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ABSTRACT

We use an instrumental-variables estimator reliant on variation in congressional representation to analyze the effects of federal aid to state and local governments across all four major pieces of COVID-19 response legislation. Through December 2022, we estimate that the federal government allocated \$603,000 for each state or local government job-year preserved. Our baseline confidence interval allows us to rule out estimates of less than \$220,400. Our estimates of effects on aggregate income and output are centered on zero and imply modest if any spillover effects onto the broader economy. We discuss aspects of the pandemic context, which include the surprising resilience of state and local tax revenues as well as of broader macroeconomic conditions, that may underlie the small employment and stimulative effects we estimate in comparison with previous research.

I Introduction

Fiscal transfers from the federal government to state and local governments play an important role in the US federal system. During the COVID-19 pandemic, federal fiscal assistance reached unprecedented levels, with aid to state and local governments spanning four legislative vehicles and summing to almost \$1 trillion.²

The rationale for federal fiscal stabilization arises from state and local balanced-budget constraints. When state and local governments face downturns, these constraints would, in the absence of federal relief, prevent them from contributing to countercyclical policy. As revenues decline and spending needs rise, compliance with the rules dictates tax increases and a search for budgetary savings. Savings may come from wage freezes and layoffs for members of the public-sector work force. Figure 1's Panel B, for example, illustrates the reductions in state and local government employment that took place at the start of the pandemic, as well as the recovery in state and local government employment, through December 2022. These early-crisis reductions can, in turn, lead to a deterioration in public service delivery just as needs run high.

Over the course of the pandemic, federal fiscal assistance has been distributed through a variety of channels, including general aid to states, general aid to local governments, and aid appropriated for specific functions of state and local government. A primary purpose of this aid was to limit the severity of public-sector layoffs and to increase the pace at which it would ultimately recover (Driessen and Gravelle, 2020; The White House, 2021; US Department of the Treasury, 2021b). This is motivated, at least in part, by standard concerns for macroeconomic stabilization and the slow recovery of state and local government employment following the Great Recession, as illustrated in Figure 1's Panel A. Our analysis thus undertakes to understand the extent to which federal assistance achieved this objective. We also assess the overall impact of federal fiscal assistance on the labor market more broadly, as well as on aggregate income and output.

The key challenge to estimating the effects of fiscal stabilization funds is a standard endogeneity concern: stabilization efforts are undertaken when and where economic conditions are poor, such that they correlate negatively with employment. To overcome this impediment, we adopt an instrumental-variables strategy. Specifically, we draw on existing work demonstrating that federal fiscal assistance to state and local governments exhibited a strong bias towards small states, which enjoy disproportionate representation in the US Congress (Clemens and Veuger, 2021a). Crucially, as our analysis confirms, the dollars driven by the US Congress's bias towards small states were orthogonal to a rich set of measures of the pandemic's direct effects on states and on the health of their populations. This and additional evidence support the validity of variations in states' over- and under-representation as an instrument.

Applying our instrumental-variables strategy, we estimate that federal fiscal assistance has had a modest impact on employment by state and local governments. In our preferred specification, we estimate that the federal government had to allocate just over \$603,000 to preserve a job-year through December of 2022. Our baseline estimates are sufficiently precise that we can rule out estimates that less than \$220,400 was needed to preserve a job-year over this time period. Across a broad set of additional specifications we consider, the implied cost per job year-saved tends to be higher. Because a

² The 2009 American Recovery and Reinvestment Act (ARRA), in comparison, included some \$223 billion for three years of fiscal relief for state and local governments (Inman, 2010).

number of alternative specifications yield moderately smaller standard errors, confidence intervals regularly rule out costs of less than \$500,000 per job-year saved over a 2-year time horizon and of \$300,000 per job-year saved over the full 2.75-year time horizon we analyze.

We next assess the effects of federal fiscal assistance on the broader labor market. In our analysis of private-sector employment, we cannot reject the null hypothesis of no effect, though our estimate is imprecise. Our estimates for real wages and salaries are also near zero. While we consistently estimate small effects on total wages across a broad set of specifications, only a small subset of those specifications are estimated with sufficient precision to rule out moderately large “wage bill multipliers.” In sum, we find little evidence of meaningful spillovers from state and local government aid to the overall labor market, though we cannot rule out nontrivial impacts on private employment or wages in most specifications.

We present additional analyses of effects on aggregate income and output. These estimates can be described as being of an “open economy relative multiplier” (Nakamura and Steinsson, 2014) or a “regional transfer multiplier” (Corbi et al., 2019; Pennings, 2021). They also center on zero, implying that fiscal stabilization dollars have had little overall impact on economic activity in the pandemic context. Some of our estimates of effects on income and output, including essentially all of our unweighted estimates as well as the more precise of our population weighted estimates, allow us to rule out substantial effects, in particular across the period of heightened fiscal uncertainty. To illustrate the evolving magnitude of our multiplier estimates, we present event-study analyses of each of our outcomes of interest.

Our multiplier estimates are small relative to several prominent estimates from other settings (Suárez-Serrato and Wingender, 2016; Corbi et al., 2019; Shoag, 2013 and 2016). Later, we discuss the key features of the setting we analyze that, in our view, are the most plausible explanations for this difference.

