	(0.145)	(0.101)	(0.112)	(0.089)
HR-related cuts	-0.0618	-0.0434	-0.0590	-0.00110	0.00142	0.000539
	(0.811)	(0.872)	(0.820)	(0.996)	(0.995)	(0.998)
Targeted or ATB cut	1.097**	1.175***	0.962**	0.939**	0.832**	0.842**
	(0.020)	(0.008)	(0.028)	(0.038)	(0.041)	(0.043)
Recession-era state GDP growth rate, 2008-11	-0.940*	-1.469**	-0.879	-0.0755	0.0901	-0.0588
	(0.085)	(0.042)	(0.125)	(0.841)	(0.842)	(0.881)
Post-recession state GDP growth rate, 2012-18	1.857**	1.847***	1.669**	1.527**	1.447**	1.354**
	(0.015)	(0.009)	(0.023)	(0.032)	(0.027)	(0.046)
State bond rating, 2010	-0.342			-0.398		
	(0.668)			(0.598)		
Average GR unemployment rate		-0.496			0.316	
		(0.313)			(0.469)	
RDF balance			-0.0667			-0.0183
			(0.661)			(0.852)
N	49	49	49	49	49	49

p-values in parentheses; * p<0.10 ** p<0.05 *** p<0.01

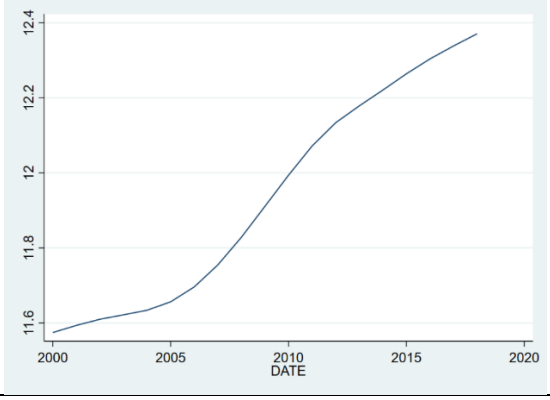
Table 1.6: OLS Regression Results using Ringwood, et al. (2019) Resilience Measure

Specification	**(1)**	**(2)**	**(3)**
DV: Summed differences between pre-recession expenditure trend and post-recession actual expenditures, log transformed dollars			
Bond-related maneuver	0.276	0.261	0.410
	(0.423)	(0.414)	(0.422)
Cash fund sweeps	-0.775	-0.753	-0.807
	(0.519)	(0.504)	(0.498)
Expense shift	0.869*	0.784*	0.730*
	(0.463)	(0.428)	(0.379)
HR-related cuts	-0.306*	-0.315*	-0.318*
	(0.173)	(0.175)	(0.173)
Targeted or ATB cut	0.536*	0.481	0.690**
	(0.312)	(0.351)	(0.291)
Recession-era state GDP growth rate, 2008-11	1.349***	1.527***	1.314***
	(0.301)	(0.427)	(0.316)
Post-recession state GDP growth rate, 2012-18	0.536	0.534	1.005*
	(0.604)	(0.573)	(0.522)
State bond rating, 2010	0.062		
	(0.601)		
Average GR unemployment rate		0.341	
		(0.590)	
RDF balance			0.048***
			(0.011)
Constant	-6.797**	-8.699**	-8.270***
	(3.137)	(3.767)	(1.606)
N	50	50	50

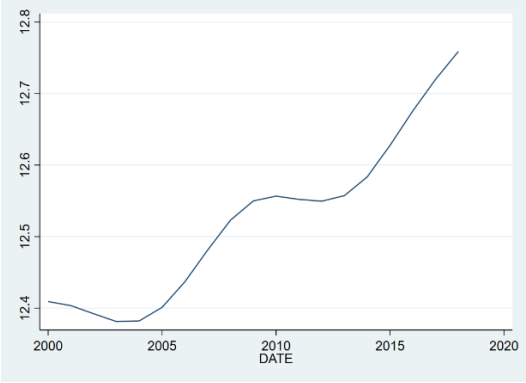
Note: Robust standard error in parentheses; * p<0.10 ** p<0.05 *** p<0.01

Figure 1.1: Categorization of States by Post-Recession Budget Growth

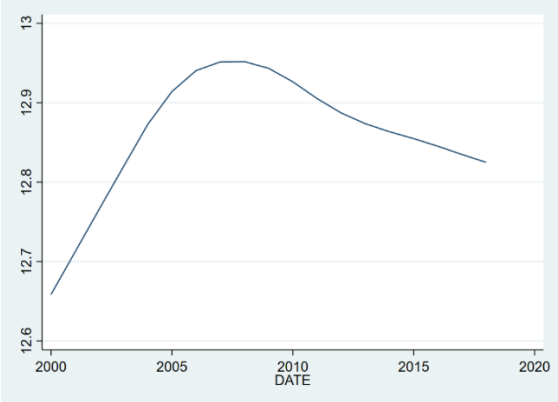
Type 1: Consistent growth with no apparent evidence of recessionary shock (24)



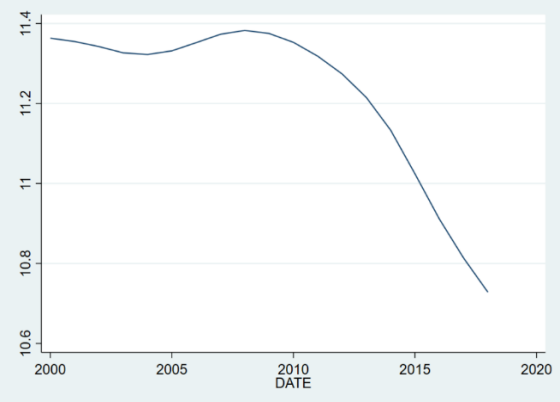
Type 2: Steady pre-recession growth, recession-era flatline, followed by growth recovery (14)



Type 3: Pre-recession growth followed by post-recession stagnation or decline (11)



Type 4: Post-recession substantial decline (1)



Note: A fifth category, which depicts recession-era decline in expenditures followed by post-recession growth was included as an option. No states' direct general expenditures were assigned to this category.

Figure 1.2: Map of State Budget Growth Resilience Categories

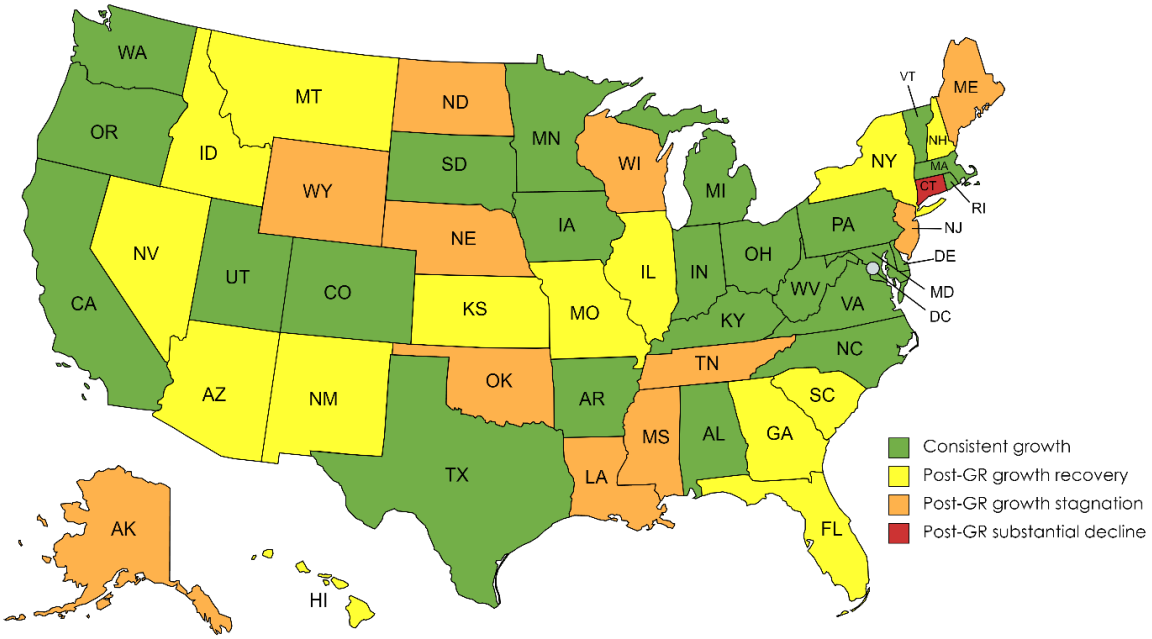
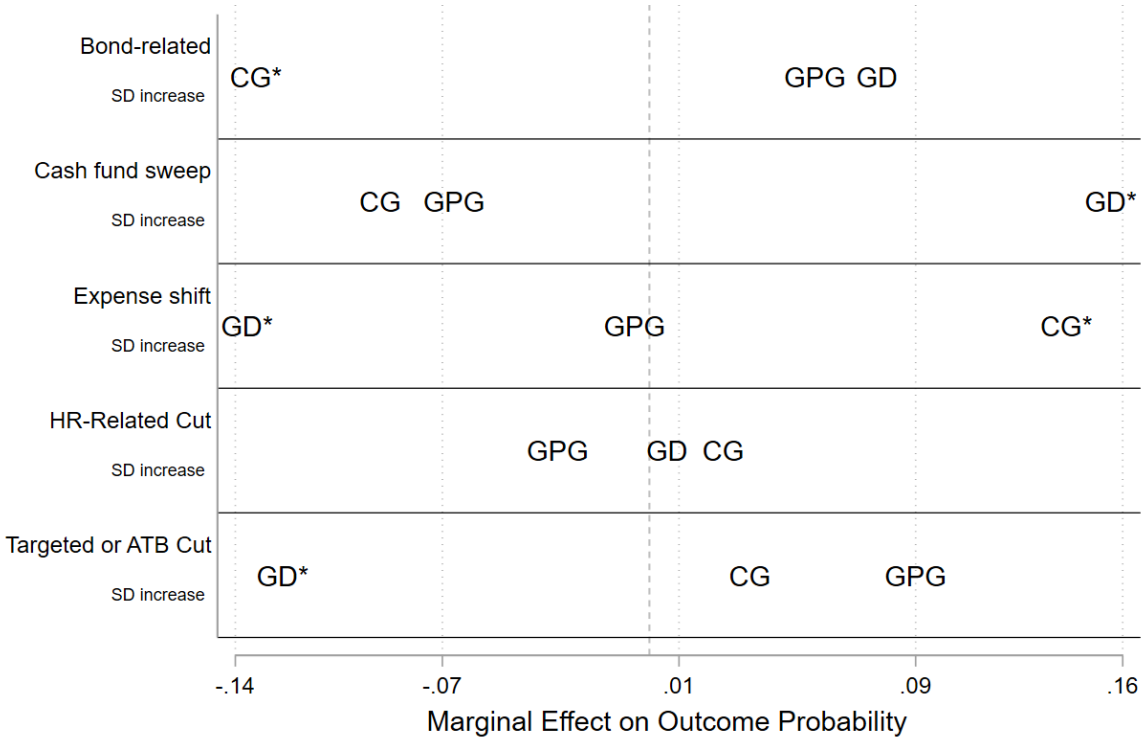
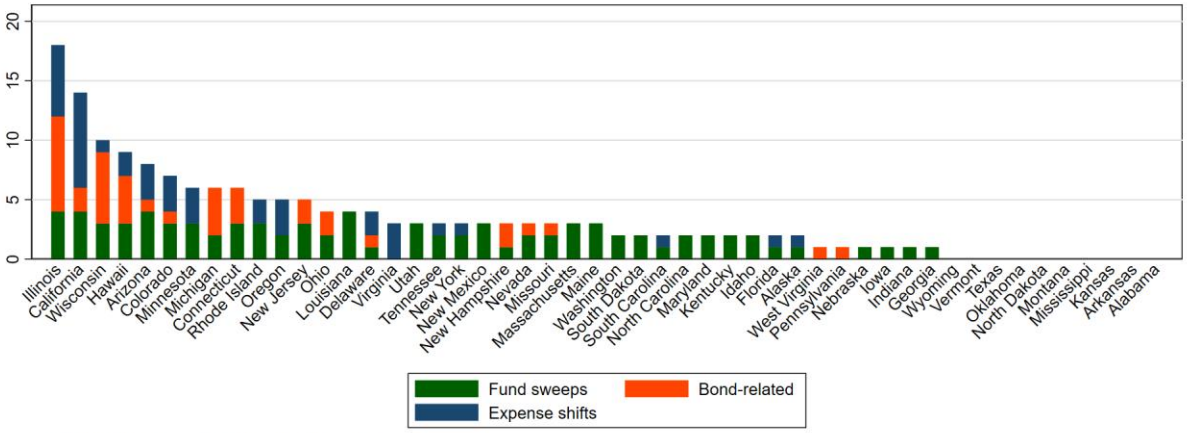


Figure 1.3: Probability of Budget Resiliency by Budget Cutting Strategy



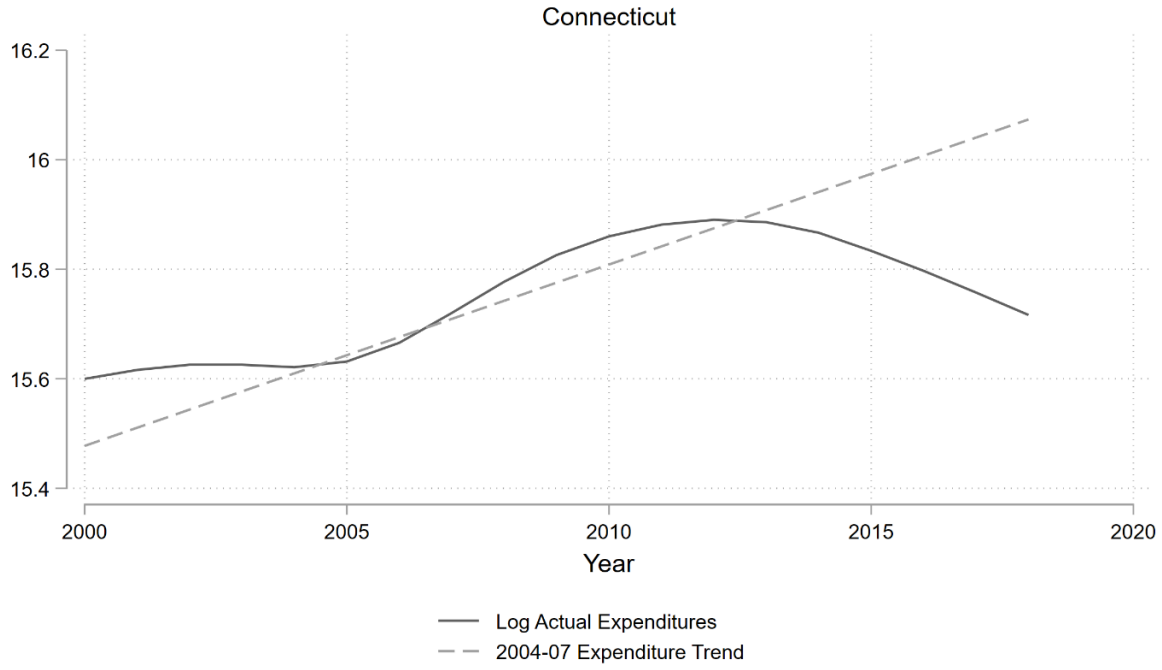
Abbreviations: CG – Consistent Growth (Type 1 in Figure 1.1); GPG – Growth Pause Growth (Type 2 in Figure 1.1); GD – Gradual Decline or stagnation (Type 3 in Figure 1.1).
Note: Marginal effects are calculated using coefficients in Table 1.5 using the "margins" procedure in Stata 17. Statistical significance of the variable on each outcome at the 10 percent level indicated by *.

Figure 1.4: Frequency of Budget Maneuver Use by Type, FY 2008-11



Source: Author's compilation from various sources

Figure 1.5: Ringwood, et al. Resilience Approach Applied to Connecticut



Chapter 2

Organizational Memory and Snap Back Performance in Public Agencies

2.1 Introduction

Organizational attributes that help or hinder public sector performance are a mainstay of public administration theory. The challenges of addressing a research agenda in public sector performance are well known – in particular, it is difficult to measure output and assess complex systems that frequently define public production (Grissom, Viano, and Selin 2016; Hur 2013). Not surprisingly, theoretical research has emphasized settings where hypotheses may be tested empirically and large comparable datasets can be generated, such as student test scores (Meier and Hicklin 2008), federal civil service goal attainment (Lee 2018), and criminal justice outcomes (Boylan 2004; Hur 2013). A common feature of theoretical research is the tendency to assess organizational attributes in these settings.

Organizational memory, the attribute of interest in this paper, might affect the delivery of public services, whether those services are waste management, law enforcement, or education. However, the knowledge needed to produce some public services can be less "ordinary and routine" and instead must survive periods of inactivity until called upon. For example, a branch of the military may be deployed after many years of peace, banking regulators may confront a financial crisis every few decades, and a public health agency may need to respond to an emergency that threatens public health. These agencies must "snap back" into performance on functions for a subset of activities that differ by having relatively low degrees of task routinization and frequency. In a task with a high degree of task routinization, performance depends largely on the ability to adapt to revealed parameters of largely predictable variables. In

a task with low routinization, performance depends on the ability of organizations to bundle the cross-cutting, complex skills needed to respond to "known unknowns." A high frequency task is characterized by improved performance through iteration via trial-and-error, whereas a low frequency task implies there are relatively few opportunities to execute improved iterations of the task.

Table 2.1 provides illustrative examples in a 2x2 matrix of tasks categorized along a spectrum of high to low frequency and routinization. The "snap back" tasks are those which are low in both frequency and routinization. An example of a highly routinized, high-frequency task includes residential waste collection, where performance will depend largely on the ability to carry out tasks whose specifications are largely predictable, such as quantities of trash to be collected at specified locations, scheduling of employees, and maintenance of vehicles (de la Riva Agüero 2022). If waste pickup service is performed at a regular frequency, as it customarily is by American local governments, then the agencies providing these services can observe feedback and correct upon systemic errors that improve performance of the task. An example of a task characterized by high routinization, but low frequency includes the investigation of crime scenes by law enforcement agencies. Regardless of the crime, the process followed by law enforcement agencies is routine: Taking statements from witnesses, arranging for emergency medical services, securing the scene, collecting evidence, and writing reports (U.S. Department of Justice 2000). Although crime scene investigations may be infrequent for a specific officer, the extent to which lessons learned are reflected in revisions to the investigation protocol which may reduce the threat of turnover to performance if newly hired employees can readily implement these routines in their work (Levitt and March 1988).

A task carried out by the public sector characterized by high frequency, but low routinization includes the tax enforcement operation of the Internal Revenue Service. Like the investigation of crime scenes, income tax audits of taxpayers follow a routine set of procedures. However, the process of litigating cases against non-compliant taxpayers is the result of IRS legal counsel's interpretation of the Internal Revenue Code and administrative rulings, upon which arguments are developed and made before a federal tax court to show negligence on the part of taxpayers they believe failed to settle their deficiency determinations. This task is carried out by a dedicated staff of tax enforcement attorneys who benefit from frequent opportunities to negotiate settlements and refine their arguments before judges.

In all cases, employee retention and turnover can contribute to organizational memory and ultimately its performance, but the theoretical mechanisms and their empirical relevance are plausibly quite different. A snap back agency like a public health department must develop cross-cutting skills to respond to "known unknowns," drawing upon lessons learned between distant events. In this latter example, knowing which set of skills will be needed is itself learned, and organizational memory is built through infrequent and idiosyncratic public health crises, such as the 2009 H1N1 epidemic, the Flint, Michigan water crisis, and the 2015 HIV outbreak in southern Indiana.

Because the response to the COVID-19 pandemic is a complex and irregular event, it affords an opportunity to assess public performance in this new context. That is the aim of this paper, and specific attention is focused on the retention of experienced employees in state health departments that may possess previous crisis experience. This research contributes to the extant public sector turnover and performance literature in several important ways: First, the relationship between turnover and performance is investigated in an unpredictable setting by

which a public agency must dramatically increase the scale of its output on short notice in response to a crisis, using its fixed infrastructure as a foundation for performance. Second, this research uses several measures of organizational memory operationalized through employee turnover and retention. Measurement of long-term employee retention and turnover is made possible with a panel dataset of state employee administrative payroll collected from 45 states, which represents about 94% of state employees in the United States.

This research tests the hypothesis that state health department turnover rates are negatively related to vaccine take-up rates, while the ratio of the department's employees with at least eight years of experience in 2020 is a positive contributor. In the results that follow, the health department turnover rate shows the strongest relationship with the two-dose adult vaccination rate, while retention of experienced employees also makes a positive but weaker contribution to the two-dose adult vaccination rate.

The paper proceeds as follows. Section 2.2 contextualizes the nature of assessing performance in snap back agencies and discusses how state health departments developed vaccination campaigns in response to COVID-19. Section 2.3 further contextualizes this research's contribution to the turnover and performance literature in public administration and public health. Section 2.4 presents key data sources required for empirical analysis of the research question, such as employee turnover and retention rates by each state health department. Section 2.5 discusses those results and various robustness checks. Section 2.6 uses these results to impute the value of public health benefits arising from decreased health department employee turnover, and section 2.7 concludes.

2.2 Snap Back Agencies and the Case of State Health Department COVID-19 Vaccination Programs

In the previous section, agencies were characterized by a broader scope of task routinization and frequency, with snap back agencies being those which are low in both dimensions. It is overly simplistic, however, to characterize agencies as strictly existing solely in one quadrant of these two dimensions. The primary function of this government agency is to have a response plan to these adverse events given that they are infrequent and idiosyncratic. Broadly, three types of agencies could be tasked with emergency responsibilities:

1) *An agency whose mission is fully dedicated to emergency response.* For example, each state has an emergency management agency whose efforts are largely focused on developing and revising emergency operations plans and conducting practices and drills between emergencies (Institute of Medicine 2012a). Likewise, the branches of the U.S. military undertake war game scenarios and other battlefield training exercises to remain ready for real action. In this strategy, the agency is singularly focused on preparing for emergencies.
2) *An agency is tasked with handling certain emergencies as an ancillary task distinct from their primary mission.* An example includes certain first responders that are certified to handle releases of hazardous materials. For all local fire departments, suppression of fires and paramedic functions are the core tasks. Specific fire departments also become designated responders to hazardous materials releases on a regional basis, and they receive specialized training and equipment to carry out this task. However, the response to hazardous materials releases is not the core task of these agencies. It is a task that is deemed appropriately adjacent to the regular activities of fire departments.
3) *An agency whose core task is emergency response, but whose expertise is also useful in performing certain routine tasks between emergencies.* This section develops the

argument that public health departments are primarily responsible for responses to pandemic events, and that the type of skills needed to anticipate and respond to pandemics are also useful in conducting routine public health tasks.

From these alternatives, we can begin to formalize the theoretical expectations of how the performance of an organization may be impacted by turnover. The first case, emergency management agencies, in practicing regularly through devotion to task preparation, is likely better equipped to handle fluctuation in turnover rates given their exclusive focus on planning and preparation. In the second case, turnover may be less consequential to performance because the emergency task is outside the core competency of the agency and its employees are not selected for specialized skills in carrying out the ancillary task. The third case, which best represents state health departments, is likely to have many more instances of performance review evaluations for their between-emergency functions. Since assessment and performance is infrequent and idiosyncratic for the emergency case, an agency manager might rationally optimize performance for those non-emergency tasks with the implication for emergency performance depending on how complementary the emergency and non-emergency tasks relate. Having foundational infrastructure in place during non-emergency periods that contributes to the performance of frequent and routine tasks that may be complementary to those infrequent and nonroutine tasks that arise during emergencies may reduce the need for employees with long-standing experience, but nevertheless implies they would be impacted by fluctuations in employee turnover.

The following discussion overviews the roles of task frequency and routinization on organizational learning. Specific attention is paid to preservation of knowledge arising from lessons learned by public health employees in confronting previous pandemics. Next, the

responsibilities and context in which state health departments operate is discussed, and the role these agencies played in developing large-scale vaccination campaigns in response to COVID-19 is overviewed.

2.2.1 Organizational Learning from Previous Pandemics

Levitt and March (1988, 320) argue that experiential learning is preserved and encoded through routines practiced within the organization that are "capable of surviving considerable turnover of individual actors." The formalization of such routines varies across organizations. For example, organizations facing complex and uncertain tasks, such as those in state health departments, "…rely on informally shared understandings more than do organizations dealing with simpler, more stable environments" (Levitt and March 1988, 327). Certain circumstances present significant challenges in the preservation of memory and the transfer of lessons learned by those who experienced them to those who did not. In the absence of such a transfer, "the lessons of history are likely to be lost through turnover of personnel" (Levitt and March 1988, 328). Weakness of organizational control, conflicting interpretations of history, and difficulty in implementing experience across "…vast geographic or cultural distances threaten the capacity of organizations to teach the lessons of history to its new members" (Levitt and March 1988, 328). The usefulness of a given routine is influenced by the frequency and recency of its use. Therefore, routines informed by history that are infrequently used are more challenging for organizations to access and preserve (Levitt and March 1988, 328).

Public health agencies had opportunities to learn from their experiences with previous pandemics which may have informed their responses to COVID-19. The following discussion highlights the extent to which previous experience with pandemics may have influenced

national-level responses to COVID-19. However, they do not discuss the role that turnover, or retention of public health employees, may have had in preserving organizational memory arising from experience with previous pandemics or whether it affected their performance.

Hur and Kim (2020) find that South Korea's experience with the 2015 Middle East respiratory syndrome (MERS) enabled the Korean Center for Disease Control (KCDC) to respond proactively to COVID-19. After the MERS outbreak, which was prolonged by challenges related to rapid diagnoses of infection, the KCDC established new institutions intended to collect and share information related to the mitigation of novel infectious diseases. The authors argue that these early and proactive actions enabled the KCDC to substantially flatten the COVID-19 infection curve to 10 or fewer cases per day in the early phases of the pandemic. The KCDC quickly activated the policies developed in the aftermath of the MERS outbreak in early 2020. Elected officials may also be motivated to look to the past in optimizing pandemic response in hopes of bolstering their prospects for reelection (Park and Chung 2021).

Kirlin (2020) expresses skepticism of this view, arguing that the COVID-19 pandemic was dramatically more complex and lethal than the 2003 SARS and 2009 H1N1 outbreaks. As a result, he suggests those outbreaks may have had limited relevance in informing the CDC's response to COVID-19, and that this necessitated decentralization of process development and decision making which shifted from public health experts to elected officials. On the other hand, Hsiang-Te Tsuei (2020) finds that public health systems with exposure to previous pandemics responded with mitigation policies such as travel restrictions, social distancing, etc. six to ten days sooner than countries without such an exposure once the World Health Organization declared that COVID-19 reached pandemic status.

2.2.2 State Health Departments and the Campaign to Vaccinate as a Case Study

The origins of state and local public health agencies arose from the need to respond to the epidemics that emerged during the Industrial Revolution. Urbanization, unsanitary living conditions, immigration, and invasive pests accompanying cargo severely compromised the state of public health in the late nineteenth century by increasing the frequency and severity of epidemics. As medical and scientific developments reduced the morbidity and mortality of such epidemics, health departments began to refocus their attention to more routine tasks, such as surveillance and disease prevention between epidemics (Birkhead, Morrow, and Pirani 2020). During the twentieth century, public health agencies pursued the goal of disease prevention through vaccination, education, water quality control, and provision of medical care (Hoehn-Velasco and Wrigley-Field 2022).

All fifty U.S. states, U.S. territories, and the District of Columbia operate a public health agency or state board of health. Although the responsibilities delegated to these agencies vary widely across jurisdictions, each state health department provides the following services on a routine basis: Health promotion activities, such as provision of healthcare related to communicable diseases of public concern; Prevention activities, such as screening of illness among newborn infants, detection of sexually transmitted diseases, and the administration of immunization programs; and health protection activities, which includes laboratory testing, vital recordkeeping, population surveillance, and epidemiology (Birkhead, Morrow, and Pirani 2020). State health departments also manage federal public health grants, some of which are passed through to local health departments. Environmental health is a function of state health departments, such as water quality monitoring and radon detection. In a few states, such as

Colorado, Kansas, and South Carolina, the state health department serves as the state's primary environmental regulation agency.

According to the Association of State and Territorial Health Officials (2020), eighteen states and the District of Columbia administer public health as a division within a human services "superagency" that includes some combination of the following responsibilities: Medicaid administration, income maintenance, operation of psychiatric hospitals and/or long-term care facilities, child support enforcement, care of foster children, and disability insurance determination. The remaining states operate their health departments as independent public health-focused agencies. In recent years, state health departments shifted their focus from provision of clinical care and health insurance to health information management and preparedness for natural and man-made disasters (Birkhead, Morrow, and Pirani 2020).

2.2.3 Role of State Health Departments in COVID-19 Vaccine Distribution

Some scholars of public sector turnover and performance restrict the measurement of performance to that of employees that are direct producers of output, such as public-school teachers and the outcome of test scores (Meier and Hicklin 2008). In the case of public health, the Institute of Medicine (1988, 147) argues that "states are the primary force in public health." Even though most doses of the COVID-19 primary series vaccine were administered by local health departments, health care providers, pharmacies, or other external entities, the success of the COVID-19 vaccination campaigns depended on the varied domains of expertise of state health officials that range from demography, marketing, epidemiology, information technology, and cold storage supply chain management. They also possess relationships with key health care providers such as pharmacies, large hospital systems, long term care facilities, and rural health

clinics. During the strategy-building phase of the vaccination campaign during which quantities of vaccine doses were limited, state health departments sought to maximize vaccine take-up rates among populations most vulnerable to mortality if infected with COVID-19, a priority they shared with the CDC. The sense of urgency in vaccinating adults over the age of 65 arises from the fact that this age group constitutes 75% of all COVID-19 mortality since the pandemic began (Centers for Disease Control and Prevention 2022b).

In the months prior to the COVID-19 vaccine deployment to critical populations, state health departments established advisory groups whose goals were to accomplish the following: Recruit, enroll, and train healthcare providers on best practices in proper storage and administration of the vaccine while minimizing the spoilage of doses; identification of critical populations targeted for early vaccine administration, such as the elderly, immunocompromised, and healthcare workers; establishment of inventory management systems and databases necessary to track administered doses of the vaccine; deployment of statewide vaccine appointment registration systems; building awareness of the vaccine among the general public through advertising campaigns, including with local organizations that can target hard-to-reach and at-risk populations; monitoring quality assurance, such as proper handling of vaccine doses given cold storage requirements and expiration dates; and development of strategies to mitigate the spread of COVID-19 at vaccine sites during periods of peak demand (Centers for Disease Control and Prevention 2020).

Once the initial phases of the vaccination campaign began, it was the responsibility of state health departments to monitor daily take-up rates of the vaccine and adjust vaccine distribution where possible or feasible. State health departments were also responsible for deploying systems to remind patients of the date to receive their second dose, such as automated

phone calls and text messages, with the goal of maximizing the efficacy of the two-dose vaccination regimen. To summarize, state health departments and their employees of varied occupations were responsible for matching the right quantity of doses with the right people at the right time.

The CDC established allocations of COVID-19 vaccine doses to states according to formulas that account for the size of at-risk populations, healthcare and critical infrastructure workers, and overall vaccine availability. Within states, organizations that administer the vaccine, other than major retail chains and federal agencies, coordinate with the state health department to replenish supplies of the vaccine as needed. Local providers place orders for vaccine doses through systems operated by the state health department and developed by the CDC, often using parallel existing systems used by the state and local providers to administer the seasonal flu vaccine or childhood immunizations. For example, the Indiana Department of Health adapted its existing Children and Hoosier Immunization Registry Program to collect and manage records related to COVID-19 vaccinations.

As advisory groups in state health departments were developing vaccine deployment strategies during the fall of 2020, the CDC suggested that states may find useful guidance from the past: “Jurisdictions may find it helpful to review their 2009 H1N1 pandemic vaccination response plans and lessons learned” (Centers for Disease Control and Prevention 2020). One may hypothesize that high rates of turnover may threaten the preservation of memory arising from the loss of state health department employees who navigated the H1N1 pandemic and other crises during their careers.

The Council of State and Territorial Epidemiologists (2021) surveys state epidemiologists in all fifty states and the District of Columbia to gauge the epidemiological capacity of each state

health department. In their analysis of the 2017 CSTE survey, Arrazola, Israel, and Binkin (2019) report that state epidemiologists expressed concern about knowledge transfer amid turnover especially given the rapid changes of crises that affect public health, such as the opioid epidemic: “Emerging diseases . . . would not be as disruptive if the staff were more seasoned and comfortable with day-to-day activities before the crisis hits.” Further, “…it is challenging to keep the workforce well prepared in the face of so much change at a rapid pace.”

In synthesizing public administration theory relevant to agencies responsible for performing tasks with low frequency and low routinization, such as in the case of state health departments and their emergency-driven vaccination campaigns, the following hypotheses are proposed:

H1: State health departments with lower turnover rates will have higher vaccination rates.

H2: State health departments with greater retention of experienced employees will have higher vaccination rates.

H3: State health department turnover and/or retention rates will be more predictive successful administration of the second vaccine dose due to increased administrative complexity.

The hypotheses above test whether the flow of employees exiting the agency or the stock of employees working at the agency in 2020 with at least eight years of experience affects the vaccine take-up rate negatively and positively, respectively, while the third hypothesis tests whether performance in administration of the complete vaccine series is more sensitive to organizational memory than that of the first dose.

2.3 Literature Review

The purpose of this literature review is to contextualize the contribution of this research in two areas of previous work. First, in public administration research on performance and employee turnover, this literature review illustrates how its theory and empirical research has emphasized agencies whose tasks are characterized by high frequency and routinization. In research where performance is measured by employee perception, the frequency and routinization of tasks performed in the agency is either ambiguous or ignored. Second, this paper contributes to the literature on labor force turnover in public health agencies, which often references concerns about the impact of turnover on performance but has not subjected this concern to empirical scrutiny.

Progress in investigating the relationship between turnover and performance in public administration is limited due to challenges in measuring the productivity of public employees (Grissom, Viano, and Selin 2016; Hur 2013). Most recent turnover and performance research in public administration focuses on testing the theory of a nonlinear, U-shaped relationship between the two variables. It was first proposed by Abelson and Baysinger (1984) and initially applied to the public sector context by Meier and Hicklin (2008). When evidence for the theory is found, it implies that both low and high levels of turnover are detrimental to the organization's level of performance, with an optimal turnover rate lying on the minimum point on the U-shaped curve.

High rates of employee turnover are frequently theorized to erode organizational memory, increase costs to recruit new employees, and compromise social networks within affected organizations. If the relationship is shown to be nonlinear, there are opportunities for public administrators to actively manage employee turnover in such a way that captures some

benefits of turnover, such as the hiring new employees with fresh ideas and recent training and the dismissal of unproductive employees, while avoiding high rates of turnover associated with the pitfalls specified above. Most public administration research on turnover and performance rests on this foundation.

2.3.1 Turnover and Performance in Public Education

Meier and Hicklin (2008) investigate how turnover of teachers in Texas' public-school districts affect the performance of students as measured by their standardized test scores. They find that "very low levels of turnover are detrimental to performance," and they estimate the optimal teacher turnover rate at 16.2% per year. They also argue that task difficulty increases the cost of replacing highly skilled employees which they argue lends "practical importance to the inverted U-shaped relationship" (Meier and Hicklin 2008, 587). Ryu and Lee (2013) also use Texas standardized exams as a measure of performance while including innovative management as a mediating variable. They find that innovative management is used to manage turnover in poorly performing districts and to decrease turnover rates in high-performing districts. An (2019) uses teacher exit survey data that allows for isolation of voluntary from involuntary turnover which enables him to separately investigate whether the inverted U-shaped relationship holds for voluntary and involuntary turnover. Using statewide standardized test scores of math and reading from Florida school districts as the measurement of performance, he finds further evidence for the nonlinear relationship in the case of involuntary turnover and performance.

Wang and Sun (2020) investigate whether there is a temporal feedback effect between performance and turnover by implementing turnover rates as the dependent variable. They hypothesize that turnover is negatively associated with academic achievement, which feeds back

into performance in subsequent years through changes in organizational strategy. Low performance on student test scores may ultimately result in subsequent teacher departure from the organization in a future period due to managerial pressure. They find a significant negative relationship between the feedback effects of performance and subsequent turnover. Wang and Sun (2022) reprise this dataset to investigate whether turnover among principals in the New York City school system affects student performance on standardized exams. They find that turnover among school executives negatively affects performance on exams in subsequent periods and that turnover is more detrimental to student performance in low-performing schools.

2.3.2 Turnover and Performance in the Federal Bureaucracy

Public management scholars also find opportunities to test the inverted U-shaped relationship between turnover and performance within the context of the federal civil service. Lee (2018) uses Fedscope data on the separations of federal employees in tandem with the Federal Employee Viewpoint Survey (FEVS) which asks its respondents whether they believe their agency is successful at accomplishing its mission. He finds confirmation of the inverted U-shaped relationship between turnover arising from transfers of employees to other federal agencies and organizational performance, and he also finds a significant positive linear relationship between involuntary turnover and performance. Moon (2017) also uses the FEVS to estimate the effect of moderating variables related to employee perceptions of high-commitment human resource practices (HCHRP) in the relationship between turnover and performance. This measurement of performance differs from the data used by Lee (2018) such that federal agency leaders are required to report on the magnitude of goal attainment on an ordinal scale as reported in the Performance and Accountability Review. Moon (2017, 1494) finds that organizations with

high HCHRP suffer greater dysfunction from high rates of turnover due to the loss of high-quality human capital.

Wynen et al. (2019) find support for the inverted U-shaped relationship between turnover and performance within the national Belgian unemployment benefits agency. They investigate the moderating effect of process conformance on turnover and performance using data obtained from the agency's management information system. Performance is measured by the number of unemployment payments processed correctly by an employee over a six-month period. They find that the inverted U-shaped relationship holds for tasks associated with high process conformance and argue that knowledge is more easily transferred between employees that perform tasks with high levels of process conformance.

2.3.3 Turnover and Performance in Criminal Justice

Boylan (2004) investigates the turnover and performance relationship within the context of the federal pay structure and the productivity of U.S. attorneys. He finds a significant negative relationship between the pay of U.S. attorneys and their turnover rates, which leads to lower performance measured as the length of prison sentences upon conviction. Hur (2013) tests the turnover/performance relationship using data related to the turnover rates of municipal law enforcement officers and crime rates. He finds that voluntary turnover has significant negative effects on the crime control performance of law enforcement, part of which he attributes to the long recruitment period of filling sworn officer positions that average six months in length once vacancies emerge.

2.3.4 The Public Health Workforce, Capacity, and Turnover

There are no known applications of turnover and performance research to public health agencies.

The public health workforce literature describes trends in turnover as indicated by surveys and argues that turnover may be a threat to performance, but this proposition has not been empirically investigated (Bogaert et al. 2019; Halverson et al. 2017; Leider, Coronado, et al. 2018; Newman, Ye, and Leep 2014; Pourshaban, Basurto-Dávila, and Shih 2015; Sellers et al. 2019).

During the period in which state and local health departments were developing and executing their responses to COVID-19, published news reports discussed resource constraints faced by these agencies. In their survey of 300 local health departments and interviews with 140 local health officials, Baker and Ivory (2021) report that "widespread staff defections, burnout, firings, unpredictable funding and a significant erosion in their authority to impose the health orders" were among the most significant challenges facing local health departments in addition to the pandemic itself. Turner (2021) reports that some rural Indiana county health departments, some of which employ only one full-time staff member, relied on retired volunteer nurses to increase the output of COVID-19 vaccine doses. Campo-Flores (2021) reports that Alabama's public health system has been "depleted by years of poor funding, leaving some counties with thinly staffed health departments or no department at all," with similar stories of public health employees being redirected from food safety inspections and rabies control to the COVID-19 response. As of 2019, staffing at Alabama's local health departments was 65% of its level in 2000. Weber, Ungar, and Smith (2020) report state and local public departments eliminated 38,000 jobs since 2008, and those who remain are subject to low pay and few opportunities for advancement, which they largely attribute to stagnation in state support for public health.

Halverson et al. (2017) produce the first investigation of the incidence of turnover and job tenure length among state health officials (SHOs) and directors longitudinally among those who

served between 1980-2017. They argue SHOs face challenges in straddling the "nexus of science, public interest, and political system" in leading their agencies through biologic and natural disasters. They find that the average tenure of a SHO is 3.9 years, with 20% of SHOs that served over the 38-year period remained for less than one year. They also find that SHOs currently remain an average of one fewer year than their predecessors did in 1980.

2.4 Data Sources and Variables

2.4.1 Dependent Variable: COVID-19 Vaccine Uptake

To assess the performance of state health departments in responding to a crisis, various measures of the statewide adult vaccination rate observed on October 1, 2021, are used as the dependent variables in this analysis. The panel dataset published by the Centers for Disease Control and Prevention (2022a) from which the dependent variables are obtained offers vaccination rates observed daily by state, dosage, vaccine type, and age group of the recipient. These various dependent variables enable the testing of the hypotheses related to the relationship between turnover, take-up of the first versus second vaccine dose, and the contribution of experienced employees on performance, and are discussed below.[7]

2.4.2 Variables of Interest: Employee Turnover and Retention Rates

The measurement of organizational memory within a state health department is operationalized through two variables of interest: rates of employee turnover and retention of experienced employees. These two variables are calculated from a panel dataset of administrative employee payroll data collected from 45 states as shown in Figure 2.1. Some states publish panel datasets

[7] Additional measures of performance, such as vaccine take-up by population subgroups such as race, are not undertaken in this research due to data limitations. See Kaiser Family Foundation (2022).

of state employee payroll on their budget transparency websites. For those that do not, Freedom of Information Act requests were submitted to custodians of state employee payroll data. Some states' data is not available for this project: Tennessee and Alabama restrict the release of data to their residents, and South Dakota does not release payroll datasets in any case. Hawaii was unable to provide data in an annual periodicity, and Alaska was not responsive to requests for data. Although Texas is included in the panel, the state restructured its public health division which isolated it from the state human services agency in 2015. To avoid overstating Texas' turnover rate arising from interagency transfers, observations before 2017 are omitted from the analysis.

By late summer 2021, adult vaccination rates began to plateau. The adult vaccination rates prevailing on October 1, 2021, range from 62.26% of adults over the age of 18 having received one dose to 83.87% of adults over the age of 65 that had received the complete vaccination series. Table 2.2 includes detailed summary statistics of vaccine take-up rates by dependent variable.

Turnover rate: The state health department turnover rate is calculated as the number of employees observed exiting agency i in year t divided by the total number of employees employed by the agency in year t. The average rate is taken between 2017-19 to capture employee churn in the years leading up to the COVID-19 pandemic. A separate regression using the average turnover rate between 2010-19 is also included in Table 2.7 as a robustness check. The use of these periods avoids the volatility inherent in 2020-21 turnover rates, such as those arising from surges in health department hiring of temporary contact tracers. An employee is observed as exiting the agency if the employee's name disappears from the panel each year before the last available year of panel data, or if the dataset includes an employee separation date

variable. With the available data, it is not possible to observe for each employee the reason for the employee's exit from the agency. Therefore, it cannot be determined whether exit results from employee retirement or voluntarily versus involuntary termination.[8]

The turnover rate variable omits observations form Arkansas and Maryland due to panel data quality issues, leaving 43 state health departments upon which the turnover rate is calculated. The average turnover rate observed in state health departments between 2017-19 is 15.18% per year. Average turnover rates during this period range from a low of 7.95% in Minnesota to 25.11% in North Dakota. This compares to rates of turnover intention ranging from 22% in 2014 to 31% observed in the 2017 Public Health Workforce Interests and Needs Survey (Bogaert et al. 2019). Newman, Ye, and Leep (2014) observe a turnover rate of 9.88% in local health departments using survey responses collected in 2013 from the National Association of County and City Health Officials.

The first hypothesis expressed earlier implies an expected negative sign on the turnover coefficient, such that states with higher turnover rates are expected to vaccinate smaller shares of its adult population. However, according to the theory of the U-shaped relationship between turnover and performance, it is possible for state health departments to exhibit turnover rates that are suboptimal. In such a case, health departments can theoretically increase performance by increasing turnover by hiring employees with recent training and dismissing unproductive employees.

Retention of experienced employees: The retention rate variable measures the ratio of employees in state health departments in 2020 that were employed at the agency in 2012 or

[8] This approach may overstate turnover rates because many women change their last names after embarking on marriage. It is likely that these sources of bias occur at similar rates across states.

earlier. The motivation for investigating whether retained employees with eight or more years of experience contributed to vaccine uptake is to test the second hypothesis: whether health departments with more experienced employees benefitted from the lessons of previous crises while working to broadly deploy the COVID-19 vaccine in their state. However, it is possible that states with strong foundational infrastructure may be successful in vaccinating their adult populations despite low retention rates. It this is true, then the expected relationship between retention and performance may be ambiguous.

The baseline year 2012 was chosen given trade-offs inherent between sacrificing statistical power for increased years of experience given the varying lengths of the panels available. For most states, the experienced employee retention rate is calculated as the number of employees with eight or more years of experience working in a state health department divided by the total headcount of employees at the agency in 2020. For some states, a variable that indicates the employee's date of hire is used where available, in which case the ratio of employees in 2020 whose hire dates are on or before December 31, 2012, which serves as the numerator in the experienced employee retention rate calculation. States whose panels begin after 2012 are excluded, while Arkansas and Maryland are included due to the availability of a date hired variable. This totals 40 state health departments upon which the retention rate variable is calculated. An additional variable of interest related to the retention rate of managers was calculated by identifying whether a given employee was a manager in 2020 and whether the employee was employed at the health department in 2012, not necessarily as that of a manager. Managers were selected using managerial indicators as an encoded variable in the dataset or by using string functions to identify an employee's job title that indicates some supervisory capacity.

In 2020, about 36% of a state health department's employees had at least eight years of experience at the agency. The retention rate varied from a minimum of 1.4% in West Virginia to a maximum of 67.6% in Connecticut. The retention rates do not vary significantly depending on whether the health department is a stand-alone agency or housed within a human services superagency. Figures 2.2 and 2.3 show that retention and turnover rates roughly fit a normal distribution across states. Table 2.2 includes additional descriptive statistics on the turnover and retention independent variables.

2.4.3 Control Variables: Agency Resources and Public Acceptance of Vaccine

To avoid bias and spurious conclusions, the regressions below include control variables that are plausibly correlated with the outcome measurement of state health department vaccine take-up rates, and the variables of interest: turnover rates and retention rates of experienced employees. There are two categories of control variables: agency resources and vaccine acceptance. The first category of control variables includes those related to the resources of state health departments to perform the vaccination task: state general fund support for infectious disease programs, public health budgetary dependence on federal grants, the size of health department workforce per capita, and a dummy variable indicating whether the agency is under the umbrella of a "superagency." The second category controls for demographic and cultural circumstances embedded in each state that may also influence vaccine take-up rates that are beyond the control of state health departments: educational attainment, race, and political ideology.

Agency resources: General fund support for infectious disease programs, $GFExpenditures_i$, and the size of the state health department workforce, $FTEs_i$, measured as full-time equivalents per capita, are theorized to positively contribute to vaccine take-up rates.

Alfonso et al. (2021) argue that states did not retore cuts made to public health expenditures after the Great Recession which they argue left state health agencies ill-equipped to respond to emergencies. They find that state per capita public health expenditures in 2016-18 were not statistically different from their levels in 2008-10 despite several public health threats that emerged during that period. Per capita public health spending varies greatly across state lines, leaving some states more vulnerable than others in responding to public health threats that do not respect political boundaries (Alfonso et al. 2021; Levi, Juliano, and Richardson 2007). Arguments have been made in support of foundational services for public health in all states, making a core level of public health services available to all citizens and to eliminate gaps in their provision across states (Public Health National Center for Innovations 2021; Institute of Medicine 2012b).

The superagency dummy variable $SuperAgency_i$ indicates cases in which the public health agency is a division housed within a human services superagency and where the payroll data lacks a divisional or sub-agency descriptor variable to permit isolation of the public health agency from that of other human service-related divisions. Because this dummy variable is used to indicate cases where the measurement of turnover for public health purposes is likely to be less precise, it does not directly lead to conclusions about whether public health divisions within superagencies underperform stand-alone independent public health departments. Public health literature hypothesizes that public health divisions within superagencies are less productive than stand-alone agencies.

A trend of consolidations between state health departments and human service agencies arose over the past several decades. Although some scholars express concern that such consolidations reduce the performance of public health agencies, the claim has not been

empirically investigated (Beitsch et al. 2006; Hyde and Shortell 2012; Mays et al. 2009). Anecdotal evidence from the state of Washington suggests that the merger of its human services and public health agencies in 1970 resulted in neglect among "superagency" management and it compromised the influence of public health officers in the state's budget and policy setting processes (Milne 1990). Washington's existing State Department of Health was isolated from human services functions and resumed operations as an independent agency in 1989. It is not an accident that the timing of this spin-off coincided closely with the Institute of Medicine's recommendation that core functions of health should be carried out in stand-alone agencies. In fact, they argued that the wave of consolidations that combined public health functions with income maintenance activities has "gone too far in many states" (Institute of Medicine 1988, 147).

More recently, the Texas Legislature substantially reorganized the Texas Department of State Health Services, which initially involved merging agencies providing human, aging, and rehabilitative services into a new agency in 2015. Meanwhile, the Texas Department of State Health Services retained responsibility for providing core public health services as an independent agency (Texas Department of State Health Services 2020). Alaska is dividing its Department of Health and Social Services into two agencies, one of which moves family and community services functions into a separate agency (Alaska Department of Health and Social Services 2022).