Our primary contribution is to the literature on the macroeconomic effects of federal fiscal assistance. There are many papers in this literature. Some examples include Fleck (1999), Chodorow-Reich et al. (2012), Suárez-Serrato and Wingender (2016), Corbi et al. (2019), and Pennings (2021). Other papers have estimated conceptually similar objects using other sources of windfall gains to state and local government budgets (Shoag, 2013 and 2016).³ What differentiates our work from these earlier analyses is both the context and the magnitude of the spending shocks generated by our instrument.⁴

Papers set in the period immediately following the Global Financial Crisis (e.g., Chodorow-Reich et al., 2012) or in the Great Depression (e.g. Fleck, 1999) can be described as coming from eras of secular stagnation or rampant demand shortfalls (Eichengreen, 2015; Summers, 2015; Eggertson et al., 2019). The period we study, on the other hand, is characterized by a transition from the Great Recession’s low-

³ These papers do not estimate a traditional balanced budget multiplier because the spending they analyze is financed by windfall gains, as emphasized by Clemens and Miran (2012).

⁴ Fishback (2017), Ramey (2019), and Chodorow-Reich (2020) provide overviews of the even more extensive literatures on the effects of fiscal policy more broadly defined on employment, output, and other variables of interest. Nakamura and Steinson (2014), as well as Ramey (2016 and 2019) and Chodorow-Reich (2020), provide frameworks for interpretation of the different estimates in these literatures.

inflation environment to one of rapidly increasing prices, suggesting a different imbalance between aggregate demand and supply.⁵

In addition, the standard transmission mechanisms for multiplier effects may have been blunted by pandemic restrictions on service provision and spending and by the public-health situation more broadly. This macroeconomic context may lead one to expect smaller employment and stimulative effects. In fact, it has been argued that the provision of social insurance, not aggregate-demand management, was and should have been at the heart of the economic-policy response to the pandemic (Romer and Romer, 2022). While we believe there is truth to that line of argument, in particular as far as the Paycheck Protection Program (PPP) and Unemployment Insurance (UI) components of the relief efforts were concerned, policymakers explicitly intended for the state and local aid component to help preserve employment, maintain quality of state and local service delivery, and support aggregate demand.⁶

Our context also differs from the Great Recession setting in key respects related to state and local government finances and operations. State government revenues, as has now been widely documented, were far more robust to the pandemic's effects than had been anticipated (Clemens and Veuger, 2021b; National Association of State Budget Officers, 2021). Indeed, as shown in Panels C and D of Figure 1, the own-source revenues of state and local governments were modestly suppressed for a single quarter during the pandemic, whereas they had remained below trend for a number of years following the Great Recession. By reducing expenditures, pandemic-related limits on service provision (e.g., transportation to schools) further alleviated strains on state budgets. While some new expenditure needs directly related to the public-health crisis arose, in overall terms states were less liquidity-constrained than had been anticipated and thus had less cause to make rapid use of fiscal assistance dollars. While the remaining federal dollars will either be spent or used to finance reductions in taxes over time, their impact on states' economies will come after, rather than during, the period of pandemic-driven uncertainty and potential revenue and aggregate-demand shortfalls.

Finally, the magnitude of the spending shocks induced by our instrument is quite large. Variations in states' over- and underrepresentation predict considerable variations in states' funding allocations. As can be seen in Figure 2, allocations to the most over-represented states exceeded allocations to the least-represented states by several thousand dollars per capita.⁷ This is considerably more variation than studies of fiscal stabilization efforts are typically able to analyze.

We also contribute to the literature on state and local government budgets over the course of the pandemic. Initial papers in this literature sought to forecast the magnitudes of the revenue shortfalls faced by various levels of government within the United States (Auerbach et al., 2020; Clemens and Veuger, 2020a, 2020b; Chernick et al., 2020; Gordon, Dadayan, and Rueben, 2020; Whitaker, 2020a;

⁵ See Hale et al. (2023) for an empirical cross-country analysis of the inflationary effects of COVID-19 support for households and businesses.

⁶ This is reflected in policy documents (e.g., as above, Driessen and Gravelle, 2020; The White House, 2021; US Department of the Treasury, 2021b), in the contemporary policy debate (e.g. Bartik, 2020; McNichol et al., 2020; Zandi, 2020), as well as in the explicit association of some elements of state and local aid with specific functions of those levels of government (e.g. education and health care).

⁷ The differential between the most and least well-represented states exceeds one-third of the combined, annual per capita state and local government revenues from own sources of a typical state in recent years.

2020b). Additional analyses have considered the pandemic's implications for spending needs (Gordon and Reber, 2020; Clemens, Ippolito, and Veuger, 2021). Researchers have also explored the effects of initial state and local aid allocations on the extent of public sector layoffs in April 2020 (Green and Loualiche, 2020). We offer the first systematic analysis of the regional employment, income, and output multiplier effects of federal allocations to state and local governments across the four major pieces of COVID-19 response legislation.

The paper is organized as follows. In Section II we introduce the data sets and sources on which our analysis relies. We turn to our empirical strategy in Section III. Sections IV and V present our empirical results and a battery of robustness tests, respectively. We conclude with a discussion of our findings in Section VI.