Although federal grants ($FederalGrants_i$) are an important resource for state health departments, the public health finance literature argues that increased dependence on federal grants inhibit health departments from making long-term investments in foundational infrastructure due to their restrictions and unpredictable funding levels. Therefore, increased

dependence on federal grants is theorized to be negatively correlated with vaccine take-up rates. The federal grants control variable is constructed from data obtained from the U.S. Department of Health and Human Services' Tracking Accountability in Government Grants System (TAGGS) and include grants awarded to state health departments by the Centers for Disease Control and Prevention, the Health Resources and Services Administration, the Agency for Health Care Research and Quality, the Food and Drug Administration, and the Department of Health and Human Services Office of the Secretary. The annual grant amounts were divided by each state's direct general health expenditures as reported by the Census of State Government Finances (expenditure function code 32) tabulated in the Government Finance Database (Pierson, Hand, and Thompson 2015).

Most federal support for public health arrives in the form of categorical grants received from the Centers for Disease Control and Prevention (Levi, Juliano, and Richardson 2007; Trust for America's Health 2021). These grants are often restricted for use in response to specific public health crises, such as the opioid epidemic. The Institute of Medicine (2012b, 50) argues that this method of state and local public health financing leaves little discretionary funding available to fund "cross-cutting capabilities such as information systems and policy analysis." Such restrictions on the use of categorical grants limits the flexibility of state and local public health agencies to build foundational infrastructure, including their workforces (Leider, Resnick, et al. 2018). Further, states are increasingly using federal categorical grants to fill funding gaps that arise from general fund budget cuts (Leider, Resnick, et al. 2018). Federal grants to fund public health are often episodic in response to crises, which Alfonso et al. (2021) argues lead to cycles of "neglect, panic, neglect." As a result, the share of state support for public health

supported by own-source revenues declined from 37% to 12% of state public health spending between 2001 and 2021 (Council of State and Territorial Epidemiologists 2021).

The enactment of the 2010 Affordable Care Act authorized public health grants to be dispersed by the CDC through the Prevention and Public Health Fund, which was likely an event that tipped the scales to permanently increased federal support. However, this fund was often raided to offset cuts to Medicare resulting from federal budget sequester rules (Leider, Resnick, et al. 2018; Maani and Galea 2020). Further, federal grant funding enacted in response to emergencies is often subject to change according to the whims of Congressional budget priorities. According to responses to the 2017 Epidemiology Capacity Assessment, heavy reliance on federal grants, which averages about 77% of state health department funding for epidemiological activities, has negative consequences for employee retention, capacity, and readiness at state health departments (Arrazola, Israel, and Binkin 2019).

Factors affecting vaccine acceptance: The following variables control for factors beyond the direct control of state health departments in accomplishing the goal of statewide adult vaccination and are generally thought to be artifacts of state cultures and demographics. These demographic-related control variables include educational attainment measured as the percentage of the adult population having earned a college degree in 2019 ($EduAttainment_i$), the percentage Black adult population in 2019 ($PctBlack_i$), and the percentage of the state presidential election vote for the Republican candidate in 2016 ($Republican_i$).

Measurement of the relationship between COVID-19 vaccine acceptance and certain demographic characteristics is assessed through survey instruments. One may hypothesize that states with larger minority populations, more conservative voters, and lower educational attainment will see lower vaccine take-up rates. As far as intentions to vaccinate for COVID-19

is concerned, Malik et al. (2020) find in their May 2020 survey of COVID-19 vaccine acceptance that 40% of Black adult respondents stated the intention to receive the vaccine, compared to 68% of white respondents. In terms of educational attainment, they find that 72% of college educated respondents intend to get vaccinated, a rate that falls to 51% for those with a high school diploma. As 2020 progressed, general vaccine acceptance rates fell from 72% in April to 54% in December (Yasmin et al. 2021). Decreased vaccine acceptance among Black adults, who are 2.4 times more likely to be vaccine hesitant than white respondents, is attributed to issues related to trust (Willis et al. 2021). Survey evidence shows that respondents who identify as Democrats are moderately more likely to take up vaccination than Republicans under the assumption of high vaccine efficacy (Kreps and Kriner 2021). SteelFisher, Blendon, and Caporello (2021) find that 26% of survey respondents identifying as Republicans "definitely will" get the vaccine, compared to 51% of Democrats.

Figure 2.4 is a directed acyclic graph that shows how the control variables described above are plausibly correlated with variable of interest, organizational memory, and the dependent variable, vaccine uptake rates. Vaccine acceptance, which is not directly observed, is a function of state demographics and ideology as well as the effectiveness of the health department to engage in outreach to hesitant populations through effective messaging campaigns. Therefore, vaccine acceptance itself fits the criteria of a "bad control" because it may plausibly explain vaccine take-up while also serving as a suitable dependent variable that explains the outreach effectiveness of the public health agency. Therefore, only the measurable characteristics that explain vaccine take-up that cannot be manipulated by the health department are included as control variables. State demographics and ideology are also correlated with the resource constraints faced by each health department because budget decisions are a function of state

ideology. The ability to preserve organizational memory depends on the magnitude of resources directed to the department by elected representatives of the state's citizens.

This results in the following model:

$$VaccineUptake_i = \gamma OrgMemory_i + \alpha AgencyResources_i + \beta VaccineAcceptance_i + \varepsilon_i \quad (2.1)$$

The dependent variable, $VaccineUptake_i$, is operationalized as the vaccination rate observed on October 1, 2021, in state i by age group and dose. $OrgMemory_i$ represents the variable of interest, the average turnover rate from 2017-19 or the percentage of employees in 2020 with at least eight years of experience and is used to test hypotheses H1 through H3.

Although the dependent and independent variables are constructed from panel datasets, ordinary least squares is implemented because the goal is to assess how state health departments fared in the performance of their vaccination campaigns given the various resources and constraints they faced as they entered the pandemic, which are presumed to be fixed at the time the vaccination campaign began. Multiple variations of the dependent variable, $VaccineUptake_i$, are used to make comparisons between the turnover-performance relationship given varying degrees of task difficulty, such as the take-up rates of the first dose versus the complete series, and the age group upon which the vaccination doses are administered. The model is also implemented with the experienced employee retention rate as the independent variable of interest whose results are described in the following section.

2.5 Results

2.5.1 OLS Results Using 2017-19 Turnover Rate

Table 2.3 displays the OLS regression results of state health department turnover rates on COVID-19 vaccine take-up rates. Here, the sensitivity of the variable of interest, employee turnover rates to the inclusion of control variables, is investigated. When demographic controls are added to model specifications with the one-dose dependent variable, the turnover rate coefficient loses its statistical significance. Specifically, two control variables – the 2016 Republican vote share and per capita general fund expenditures on infectious disease programs - are highly significant and thus absorb much of the explanatory power of turnover rates for the one-dose dependent variables. Therefore, the fully specified models show no significant relationship between the state health department turnover rate and the one-dose vaccine take-up rate for any age group.

The regression specifications using two-dose dependent variable for all age groups (senior citizens and non-senior adults) show that the turnover rate coefficient remains significant for all age groups, especially senior citizens ($p < .01$) in the fully specified models. These results lead to the conclusion that a one percentage point increase in state health department turnover rates is associated with a 0.4 and 0.5 percentage point decrease in the vaccine series completion rate for non-senior and senior-aged adults, respectively. For non-senior adults, the coefficient is about -0.4 for the fully specified model and is significant at the five percent level. These results support Hypothesis 1 in the case of the two-dose dependent variable for senior and non-senior adults.

The strongest statistical relationship between turnover and vaccine take-up is found in the case of two-dose take-up rates among adults over the age of 65. The coefficient on turnover rate

remains the most consistent through each specification of models using the senior adult vaccine series completion rate dependent variable, and the turnover rate coefficient the most statistically significant in the fully specified model ($p < 0.001$). This result is likely driven by the high rate of vaccine take-up among senior citizens. The one- and two-dose vaccine take-up rates are about 23 percentage points higher for senior citizens versus non-senior adults. On October 1, 2021, about 84 percent of senior citizens nationwide received the complete series of the COVID-19 vaccines, while about 60 percent of adults aged 18-64 had received the complete series. See the descriptive statistics in Table 2.2 for further comparison.

An important distinction between the success of state health departments in administering one versus two doses to its adult population is the role of task complexity. Because the mRNA vaccines required two doses to complete the series, the capacity of the state health department to follow up with vaccine recipients and ensure they return to receive the second dose at the right time, if at all, was crucial in maximizing the vaccine's efficacy. In addition to scheduling information provided to vaccine recipients at the time of their first dose inscribed on their COVID-19 Vaccination Record Cards, state health departments sent electronic reminders to first-dose recipients, such as robocalls, text messages, and emails. It was also necessary for the state health department to impart on vaccine recipients the importance of returning for the second dose in achieving full protection. Therefore, the organizational memory of state health departments used to achieve this task proved to be a more vital input for completion of the vaccine series than the first dose only. In both age groups, the influence of the political ideology on vaccination take-up falls between the first and second doses, which suggests that administrative capacity provides greater explanatory power of the success of vaccine series completion than that of politics. This result establishes empirical support for Hypothesis 3.

2.5.2 Turnover Versus Retention Rate Results

Table 2.4 shows results which includes models specified with various combinations of independent variables: the 2017-19 average turnover rate, the share of employees with at least eight years of experience in 2020, and the share of state health department managers in 2020 with similar experience. Each of the results shown arise from fully specified models including all controls while varying only combination of independent variables included. Because it is established that the turnover rate coefficients are only significant in the fully models using the vaccine series completion rate dependent variable, results from the one-dose models are excluded. All three independent variables are similar measures of the same concept: organizational memory and are therefore collinear with each other. The goal of this exercise is to determine the extent to which each measure of organizational memory - turnover or retention rates - provides the strongest predictive power of the vaccine series completion rate.

In this series of regressions, the coefficients on the turnover rate show the most consistent, significant relationship with vaccine take-up rate among senior citizens even when both experienced employee retention rate variables are included in the model. Meanwhile, the results also show that experienced employees contribute significantly to performance of vaccine series completion among adults aged 18-64 relative to the turnover rate coefficients. The coefficients on experienced manager retention are never significant in any specification.

Table 2.5 shows the regression results arising from the experienced employee variable of interest and shows further detail of how the contribution of experienced employees to vaccine administration performance is more significant for the non-senior adult take-up rate than for those over the age of 65. The experienced employee retention rate coefficient is significant and

positive for both the first dose and series completion rates among adults aged 18-64. Among senior citizens, the experienced employee retention rate is significant at the ten percent level for the one-dose specification, but otherwise shows a weaker contribution to take-up among seniors. Therefore, the results support Hypothesis 2 in the case of non-senior adults, but not among seniors, where the turnover rate holds greater explanatory power of vaccine series completion rates.

2.5.3 Robustness Checks: Placebo Test and Alternative Model Specifications

To test the robustness of the results related to turnover in state health departments, the regressions in Table 2.3 are repeated in Table 2.6 using a placebo variable of interest: average turnover rates from 2017-19 in state transportation departments. State transportation departments share some characteristics with health departments, such as an outsized role of federal grant funding and competition with the private sector (in this case, the transportation consulting and contracting industry) for skilled workers. However, one major distinction between state health and transportation departments is that the latter lacks the "emergency response" element by which the agency is expected to snap back in response to an unanticipated emergency, such as a pandemic.

Although there are occasions by which Congress appropriates large sums of federal funds for transportation projects, such as after the passage of the American Recovery and Reinvestment Act of 2009 that result in an increase in transportation department output, the process of letting contracts is considerably slower than that of a pandemic response.[9] According to the summary statistics of the placebo variable, state transportation departments have lower annual turnover

[9] Details regarding the realities of accomplishing fiscal stimulus through "shovel-ready projects" can be found in Condon (2010).

rates and considerably higher employee retention rates than state health departments. These key differences between state health and transportation departments may explain the fact that none of the transportation department turnover coefficients are statistically significant predictors of vaccine take-up rates, even in the bivariate specifications. Should the coefficients on the transportation department turnover rate placebo variable also be significant, we could conclude that there is nothing structurally distinct about health departments from that of others that make them well-suited to respond to pandemics using foundational infrastructure on short notice. If this statement were true, then this would undercut a key argument of this research: Foundational infrastructure and organizational memory are key contributors to a state's success in quickly snapping back in response to a public health crisis.

To test the robustness of the results derived from the econometric model specified above, the model was respecified with alternative dependent and independent variables. First, Table 2.7 shows the results of an alternative measurement of turnover calculated as each state's average turnover rate between 2010 and 2019. In this case, no coefficient on the average turnover rate coefficient measuring turnover observed between 2010 and 2019 in fully specified models is a significant predictor of vaccine take-up in 2021. This may be explained by the fact that average turnover rates in the early years of the decade ranged from 11-13 percent and increased to 15-16 percent by the end of the decade.

Tables 2.8 and 2.9 show regressions using alternative dependent variables: The vaccination rates observed on May 1 and August 1, 2021. Most states expanded eligibility for vaccination to all adults by April 15, 2021, and the White House directed all states to open eligibility to all adults by May 1 (National Public Radio 2021). Table 2.8 shows the results derived from the May 1, 2021, vaccination date dependent variables are much less significant in

the case of the 18-64 age group, which coincides with the short time window this age group had access to the COVID-19 vaccine at that time. The statistically strongest relationship remains with the completed vaccination series among adults over the age of 65, who already had access to the vaccine for several months at that time. Because most other adults did not have many opportunities to receive the vaccine before May 1, the turnover rate does not provide a strong explanation of the vaccine take-up rate for those age groups.

The effect of broader adult vaccine take-up is reflected in the results of the August 1 dependent variables, which is shown in Table 2.9. Most of the results are similarly significant as the October 1 results and the coefficients are of the same sign and similar magnitudes. All told, the variation in results from the alternative specifications show only minor differences from the primary results using the October 1 dependent variables, except for the May 1 specifications due to restrictions on vaccination eligibility prevailing at that time.

2.6 Cost Effectiveness of Turnover Reduction

There are several tools that states can use to manipulate their vaccine take-up rates. For example, during the pandemic, several states created “vaccine lotteries” that offered sizable cash prizes to randomly selected vaccinated adults, and some states saw success in vaccine take-up from such incentives. This paper’s findings identify health department employee turnover reduction as another mechanism by which states may pursue increased vaccine take-up rates. More specifically, a one percentage point reduction in the turnover rate is estimated to increase the administration of the complete vaccine series by 389 people per 100,000 aged 18-64 and 472 people per 100,000 aged 65 and above. Using Census population estimates, this implies

approximately 2,570 U.S. residents would complete the vaccine series.[10] This section considers some back of the envelope estimates and calculations for the cost of reducing employee turnover in these departments to weigh against the public benefits of completing the vaccination series for a larger set of the population.

To begin, I leverage the public employee dataset discussed in section 2.4 for calculating turnover rates to estimate a simple turnover on wage regression. More specifically, regressing the average state health department turnover rate from 2017-2019 on the average state health department employee salary observed during the same period indicates that a $10,000 increase in salary is associated with a 0.879 percentage point reduction in the health department turnover rate. Therefore, reducing the turnover rate in each state by one percent would, on average, require a $11,370 per public health employee salary increase. There are approximately 143,000 state public health department employees in the United States, implying that this would collectively cost about $1.6 billion in additional compensation.

The main estimate from this research on the increase in vaccine series completion rate can be used to impute a mortality effect. Haas et al. (2021) and Dagan et al. (2021) cite CDC data to adopt 24.7% as the incremental reduction in mortality from a person receiving one dose to completing the series. In a similar COVID vaccination analysis, Carlin et al. (2022) imputes the Value of Statistical Life (VSL) implied from the Department of Health and Human Services to be about $11 million per life saved for adults under 65 and $4 million per life saved for those 65 and over. Carlin et al. (2022) impute therefore the dollarized expected VSL benefits of

[10] For 2020, the Census estimated there to be about 54 million residents over age 65 and 203 million adults under 65.

finishing the series to be $2.72 and $0.99 million per life saved for under and over age 65, respectively.

Applying these expected VSL benefits to the second-dose gains in vaccination estimated by this paper implies $2.4 billion in avoided death benefits.[11] This gain in public health exceeds the estimated $1.6 billion in the public health employee compensation to induce the 1% turnover reduction.

2.7 Conclusion

This research finds that employee turnover rates in state health departments during the years before the COVID-19 pandemic are significantly and negatively related to state vaccine take-up rates for both age groups of adults, but especially for senior citizens, which supports Hypothesis 1. This result also supports comments made by state epidemiologists cited earlier in this paper who argue that turnover hampers the capacity of health departments to snap back into performance when crises arise. The retention of experienced employees also makes a significant contribution to vaccine take-up rates among adults aged 18-64, but not among senior citizens, which provides partial support for Hypothesis 2. With respect to Hypothesis 3, robust evidence is found across age groups that turnover rates matter for task complexity – the administration of the complete vaccine series. This result is important because it underscores how stability in the public health workforce is vital in carrying out complex tasks during emergencies when the agency must "snap back" into performance, such as repeat doses of the COVID-19 vaccine.

[11] The calculation of expected benefits is population of interest x vaccination impact x mortality impact x VSL. For the under age 64 group this is = 2,030 hundred thousand residents x 0.389 x 0.247 x $11 million = $2,147.9 million. For over 65 this is = 540 hundred thousand residents x .472 x 0.247 x $4 million = $252.33 million.

However, the results only partially support Hypothesis 3 because those results appear to be more sensitive to age group than whether the complete series was administered.

The turnover rate results discussed above are robust to multiple specifications in the case of the second dose dependent variable, especially among those over the age of 65. Other tests of robustness, including those with alternative measures of turnover and vaccine take-up rates observed earlier in 2021, provide a strong foundation for these results. An interesting result also arises from a robustness check in which the May 1, 2021, vaccine take-up rate serves as dependent variable. The results show that the state health departments largely succeeded in vaccinating senior citizens through the winter and spring months of 2021, and the coefficient of the turnover variable varies only marginally for the two-dose senior citizen dependent variable between August 1 and October 1, 2021.

Future studies should investigate more deeply the dynamics of task routinization and frequency and the extent to which those variables affect the extent to which turnover affects performance. The goal of this paper is to show evidence that the consequence of turnover is different for agencies that must snap back into performance in times of emergencies, which is different than that of organizations whose tasks are frequent and routine. As argued earlier in this paper, for organizations whose tasks are executed frequently and are defined by highly structured routines, turnover should theoretically be less of a threat to performance. Although it would be ideal to investigate this research question at the occupational level, the possibility of obtaining performance data for specific employees diminishes as task difficulty increases and task routinization and frequency decreases.

The robustness of the results found in this paper could be tested by studying other organizations that must snap back to perform in times of emergencies, such as state national

guards and emergency management agencies. Because these agencies spend much of their time preparing for emergencies as opposed to the execution of frequent and routine tasks, they may be good candidates for comparison in a similar study. Additionally, analysis of turnover in agencies with routine tasks could reveal whether the claim that turnover is less of a threat in these settings is correct. If it is true that turnover is less of a threat when training new employees to perform routine tasks, this would support the contention of Levitt and March (1988, 320) who argue that highly structured routines are "…capable of surviving considerable turnover in individual actors."

Figure 2.1: Map of U.S. States with State Employee Payroll Data Collected

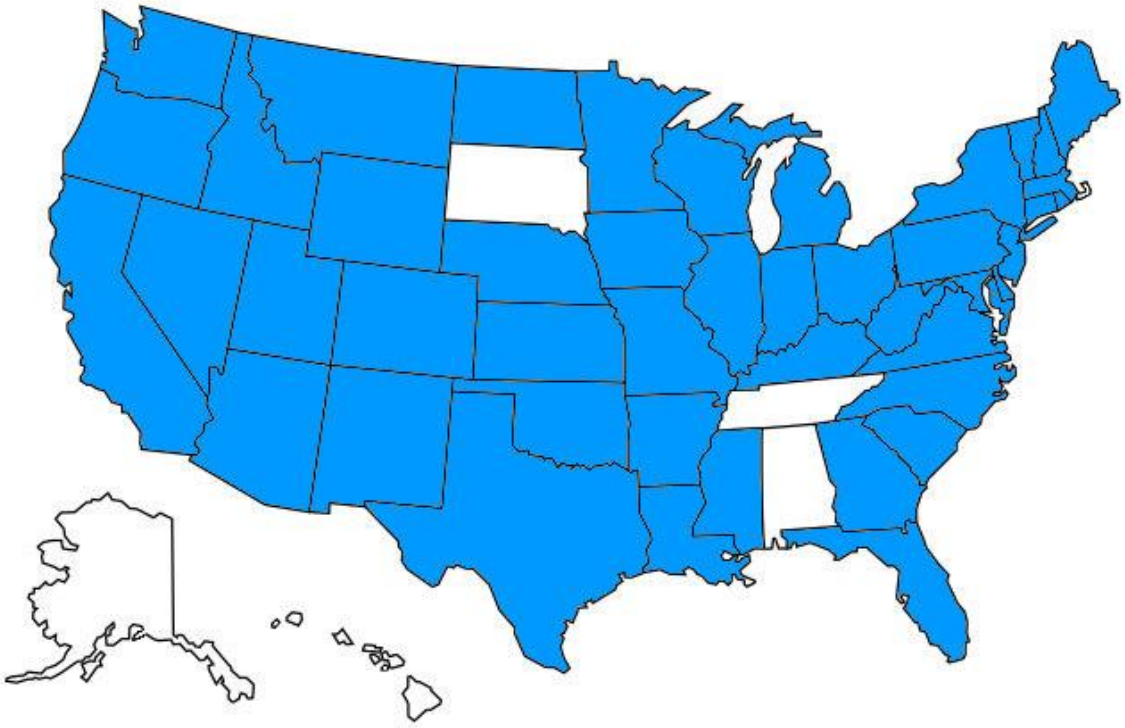


Figure 2.2: Histogram of State Health Department Average Turnover Rates, 2017-19

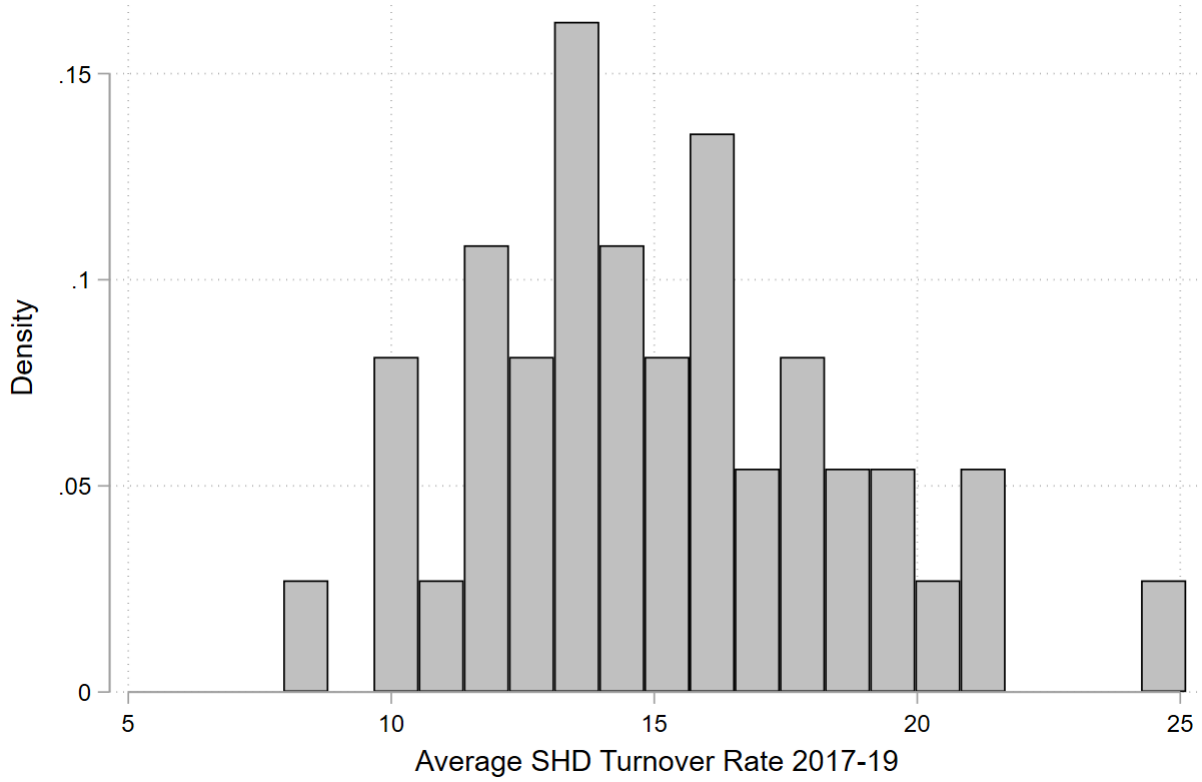


Figure 2.3: Histogram of Retention Rates of Experienced State Health Department Employees in 2020