II Data

We analyze the fiscal assistance resulting from four major pieces of legislation during the COVID-19 pandemic: the CARES Act, the Families First Coronavirus Response Act (FFCRA), the Response and Relief Act (RRA), and the American Rescue Plan Act (ARPA).⁸ Taken together, these packages constituted a massive relief effort that provided as much as \$6 trillion in income support to households, a mix of loans, grants, and tax relief to firms and non-profits, funding for (public) health efforts, and intragovernmental grants to subnational governments. This final category includes almost \$900 billion in funds for state, local, territorial, and tribal governments, as well as the District of Columbia. We focus on the impact of these funds across the 50 states.

Following Clemens and Veuger (2021a), data from the Committee for a Responsible Federal Budget (CRFB, 2021) form the foundation for our fiscal assistance variables.⁹ We supplement the CRFB data with information from several sources.¹⁰ Our main independent variable is the grand total of aid distributed to each state per resident in millions of dollars.

Figure 2 provides an initial look at the distribution of funds across the four pieces of legislation. Dollar values are expressed on a per capita basis, and we use a state's population according to the US Census Bureau (2021) official count estimated during the 2020 census. Panel A shows that the distribution of

⁸ This section's description of COVID-19 relief legislation draws heavily on the description from Clemens and Veuger (2021a). Readers interested in detailed legislative histories should look to the more expansive discussion there.

⁹ We use data from the CRFB's COVID-19 Money Tracker as of August 19th, 2021.

¹⁰ As in Clemens and Veuger (2021a), "[w]e obtain information on the distribution of transit funds for the RRA and ARPA from the US Federal Transit Administration (2021a, 2021b). Data on the allocation of ARPA assistance to non-public schools come from the US Office of Elementary and Secondary Education (2021). We obtain estimates of ARPA section 9817 matching increases from Chidambaram and Musumeci (2021). We approximate the allocation of ARPA section 9819 federal matching funds for uncompensated care using FY2021 estimates of federal disproportionate share hospital allotments by state from the Medicaid and CHIP Payment Access Commission (2021)." The Coronavirus Capital Projects Fund outlined in ARPA is distributed according to guidance from the United States Department of the Treasury (2021a).

money across states has not been equal, with smaller states receiving relatively more per person than larger states.

In this paper’s analysis, we use a state’s number of congressional representatives per million residents to instrument for federal aid per capita.¹¹ Clemens and Veuger (2021a) establish a relationship between the relative representation of states in Congress and the amount of aid they were allocated during the pandemic. Smaller states, such as Wyoming, receive relatively more representation per capita as each state is guaranteed two senators regardless of population, ensuring that Wyomingite voices are relatively more powerful in legislative negotiations. Congressional representation is measured using rosters of the House of Representatives and Senate during the 116th and 117th Congresses from Lewis et al. (2021). Of note, Congressional representation in 2020 was allocated according to state population in the 2010 census, thus ensuring that Congressional representation is not affected by COVID-19-induced variations in population. Panel B shows the relationship between federal aid and our instrument.

The first outcome of interest in our analysis is state and local employment. The US Bureau of Labor Statistics employs several approaches to estimate employment levels. We primarily rely on employment counts from the Quarterly Census of Employment and Wages (QCEW), and use Current Employment Statistics (CES) data for robustness check. The QCEW counts the monthly unemployment insurance records of 10.9 million establishments to estimate the number of “covered workers who worked during, or received pay for, the pay period that included the 12th day of the month” (US Bureau of Labor Statistics, 2021c). Estimates are broken down by establishment location and NAICS industry code. The CES, on the other hand, is based on a set of 697,000 establishments monthly, over the same time period as the QCEW, to approximate employment across states and industries. Generally speaking, the QCEW estimates are more detailed and precise.¹² We use QCEW and CES data through December 2022. We also analyze the effects of fiscal assistance on state-wide aggregate income and output as reported by the Bureau of Economic Analysis (BEA).

Table 1 presents summary statistics on the full set of variables used in our analysis. Additionally, some of the variables we analyze are reported at a monthly frequency while others are reported at a quarterly frequency. Further details on the definitions of key variables can be found in Appendix Table 1.

III Empirical Strategy

We seek to identify the direct impact of COVID-19 relief funds to state and local governments on employment during the COVID-19 pandemic. Equation (1) presents a “naïve” OLS model of the

¹¹ Congressional representation per million residents is calculated as $\frac{\# \text{ of Representatives}_s + \# \text{ of Senators}_s}{\text{Pop}_{s,2020}/1,000,000}$, for each state s . Clemens and Veuger (2021a) show that assigning greater weight to the number of senators does not qualitatively affect the estimated importance of congressional over- and under-representation.

¹² It should be noted that the QCEW excludes up to 700,000 state and local government employees that are sampled in the CES survey. Excluded employees include elected officials, members of a legislative body or judiciary, state National Guardsmen, and temporary employees serving during a declared emergency. Students employed in a work-study program do not enjoy Unemployment Insurance (UI) coverage and are therefore not captured by the QCEW either. For an in-depth discussion of UI coverage, see US Department of Labor (2020).

relationship between per capita aid and changes in the per capita employment of state and local governments:

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y} \quad (1)$$

In the equation above, $\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right)$ is the arithmetic change in per capita state and local government employment in state s during month m of year y of the pandemic relative to per capita state and local government employment in the same month in 2019 or 2018.¹³ $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total per capita funding (in millions of dollars) to state and local governments in state s pooled across all four COVID-19 relief bills. This variable is time-invariant. $X_{s,m,y}$ is a vector of state-level demographic, economic, and political controls, which we discuss in greater detail below and in Appendix Table 1.