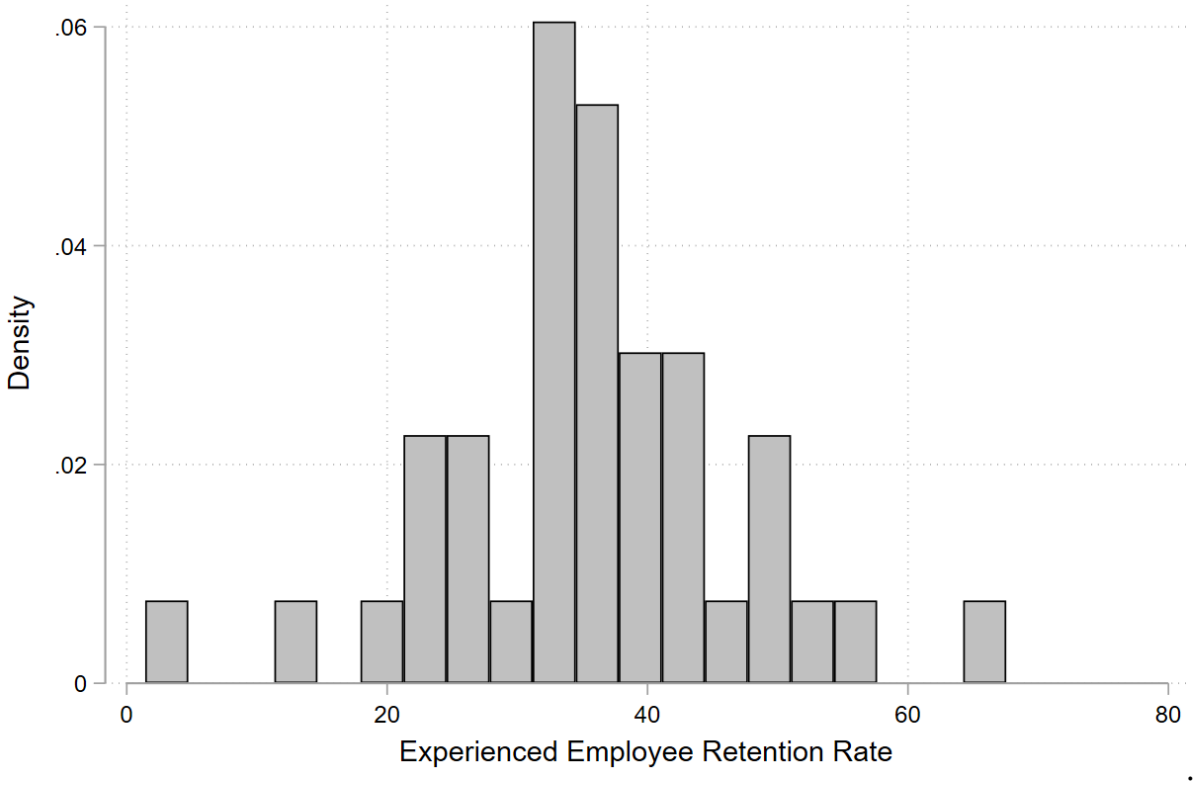


Figure 2.4: Directed Acyclic Graph

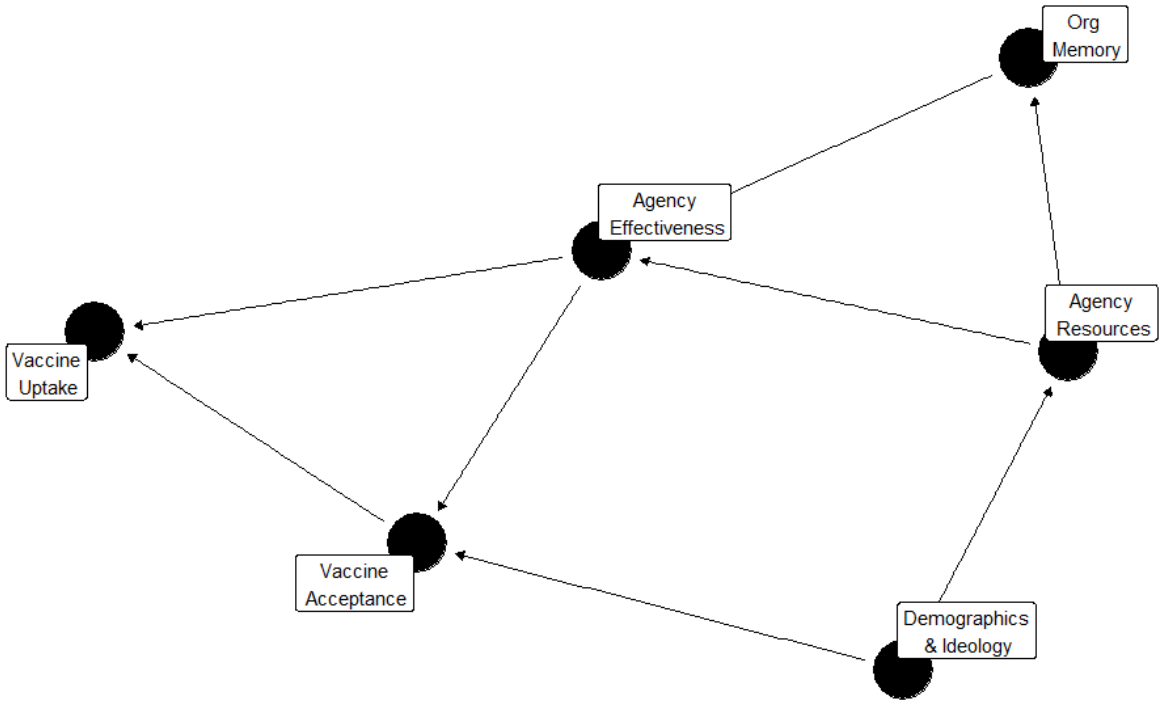


Table 2.1: Spectrum of Frequency and Routinization in Public Service Provision

		Routinization	
Frequency		**High**	**Low**
	High	Trash pickup Street cleaning	Litigation of delinquent taxes
	Low	Crime scene investigation	Pandemics War Financial crises

Table 2.2: Descriptive Statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
Dependent variables					
Dose 1, Age 18+[12]	45	62.40	8.70	47.10	77.80
Dose 1, Ages 18-612[12]	45	69.74	10.01	49.59	86.50
Dose 1, Age 65+[12]	45	92.29	5.43	79.60	99.90
Series Complete, Age 18+[12]	45	54.65	8.16	40.40	69.50
Series Complete, Ages 18-64[12]	45	60.65	9.49	40.54	76.85
Series Complete, Age 65+[12]	45	83.91	5.64	71.30	95.40
Independent variables (incl. placebo)					
State health dept. turnover, 2017-19[13]	43	15.18	3.55	7.95	25.11
State transportation dept. turnover, 2017-19[13]	43	12.22	2.61	7.36	16.94
State health dept. retention rate[13]	40	35.57	11.80	1.42	67.55
State health dept. manager retention rate[13]	39	36.22	21.76	0.59	84.62
Control variables					
General fund expenditures on infectious disease programs, per capita[14]	45	1.51	1.79	0.06	10.13
Superagency[14] (1=yes)	45	0.27	0.45	0.00	1.00
State health department FTEs per capita, 2019[14]	45	0.04	0.03	0.01	0.17
Percent Republican presidential vote share, 2016[15]	45	48.82	9.91	30.27	68.50
State health department dependence on federal grants, 2019[16]	45	11.10	6.17	2.67	30.02
Percent Black adult population, 2019[17]	45	10.06	8.91	0.48	35.25
Educational attainment, percentage aged 25+ with college diploma[17]	45	20.05	3.06	12.60	26.60

[12] Centers for Disease Control and Prevention. Rates are observed on October 1, 2021.
[13] Calculated by author using information compiled from state administrative payroll data.
[14] Association for State and Territorial Health Officials, *Profiles of State and Territorial Public Health*
[15] CQ Elections and Voting
[16] U.S. Department of Health and Human Services Tracking Accountability in Government Grants System
[17] American Community Survey, U.S. Census

Table 2.3: OLS Results with Dependent Variable: Vaccine Take-up Rate on October 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average SHD Turnover Rate 2017-19	-0.799*	-0.898**	-0.101	-0.926***	-1.037***	-0.389**	-0.341*	-0.420**	-0.074	-0.557***	-0.684***	-0.472***
	(0.398)	(0.332)	(0.192)	(0.341)	(0.304)	(0.168)	(0.197)	(0.177)	(0.135)	(0.164)	(0.157)	(0.156)
PC General Fund Expenditures Infectious Disease		1.698***	0.910***		1.634***	0.877**		0.798***	0.418		0.824***	0.509
		(0.479)	(0.253)		(0.409)	(0.354)		(0.282)	(0.253)		(0.263)	(0.369)
State Health Dept. FTEs PC 2019		60.779	34.851		54.490	39.509*		38.264*	31.519		44.000**	42.223*
		(36.849)	(24.445)		(32.808)	(19.695)		(22.398)	(21.291)		(21.704)	(21.050)
Average Share of Health Spending from Federal Grants		-0.209	-0.088		-0.098	-0.020		0.046	0.094		0.129	0.142
		(0.245)	(0.127)		(0.212)	(0.101)		(0.161)	(0.118)		(0.100)	(0.088)
Superagency Dummy Variable		-4.218	-0.353		-2.697	0.378		-1.163	0.683		0.974	1.907
		(3.227)	(2.125)		(3.194)	(1.905)		(2.019)	(1.743)		(1.972)	(1.647)
Adult Population Percent Black			-0.137*			-0.186**			-0.053			-0.110
			(0.075)			(0.074)			(0.064)			(0.069)
Percent of population 25+ with College Degree			0.364			0.550*			0.320			0.314
			(0.346)			(0.313)			(0.306)			(0.324)
2016 Vote Share – Republican President			-0.736***			-0.605***			-0.310***			-0.204*
			(0.108)			(0.109)			(0.092)			(0.105)
Constant	81.780***	82.352***	99.750***	74.668***	73.985***	84.317***	97.528***	96.035***	99.736***	92.464***	89.907***	91.516***
	(6.531)	(6.179)	(11.089)	(5.601)	(5.269)	(10.339)	(3.159)	(3.466)	(9.651)	(2.548)	(2.543)	(9.941)

Note: n=43, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.4: SHD Results by Permutation

	Fraction of Population 18-64 with Completed Vax Series 10/1/2021					
Average SHD Turnover Rate 2017-19	-0.335	-0.340	-0.379*	-0.389**		
	(0.217)	(0.204)	(0.192)	(0.168)		
Experienced Employee Retention Rate	0.240*	0.131**	0.214*	0.112**		
	(0.130)	(0.054)	(0.125)	(0.044)		
Experienced Manager Retention Rate	-0.073	0.002	-0.063		0.006	
	(0.068)	(0.047)	(0.065)		(0.044)	
	Fraction of Population 65+ with Completed Vax Series 10/1/2021					
Average SHD Turnover Rate 2017-19	-0.409**	-0.370*	-0.412**	-0.472***		
	(0.180)	(0.197)	(0.177)	(0.156)		
Experienced Employee Retention Rate	0.015	0.139**	-0.005	0.080		
	(0.109)	(0.056)	(0.112)	(0.064)		
Experienced Manager Retention Rate	0.030	0.034	0.006		0.005	
	(0.058)	(0.033)	(0.059)		(0.042)	
	Fraction of Population 18+ with Completed Vax Series 10/1/2021					
Average SHD Turnover Rate 2017-19	-0.284	-0.305*	-0.328*	-0.384**		
	(0.172)	(0.158)	(0.160)	(0.142)		
Experienced Employee Retention Rate	0.240*	0.104**	0.222*	0.086**		
	(0.119)	(0.043)	(0.113)	(0.040)		
Experienced Manager Retention Rate	-0.068	0.008	-0.064		0.008	
	(0.064)	(0.042)	(0.058)		(0.040)	
N	37	38	37	39	43	40	39

Note: All controls are included for each regression. * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.5: OLS Results with Dependent Variable: Vaccine Take-up Rate on October 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
% Experienced Employees 2020	0.165	0.135	0.119**	0.154	0.120	0.112**	0.090	0.082	0.083*	0.087	0.080	0.080
	(0.153)	(0.148)	(0.046)	(0.159)	(0.162)	(0.044)	(0.088)	(0.106)	(0.045)	(0.097)	(0.123)	(0.064)
Infectious Disease Expenditures		1.169	0.462		1.093	0.346		0.507	0.122		0.423	0.039
		(0.842)	(0.295)		(0.839)	(0.368)		(0.515)	(0.272)		(0.509)	(0.396)
PC SHD FTEs 2019		59.081	39.921*		46.645	32.906*		33.758	30.416*		30.207	25.645
		(35.229)	(20.110)		(35.860)	(18.431)		(23.495)	(17.573)		(26.368)	(21.612)
Average Share of Health Spending from Federal Grants		-0.286	-0.120		-0.218	-0.056		-0.044	0.029		-0.015	0.063
		(0.269)	(0.125)		(0.258)	(0.099)		(0.194)	(0.132)		(0.171)	(0.113)
Superagency Dummy Variable		-4.893	-1.455		-3.819	-0.394		-1.440	0.141		-0.078	1.593
		(3.677)	(2.172)		(3.679)	(1.970)		(2.262)	(1.882)		(2.176)	(1.815)
% Black Adult Population			-0.206***			-0.199***			-0.097*			-0.096
			(0.068)			(0.072)			(0.056)			(0.079)
Percent of population 25+ with College Degree			0.301			0.489			0.335			0.315
			(0.339)			(0.325)			(0.290)			(0.316)
2016 Vote Share – Republican President			-0.734***			-0.699***			-0.313***			-0.329***
			(0.112)			(0.117)			(0.094)			(0.110)
Constant	63.332***	65.395***	97.210***	54.870***	56.483***	82.401***	88.948***	88.203***	97.385***	80.968***	79.651***	90.057***
	(5.768)	(6.293)	(11.624)	(5.960)	(6.256)	(12.044)	(3.345)	(4.261)	(10.374)	(3.643)	(4.705)	(13.050)

Note: n=40, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.6: Placebo Results, Dependent Variable: Vaccine Take-up Rate on October 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average DOT Turnover Rate 2017-19	-0.563	-0.240	-0.128	-0.553	-0.324	-0.203	-0.253	-0.240	-0.167	-0.044	-0.063	-0.006
	(0.528)	(0.492)	(0.388)	(0.479)	(0.455)	(0.321)	(0.281)	(0.305)	(0.296)	(0.324)	(0.334)	(0.309)
PC General Fund Expenditures Infectious Disease		1.592**	0.869***		1.500**	0.784**		0.717**	0.372		0.773**	0.449
		(0.608)	(0.275)		(0.554)	(0.364)		(0.330)	(0.255)		(0.319)	(0.369)
State Health Dept. FTEs PC 2019		32.623	31.132		22.482	23.883		26.493	29.126		21.259	22.206
		(37.667)	(23.526)		(34.669)	(20.795)		(21.862)	(19.905)		(21.987)	(19.844)
Average Share of Health Spending from Federal Grants		-0.165	-0.063		-0.042	0.038		0.083	0.122		0.147	0.182*
		(0.264)	(0.133)		(0.235)	(0.100)		(0.173)	(0.125)		(0.128)	(0.100)
Superagency Dummy Variable		-5.716	-0.379		-4.432	0.388		-1.877	0.637		-0.154	2.009
		(3.689)	(2.118)		(3.697)	(1.982)		(2.221)	(1.769)		(2.257)	(1.747)
% Black Adult Population			-0.134*			-0.164**			-0.053			-0.075
			(0.076)			(0.076)			(0.066)			(0.083)
Percent of population 25+ with College Degree			0.311			0.410			0.265			0.197
			(0.385)			(0.374)			(0.316)			(0.343)
2016 Vote Share – Republican President			-0.763***			-0.701***			-0.332***			-0.313***
			(0.110)			(0.115)			(0.089)			(0.098)
Constant	76.533***	72.634***	102.029***	67.362***	63.267***	88.126***	95.445***	92.878***	102.651***	84.545***	81.211***	92.053***
	(6.673)	(6.611)	(14.060)	(6.083)	(6.055)	(14.011)	(3.323)	(3.686)	(11.362)	(3.726)	(3.742)	(12.303)

Note: n=40, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.6: Placebo Results, Dependent Variable: Vaccine Take-up Rate on October 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average DOT Turnover Rate 2017-19	-0.563	-0.240	-0.128	-0.553	-0.324	-0.203	-0.253	-0.240	-0.167	-0.044	-0.063	-0.006
	(0.528)	(0.492)	(0.388)	(0.479)	(0.455)	(0.321)	(0.281)	(0.305)	(0.296)	(0.324)	(0.334)	(0.309)
PC General Fund Expenditures Infectious Disease		1.592**	0.869***		1.500**	0.784**		0.717**	0.372		0.773**	0.449
		(0.608)	(0.275)		(0.554)	(0.364)		(0.330)	(0.255)		(0.319)	(0.369)
State Health Dept. FTEs PC 2019		32.623	31.132		22.482	23.883		26.493	29.126		21.259	22.206
		(37.667)	(23.526)		(34.669)	(20.795)		(21.862)	(19.905)		(21.987)	(19.844)
Average Share of Health Spending from Federal Grants		-0.165	-0.063		-0.042	0.038		0.083	0.122		0.147	0.182*
		(0.264)	(0.133)		(0.235)	(0.100)		(0.173)	(0.125)		(0.128)	(0.100)
Superagency Dummy Variable		-5.716	-0.379		-4.432	0.388		-1.877	0.637		-0.154	2.009
		(3.689)	(2.118)		(3.697)	(1.982)		(2.221)	(1.769)		(2.257)	(1.747)
% Black Adult Population			-0.134*			-0.164**			-0.053			-0.075
			(0.076)			(0.076)			(0.066)			(0.083)
Percent of population 25+ with College Degree			0.311			0.410			0.265			0.197
			(0.385)			(0.374)			(0.316)			(0.343)
2016 Vote Share – Republican President			-0.763***			-0.701***			-0.332***			-0.313***
			(0.110)			(0.115)			(0.089)			(0.098)
Constant	76.533***	72.634***	102.029***	67.362***	63.267***	88.126***	95.445***	92.878***	102.651***	84.545***	81.211***	92.053***
	(6.673)	(6.611)	(14.060)	(6.083)	(6.055)	(14.011)	(3.323)	(3.686)	(11.362)	(3.726)	(3.742)	(12.303)

Note: n=40, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.8: OLS Results with Dependent Variable: Vaccine Take-up Rate on May 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average SHD Turnover Rate 2017-19	-0.633**	-0.701**	-0.138	-0.095	-0.204	-0.138	-0.369*	-0.392*	-0.106	-0.503**	-0.642**	-0.550**
	(0.307)	(0.288)	(0.169)	(0.202)	(0.222)	(0.169)	(0.209)	(0.200)	(0.149)	(0.217)	(0.246)	(0.242)
PC General Fund Expenditures Infectious Disease		1.765***	0.639**		0.887***	0.639**		0.979***	0.514*		1.144***	0.857**
		(0.417)	(0.243)		(0.213)	(0.243)		(0.303)	(0.271)		(0.262)	(0.392)
PC SHD FTEs 2019		25.567	38.316*		32.953	38.316*		16.626	16.010		28.469	33.987
		(39.273)	(21.967)		(24.140)	(21.967)		(31.371)	(25.933)		(28.780)	(26.906)
Average Share of Health Spending from Federal Grants		0.099	-0.112		-0.088	-0.112		0.270	0.280*		0.184	0.162
		(0.253)	(0.123)		(0.111)	(0.123)		(0.227)	(0.163)		(0.127)	(0.134)
Superagency Dummy Variable		-2.113	1.065		1.021	1.065		-2.234	-1.030		2.870	3.067
		(2.579)	(1.409)		(1.417)	(1.409)		(2.196)	(1.911)		(2.072)	(2.176)
% Black Adult Population			-0.157**			-0.157**			-0.179**			-0.164*
			(0.059)			(0.059)			(0.070)			(0.087)
Percent of population 25+ with College Degree			0.365*			0.365*			0.502			0.417
			(0.216)			(0.216)			(0.313)			(0.302)
2016 Vote Share – Republican President			-0.082			-0.082			-0.280***			-0.106
			(0.095)			(0.095)			(0.100)			(0.126)
Constant	57.337***	54.268***	30.914***	33.283***	33.262***	30.914***	88.429***	84.181***	85.396***	78.740***	75.201***	72.636***
	(5.209)	(4.964)	(8.186)	(3.206)	(3.574)	(8.186)	(3.539)	(3.605)	(10.072)	(3.484)	(3.738)	(10.561)

Note: n=43, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.7: OLS Results with 2010-19 Average Turnover Rate and Dependent Variable: Vaccine Take-up Rate on October 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average SHD Turnover Rate 2010-19	-0.743**	-0.807***	0.147	-0.858***	-0.909***	-0.072	-0.337*	-0.375**	0.053	-0.536***	-0.590***	-0.270
	(0.338)	(0.285)	(0.238)	(0.297)	(0.278)	(0.227)	(0.177)	(0.170)	(0.194)	(0.182)	(0.182)	(0.192)
Per Capita General Fund Expenditures Infectious Disease		1.443**	0.921***		1.345**	0.817**		0.679**	0.417		0.636*	0.407
		(0.565)	(0.250)		(0.517)	(0.359)		(0.332)	(0.247)		(0.317)	(0.371)
PC SHD FTEs 2019		58.633	24.485		51.204	25.952		37.197	26.222		41.485*	33.347*
		(38.810)	(25.360)		(35.636)	(21.873)		(22.589)	(21.194)		(21.635)	(18.875)
Average Share of Health Spending from Federal Grants		-0.256	-0.060		-0.151	0.003		0.024	0.108		0.095	0.145
		(0.266)	(0.121)		(0.233)	(0.104)		(0.172)	(0.115)		(0.110)	(0.087)
Superagency Dummy Variable		-4.980	-0.209		-3.598	0.405		-1.521	0.743		0.372	1.787
		(3.389)	(2.042)		(3.374)	(1.947)		(2.106)	(1.694)		(2.060)	(1.731)
% Black Adult Population			-0.122			-0.161**			-0.045			-0.089
			(0.076)			(0.076)			(0.065)			(0.073)
Percent of Population 25+ with College Degree			0.316			0.465			0.293			0.240
			(0.359)			(0.343)			(0.302)			(0.322)
2016 Vote Share – Republican President			-0.791***			-0.680***			-0.338***			-0.255**
			(0.102)			(0.108)			(0.085)			(0.103)
Constant	80.313***	81.523***	99.557***	72.917***	72.703***	84.807***	97.185***	95.622***	99.701***	91.692***	88.922***	92.464***
	(5.360)	(6.259)	(11.690)	(4.719)	(5.604)	(11.601)	(2.666)	(3.619)	(9.836)	(2.742)	(3.173)	(10.702)

Note: n=43, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Table 2.9: OLS Results with Dependent Variable: Vaccine Take-up Rate on August 1, 2021

	Fraction of Population Aged 18-64						Fraction of Population Aged 65+					
	One Dose			Complete Series			One Dose			Complete Series		
Average SHD Turnover Rate 2017-19	-0.890**	-0.998***	-0.213	-0.943***	-1.065***	-0.412**	-0.358*	-0.418**	-0.064	-0.574***	-0.702***	-0.471***
	(0.394)	(0.355)	(0.172)	(0.344)	(0.329)	(0.160)	(0.204)	(0.195)	(0.131)	(0.178)	(0.178)	(0.160)
PC General Fund Expenditures Infectious Disease		1.817***	0.923***		1.803***	0.960***		0.788***	0.355		0.974***	0.602
		(0.518)	(0.244)		(0.437)	(0.312)		(0.288)	(0.242)		(0.264)	(0.372)
PC SHD FTEs 2019		56.627	30.523		48.841	32.166*		34.393	24.551		39.319	36.428
		(44.919)	(22.968)		(40.225)	(18.800)		(26.495)	(22.911)		(26.019)	(22.488)
Average Share of Health Spending from Federal Grants		-0.174	-0.082		-0.044	0.014		0.026	0.062		0.169	0.176*
		(0.267)	(0.114)		(0.240)	(0.095)		(0.156)	(0.099)		(0.119)	(0.090)
Superagency Dummy Variable		-3.483	-0.273		-1.711	0.894		-1.792	-0.332		1.263	2.065
		(3.148)	(1.819)		(3.091)	(1.689)		(2.017)	(1.686)		(1.986)	(1.660)
% Black Adult Population			-0.296***			-0.311***			-0.148**			-0.170**
			(0.074)			(0.072)			(0.059)			(0.069)
Percent of population 25+ with College Degree			0.406			0.549*			0.259			0.328
			(0.314)			(0.280)			(0.292)			(0.310)
2016 Vote Share – Republican President			-0.764***			-0.642***			-0.344***			-0.236**
			(0.099)			(0.102)			(0.088)			(0.113)
Constant	75.489***	75.513***	95.834***	68.486***	66.987***	80.798***	94.337***	93.121***	100.921***	89.821***	86.638***	90.035***
	(6.607)	(6.086)	(10.031)	(5.796)	(5.442)	(9.718)	(3.304)	(3.488)	(9.522)	(2.876)	(2.851)	(10.352)

Note: n=43, * p<0.10, ** p<0.05, *** p<0.01, robust standard error in parentheses

Chapter 3

Public Employee Furloughs as a Budget Balancing Strategy: Evidence of Effects on Employees and Agencies

3.1 Introduction

Fiscal crises force states to make difficult decisions to restore the balance between current period revenue and expenditures. Ideally, states would remedy this imbalance by tapping resources from a rainy day fund whose balance is sufficient to offset unanticipated tax revenue shortfalls or expenditures. Given the historic severity of fiscal pressure exerted on state budgets during the Great Recession, many states did not have the luxury of fully restoring fiscal balance with rainy day funds alone. This led states to pursue some combination of tax rate increases, tax base expansions, expenditure cuts, and in some cases, budget maneuvers to keep budgets balanced (Stavick 2022). Several states furloughed their employees to reduce expenditures.

This paper explores the effect of furloughs on public employees as a public budgeting concern with specific attention paid to the responsiveness of furloughed employees. Specifically, I first use several approaches to study the effect of mandatory furloughs on employee separation rates. Second, I investigate whether public sector agencies whose employees are subject to furloughs show evidence of difficulty in rehiring and whether post-furlough rehires were paid differently than their predecessors. Finally, variation in the intensity of furlough exposure is used as a source of exogenous variation in pay to estimate public employee labor supply elasticities. To investigate these questions, an administrative employee dataset obtained from California allows verification of identification assumptions and enables causal inferences about the effect of mandatory furloughs on the public sector workforce.

Survival model estimates show that furloughed employees exit state employment after the furlough more quickly than a control group of exempt employees within the same occupational class categorized by bargaining unit. I find some evidence from an event study of furloughed and exempt employees that the furlough caused increased current-year separation rates among the treatment group after exposure, although most post-furlough point estimates are not statistically different from zero. Using a differences-in-differences regression built on the survivor model framework, I find causal evidence of increased employee separation among furloughed employees after exposure to the furlough. I also find that the furlough had no effect on the ability of the public agencies to fill vacancies left by employees that separated after the furlough. There is some evidence that employees hired after the furlough period received lower pay than their predecessors, but most post-furlough point estimates are not statistically different from zero. Finally, results from two-stage least squares regression shows that employee separation elasticities are low, especially in the short run, suggesting that public employees prefer to cope with the furloughs as a "shared pain" strategy rather than pursue alternative employment opportunities.

Labor expenditure savings can be decomposed into two sources: Reduced payroll expenses arising from the separation of employees vacating their positions and from retained employees that accept the furlough-induced wage reduction. From the perspective of a supply and demand framework, the furlough-induced elasticities correspond with the inelastic range of the labor supply curve, suggesting that the state may have some monopsony power to temporarily reduce payroll costs without facing an exodus of its workforce. Using estimates of post-furlough separation rates by bargaining unit, I find that employees in most bargaining units were not responsive to the furlough regardless of furlough intensity, but the state nonetheless

furloughed some highly sensitive bargaining units more intensively than others. If public employees are insensitive to furloughs in their decisions to remain employed with state government, then they may be a reasonable expenditure-reduction option during fiscal crises. This research contributes to the cutback management literature by assessing the use of furloughs as a public budgeting and human resource management tool to confront budget constraints. This research implements empirical methods conducive to causal inference of the impact of furloughs on public sector employees using administrative data on employee pay and separations by bargaining unit. This contribution supplements the furlough-focused cutback management literature discussed in the following section.

This paper proceeds as follows: The following section reviews the extant literature that investigates the behavioral responses of affected employees to furlough exposure. I then discuss the context of the post-Great Recession furlough program implemented in California and the features of the administrative employee dataset that permits causal inference. Empirical models are introduced and justified, and their results are discussed. I conclude with discussion focused on the separation elasticity of public sector employees using labor supply graphs to motivate the results.

3.2 Literature Review

Scholarly investigations of the impact of furlough programs on employees are undertaken in the psychology and the public/private management literatures, and some appear in field journals related to specific professions, such as social work. These studies use survey instruments to investigate the attitudes of employees about their employers and measure other psychological responses, such as job satisfaction and turnover intention, after exposure to a furlough program.

Critics of mandatory employee furlough programs in the public sector argue that they negatively affect the quality of public services, impose psychological costs on affected employees, and result in other unintended costs such as the accumulation of vacation leave balances (California Legislative Analyst 2013; Johnson, Oliff, and Williams 2011). Another criticism of mandatory employee furloughs relates to the possibility that a furlough-induced pay reduction may motivate affected employees to separate with public employment to pursue more lucrative opportunities in the private sector. Because state employee wages and benefits are one of the largest expenditure items in state general fund budgets, they often draw scrutiny from budget directors and policy makers charged with developing strategies that restore fiscal balance. There is a perception shared among policy makers and public employees that mandatory furloughs are a "compassionate" response because they impose the least psychological burden on affected employees while keeping an agency's workforce intact as a means of temporarily reducing expenditures as necessary to muddle through the deficit period. Furloughs may offer other benefits, such as increased leisure (Green 2009).

California's mandatory furlough program is the focus of several studies that investigate its impact on employees within the context of the California State University (CSU) system. Jones et al. (2014) surveyed 114 faculty members in CSU's various social work departments subject to the furlough program. Unlike furloughs for employees working in state agencies, they find that furloughs increase faculty workloads arising from increased student to teacher ratios at the expense of service obligations to the community and the university. Because tenure requirements were not modified for junior faculty, many chose to pursue research on furlough days. Their survey results do not indicate whether furloughs induced any faculty members consider separating employment with the CSU system. Pelletier, Kottke, and Reza (2015) test the

organizational attachment of CSU faculty, staff, and administrators. They find differing impacts on how furloughs affect attachment to the organization, and the authors argue that perceived organization membership is an important predictor of turnover intention.

Osborne, Smith, and Huo (2012, 637) investigate mandatory furloughs among 953 CSU university faculty members from a psychological perspective. Among other emotional responses to furloughs, they find evidence that furloughed faculty members "made plans to leave their jobs." Huffman et al. (2022, 2818) surveyed faculty and staff at two public universities in different states whose employees were subject to COVID-19 pandemic-era furloughs. Turnover intention was included among the items on the post-furlough iteration of their survey. A key result of this component of their survey research indicates that in cases of low distributional justice, employees were "more likely to report psychological contract breach perceptions, and important component in the turnover intentions process."

The following studies use survey instruments to investigate the impact of furloughs on public employees at all levels of government. Lee and Sanders (2013) surveyed 273 furloughed state employees in Georgia about their reaction to its furlough program. Their findings show that while furloughed employees believe the program diminished their personal finances and sense of job satisfaction, they found that the furlough program was a "reasonable policy" that prevented layoffs while preserving the workforce of each agency. They conclude, "There appears to be no superior alternative during cutbacks" (Lee and Sanders 2013, 309). Baranik et al. (2019) survey 212 federal employees subject to federal shutdown-related furloughs who reported having experienced decreased life satisfaction, burnout, and increased work-family conflict. Survey respondents were not asked about intention to quit arising from these personal resource losses, but the authors make recommendations to organizations subject to furloughs to help their

employees cope with resource losses. Kim (2019) uses a survey-based experimental approach to study how county health and human services agency leaders would respond to hypothetical fiscal stress scenarios of varying severity. They find that managers who confront major resource constraints are more likely to implement salary freezes, adjusted work hours, service cuts, furloughs, and reduced retirement contributions as preferred methods of cutbacks.

Zvonicek (2012) finds that the 173 California disability determination employees they surveyed continued to feel upbeat about their jobs and the agency's mission despite the furloughs. Adams-Prassl et al. (2020) survey the responses of furloughed public sector workers in the United Kingdom during the COVID-19 pandemic. They find that furloughed employees were more pessimistic about keeping their existing jobs and were more likely to spend their time looking for new jobs while furloughed. Bedeian and Armenakis (1998) argue that the most talented furloughed employees take advantage of the opportunity to search for new jobs while off the clock at home which leaves organizations at the mercy of lesser-skilled or talented employees, an effect they call the "cesspool syndrome."

3.3 California's State Employee Furlough Program

Like many states during the Great Recession and its aftermath, California implemented a mandatory employee furlough program to reduce expenditures amid a $40 billion general fund budget deficit estimated for the FY 2009/2010 biennium. California's biennial budget was initially enacted in September 2008 with further adjustments to appropriations enacted on February 20, 2009, and July 28, 2009. Actual revenue collections for the year were 18% below the state's revenue forecast three months after FY 2009 began (California Legislative Analyst 2009). Some remedies to the budget deficit pursued by the California Legislature included the

use of federal stimulus funds, allocations from a November 2006 bond issue, tax rate increases and base expansions, expenditure and revenue timing shifts, and cash management techniques, such as IOUs. The California Legislative Analyst (2013) estimated that the furlough program would contribute $3 billion in savings to reduce the biennial budget deficit.

Although it may be seen as an egalitarian way to cut labor costs while reducing the threat of layoffs, the furlough program introduced and supported by Gov. Schwarzenegger was subject to numerous lawsuits initiated by California state employee organizations. Ultimately, the California Supreme Court ruled that the governor had the administrative authority to implement the program, which took effect on February 1, 2009. All applicable employees were initially subject to two furlough days per month, and an additional furlough day per month was added in July 2009 pursuant to Proposition 58 which declared a fiscal emergency (California Legislative Analyst 2009). The three day per month furlough implies a 13.9% pay cut for affected employees (California Legislative Analyst 2009). Employees were subject to the furlough schedule as shown in Table 3.1. Furloughed employees were required to exhaust all furlough obligations before accessing paid vacation time.

Employees were assigned to furlough schedules according to the collective bargaining unit associated with the employee's job classification. About 11% of California state employees were exempt from the furloughs. Exempt employees include rank-and-file positions that are covered by the following bargaining units: Craft and maintenance workers; physicians, dentists, and podiatrists; psychiatric technicians; and health and social services professionals. Management and supervisory employees within these bargaining units were subject to 28 furlough days in 2009 and 27 days in 2010. Therefore, dentists with supervisory job classifications were subject to furlough while rank-and-file dentists were exempt. Both types of

dentists face similar outside job opportunities in the private sector and therefore face a similar propensity to separate their employment with state government. Therefore, the decision to separate is exogenous to the job classification but instead is induced by furlough-induced pay reductions. This is the key identification assumption that underlies the empirical models in the following section.

The data set necessary to investigate the research questions addressed in this paper was obtained from the California State Controller's Office (SCO) through a Public Records Act request. The California SCO provided an administrative payroll dataset that includes all employee records on a calendar year basis from 1998-2021, totaling about six million panel observations. The dataset includes the following variables that are relevant to the empirical models specified below: Employee name, agency, total gross pay, county of employment, year, job classification, and bargaining unit. Although the dataset does not include a unique identifier for each employee, the inclusion of the first, last, and middle initial of each employee and their work county in the dataset uniquely identifies 97% of all California state employees. Duplicate observations for employee name, work county, and year were dropped. Employees with intermittent and part-time status were also dropped from the analysis as these employees are more likely to separate due to the temporary duration of their employment.

3.4 Empirical Models

To study the effects of mandatory furloughs on the public sector and its employees, I implement several empirical methods, including a Cox proportional hazards model and a related differences-in-differences approach, event studies, and two-stage least squares regressions. The identification strategy is implemented by comparing separation rates, new hires, and their pay

rates among employees within the same bargaining unit but with differential furlough treatment. Because similar occupations are bundled within each bargaining unit, employees in each unit access similar outside job opportunities and exhibit similar propensity for exit while certain employees are subject to exogenous furlough-induced variation in pay. As displayed in Table 3.1, there are four bargaining units in which rank-and-file employees were fully exempt from furlough exposure, while managerial and supervisory employees in those units were subject 28 furlough days in 2009 and 27 days in 2010. To reduce heterogeneity among members of the control group and to permit the cleanest identification possible, the remaining clusters of employees in other bargaining units are omitted from this analysis. Therefore, the separation rates of furloughed dentists and other affected occupation groups pre- and post-treatment are compared to the control group separation rates of their furlough-exempt peers, as opposed to the separation rate of dentists relative to firefighters that participate in different labor markets.

An important concern related to the long-term consequences of the mandatory furlough program is whether furlough-induced pay reductions motivate affected employees to reconsider their commitment to public sector employment. Because the purpose of the furlough program is to reduce expenditures on employee salaries for budgetary purposes, furloughed employees may respond by considering more lucrative job opportunities in the nonprofit and/or private sectors. The longitudinal structure of the administrative dataset permits observation of individual employee exit rates between implementation of the furlough in 2009 and 2020, the year before the end of the data series.

3.4.1 Furlough Impact on Post-Period Employee Separations

Two approaches are taken to study whether the furlough program caused affected employees to

depart public sector employment after exposure relative to exempt employees. First, a Cox proportional hazards model is implemented. Survival analysis is well-suited to meet the empirical challenges of event time data in the context of modeling employee turnover (McCloy, Purl, and Banjanovic 2019). Within the four bargaining units specified above, the dataset is restricted to a cohort of 26,641 employees observed as employed in 2008, the year before the furlough program was announced. This approach eliminates the incidence of "late entry" among employees hired after 2008 (McCloy, Purl, and Banjanovic 2019). A time-to-exit variable is constructed which indicates the number of years after 2008 each employee remains employed. Covariates in the Cox proportional hazards regression include the number of years of each employee's pre-furlough tenure left-censored in 1998, a dichotomous furlough treatment variable, and the log of each employee's pay in 2008.

This approach, however, does not reveal whether rank-and-file employees separate from employment at elevated rates relative to supervisors despite the furlough. To address this limitation, a differences-in-differences approach is established on this cohort-based survival analysis foundation. Two cohorts of employees are constructed: One snapshot of employees observed in 1998 is observed through 2007, and a second 2008 post-period cohort is observed through 2017. Each cohort is restricted to employees observed as employed in 1998 and 2008, and a "post" dummy variable is coded to equal one for members of the 2008-2017 cohort. The panel for each cohort is balanced by a rectangular transformation of the dataset. A dummy variable "*exit*" is encoded to equal one for years after the employee exits employment, which becomes the dependent variable in the regression specified below. Employees assigned to furlough-affected bargaining units are assigned a "treat" dummy variable equal to one in both pre- and post-furlough cohorts. The differences-in-differences regression model is given by:

$$exit_{it+1} = \alpha + \sum_{j=2}^{10} \beta_j \, eventyear_{it} + \sum_{j=2}^{10} \beta_j \, eventyear_{it} * treat_{it} + \sum_{j=2}^{10} \beta_j \, eventyear_{it} * post_{it} + \sum_{j=2}^{10} \beta_j \, eventyear_{it} * treatpost_{it} + \varepsilon_{it} \quad (3.1)$$

The goal of the differences-in-differences approach is to estimate the treatment effect on the treated. Specifically, the coefficient on the *treatpost* by event year interaction gives the causal effect of the furlough on employee separation rates on furloughed employees in the post-period. Differences-in-differences solves the problem that the control group might separate at higher rates than the control group despite the furlough. Therefore, the method subtracts away the difference in pre-period separation rates on the treated versus control employees. See Figure 3.2 for a graphical demonstration of the intuition behind this approach.

The differences-in-differences regression meets the assumptions of this framework that permit causal identification. The composition of treatment and control groups remains stable through the pre- and post-furlough periods because the employee classification scheme remains constant across both periods. There are no spillover effects given the timing of the 2008 cohort because the furlough was announced in February 2009. Therefore, treated employees would not have had the opportunity to anticipate the furlough and quit before exposure to treatment. However, it is worth noting that this approach differs from the typical differences-in-differences setup due to the cohort-based framework.

3.4.2 Furlough Impact on Public Agencies

Next, I implement event studies based on a differences-in-differences regression framework to estimate the causal relationship between furlough exposure, post-furlough hiring rates, and pay rates for new employees hired after the furlough period. The motivation behind the use of event studies is to observe whether there is a significant difference between the treated and control groups before and after furlough exposure with respect to workforce composition and new employee pay. Identification requires no difference in pre-period separation rates between the two groups pursuant to the parallel trends assumption. For example, if furlough-affected employees anticipate the furlough and separate before the program is initiated, this would likely violate the parallel trends assumption. If a break in trends is observed between the treatment and control groups after furlough exposure, then it can be inferred that the furlough caused a significant difference in post-period hiring or pay for new employees.

Did hiring managers presiding over the furloughed bargaining units rehire at a rate necessary to refill these vacant positions after the furlough? This question is investigated by implementing an event study using the logged ratio of newly hired employees to total employees observed in year t subject to bargaining unit i which serves as the dependent variable. The event study investigates whether the furlough program resulted in unintended consequences for post-furlough hiring, such as creating a potential stigma associated with working in the furlough-prone public sector. The event study is capable of revealing effects on the "stock" of experienced employees while investigation of turnover rates permits investigation of the flow of employees out of an agency. It is possible that an initial exodus of employees from an affected bargaining unit that are not replaced may result in low downstream turnover rates. A second event study investigates whether a significant difference emerged between the treated and control groups

with respect to the log of average pay after the furlough program. The event study for the log of average pay in bargaining unit i in year t is the dependent variable and whose results are shown in Figure 3.6 and discussed in the following section.

The event studies were estimated with the user-written *eventdd* command in Stata (Clarke and Tapia-Schythe 2021). The models were fit using high-definition fixed effects (HDFE) regression where fixed effects are absorbed at the year and bargaining unit levels, and robust standard errors were clustered at the bargaining unit level as treatment assignment depends on each employee's bargaining unit. The general form of the event study model adapted from Clarke and Tapia-Schythe (2021) is specified below:

$$y_{it} = \alpha + \sum_{j=2}^{10} \beta_j (Lead\ j)_{st} + \sum_{k=0}^{11} \beta_k (Lag\ k)_{st} + \mu_i + \lambda_t + \varepsilon_{it} \tag{3.2}$$

where y_{it} is one of two dependent variables (logged ratio of bargaining unit new hires or logged average bargaining unit pay per year), a series of ten lag and eleven lead coefficients estimated before and after treatment, and bargaining unit and time fixed effects, μ_i and λ_t, respectively.

3.4.3 Separation Elasticity of Furloughed Employees

An instrumental variables approach is used to control for exogenous variation in employee pay resulting from furlough exposure to estimate the separation elasticity of California's state employees. This approach reveals the causal effect of a furlough-induced pay cut on separation rates. A dependent dichotomous variable is constructed that equals one if employee i separates from employment in year t. To focus more closely on the period surrounding the furlough program, the dataset was restricted to the years 2006-2013.

Because each employee's bargaining unit was assigned to a specific furlough schedule, the bargaining unit variable enables observation of the intensity at which the employee was subject to mandatory unpaid leave during the furlough period. According to each employee's bargaining unit, a separate numeric variable was encoded that measures the number of furlough days each employee was exposed to each year which is displayed in Table 3.1. Additional dependent variables indicating separation for years $t + 1$, $t + 2$, and $t + 3$ were encoded to equal one if the employee separated within the given number of years after exposure to the furlough program. An employee is coded as having separated if the individual exits the dataset before 2021, at which point the data is right censored. A "maximum year" variable is coded for each employee that indicates the last year the employee is observed in the dataset. Lateral moves of employees across agencies are not defined as separation.

The two-stage least squares regression to estimate employee separation elasticity is implemented with the following specification:

$$\text{First stage: } \ln(totalpay)_{it} = furloughexposure_{it} + \gamma_i + \varepsilon_{it} \quad (3.3)$$

$$\text{Second stage: } Separation_{it} = \ln(\widehat{\text{totalpay}})_{it} + \gamma_i + \varepsilon_{it} \quad (3.4)$$

It is ideal to implement an instrumental variable approach because the determinants of employee pay are likely correlated with unobserved factors residing in the error term that also influence the decision to separate. This would otherwise result in a biased estimate of separation rates. Because individual employees had little influence over the decision to implement a furlough program, it presents an opportunity to investigate the sensitivity of affected employees to an exogenous shock to their pay induced by the furlough. The instrumental variable is coded as the intensity of furlough exposure for employee i in year t according to the furlough schedule shown

in Table 3.1. Therefore, employees subject to the various furlough schedules were exposed to treatment in the form of furlough-induced reduced pay. A low separation elasticity may indicate a willingness on the part of the employee to "muddle through" the furlough period if the employment arrangement is otherwise agreeable to them or if they hesitate to separate due to some degree of path dependence.

A second two-stage least squares regression, specified below, is implemented to test whether the public sector exploits its monopsony power among bargaining units that exhibit low separation elasticity. The instrument is replaced with *furloughcost*, which measures the average pay reduction arising from the various degrees of furlough exposure confronted by each employee between 2009-2013, which is the full span of years the furlough was in effect. The results of this regression, which is run for each bargaining unit, is displayed in Figure 3.10.

$$\text{First stage: } \ln(totalpay)_{it} = \alpha \ln(furloughcost)_{it} + \gamma_i + \varepsilon_{it} \quad (3.5)$$

$$\text{Second stage: } Separation_{it+1} = \beta \ln(\widehat{\text{totalpay}})_{it} + \gamma_i + \varepsilon_{it} \quad (3.6)$$

3.5 Results

3.5.1 Survival Analysis Results

The Cox proportional hazards model results, displayed in Table 3.3, show evidence that furloughed employees exit state employment faster than their furlough-exempt colleagues. The hazard ratios indicate that employees subject to furlough were 1.3 times more likely to exit state employment also contributed to the speed of exit, although it is likely that some part of this effect may be attributable to retirements. As expected, as the log of employee pay increases, the speed of employee exit decreases. Testing the proportional hazards assumption results in a chi-squared

statistic of 70.88 and a p-value of 0.000, which means the null hypothesis of zero slope is rejected. Failure to reject the null would violate the proportional hazards assumption. However, one weakness with this approach is that it does not indicate whether the furloughed employees would separate from public employment at a faster rate despite the furlough, and this limitation is addressed with the differences-in-differences approach presented in the following section.

The Kaplan-Meier survival time estimates are displayed in Figure 3.1, where the y-axis in the graph shows the fraction of employees retained over time, starting with a baseline of 100% in 2008. An interesting result is that the Kaplan-Meier estimates show the steepest reductions in furloughed employee retention during the five years within the first exposure to the furlough, although it is also likely that the effect of the furlough on separation would be negligible several years after it was implemented. By the end of the analysis period in 2020, about 32% of the 2008 cohort of furloughed employees remained employed with California state government.

3.5.2 Cohort Differences in Differences Regression Results

Results from the cohort-based differences-in-differences specification are displayed in Table 3.4 and Figure 3.3. Individual employees are the unit of observation in this analysis. While Table 3.4 shows the full set of coefficients from the regression, Figure 3.3 graphs the coefficients and 95% confidence intervals of the *treatpost* coefficients. Although the results for separation rates three and four years after the first exposure to the furlough are not statistically significant, the *treatpost* coefficients show a treatment effect of a five percent increase in separation rates among the treated employees. The *treatpost* coefficient indicates the difference between observed and counterfactual exit rates among treated employees. The coefficients are significant at the one percent level. It is worth noting that employees that separate in 2009 or 2010 had not been fully

exposed to the entire duration of the furlough program, which ended in 2010 for treated employees in the 2008-17 cohort.

3.5.3 Agency Furlough Impact Event Study Results

In each of the following event studies, the unit of observation is each employee bargaining unit by treatment status. Event studies evaluating bargaining unit-level separation rates shows that the furlough program caused some increase in separation rates, but most point estimates of the lag coefficients are not significantly different from zero. The coefficients of all event study leads and lags are graphed in Figure 3.4, which indicates whether there is any divergence in the dependent variable, same-year separation, after treatment among the furloughed employees. Investigations of parallel trends before the furlough indicates that there is no statistically significant difference in separation rates between the furloughed and exempt bargaining units, a necessary condition for causal inference. The only significant point estimate after treatment is found two years after the furlough is implemented, indicating that there is some evidence that the furlough caused increased separation rates among the furloughed bargaining units relative to separation rates of the exempt group. However, most post-furlough point estimates are not statistically significant from zero at a 95 percent confidence interval. This result raises questions as to whether the separation of furloughed employees after treatment altered the composition of the public sector workforce by retaining career employees who are relatively less likely to separate from state employment after the furlough. If so, the result of this effect may decrease post-furlough separation rates.

There is no evidence that the furloughs caused difficulty for hiring managers to fill vacant furlough-affected positions after the furlough period. The results of this event study are graphed

in Figure 3.5, which shows the logged ratio of new hires to incumbent employees in each bargaining unit by treatment status. Observation of parallel trends show that all pretreatment point estimates are not statistically different from zero. The post-treatment point estimates show some uptick in the rate of new hires after the furlough, but in most cases, the point estimates are not statistically different from zero at the 95 percent confidence interval. Because the previous analysis showed little difference in separation rates between the two groups after treatment, it is possible that the furlough-affected bargaining units are increasingly composed of employees that are least likely to exit even when faced with the furlough, given that there is no significant increase in the ratio of new to incumbent employees in the post-furlough era.

New employees hired into furlough-affected bargaining units were paid less than their predecessors after the furlough period. The comparison focuses on the difference between the ratio of new employee pay to incumbent pay in the pre- and post-periods. The point estimates show that the logged ratio of new employee pay to incumbent pay decreased in furloughed units after exposure to treatment, but most of these point estimates are not significantly different from zero, except in the case of four years after the beginning of furlough treatment. The noisy results of both event studies are likely due to the small number of bargaining units as the unit of observation reduced statistical power.