Addressing Endogeneity

OLS estimates of β_1 from equation (1) are subject to potential biases linked to the endogeneity of fiscal assistance allocations. If policymakers allocated more money to states with worse outbreaks of COVID-19, for example, then federal aid would be correlated with any variations in employment that were driven by variations in the severity of the pandemic. This would introduce downward bias as it would generate a spurious, negative correlation between aid dollars and employment outcomes. A more direct form of reverse causality may also arise if, for example, the severity of states' public-sector layoffs shaped federal aid allocations. In this case, the employment shock determines the amount of aid given, creating a spurious negative relationship.

We adopt an instrumental-variable approach to address these challenges. We draw on evidence from Clemens and Veuger (2021a), who show that a state's per capita representation in Congress has two relevant features, as discussed in more detail below. First, it is strongly predictive of variations in per capita federal aid allocations. Second, it is orthogonal to a rich set of measures of the pandemic's direct effects on states and on the health of their populations. This leads us to estimate the following set of equations:

$$\frac{TotalAid_s}{Pop_{s,y_{2020}}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}. \quad (2a)$$

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}. \quad (2b)$$

In the first-stage regression (2a), $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is regressed on $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, and a set of additional controls $X_{s,m,y}$, the components of which we discuss below. Robust standard errors are clustered at the state level. In our baseline analysis, we weight observations by state population, though we present robustness analyses

¹³ We report estimates using changes from both base years.

in which we weight each state equally. Fitted values from the first stage (2a) are used to estimate the second stage (2b).

Instrument Relevance

A valid instrument satisfies both the relevance and exogeneity (or exclusion) restrictions. To serve as a good instrument, congressional representation first needs to be statistically related, or relevant, to the amount of aid disbursed by the federal government. If the relationship is not strong, the fitted value will not pick up the exogenous variation needed to estimate a correctly specified second stage. As established by Clemens and Veuger (2021a), the relationship between representatives per million and COVID-19 relief aid is very strong. On a per capita basis, as can be seen in Figure 2, Panel A, small states received much more money than large states. These same small states are over-represented in Congress, a status that provides them with an advantage in the political bargaining process. Figure 2, Panel B shows that, for those states with more than two congressional representatives per million residents, the amount of aid scales almost proportionately with representation, while there is no such relationship for states with less representation. Thus, congressional representation per resident is a strong instrument for the relative amount of aid received by a state.

More formally, panels A and B in Figure 3 present coefficients on *RepsPerMillion_{it}* as in equation (3a). In Panel A the dependent variable is, in each month, the eventual total of per capita aid to state and local governments across the four major pieces of relief legislation. In Panel B the dependent variable is the running total, rather than the cumulative total, of federal aid per capita. In all months after March 2020, the coefficient on the instrumental variable is both economically substantial and statistically significant at the 1 percent level. In Panel B, estimates for months extending from April 2020 through March 2021 are around \$650 per capita and primarily reflect the small-state bias embedded in the CARES Act. The coefficients rise to roughly \$1,000 beginning in April 2021, reflecting the additional small-state bias embedded in the ARPA. The estimates in Panel A are consistently at roughly \$1,000, reflecting that the dependent variable is the cumulative total of fiscal assistance regardless of the month in the sample.

Our baseline first-stage F-statistic of 56.93 exceeds the traditional rule-of-thumb threshold value of 10 used to reject a null hypothesis of weak instruments (Stock and Yogo, 2005). Montiel Olea and Pflueger (2013) propose a test for weak instruments that allows for errors that are not conditionally homoscedastic and serially uncorrelated. Based on the routine introduced by Pflueger and Wang (2015), our baseline F-statistic also allows us to reject at the 95% confidence level the null hypothesis that the approximate asymptotic bias of our 2SLS estimator exceeds 10% (23.11), or even 5% (37.42) of the bias in our OLS estimator. Similarly reassuring are the results of Angrist and Kolesár (2022, Figure 2), which suggest that the median bias in our 2SLS estimator is negligible relative to the bias in our OLS estimator. The strength of our instrument also bears on the potential relevance of violations of the monotonicity assumption (i.e., the “no defier” assumption, which in our setting requires that states with higher values of our instrument are never made less likely to be exposed to the treatment of greater federal fiscal assistance). As noted by Angrist, Imbens, and Rubin (1996), “the stronger the instrument, the less sensitive the IV estimand is to violations of the monotonicity assumption.” All of this is particularly reassuring given the (justified) concerns over weak instruments in this literature, as discussed by Ramey (2016).

Our first-stage is also robust to the combination of baseline controls included in the regression, as evidenced by Appendix Table 2 and Appendix Table 3. The estimated F-statistic remains large with the separate addition of each control.