To summarize the event study results, after implementation of the furlough program, some evidence of increased separation rates in the furloughed bargaining units is found, but most point estimates are not significantly different from zero. The furloughed bargaining units saw somewhat of an increased logged ratio of new employees to existing employees and reduced logged pay, but most point estimates are not statistically significant. Within the context of the Great Recession, managers hiring to replace separated employees in furloughed bargaining units

did not need to offer replacement hires higher wages to fill vacancies, which may indicate that public knowledge of the furlough program did create headwinds in recruiting new hires in the post-furlough period. This may be due to a lack of alternative employment possibilities in the private and nonprofit sectors in the aftermath of the Great Recession. In a more robust labor market, hiring managers may need to offer higher wages to prospective employees when facing greater competition.

3.6 Discussion

The results presented in the previous section show that furloughs cause some increase in separation rates among treated employees after furlough exposure, but most of the post-period point estimates are not statistically different from zero. Furloughs do not meaningfully cause headwinds in hiring to fill vacant positions after the furlough period. There is also evidence that the logged ratio of new employee to incumbent pay in furlough-affected bargaining units diverges in a negative direction after the furlough period.

Are public employees responsive to a furlough-induced exogenous shock to their wages? Table 3.5 displays the first stage results of the instrumental variables regression that shows a significant negative relationship between the instrumental variable, intensity of furlough exposure, and the log of total employee pay, particularly in specifications absorbing fixed effects at the employee level. Table 3.6 displays the second stage results of the instrumental variables regression. In both the first and second stage results, omitting fixed effects at the employee level results in coefficients that are less statistically significant, and in the case of the second stage results, the sign of the coefficient flips between years, which is not intuitive. Therefore, preferred specifications include employee fixed effects as opposed to bargaining unit fixed effects. The

estimates of separation elasticity increase when the span of years after furlough exposure is increased, which is intuitive given that furloughed employees are more flexible in considering alternative employment arrangements in the long run. However, the coefficient associated with separation within three years is smaller than the ascending nature of the coefficients of same-year separation, separation within one year, and separation within two years.

Evaluation of the furlough policy from a labor supply and demand framework reveals two sources of labor expenditure savings after the furlough: reduced payroll expenditures arising from separated employees, and temporary furlough-induced pay reductions for employees who do not separate. The short-run separation elasticity discussed above shows that a one percent reduction in pay results in a 0.33 percent increase in separation rates. Multiplying the separation elasticity by -2 results in a labor supply elasticity of about 0.7, which implies that the labor supply response of public sector workers to the furlough is inelastic (Bassier, Dube, and Naidu 2022). In the longer run, the absolute value separation elasticity estimates increase to about 0.85, implying a labor supply elasticity of about 1.7. These short- and long-run labor supply elasticities imply a reduced slope of the labor supply curves for public sector workers over time as demonstrated in Figure 3.7.

Figure 3.7 shows two labor supply curves: One inelastic labor supply curve labeled S_I, and a relatively flatter and more elastic labor supply curve labeled S_E. Before the furlough, the public sector wage rate was W which attracted L units of labor supply, resulting in labor expenditure WL. When the furlough program is implemented, the wage rate faced by furloughed employees falls to W_F and labor expenditures are reduced to the product $W_F L_{IF}$ and $W_F L_{EF}$ for the cases of inelastic and elastic labor supply, respectively. Although the hourly wage rate itself is not directly reduced by the furlough program, the furlough reduced total annual earnings for

most furloughed employees by 13.9% in 2009 and 2010 when the program was in effect. The sensitivity of labor supply decisions before and after the furlough is shown on the X-axis of the graph.

Along the inelastic labor supply curve S_I, as the wage rate falls from W to W_F, the quantity of labor supplied falls from L to L_{IF} after the furlough begins, with the reduction of the quantity of labor supply given by the difference $L - L_{IF}$. However, the same reduction in the wage rate from W to W_F implies a larger reduction in the quantity of labor supplied along the elastic supply curve, which decreases from L to L_{EF}, the quantity of labor supply associated with furlough-induced wage rate W_F. Given that the difference in labor supply elasticities, $L - L_{EF} > L - L_{IF}$.

The labor expenditure savings arising from the change in the quantity of labor supplied given wage rate reduction W to W_F can be decomposed into two categories: employee separations and from temporarily reduced pay to retained employees that tolerate the furlough. The latter of which is an indicator of monopsony power on the part of the public sector as an employer. As shown in Figure 3.8, according to inelastic labor supply curve S_I, a reduction in the wage rate from W to W_F implies savings equal to region a arising from lower wages paid to retained workers and region c arising from separated workers no longer on the payroll. The public sector as an employer exerts less monopsony power when it faces the elastic supply curve S_I. Under circumstances of elastic labor supply, demonstrated in Figure 3.9, the public sector saves expenditures arising from region a from retained workers paid the reduced furlough wage W_F, while region c is associated with expenditure reductions arising from employee separations. Since the monopsony power of the public sector diminishes in the long run, the use of furloughs to balance budgets may be seen as a short-term remedy for budget deficits.

Figure 3.10 presents additional analysis of the monopsony power of the public sector as an employer. The x-axis of the scatterplot represents the elasticity of employee separation by bargaining unit. All bargaining units are included in the analysis, and the unit of observation is employee. Separation elasticities by bargaining unit are estimated using the same instrumental variables specification approach presented earlier in which the intensity of furlough exposure serves as the instrumental variable and the log of employee pay is instrumented. The y-axis measures the average reduction in pay by bargaining unit over the period 2009-13, which accommodates for the prolonged nature of some furlough schedules. The results plotted in Figure 3.10 show that over the 2009-19 period, most employees were subject to an average pay reduction of about five percent with minimal separation elasticity. However, there are some noteworthy exceptions, such as furloughed engineers and law enforcement officers, who responded to the furloughs with large rates of separation after exposure. Among the least responsive to the furlough were rank and file and managerial support staff, engineering and scientific technician supervisors, rank-and-file medical and social services staff, and corrections supervisors, whose bargaining unit separation elasticities are close to zero despite the furlough.

3.7 Conclusion

The goal of this research is to assess the feasibility of pursuing mandatory employee furloughs as a mechanism to reduce expenditures as a part of a budget balancing strategy. I find some evidence that furloughs cause increased separation rates among treated employees after treatment. However, the evidence does not suggest that furloughs tarnish the desirability of the public sector as a destination for employment after furloughs are implemented, although this result is likely sensitive to the state of the business cycle. In the short run, public sector employees are not especially sensitive to furloughs, and most choose to stay despite the furlough,

even under circumstances implying a 13.9% annual pay cut during years when the furlough is in effect.

There are some limitations to this research and some opportunities to improve upon its results. One approach may include using the California case as treated units and compare its pre- and post-treatment outcomes to a state that did not implement a furlough during the Great Recession era. Further investigation of public sector furloughs may gain statistical power from this approach. In this case, greater specificity in the sensitivity of certain occupations to furloughs could be achieved. Because 89% of all California state employees were subject to some furlough of various intensities, it would be instructive to investigate how those separation elasticities vary for occupations beyond those that were exempt in California's furlough program.

Future research should investigate more closely the extent to which the public sector can exercise monopsony power over certain occupations. Does the sensitivity to furlough exposure and propensity to separate explain the variation in the intensity of furlough treatment of various clusters of occupations? If so, this may result in some evidence that explains whether states are able to exercise monopsony power by exercising the most intensive furloughs on employees least likely to separate. However, this approach is likely to draw criticism related to inequity, especially considering the "shared pain" argument that often attends the argument to impose furloughs as a "humanitarian alternative" to layoffs.

Table 3.1: California Furlough Schedule

Bargaining Unit	Applicability	Furlough Days				
		2009	2010	2011	2012	2013
Professional, Administrative, Financial, and Staff Services	All employees	28	27	0	0	0
Attorneys and Hearing Officers	Management/Exempt	28	27	0	0	0
	Rank and file	28	33	12	0	0
Professional Educators and Librarians	All employees	28	27	0	0	0
Office and Allied	All employees	28	27	0	0	0
Highway Patrol	All employees	28	33	12	6	6
Corrections	Management/Exempt	28	27	0	0	0
	Rank and file	28	33	12	0	0
Protective Services and Public Safety	Management/Exempt	28	27	0	0	0
	Rank and file	28	33	12	0	0
Firefighters	All employees	28	33	12	6	6
Professional Engineers	Management/Exempt	28	27	0	0	0
	Rank and file	28	18	0	0	0
Professional Scientific	Management/Exempt	28	27	0	0	0
	Rank and file	28	33	12	0	0
Engineering and Scientific	All employees	28	27	0	0	0
Craft and Maintenance	Management/Exempt	28	27	0	0	0
	Rank and file	0	0	0	0	0
Stationary Engineers	Management/Exempt	28	27	0	0	0
	Rank and file	28	18	0	0	0
Printing and Allied Trades	All employees	28	27	0	0	0
Allied services	All employees	28	27	0	0	0
Physicians, Dentists, Podiatrists	Management/Exempt	28	27	0	0	0
	Rank and file	0	0	0	0	0
Registered Nurses	All employees	28	27	0	0	0
Psychiatric Technicians	Management/Exempt	28	27	0	0	0
	Rank and file	0	0	0	0	0
Health and Social Services	Management/Exempt	28	27	0	0	0
	Rank and file	0	0	0	0	0
Medical and Social Services	All employees	28	27	0	0	0
Educational Consultants and Library	All employees	28	27	0	0	0

Source: California Department of Human Resources. Obtained from https://hrmanual.calhr.ca.gov/ManualItem/HistoricalView/1/80?date=02%2F06%2F2018%2006%3A23%3A52

Table 3.2: Descriptive Statistics: 2008 Cohort of Furloughed and Exempt Employees

Variable	Furloughed	Exempt
N	3,412	23,229
Mean survival time after treatment (years)	6.13	7.30
Mean pre-furlough job tenure (years)	8.50	5.92
Mean pay in 2008	$85,813	$57,870

Table 3.3: Survival Analysis Regression Table

Variable	Haz. ratio	Std. err.	z	P>z	[95% conf.	interval]
Furlough Exposure	1.296	0.028	11.33	0.000	1.239	1.356
Years of Tenure Before 2009	1.060	0.002	25.59	0.000	1.055	1.064
Log of Total Pay	0.931	0.012	-6.01	0.000	0.909	0.953

Table 3.4: Cohort Differences-in-Differences Regression Results

Dependent Variable: Current Year Separation Rate

Interaction Term	Coefficient	Std. Err.
2.eventyear	0	(.)
3.eventyear	0.0695***	(0.0045)
4.eventyear	0.1408***	(0.0045)
5.eventyear	0.2195***	(0.0045)
6.eventyear	0.2543***	(0.0046)
7.eventyear	0.2995***	(0.0046)
8.eventyear	0.3586***	(0.0046)
9.eventyear	0.4154***	(0.0046)
10.eventyear	0.4557***	(0.0046)
2.eventyear#1.treat	-0.0063	(0.0087)
3.eventyear#1.treat	-0.0262**	(0.0084)
4.eventyear#1.treat	-0.0203*	(0.0081)
5.eventyear#1.treat	-0.0395***	(0.0080)
6.eventyear#1.treat	-0.0303***	(0.0079)
7.eventyear#1.treat	-0.0401***	(0.0078)
8.eventyear#1.treat	-0.0598***	(0.0076)
9.eventyear#1.treat	-0.0738***	(0.0075)
10.eventyear#1.treat	-0.0810***	(0.0074)
2.eventyear#1.post	0.0065	(0.0044)
3.eventyear#1.post	0.0174***	(0.0044)
4.eventyear#1.post	0.0203***	(0.0044)
5.eventyear#1.post	-0.0052	(0.0044)
6.eventyear#1.post	0.0107*	(0.0044)
7.eventyear#1.post	0.0297***	(0.0044)
8.eventyear#1.post	0.0233***	(0.0045)
9.eventyear#1.post	0.0176***	(0.0045)
10.eventyear#1.post	0.0189***	(0.0045)
2.eventyear#1.treatpost	0.0051	(0.0118)
3.eventyear#1.treatpost	0.0200	(0.0114)
4.eventyear#1.treatpost	0.0196	(0.0112)
5.eventyear#1.treatpost	0.0509***	(0.0110)
6.eventyear#1.treatpost	0.0510***	(0.0109)
7.eventyear#1.treatpost	0.0457***	(0.0107)
8.eventyear#1.treatpost	0.0433***	(0.0105)
9.eventyear#1.treatpost	0.0452***	(0.0104)
10.eventyear#1.treatpost	0.0454***	(0.0102)
Constant	0.0849***	(0.0032)

N=446,688. Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 3.5: First Stage Instrumental Variables Results

	Total Pay (ln)		
Furlough Exposure	-0.000896***	-0.000112*	-0.000949***
	(0.0000358)	(0.0000450)	(0.0000357)
Employee FE	Yes	No	Yes
Bargaining Unit FE	No	Yes	Yes
Observations	1,692,426	1,724,489	1,692,420

Standard errors in parentheses

* p<0.1 ** p<0.01 *** p<0.001

Table 3.6: Second Stage Instrumental Variables Results

	Total Pay (ln)		
Sep $t = 0$	-0.351***	1.430*	-0.333***
	(0.0167)	(0.638)	(0.0153)
Sep $t + 1$	-0.708***	0.584	-0.668***
	(0.0304)	(0.339)	(0.0273)
Sep $t + 2$	-0.865***	-0.887*	-0.814***
	(0.0378)	(0.366)	(0.0339)
Sep $t + 3$	-0.686***	-1.519*	-0.642***
	(0.0332)	(0.606)	(0.0298)
Employee FE	Yes	No	Yes
Bargaining Unit FE	No	Yes	Yes
Observations	1,692,426	1,724,489	1,692,420

Standard errors in parentheses
* p<0.1 ** p<0.01 *** p<0.001

Figure 3.1: Kaplan-Meier Survival Estimates, Furloughed (A) versus Exempt (E) Employee Bargaining Units

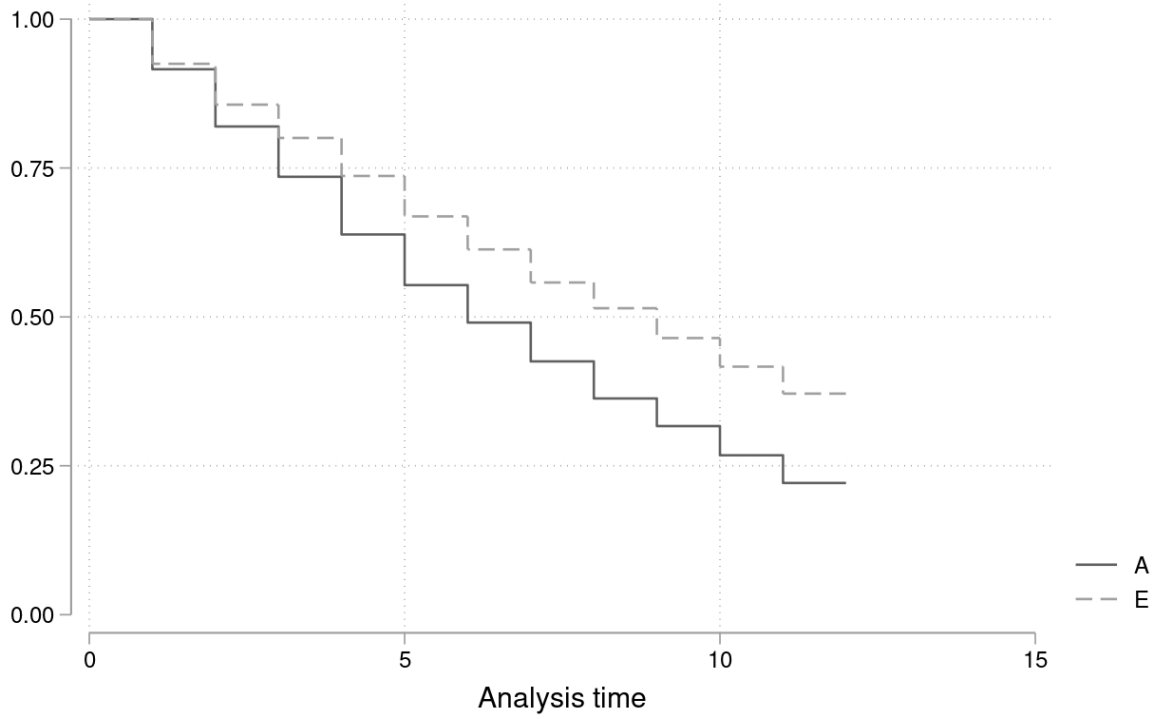


Figure 3.2: Cohort-based Differences-in-Differences Framework

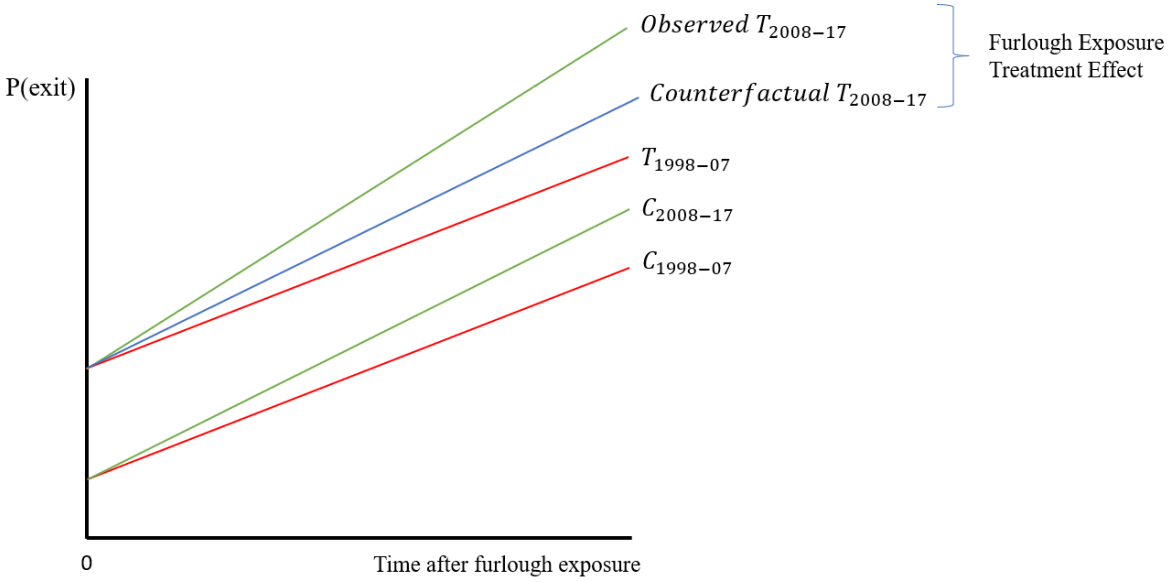


Figure 3.3: Cohort Differences-in-Differences Post x Treat Coefficient Plot

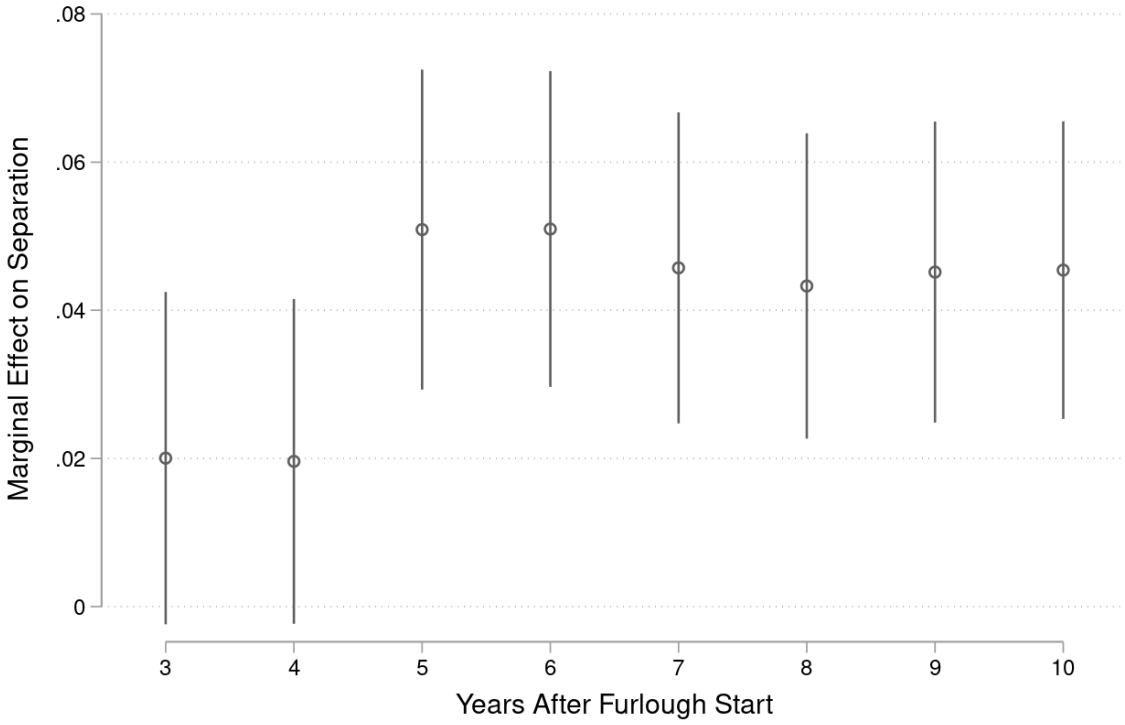


Figure 3.4: Current-Year Separation Rate Event Study, Furloughed versus Exempt Employee Bargaining Units

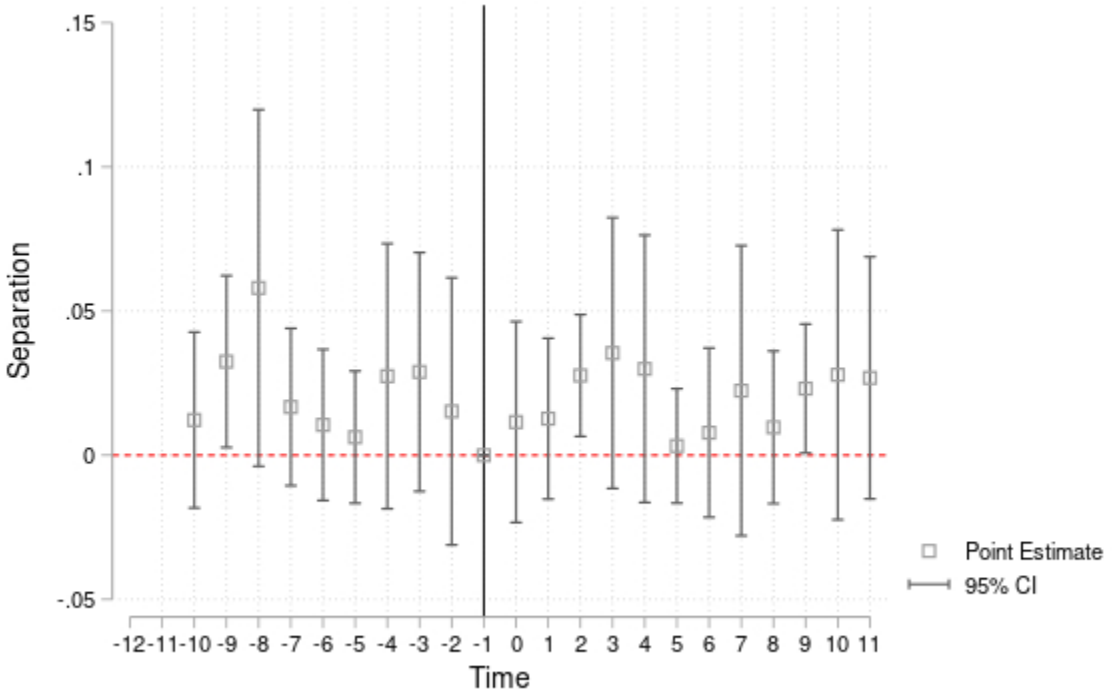


Figure 3.5: Rate of New Hiring Event Study, Furloughed versus Exempt Employee Bargaining Units