Instrument Exogeneity

The exogeneity restriction, on the other hand, requires that, conditional on other independent variables, congressional representation be structurally unrelated to other factors that influenced state and local government employment during the pandemic. Here it becomes relevant to discuss the variables we include in the vector $X_{s,m,y}$. In our baseline specification, $X_{s,m,y}$ includes the log of state s 's official 2020 Census population, the share of population in state s that lives in a local jurisdiction eligible for financing through the Federal Reserve's Municipal Liquidity Facility,¹⁴ and the arithmetic changes in state and local government employment per capita, private employment per capita, real wages and salaries per capita, real GDP per capita, and real income per capita in state s between December 2018 and December 2019.¹⁵ As proxies for the stringency of COVID-related restrictions on economic activity, the average Oxford Stringency Index (OSI) value for state s during March 2020 and the average OSI value for state s during month m and year y are also included.¹⁶

We advance several arguments and pieces of evidence in support of the exogeneity restriction required for equation (2b) to yield a causal estimate of the effect of federal fiscal assistance. First, we emphasize that our instrument's conditional exogeneity is plausible. Since representation imperfectly scales with population, some states will be relatively over-represented; for example, Montana's roughly 1 million residents enjoy three votes per million in Congress (2 senators and 1 representative) while 3 million Arkansans enjoy only 2 votes per million (2 senators and 4 representatives). At the same time, excepting an epidemiological relationship between aggregate state population numbers, as opposed to population density, and the novel coronavirus, the number of congressional seats has no direct impact on local employment beyond its influence on the legislative priorities of Congress.

Importantly, the data support the general argument that the degree of a state's over- or under-representation was largely unrelated to the needs it faced as a consequence of the pandemic. Clemens and Veuger's (2021a) analysis of the small-state advantage shows that it is more or less orthogonal to an extensive set of proxies for dimensions of state and local government funding needs, including states' revenue shocks, economic shocks, the size of their public sector, and acreage of federal land. Appendix Table 4, a version of Clemens and Veuger's (2021a) Appendix Table 5 with the sum of federal funds across all four bills used as the dependent variable, illustrates this for the current setting. Controlling for

¹⁴ Access to the Federal Reserve's Municipal Liquidity Facility (MLF) has been described as a major contributor to settling municipal bond markets during the coronavirus's initial outbreak (Haughwout et al., 2022). Based on Federal Reserve Board (2021) guidance, we estimate the share of states' 2020 populations residing in a municipality eligible for local MLF financing (in addition to state MLF financing, which was accessible to all).

¹⁵ We use changes between December 2018 and December 2019 for specifications that use outcome variables that are calculated as changes with respect to 2019. For specifications that use outcome variables calculated with respect to 2018, we use arithmetic changes in economic controls between December 2017 and December 2018.

¹⁶ Information on the stringency of government restrictions comes from Oxford's COVID-19 Government Response Tracker (OxCGRT). This source provides daily index values of government restrictions for all 50 states since January 6, 2020. OSI ranges from 0 (no restrictions) to 100 (the highest possible level of restrictions across all eight dimensions). In all regressions, it is rescaled by dividing by 100 so that it ranges from 0 to 1.

various dimensions of perceived need does not qualitatively affect the relationship between our instrument and the amount of federal funds allocated.

Even with this initial supporting evidence, however, the exogeneity assumption requires further justification. A larger outbreak of COVID-19 will cause more people to limit mobility either voluntarily or due to health reasons. It is possible that small states may as a result have been differentially impacted by the pandemic, which may in turn have differentially impacted their employment. Social distancing necessarily translates into less spending on services, the taxation of which provides the revenues many state and local governments use to pay employees.

Another possibility is that small states may have adopted a different set of policy responses to the pandemic, and that those policy responses may have exerted independent influence on economic activity. On this point, it is useful to note that, as shown by Clemens and Veuger (2021a), the over-representation of small states is less correlated with political partisanship than is commonly assumed.

We provide additional evidence on a number of these issues by exploring our results' robustness to altering the sets of covariates we include in $X_{s,m,y}$. In particular, we implement specifications that include covariates that are associated with the pandemic's health effects, with the stringency of states' policy responses to the pandemic, with states' political leanings, and with additional proxies for states' pre-pandemic economic trends.

An additional potential concern is that the fiscal assistance that is predicted by our instrument might be correlated with other elements of the federal government's pandemic relief packages. This is a natural concern in light of the fact that fiscal relief for state and local governments accounts for roughly one-sixth (or \$1 out of \$6 trillion in total relief spending) of the federal relief packages. We are able to provide direct evidence on this potential concern with respect to three of the largest programs through which the federal government provided relief to business and households, namely the PPP, the Economic Impact Payments (EIP, or "stimulus checks"), and federal funding for enhanced UI benefits. In Appendix Table 5, we report results from an analysis in which we put the per capita spending from each of these programs on the left-hand side of Equation (2b). The point estimate on $\frac{TotalAids_s}{Pop_{s,y_{2020}}}$ thus tells us

how many dollars in spending through these major programs are correlated with each dollar in fiscal relief of states and localities as predicted by our instrument. The estimates in Panel A reveal that in our baseline specification there is no statistically significant relationship between the spending predicted by our instrument and the federal spending through PPP, EIP, and UI. In Appendix Table 6, we place the PPP, EIP, and UI spending variables on the left-hand side of Equation (2a). The results show directly that our instrument is uncorrelated with spending through these programs in our first-stage regression.