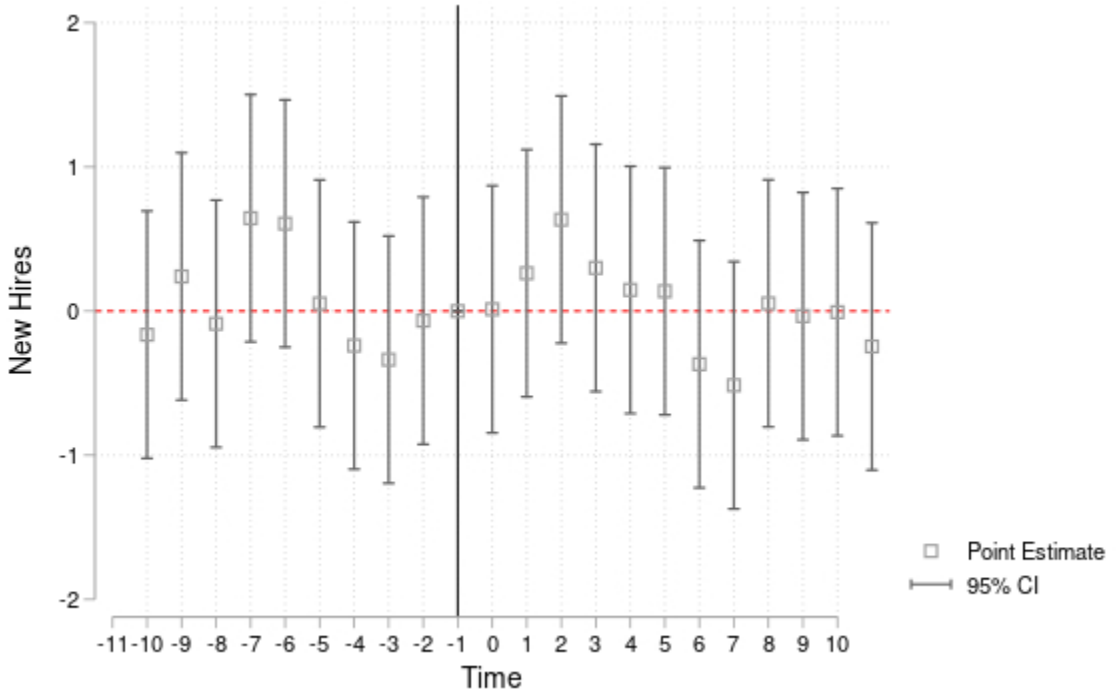


Figure 3.6: New Hires Pay Event Study, Furloughed versus Exempt Employee Bargaining Units

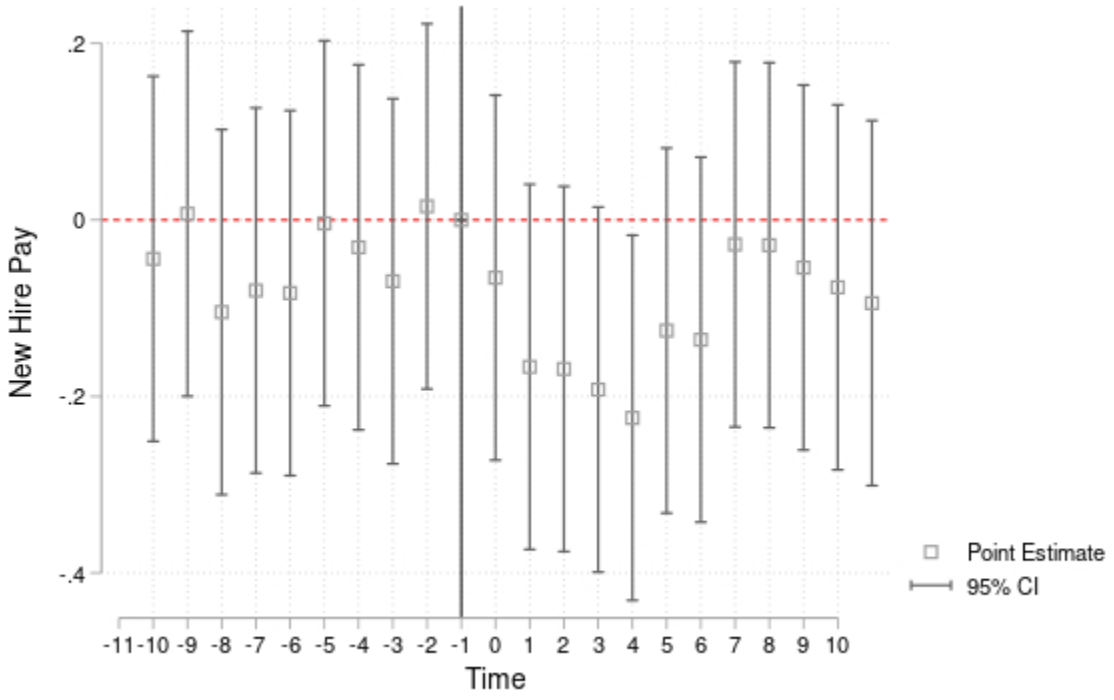


Figure 3.7: Elastic and Inelastic Labor Supply

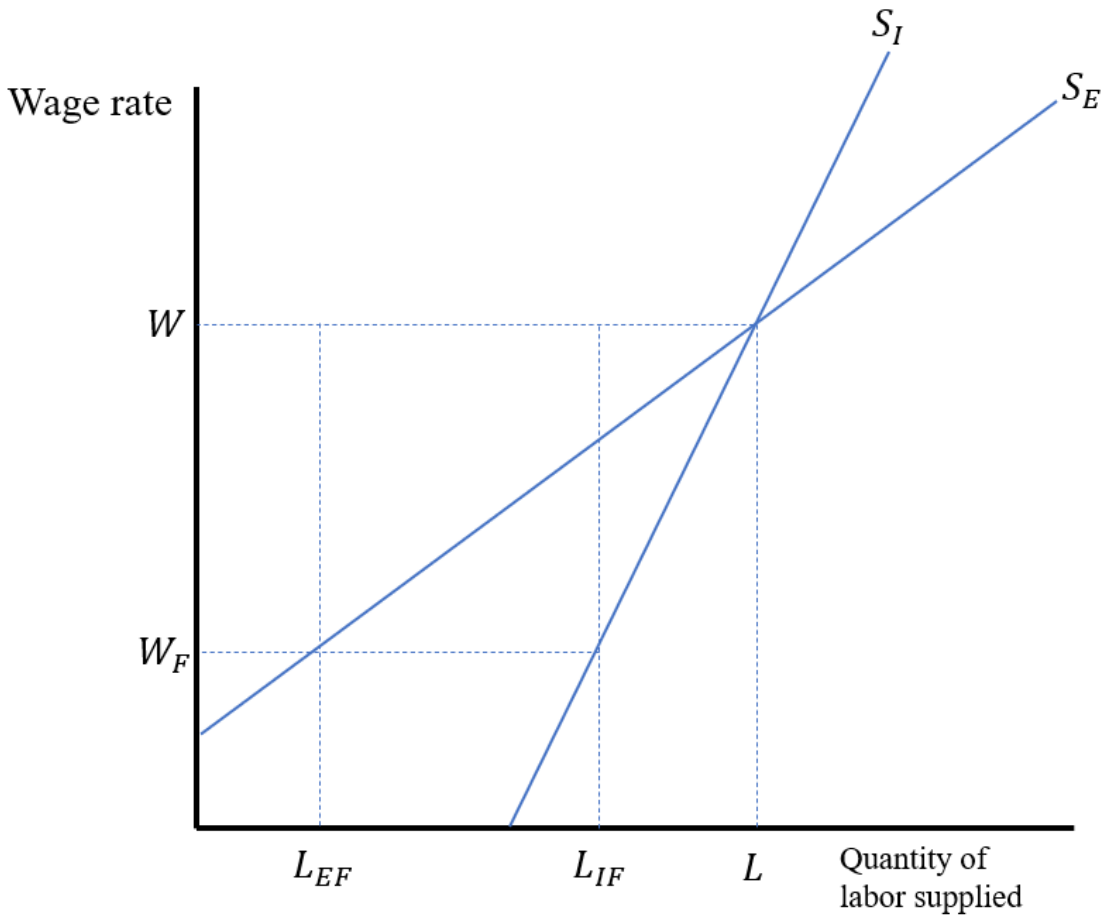


Figure 3.8: Labor Supply Graph – Inelastic Labor Supply

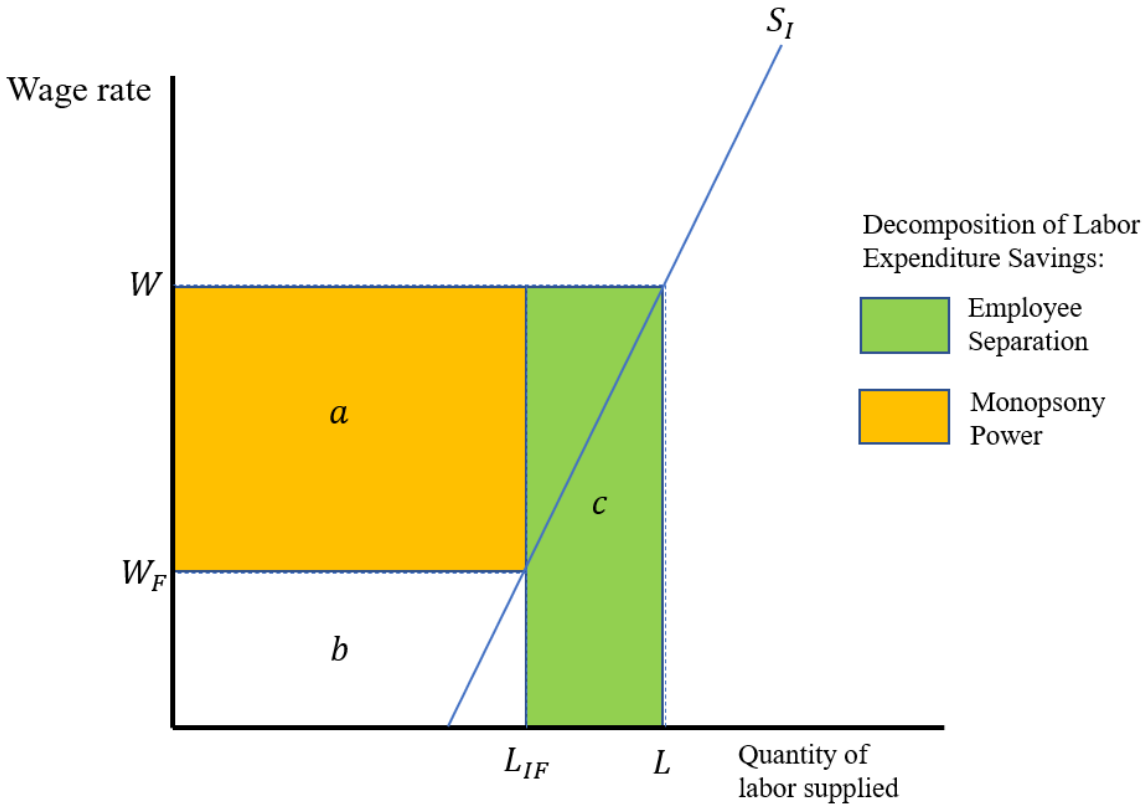


Figure 3.9: Labor Supply Graph – Elastic Labor Supply

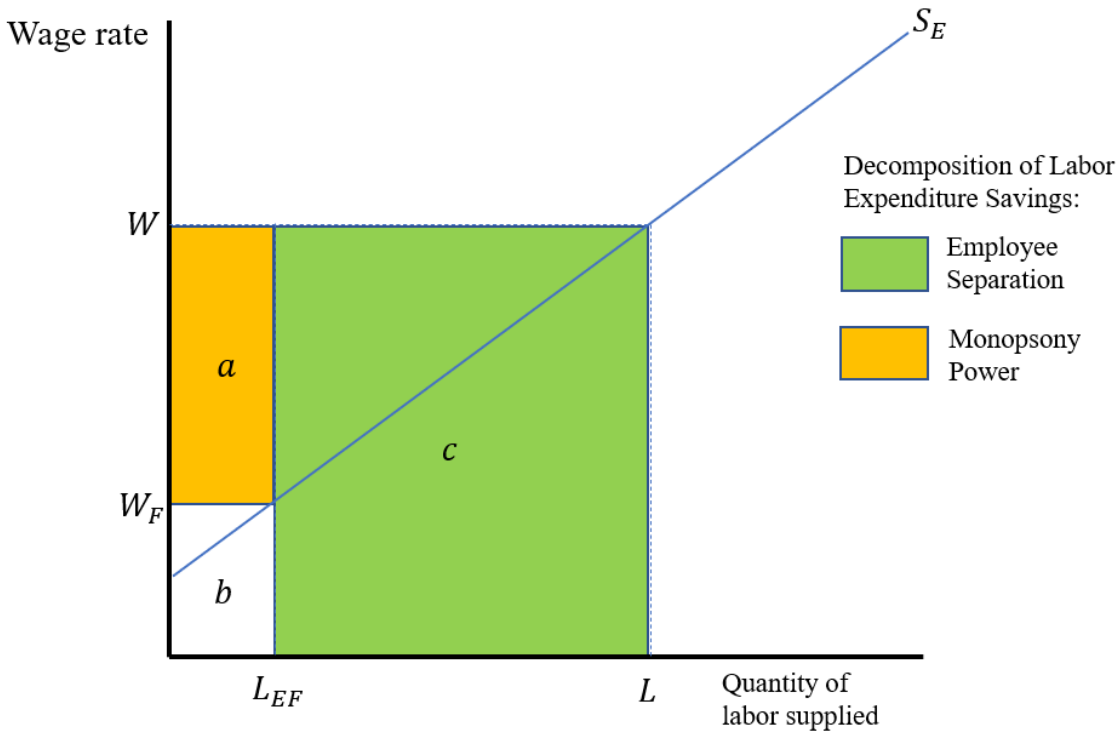
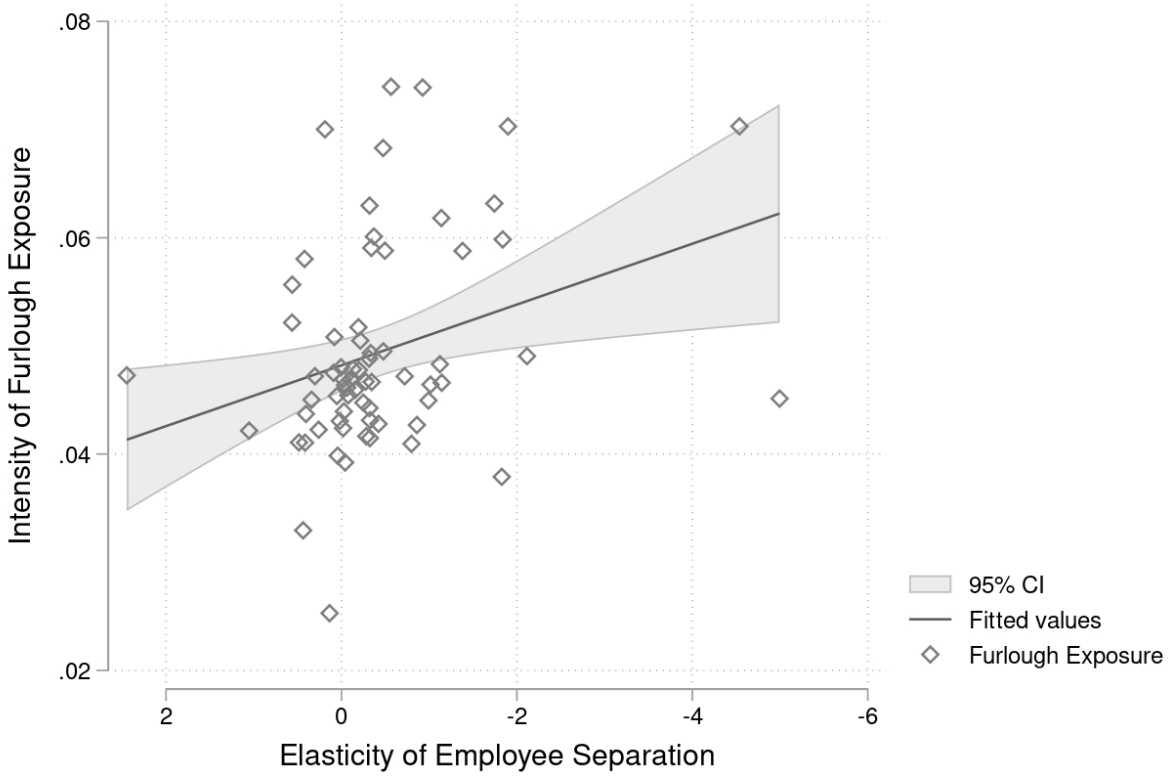


Figure 3.10: Elasticity of Furlough Separation vs. Intensity of Exposure



Bibliography

Abelson, Michael A, and Barry D Baysinger. 1984. "Optimal and dysfunctional turnover: Toward an organizational level model." *Academy of Management Review* 9 (2):331-341.

Adams-Prassl, Abi, Teodora Boneva, Marta Golin, and Christopher Rauh. 2020. "Furloughing." *Fiscal Studies* 41 (3):591-622.

Alaska Department of Health and Social Services. 2022. "DHSS Reorganization." accessed June 17, 2022. https://dhss.alaska.gov/Commissioner/Pages/reorganization/default.aspx.

Alfonso, Y Natalia, Jonathon P Leider, Beth Resnick, J Mac McCullough, and David Bishai. 2021. "US Public Health Neglected: Flat Or Declining Spending Left States Ill Equipped To Respond To COVID-19: Study examines US public health spending." *Health Affairs* 40 (4):664-671.

Ammons, David N, Karl W Smith, and Carl W Stenberg. 2012. "The future of local government: Will current stresses bring major, permanent changes?" *State and Local Government Review* 44 (1_suppl):64S-75S.

An, Seung-Ho. 2019. "Employee voluntary and involuntary turnover and organizational performance: Revisiting the hypothesis from classical public administration." *International Public Management Journal* 22 (3):444-469.

Arrazola, Jessica, Mia N Israel, and Nancy Binkin. 2019. "Applied epidemiology workforce growth and capacity challenges: the council of state and territorial epidemiologists 2017 Epidemiology Capacity Assessment." *Public Health Reports* 134 (4):379-385.

Association of State and Territorial Health Officials. 2020. ASTHO Profile of State and Territorial Public Health. Arlington, VA.

Baker, Mike, and Danielle Ivory. 2021. "Why Public Health Faces a Crisis in the U.S. ." *New York Times*, October 18, 2021. https://www.nytimes.com/2021/10/18/us/coronavirus-public-health.html.

Baranik, Lisa E, Janelle H Cheung, Robert R Sinclair, and Charles E Lance. 2019. "What happens when employees are furloughed? A resource loss perspective." *Journal of Career Development* 46 (4):381-394.

Bartle, John R. 1996. "Coping with cutbacks: City response to aid cuts in New York State." *State & Local Government Review*:38-48.

Bassier, Ihsaan, Arindrajit Dube, and Suresh Naidu. 2022. "Monopsony in movers the elasticity of labor supply to firm wage policies." *Journal of Human Resources* 57 (S):S50-s86.

Bedeian, Arthur G, and Achilles A Armenakis. 1998. "The cesspool syndrome: How dreck floats to the top of declining organizations." *Academy of Management Perspectives* 12 (1):58-63.

Behn, Robert D. 1980. "Leadership for cut-back management: The use of corporate strategy." *Public Administration Review* 40 (6):613-620.

Behn, Robert D. 1985. "Cutback budgeting." *Journal of Policy Analysis and Management* 4 (2):155-177.

Beitsch, Leslie M, Robert G Brooks, Meade Grigg, and Nir Menachemi. 2006. "Structure and functions of state public health agencies." *American Journal of Public Health* 96 (1):167-172.

Berne, Robert, and Leanna Stiefel. 1993. "Cutback budgeting: The long-term consequences." *Journal of Policy Analysis and Management* 12 (4):664-684.

Bifulco, Robert, Beverly Bunch, William Duncombe, Mark Robbins, and William Simonsen. 2012. "Debt and deception: How states avoid making hard fiscal decisions." *Public Administration Review* 72 (5):659-667.

Biller, Robert P. 1980. "Leadership tactics for retrenchment." *Public Administration Review* 40 (6):604-609.

Birkhead, Guthrie, Cynthia B Morrow, and Sylvia Pirani. 2020. *Public Health: What It Is and How It Works*: Jones & Bartlett Publishers.

Bogaert, Kyle, Brian C Castrucci, Elizabeth Gould, Katie Sellers, and Jonathon P Leider. 2019. "Research Full Report: Changes in the State Governmental Public Health Workforce: Demographics and Perceptions, 2014-2017." *Journal of Public Health Management and Practice* 25 (2 Suppl):S58.

Bourdeaux, Carolyn. 2018. "Loss Aversion and Strategic Choices in Cutting Budgets." *Public Finance and Management* 18 (1):4-38.

Boylan, Richard T. 2004. "Salaries, turnover, and performance in the federal criminal justice system." *The Journal of Law and Economics* 47 (1):75-92.

Bozeman, Barry. 2010. "Hard lessons from hard times: Reconsidering and reorienting the "managing decline" literature." *Public Administration Review* 70 (4):557-563.

Briffault, Richard. 1996. *Balancing Acts: The Reality Behind State Balanced Budget Requirements*: Priority Press Publications.

Bunch, Beverly S, Patricia Byrnes, and Ann L Schneider. 2019. "The State of Illinois's Fiscal Challenges and Budget Practices." *Municipal Finance Journal* 40.

California Legislative Analyst. 2009. The Budget Package: 2009-10 California Spending Plan. Sacramento, CA.

California Legislative Analyst. 2013. After Furloughs: State Workers' Leave Balances. Sacramento, CA.

Campo-Flores, Arian. 2021. "Why Alabama Has the Worst COVID-19 Vaccination Rates." *Wall Street Journal*, February 11, 2021. https://www.wsj.com/articles/why-alabama-has-the-worst-covid-19-vaccination-rates-11613048418.

Carlin, Patrick, Brian E Dixon, Kosali I Simon, Ryan Sullivan, and Coady Wing. 2022. How Undervalued is the Covid-19 Vaccine? Evidence from Discrete Choice Experiments and VSL Benchmarks. National Bureau of Economic Research.

Centers for Disease Control and Prevention. 2020. COVID-19 Vaccination Program Interim Operational Guidance and Jurisdictional Operations. Washington, DC U.S. Department of Health and Human Services.

Centers for Disease Control and Prevention. 2022a. COVID Data Tracker. Atlanta, GA.

Centers for Disease Control and Prevention. 2022b. Provisional COVID-19 Deaths by Sex and Age.

Clarke, Damian, and Kathya Tapia-Schythe. 2021. "Implementing the panel event study." *The Stata Journal* 21 (4):853-884.

Cole, Gail. 2021. "Which states require accelerated sales tax payments?". Avalara, accessed August 20, 2021. https://www.avalara.com/blog/en/north-america/2021/04/which-states-require-accelerated-sales-tax-payments.html.

Condon, Stephanie. 2010. Obama: "No Such Thing as Shovel-Ready Projects". *CBS News*.

Council of State and Territorial Epidemiologists. 2021. 2021 Epidemiological Capacity Report. Council of State and Territorial Epidemiologists.

Dagan, Noa, Noam Barda, Eldad Kepten, Oren Miron, Shay Perchik, Mark A Katz, Miguel A Hernán, Marc Lipsitch, Ben Reis, and Ran D Balicer. 2021. "BNT162b2 mRNA Covid-19 vaccine in a nationwide mass vaccination setting." *New England Journal of Medicine*.

de la Riva Agüero, Renzo. 2022. "Do cogovernance and CSOs supplement municipal capacity for service delivery? An assessment of differences in simple versus complex services." *Journal of Public Administration Research and Theory* 32 (1):1-22.

Devitt, Caitlin. 2009. "DEAL IN FOCUS: Michigan Moving $280M if GOs." *The Bond Buyer*, April 1, 2009.

DiNapoli, Thomas. 2010. New York's Deficit Shuffle. edited by New York State Comptroller. Albany, NY.

Downs, George W, and David M Rocke. 1984. "Theories of budgetary decisionmaking and revenue decline." *Policy Sciences* 16 (4):329-347.

Gold, Steven David. 1995. *The Fiscal crisis of the states: lessons for the future*. Washington, D.C.: Georgetown University Press.

Goodman, Josh. 2011. "Budget gimmicks explained: 5 ways states hide deficits." Last Modified June 26, 2011. https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2011/06/23/budget-gimmicks-explained-five-ways-states-hide-deficits.

Green, Michael Z. 2009. "Unpaid furloughs and four-day work weeks: Employer sympathy or a call for collective employee action." *Conn. L. Rev.* 42:1139.

Greenhalgh, Leonard, and Robert B McKersie. 1980. "Cost-effectiveness of alternative strategies for cut-back management." *Public Administration Review*:575-584.

Grissom, Jason A, Samantha L Viano, and Jennifer L Selin. 2016. "Understanding employee turnover in the public sector: Insights from research on teacher mobility." *Public Administration Review* 76 (2):241-251.

Grizzle, Gloria A, and Paul C Trogen. 1994. "Cutback budgeting in Florida: Causes, approaches, and consequences." *Southeastern Political Review* 22 (3):503-523.

Haas, Eric J, Frederick J Angulo, John M McLaughlin, Emilia Anis, Shepherd R Singer, Farid Khan, Nati Brooks, Meir Smaja, Gabriel Mircus, and Kaijie Pan. 2021. "Impact and effectiveness of mRNA BNT162b2 vaccine against SARS-CoV-2 infections and COVID-19 cases, hospitalisations, and deaths following a nationwide vaccination campaign in Israel: an observational study using national surveillance data." *The Lancet* 397 (10287):1819-1829.

Halverson, Paul K, John R Lumpkin, Valerie A Yeager, Brian C Castrucci, Sharon Moffatt, and Hugh Tilson. 2017. "Research full report: high turnover among state health officials/public health directors: implications for the public's health." *Journal of Public Health Management and Practice* 23 (5):537.

Hathaway, A, and J. Lightbourne. 2018. Budget Maneuvers in the Southern States. In *Balancing the Budget in the Southern States*. Atlanta, Georgia: Georgia State University Center for State and Local Government Finance.

Hendrick, Rebecca, and Xiaoyan Hu. 2020. "Beyond Truth and Integrity in State Budgeting: Why State Governments Use Budget Balancing Maneuvers (or Gimmicks)?" *Public Budgeting & Finance* 40 (4):104-127.

Hill, Elizabeth. 2008. 2008-09: Overview of the Governor's Budget. edited by California Legislative Analyst's Office. Sacramento, CA.

Hodrick, Robert J, and Edward C Prescott. 1997. "Postwar US business cycles: an empirical investigation." *Journal of Money, Credit, and Banking*:1-16.

Hoehn-Velasco, Lauren, and Elizabeth Wrigley-Field. 2022. "City health departments, public health expenditures, and urban mortality over 1910–1940." *Economic Inquiry* 60 (2):929-953.

Holland, Jenny L, and Francis Benjamin. 2012. "No New Gimmicks: Continued Budget Challenges in Washington State." *California Journal of Politics and Policy* 4 (3).

Hom, Peter W, Thomas W Lee, Jason D Shaw, and John P Hausknecht. 2017. "One hundred years of employee turnover theory and research." *Journal of Applied Psychology* 102 (3):530.

Hsiang-Te Tsuei, Sian. 2020. "How Previous Epidemics Enable Timelier COVID-19 Responses: A Cross-Sectional Study Using Organizational Memory Theory." *medRxiv*.

Hudspeth, Nancy W, David F Merriman, Richard F Dye, and Andrew W Crosby. 2015. "Do troubled times invite cloudy budget reporting? The determinants of General Fund expenditure share in US states." *Public Budgeting & Finance* 35 (4):68-89.

Huffman, Ann Hergatt, M David Albritton, Russell A Matthews, Lori A Muse, and Satoris S Howes. 2022. "Managing furloughs: How furlough policy and perceptions of fairness impact turnover intentions over time." *The International Journal of Human Resource Management* 33 (14):2801-2828.

Hur, Joon-Young, and KyungWoo Kim. 2020. "Crisis learning and flattening the curve: South Korea’s rapid and massive diagnosis of the COVID-19 infection." *The American Review of Public Administration* 50 (6-7):606-613.

Hur, Yongbeom. 2013. "Turnover, voluntary turnover, and organizational performance: Evidence from municipal police departments." *Public Administration Quarterly*:3-35.

Hyde, Justeen K, and Stephen M Shortell. 2012. "The structure and organization of local and state public health agencies in the US: a systematic review." *American Journal of Preventive Medicine* 42 (5):S29-S41.

Institute of Medicine. 1988. *The Future of Public Health*. Washington, DC: The National Academies Press.

Institute of Medicine. 2012a. *Crisis Standards of Care: A Systems Framework for Catastrophic Disaster Response*. Vol. Volume 1: Introduction and CSC Framework. Washington, DC.

Institute of Medicine. 2012b. *For the Public's Health: Investing in a Healthier Future*. Washington, DC: National Academies Press.

Jick, Todd D, and Victor V Murray. 1982. "The management of hard times: Budget cutbacks in public sector organizations." *Organization Studies* 3 (2):141-169.

Johnson, Nick, Phil Oliff, and Erica Williams. 2011. AN UPDATE ON STATE BUDGET CUTS: At Least 46 States Have Imposed Cuts That Hurt Vulnerable Residents and Cause Job Loss. Center on Budget and Policy Priorities.

Jones, Loring, Melinda Hohman, Sally Mathiesen, and Daniel Finnegan. 2014. "Furloughs and faculty management of time: Maintaining quality in an economic crisis." *Journal of Social Work Education* 50 (2):334-348.

Joyce, Philip G. 2001. "What's So Magical about Five Percent? A Nationwide Look at Factors That Influence the Optimal Size of State Rainy Day Funds." *Public Budgeting & Finance* 21 (2):62-87. doi: https://doi.org/10.1111/0275-1100.00050.

Kaiser Family Foundation. 2022. COVID-19 Vaccinations by Race/Ethnicity.

Kaske, Michelle. 2010. "New Jersey's Christie Signs $29.4 Billion Budget." *The Bond Buyer*, June 29, 2010.

Kaske, Michelle. 2011. "New Jersey Governor Releases Budget." *The Bond Buyer*, February 22, 2011.

Kim, Min-Hyu. 2019. "Human resource strategies in response to government cutbacks: A survey experiment." *Public Management Review* 21 (8):1125-1147.

Kirlin, John. 2020. "COVID-19 upends pandemic plan." *The American Review of Public Administration* 50 (6-7):467-479.

Klase, Kenneth A. 2018. "The relationship between fiscal stress and patterns of state budgeting strategies used in cutback management in the last two U.S. recessions." *Public Finance & Management* 18 (1).

Kreps, SE, and DL Kriner. 2021. "Factors influencing Covid-19 vaccine acceptance across subgroups in the United States: Evidence from a conjoint experiment." *Vaccine* 39 (24):3250-3258.

Lee, Shinwoo. 2018. "Employee turnover and organizational performance in US federal agencies." *The American Review of Public Administration* 48 (6):522-534.

Lee, Sooho, and Robert Mark Sanders. 2013. "Fridays are furlough days: The impact of furlough policy and strategies for human resource management during a severe economic recession." *Review of Public Personnel Administration* 33 (3):299-311.

Leider, Jonathon P, Fatima Coronado, Angela J Beck, and Elizabeth Harper. 2018. "Reconciling supply and demand for state and local public health staff in an era of retiring baby boomers." *American Journal of Preventive Medicine* 54 (3):334-340.

Leider, Jonathon P, Beth Resnick, David Bishai, and F Douglas Scutchfield. 2018. "How much do we spend? Creating historical estimates of public health expenditures in the United States at the federal, state, and local levels." *Annual Review of Public Health* 39:471-487.

Levi, Jeffrey, Chrissie Juliano, and Maxwell Richardson. 2007. "Financing public health: diminished funding for core needs and state-by-state variation in support." *Journal of Public Health Management and Practice* 13 (2):97-102.

Levine, Charles H. 1978. "Organizational decline and cutback management." *Public Administration Review* 38 (4):316-325.

Levine, Charles H. 1979. "More on cutback management: Hard questions for hard times." *Public Administration Review* 39 (2):179-183.

Levine, Charles H, Irene S Rubin, and George G Wolohojian. 1981. "Resource scarcity and the reform model: The management of retrenchment in Cincinnati and Oakland." *Public Administration Review*:619-628.

Levitt, Barbara, and James G March. 1988. "Organizational learning." *Annual Review of Sociology* 14 (1):319-338.

Lewis, Carol W, and Anthony T Logalbo. 1980. "Cutback principles and practices: A checklist for managers." *Public Administration Review* 40 (2):184-188.

Lewis, Gregory B. 1984. "Municipal expenditures through thick and thin." *Publius: The Journal of Federalism* 14 (2):31-39.

Long, J Scott, and Jeremy Freese. 2014. *Regression Models for Categorical Dependent Variables using Stata*. 3 ed. Vol. 7: Stata press.

Maani, Nason, and Sandro Galea. 2020. "COVID-19 and underinvestment in the public health infrastructure of the United States." *The Milbank Quarterly* 98 (2):250.

Malik, Amyn A, SarahAnn M McFadden, Jad Elharake, and Saad B Omer. 2020. "Determinants of COVID-19 vaccine acceptance in the US." *EClinicalMedicine* 26:100495.

Mays, Glen P, Sharla A Smith, Richard C Ingram, Laura J Racster, Cynthia D Lamberth, and Emma S Lovely. 2009. "Public health delivery systems: evidence, uncertainty, and emerging research needs." *American Journal of Preventive Medicine* 36 (3):256-265.

McCaffery, Jerry. 1981. "Revenue budgeting: Dade County tries a decremental approach." *Public Administration Review* 41:179-189.

McCloy, Rodney A, Justin D Purl, and Erin S Banjanovic. 2019. "Turnover modeling and event history analysis." *Industrial and Organizational Psychology* 12 (3):320-325.

McTighe, John J. 1979. "Management strategies to deal with shrinking resources." *Public Administration Review* 39 (1):86-90.

Meier, Kenneth J, and Alisa Hicklin. 2008. "Employee turnover and organizational performance: Testing a hypothesis from classical public administration." *Journal of Public Administration Research and Theory* 18 (4):573-590.

Mikesell, John. 2017. *Fiscal Administration*. 10 ed: Cengage Learning.

Milne, Thomas L. 1990. "A separate department of health in Washington state: four years before the mast." *Journal of Public Health Policy* 11 (3):305-315.

Moon, Kuk-Kyoung. 2017. "Voluntary turnover rates and organizational performance in the US federal government: The moderating role of high-commitment human resource practices." *Public Management Review* 19 (10):1480-1499.

Mou, Haizhen, and Maritza Lozano Man Hing. 2021. "Stringency of balanced budget laws and transparency of budgeting process." *Public Budgeting & Finance* 41 (2):45-64. doi: https://doi.org/10.1111/pbaf.12280.

National Association of State Budget Officers. 2013. State Budgeting and Lessons Learned from the Economic Downturn. Washington, DC: National Association of State Budget Officers.

National Public Radio. 2021. Nearly Half Of States Will Make All Adults COVID-19 Vaccine Eligible By April 15.

Newman, Sarah J, Jiali Ye, and Carolyn J Leep. 2014. "Workforce turnover at local health departments: nature, characteristics, and implications." *American Journal of Preventive Medicine* 47 (5):S337-S343.

Osborne, Danny, Heather J Smith, and Yuen J Huo. 2012. "More than a feeling: Discrete emotions mediate the relationship between relative deprivation and reactions to workplace furloughs." *Personality and Social Psychology Bulletin* 38 (5):628-641.

Pandey, Sanjay K. 2010. "Cutback management and the paradox of publicness." *Public Administration Review* 70 (4):564-571.

Park, June, and Eunbin Chung. 2021. "Learning from past pandemic governance: Early response and Public-Private Partnerships in testing of COVID-19 in South Korea." *World Development* 137:105198.

Pelletier, Kathie L, Janet L Kottke, and Ernesto M Reza. 2015. "During furloughs, who is more attached to a public university? staff? faculty?... managers." *Public Personnel Management* 44 (1):120-142.

Petersen, John E. 2003. "Changing red to black: deficit closing alchemy." *National Tax Journal*:567-577.

Phillips, Ted. 2010. "Rhode Island Governor Offers $7.5 Billion Budget to Fill a $405 Million Hole." *The Bond Buyer*, February 3, 2010.

Pierson, Kawika, Michael L Hand, and Fred Thompson. 2015. "The government finance database: A common resource for quantitative research in public financial analysis." *PloS one* 10 (6):e0130119.

Pourshaban, Deena, Ricardo Basurto-Dávila, and Margaret Shih. 2015. "Building and sustaining strong public health agencies." *Journal of Public Health Management and Practice* 21:S80-S90.

Public Health National Center for Innovations. 2021. Foundational Public Health Services (FPHS) and Public Health Modernization.

Ringwood, Lauryn, Philip Watson, and Paul Lewin. 2019. "A quantitative method for measuring regional economic resilience to the great recession." *Growth and change* 50 (1):381-402.

Robbins, Mark D, and Bill Simonsen. 2019. "State of Connecticut Budgeting After the Great Recession." *Municipal Finance Journal* 40.

Rubin, Marilyn M., and Katherine Willoughby. 2021. "State budget balancing strategies: COVID-19 and the Great Recession." *Public Budgeting & Finance* n/a (n/a). doi: https://doi.org/10.1111/pbaf.12299.

Ryu, Sangyub, and Young-Joo Lee. 2013. "Examining the role of management in turnover: A contingency approach." *Public Performance & Management Review* 37 (1):134-153.

Salzer, James. 2011. "Fees not spent as intended; Critics see revenue as backdoor tax; State money often never reaches programs for which it was intended." *The Atlanta Journal-Constitution*, January 18, 2011.

Salzer, James. 2021. "Kemp files 'truth-in-fees' bill to end diversion of levies." *Atlanta Journal Constition*, February 17, 2021. https://www.ajc.com/politics/kemp-files-truth-in-fees-bill-to-end-diversion-of-levies/ZA7AHEXXSBCDHHIQUDKVAZAMYY/.

Saskal, Rich. 2008. "Trends in the Region: Nevada Sets $300M of GOs as it Starts Special Session Driven by Budget Crisis." *The Bond Buyer*, June 27, 2008.

Schick, Allen. 1983. "Incremental budgeting in a decremental age." *Policy Sciences*:1-25.

Scorsone, Eric A, and Christina Plerhoples. 2010. "Fiscal stress and cutback management amongst state and local governments: What have we learned and what remains to be learned?" *State and Local Government Review* 42 (2):176-187.

Sellers, Katie, Jonathon P Leider, Elizabeth Gould, Brian C Castrucci, Angela Beck, Kyle Bogaert, Fátima Coronado, Gulzar Shah, Valerie Yeager, and Leslie M Beitsch. 2019. "The state of the US governmental public health workforce, 2014–2017." *American Journal of Public Health* 109 (5):674-680.

Sensier, Marianne, Gillian Bristow, and Adrian Healy. 2016. "Measuring regional economic resilience across Europe: Operationalizing a complex concept." *Spatial Economic Analysis* 11 (2):128-151.

Sheffrin, Steven M. 2004. "State budget deficit dynamics and the California debacle." *Journal of Economic Perspectives* 18 (2):205-226.

Shields, Yvette. 2011a. "Missouri Governor Signs $23B Budget After Cutting $172M." *The Bond Buyer*.

Shields, Yvette. 2011b. "Wisconsin to Wrap Up Delayed $276M GO Refunding." *The Bond Buyer*.

Sigo, Shelly. 2008. "Kentucky Governor Seeks to Call Special Session on $26B Liability." *The Bond Buyer*, May 30, 2008, The Regions.

Simmie, James, and Ron Martin. 2010. "The economic resilience of regions: towards an evolutionary approach." *Cambridge Journal of Regions, Economy and Society* 3 (1):27-43.

Squire, Peverill. 2017. "A Squire index update." *State Politics & Policy Quarterly* 17 (4):361-371.

Stark, Jonna. 2007. "Lay Off the One-Time Revenues, Raters Warn Rhode Island." *The Bond Buyer*, September 14, 2007, The Regions.

State of California. 2009. Economic Recovery Bonds Refunding Series 2009A/2009B. Municipal Securities Rulemaking Board

State of Connecticut Governor's Office. 2018. Gov. Malloy and Treasurer Nappier Announce State Finalizes Payment on $1.09 Billion in Debt from Economic Recovery Notes Issued by Prior Administration.

State of Illinois. 2010. General Obligation Bonds Taxable Series of January 2010. Municipal Securities Rulemaking Board.

State of Michigan. 2004. Offical Statement for Full Faith and Credit General Obligation Notes, Series 2004A. Municipal Securities Rulemaking Board.

State of Michigan. 2009. General Obligation Bonds Series 2009A/2009B. Municpal Securities Rulemaking Board.

State of Michigan. 2020. General Obligation Environmental Program Refunding Bonds, Series 2020A. Municipal Securities Rulemaking Board.

Stavick, J. 2022. "Do Budget Maneuvers Reduce Future State Budget Resilience? Evidence from the Great Recession."

SteelFisher, Gillian K., Robert J. Blendon, and Hannah Caporello. 2021. "An Uncertain Public — Encouraging Acceptance of Covid-19 Vaccines." *New England Journal of Medicine* 384 (16):1483-1487. doi: 10.1056/NEJMp2100351.

Taylor, Mac. 2018. The Great Recession and California's Recovery. edited by California Legislaive Analyst's Office. Sacramento, CA.

Texas Department of State Health Services. 2020. "Transitioning Programs." accessed June 17, 2022. https://www.dshs.state.tx.us/TransitioningPrograms.aspx.

Trust for America's Health. 2021. The Impact of Chronic Underfunding on America's Public Health System: Trends, Risks, and Recommendations. Trust for America's Health.

Turner, Brock. 2021. In Rural Indiana, Volunteers Outnumber Staff in Some COVID-19 Vaccine Clinics. *Indiana Public Media*.

U.S. Department of Justice. 2000. Crime Scene Investigation: A Guide for Law Enforcement. Washington, D.C. .

Vara, Hauhini. 2010. "Califiornia Budget Plan Draws Skepticism." *Wall Street Journal*. https://www.wsj.com/articles/SB10001424052748703465504575529031024744718.

Virginia Department of Taxation. 2021. "Accelerated Sales and Use Tax Payment." accessed June 10, 2021. https://www.tax.virginia.gov/accelerated-sales-and-use-tax-payment.

Volcker Alliance. 2021. Turth and Integrity in State Budgeting: Preparing for the Storm. New York, NY: The Volcker Alliance.

Wang, Weijie, and Rusi Sun. 2020. "Does organizational performance affect employee turnover? A re-examination of the turnover–performance relationship." *Public Administration* 98 (1):210-225.

Wang, Weijie, and Rusi Sun. 2022. "Linking top leader turnover to the performance of public organizations: Evidence from New York City public high schools." *Public Performance & Management Review* 45 (1):106-130.

Ward, Andrew. 2009. "California Offical Jury-Rig Budget Fix; Agreement Draws Widespread Protest." *The Bond Buyer*, July 22, 2009.

Weber, Lauren, Laura Ungar, and Michelle R Smith. 2020. Hollowed-Out Public Health System Faces More Cuts Amid Virus.

Willis, Don E, Jennifer A Andersen, Keneshia Bryant-Moore, James P Selig, Christopher R Long, Holly C Felix, Geoffrey M Curran, and Pearl A McElfish. 2021. "COVID-19 vaccine hesitancy: Race/ethnicity, trust, and fear." *Clinical and Translational Science* 14 (6):2200-2207.

Wynen, Jan, Wouter Van Dooren, Jan Mattijs, and Carl Deschamps. 2019. "Linking turnover to organizational performance: the role of process conformance." *Public Management Review* 21 (5):669-685.

Yasmin, Farah, Hala Najeeb, Abdul Moeed, Unaiza Naeem, Muhammad Sohaib Asghar, Najeeb Ullah Chughtai, Zohaib Yousaf, Binyam Tariku Seboka, Irfan Ullah, Chung-Ying Lin, and Amir H. Pakpour. 2021. "COVID-19 Vaccine Hesitancy in the United States: A Systematic Review." *Frontiers in Public Health* 9. doi: 10.3389/fpubh.2021.770985.

Zvonicek, Rushenka Andrea. 2012. "A study of the California furloughs and their effects on state workers." California State University, Sacramento.

John Dooley Stavick

O'Neill School of Public and Environmental Affairs
Indiana University
1315 East 10th Street
Bloomington, IN 47405
Website: www.johnstavick.com

ACADEMIC APPOINTMENTS

Oakland University
Department of Political Science
Rochester, Michigan
Assistant Professor of Political Science, starting August 15, 2023

EDUCATION

Ph.D., Public Affairs, O'Neill School of Public and Environmental Affairs, Indiana University Bloomington: May 2023
Major Field: Public Affairs
Minor Field: Public Policy
Dissertation committee: Justin Ross (chair), Katherine Willoughby, Robert Kravchuk, Craig Johnson, and Coady Wing

Master of Arts, Economics, Andrew Young School of Policy Studies, Georgia State University: May 2008

Bachelor of Arts, Economics, Andrew Young School of Policy Studies, Georgia State University: May 2005

WORKING PAPERS

Stavick, J. "Do State Budget Maneuvers Reduce Future Budget Resiliency? Evidence Following the Great Recession." Currently **revise and resubmit** at *Public Budgeting & Finance.*

Stavick, J. "Organizational Memory and Snap Back Performance in Public Agencies."

Mikesell, J., **Stavick, J**., Ross, J. "Use Tax Administration and Revenue Production in the States." Under review at *Public Budgeting & Finance*.

RESEARCH IN PROGRESS

Conley, S., **Stavick, J**., Rutherford, A. "Do Echelons Matter? Disaggregating the Effect of Turnover on Performance in Public Agencies."

Ross, J., **Stavick. J**., Carlin, P. “Did State Imposed Tax and Expenditure Limits Reduce the Fiscal Size of Local Governments? Revisiting the Evidence.”

Spreen, T.L., **Stavick, J.** "Cost of Living Adjustments and Public Workforce Turnover"

OTHER PUBLICATIONS

Sjoquist, D., **Stavick, J.,** Wallace, S. (2007) “Intergovernmental Fiscal Relations in Georgia.” Georgia State University Fiscal Research Center Report No. 141.

CONFERENCE PRESENTATIONS

2023 World Social Science Association, Tempe, AZ.
2023 American Society for Public Administration; held virtually.
2022 Northeast Conference on Public Administration; held virtually.
2022 Association for Budgeting and Financial Management, Miami, FL.
2022 Midwest Public Affairs Conference, Springfield, IL.
2022 Paul H. O’Neill Conference in Public Affairs, Bloomington, IN.
2022 Western Social Science Association, Denver, CO.
2022 American Society for Public Administration, Jacksonville, FL.
2022 Association of O’Neill PhD Students Conference, Bloomington, IN.
2021 Association for Budgeting and Financial Management, Washington, DC.
2021 National Tax Association Graduate Student Research Forum; held virtually.
2021 Association of O’Neill PhD Students Conference, Bloomington, IN.
2020 Association of O’Neill PhD Students Conference, Bloomington, IN.
2020 Western Social Science Association, Portland, OR. Proposal accepted; conference canceled.
2019 Association for Budgeting and Financial Management, Washington, DC.
2019 Association for Public Policy Analysis and Management Student Research Conference, Washington, DC.
2019 National Tax Association, Tampa, FL.

RESEARCH INTERESTS

State and local budget processes
Sales and use tax administration
Administration of state and local public health
Fiscal institutions
Public sector turnover and performance

TEACHING EXPERIENCE

O’Neill School of Public & Environmental Affairs, Indiana University, Bloomington, Indiana

SPEA-V 186: Introduction to Public Budgeting & Finance: Spring 2020-Spring 2023

Southeast Community College, Lincoln, Nebraska

ECON 2120: Principles of Microeconomics (in-person and online): 2010-16

ECON 2110: Principles of Macroeconomics (in-person and online): 2011-14

University of South Dakota, Vermillion, South Dakota

ECON 201: Principles of Microeconomics (online): 2014-17

ECON 202: Principles of Macroeconomics (online): 2015-17

ECON 580: Foundations of Economics (online): 2014-16

HONORS AND AWARDS

Michael R. Curro Award for Best Graduate Student Research Paper. "Do State Budget Maneuvers Reduce Future Budget Resiliency? Evidence Following the Great Recession." Awarded by the Association for Budgeting and Financial Management, September 2021.

Summer Merit Fellowship, O'Neill School of Public and Environmental Affairs, Summer 2022. $1,000 award.

PROFESSIONAL EXPERIENCE

Fiscal Policy Analyst, OpenSky Policy Institute
Lincoln, Nebraska
February 2016-May 2017
Conducted presentations on Nebraska tax and budget issues to various organizations; followed state budget and tax trends while prioritizing issues of concern to develop policy responses; incorporated public finance literature and its findings in written work, including policy briefs, primers, testimony, and memos; estimated magnitude of changes to state revenue in legislation, such as static fiscal impacts of tax rate and base changes.

Revenue Economist, Nebraska Department of Revenue
Lincoln, Nebraska
January 2009-February 2016
Completed tax revenue forecasts presented semiannually to the Nebraska Economic Forecasting Advisory Board; estimated fiscal impacts of proposed sales and excise tax rate and base changes; completed estimates of sales tax exemptions, and prepared presentations about the Tax Expenditure Report for legislative hearings; developed comparisons of all fifty states' tax incentive programs for publication in the Nebraska Tax Incentives reports.

RESEARCH ASSISTANTSHIPS

Assistant Economic Researcher, Indiana Business Research Center, Kelley School of Business, Indiana University
May 2018-December 2019
Timothy F. Slaper
Contributed to construction of a social capital index and coauthored manuscripts related to

regional economic resilience.

Graduate Research Assistant, O'Neill School of Public and Environmental Affairs, Indiana University
August 2017-May 2019
Justin Ross and Denvil Duncan
Developed manuscript related to tax and expenditure limits and completed data cleaning projects.

Graduate Research Assistant, Fiscal Research Center, Andrew Young School of Policy Studies, Georgia State University
August 2006-May 2008
David Sjoquist, Carolyn Bourdeaux, and Laura Wheeler

SERVICE

Peer Reviewer: Public Budgeting & Finance, Journal of Policy Studies, International Journal of Public Administration, *Research Handbook on City and Municipal Finance*
Conference Track Reviewer, 2023 American Society for Public Administration Conference
Active Learning Workshop Facilitator, Indiana University Center for Innovative Teaching and Learning, August 2022
Undergraduate Honors Thesis Writer Mentor, Fall 2021, Spring 2022, Spring 2023
Panel Chair, Undergraduate Honors Research Symposium: Spring 2021-2023
Leadership Committee, Association for O'Neill PhD Students: 2018-19

MEMBERSHIPS

American Society for Public Administration
Association for Budgeting and Financial Management
National Tax Association
World Social Science Association