A final potential concern is that small and large states may simply have been on different pre-pandemic trends. Indeed, because the data provide reason to worry that this was the case, our baseline specifications include pre-pandemic trends in the dependent variables as controls. An exploration of the robustness of our estimates to alternative approaches to controlling for this potential concern will be an important component of our analysis, but here we present initial evidence in the form of "pre-trend tests." That is, we confirm that the spending variations that are isolated by our instrument do not predict changes in employment over the months that preceded the pandemic's onset and the first pieces of legislation that we analyze.

Appendix Table 7 shows that the coefficients on federal aid per capita from estimating various specifications of equation (2b) with data from January to March 2020¹⁷ (our ‘pre-pandemic’ period) are statistically insignificant at conventional confidence levels and practically small, suggesting there is no uncontrolled trend prior to April 2020. Later we present additional evidence for the absence of divergent pre-existing trends beginning in January 2019.

Event Study Specifications

Equations (2a) and (2b) can be described as pooled panel regressions. To recover event study estimates, we also estimate sets of horizon-specific estimates at the monthly level for our employment data and at the quarterly level for our data on macroeconomic aggregates. These period-by-period regressions are described by equations (3a) and (3b):

$$\frac{TotalAid_s}{Pop_{s,y2020}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y} \quad (3a)$$

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y2020}} + \beta_2 X_{s,m,y} + u_{s,m,y}. \quad (3b)$$

In equations (3a) and (3b), m and y iterate over the month-year pairs from January 2019 to December 2022. In this specification, $\frac{TotalAid_s}{Pop_{s,y2020}}$ is still the total amount of aid per capita allocated to a state since the beginning of the pandemic.

This change in specification has two main advantages. First, for the set of regressions estimated from April 2020 onwards we are able to establish a time series of the effect that relief aid has had on employment. It is unlikely that money allocated in March would have its full effect by April, so estimating equations (3a) and (3b) month by month enables us to examine if and when COVID-19 aid significantly cushioned employment.

Second, our estimates for months that precede the pandemic provide period-by-period tests for the presence of divergent pre-trends. In order to expand the number of pre-pandemic periods available to establish common trends, we estimate versions of equations (2a), (2b), (3a), and (3b) that use outcomes measured as changes from the same period in 2018 rather than the same period in 2019. In the specifications that measure changes from 2018, our controls for pre-pandemic economic trends are also shifted in time to avoid temporal overlap with sample under analysis.¹⁸ Our tests for divergent pre-existing trends capture the intuition that instrumented COVID-19 relief aid should be conditionally

¹⁷ As the QCEW is surveyed during the second week of each month, March 2020 employment figures are estimated prior to the large-scale shutdowns that shocked normal business conditions.

¹⁸ Specifically, the five controls for pre-pandemic changes in economic variables measure changes from 2017 to 2018, instead of changes from 2018 to 2019. We note that this shift in the control variables involves a trade-off. Its benefit is that it enables a compelling test for the presence of divergent pre-existing trends through 2019. Its drawback is that the use of controls constructed using earlier data may come with a loss of precision. When our focus turns to the bounds on our confidence intervals, we thus emphasize specifications that use the more recent and hence more informative control set. Additionally, we note that we do not include the COVID-19 policy controls that capture MLF eligibility and the OSI measures in the pre-trend specifications.

unrelated to economic outcomes in months before money was actually legislated. Figures 4 and 5, analyzed further in the Results section, confirm that this is the case.

Interpreting Estimates

The coefficient β_1 estimated in equations (2b) and (3b) is the primary object of economic interest. In addition to summarizing the relationship between COVID-19 relief aid and state and local government employment, β_1 can be transformed into an intuitive metric for evaluating the efficacy of fiscal relief. Specifically it can be transformed into an estimate of the dollars spent per job-year saved. In equation (2b), the coefficient β_1 identifies the average number of jobs recovered for an additional \$1 million in federal aid across a 33-month (2.75 year) interval. Since $\frac{TotalAid_s}{Pop_s, y_{2020}}$ is defined as the amount of aid per capita in millions of dollars, the ratio $\$1,000,000/(\beta_1 * 2.75)$ is the number of federal dollars needed to recover one state or local government job-year during the pandemic. If β_1 is large, the government will have spent relatively little money to preserve or create each job-year.

IV Results

Together, the CARES Act, FFCRA, RRA, and ARPA represent an unprecedented transfer of money from the federal government to state and local governments. We focus first on assessing the extent to which this transfer helped sustain state and local employment through the crisis, before turning to broader macroeconomic impacts.

State and Local Government Employment during the Pandemic

We begin by describing the declines in state and local government employment that occurred during the pandemic in more detail. As discussed briefly in the introduction, Figure 1 provides time series evidence on the magnitude of the COVID-19 shock's initial impact on state and local government employment, as well as on the evolution of that impact over time. It uses QCEW data to summarize changes in state government employment, local government employment, and private employment. The changes are calculated relative to the same calendar month in 2019 (e.g., the first value is a change calculated from January 2019 to January 2020, while the final value is a change calculated from December 2019 to December 2022). Appendix Figure 1 uses CES data to present changes in state and local government employment on a per capita basis. Both figures reveal the same general trend: a sharp decline in government employment during the spring of 2020 that was partially undone during the summer of 2020, followed by additional, but much slower, recovery through late 2022. Appendix Figure 2 presents an additional, more direct comparison of the QCEW and CES data in percent change terms, echoing once again the significance of the contraction in employment and the lagging pace of the recovery.

The QCEW figures show that local-government employment has been durably affected by the COVID-19 shock. By June 2020, local-government employment had shrunk by 7.6 percent nationally; it remained 2.3 percent below its 2019 level in December of 2022. State government employment suffered a smaller initial shock but was 2.5 percent below its 2019 levels as of December 2022. By June 2020, combined state and local government employment had shrunk by over 1.2 million nationally (6.4 percent below 2019 levels); in December 2022 it remained 450,000 jobs (or 2.3 percent) below its 2019 levels.

Consequences of Federal Aid for State and Local Government Employment

Column 1 of Table 2 presents the second stage of our 2SLS baseline specification using QCEW data from April 2020 through December 2022. The coefficient on total aid per capita, 0.603, implies that the federal government had to allocate nearly \$603,000 per job-year saved.¹⁹ That amount corresponds to over 8 times median household income.²⁰ We can rule out cost estimates below \$220,000 per job-year saved with 95% confidence.

While our baseline estimate of federal dollars allocated per job-year saved is high, our estimate nonetheless implies a substantial number of job-years saved due to the historically large quantity of aid provided. A back-of-the-envelope calculation using \$837 billion as the total amount of aid disbursed and \$603,000 as the cost to save one job-year implies that nearly 1,400,000 public-sector job-years were saved in aggregate, or about 500,000 public-sector jobs across the entirety of the 33 months in our sample.

Table 3 shows OLS results for the same set of regressions shown in Table 2. Column 1 confirms our intuition that the OLS estimate of the effectiveness of federal aid in preserving state and local employment is in fact downward biased. Table 4 presents estimates for the version of our outcome variables that takes 2018 as the base year. The estimates in column 1 suggest a moderately higher cost per public-sector job-year saved of \$841,000. This estimate is somewhat less precise, and the lower bound of the 95% confidence interval, in dollars per job-year saved, is \$229,000.

Evolution of Employment Effects over the Course of the Pandemic

Timely delivery of funds has been a central issue for the federal government's COVID-19 response. As there is a delay between the announcement of funding allocations, the disbursement to state treasuries, and the actual spending by state and local governments, it may be useful to examine the coefficient on federal aid per capita over the course of the pandemic in order to identify any trends over time. This timing component is an important aspect of the overall policy landscape.

Figure 4 shows an event study analysis of the state and local government employment response to total federal aid per capita in millions of dollars, with equation (3b) estimated month by month. Changes in state and local employment from the same period in 2018 are shown in blue and changes in state and local employment from the same period in 2019 in red. While the coefficient on the aid variable is generally positive in both specifications, indicating that more federal support translated into jobs saved, the effect is economically modest and statistically indistinguishable from zero in all months.²¹ Estimates from January 2019 through March 2020 provide no evidence to support concerns that our estimates might be affected by divergent pre-existing trends.

¹⁹ As discussed above, our calculation of the number dollars allocated per job-year saved is as follows. Noting that our fiscal aid variable is scaled in millions, we divide 1 million by the product of the point estimate and the 2.75 years in the sample. In this particular instance, we thus divide 1 million by 2.75 times the coefficient of 0.603 to obtain an estimate of \$603,000 per job-year saved.

²⁰ This also exceeds the 2020 average annual salary of federal, state, and local government workers of \$62,765 by a factor of close to 10 (US Bureau of Labor Statistics 2021b).

²¹ This stands in interesting contrast with the practically immediate impact of federal relief on municipal credit markets observed by Haughwout et al. (2021).

Consequences for the Macroeconomy

Aid to state and local governments may support broader economic activity in two ways. First, supporting employment in the public sector buoys incomes among those employees who retain their jobs. The money they continue to spend can support employment in the private sector. It should be noted that the forced and voluntary social distancing experienced during the pandemic may limit this transmission mechanism. Second, more aid to state and local governments may also fortify their abilities to provide basic services, health-related relief, and investments that contain the economic damage of the pandemic.

Columns 2 through 5 of Table 2 present estimates of the effects of aid to states and localities on several macroeconomic indicators, measured as changes relative to 2019. Column 2 applies our baseline model to private employment using monthly data. Columns 3, 4, and 5 examine the broader economy at a quarterly frequency using real, annualized total wages and salaries (government plus private) per capita, state GDP per capita, and personal income per capita from the Bureau of Economic Analysis (2021).^{22,23}

The estimate of the impact on private employment in Column 2 is similar in size to our estimate for public-sector employment, but very imprecisely estimated. We take this as not providing strong evidence for an effect in either direction. Our findings in Column 3 indicate that an additional \$1 in aid per capita to state and local governments increased annualized real wages and salaries per capita by \$0.18 per year between Q2 2020 and Q4 2022. This result is insignificant at traditional confidence levels. Columns 2 and 3 thus provide little evidence of meaningful spillovers from state and local government aid to the overall labor market.

Columns 4 and 5 analyze two broader measures of aggregate economic activity. First, Column 4 uses annualized, seasonally-adjusted state GDP per capita (in millions of chained 2012 dollars). The estimate in column 4 suggests that an additional \$1 in relief funds per capita predicts a per-year reduction in GDP per capita of \$0.01, while the estimate in Column 5 shows that an additional \$1 in relief funds per capita predicts a per-year increase in aggregate income per capita of \$0.31. These results are statistically indistinguishable from zero at traditional confidence levels, and we interpret them in combination as suggesting a null impact on aggregate income and output.

Our point estimates in columns 3, 4, and 5 can be converted into fiscal multiplier estimates by simply scaling the coefficients in Table 2 by 2.75 (accounting for the 11 quarters in our sample). The estimates imply a wage-bill multiplier of \$0.49, a GDP multiplier of -\$0.01, and an aggregate income multiplier of \$0.89. Because these estimates are statistically indistinguishable from 0 in all cases, the evidence from our baseline specification is consistent with null effects.

Evolution of Macroeconomic Effects over the Course of the Pandemic

Figure 5 presents an event study of the macroeconomic effects of federal fiscal assistance. Panels A through Panel D present estimates of the effect of federal aid on private employment, on wage and

²² We convert nominal wages and salaries and nominal personal income from the Bureau of Economic Analysis into real terms with the national seasonally-adjusted personal consumption expenditure deflator, with a base year of 2012 equal to 100.

²³ As before, Tables 2 and 3 present results for changes with respect to 2018 instead of 2019 and OLS results.

salary earnings, on real personal income, and on real GDP. In all cases, the impact of the federal aid to sub-national governments remains small and statistically indistinguishable from zero over time. Additionally, estimates for periods extending from early 2019 through early 2020 once again reveal no evidence to support concerns that our estimates might be affected by divergent pre-existing trends.

V Robustness

We subject the full set of results in Table 2 and 4 to a set of robustness checks that gauge the potential relevance of the covariates we include, of the functional form in which we include those covariates, and the potential role of either the largest or smallest states in driving our results.

In rows A1 and B1 of Table 5, we reduce the control set to include solely the log of each state's population, to which we add lagged outcomes in rows A2 and B2. Rows A4 and B4, on the other hand, show results for a specification that augments our baseline set of controls with various political and pandemic-related controls. Broadly speaking we find the same patterns of outcomes, with evidence for some effect of pandemic aid on state and local employment but not on broader outcome measures. We emphasize that many of the estimates for state and local employment imply an even higher cost per job-year than our baseline estimates, with the lower bound of the 95% confidence interval exceeding \$400,000 in a number of cases and \$600,000 in some. The evidence that large quantities of aid were allocated per public sector job-year saved is thus strong and robust. Estimated effects on GDP and aggregate income are also persistently modest in magnitude.

Unweighted versions of the specifications in Table 5, which appear in Appendix Table 8, tend either to similarly imply null effects or in some instances to point more strongly to negative effects. Over a two-year time horizon shown in Appendix Table 9, which provides for comparability with research on the effects of the American Reinvestment and Recovery Act, a subset of the weighted estimates equivalent to those in Table 5, as well as all of the unweighted estimates like those in Appendix Table 10, make it possible to rule out multipliers in excess of 1.6.²⁴

In Appendix Table 12, we include an indicator for whether a state was “small” in the sense that it benefited from the CARES Act's floor function in addition to our baseline control set. In Appendix Table 13, we consider a more saturated specification in which the covariates include squared and cubic polynomials in all baseline covariates.²⁵ The results in Appendix Tables 12 and 13 provide evidence that our overall conclusions are not sensitive to different functional-form specifications. With the exception of our imprecise and volatile estimates for private employment, which become more strongly negative in Appendix Table 13, estimates tend to change only modestly across this set of specifications, though the point estimate for state and local government employment in Appendix Table 13 is negative and near 0. On balance, the estimates reinforce the conclusion that federal fiscal assistance had little economic impact during the pandemic.

²⁴ Column 1 of Appendix Table 11 replicates the estimates from column 1 of Table 5, while column 2 presents an equivalent set of estimates using CES employment data rather than QCEW employment data. The results are very similar, with CES estimates tending to be closer to 0 than the corresponding QCEW estimate.

²⁵ This specification also serves to address concerns raised by Blandhol et al. (2022) regarding the interpretation of instrumental-variables estimators.

In Panel A of Appendix Table 14 we drop the three most and least represented states from the sample, while in Panel B we drop the five most and least represented states from the sample. The results in Panel A reveal that, again with the exception of our estimates for private employment, point estimates are little changed by dropping the three most and least represented states. Additionally, the first stage F-statistic declines only moderately from when we remove these most extreme states from the sample. The results in Panel B reveal that after removing the five most and least represented states from the sample, our first stage F-statistics decline substantially. With the exception, once again, of the estimate for private employment, the second-stage point estimates differ only moderately from their counterparts in Table 4. The precision of the estimates is reduced substantially, however, by dropping 10 states that contribute substantially to the variation in our instrument from the sample.

Appendix Table 15 presents results in which we moderately change the construction of our outcome variables. Specifically, for the regressions reported in Appendix Table 15, we define the changes in each outcome relative to a base period of either December 2019 or the fourth quarter of 2019. Calculating changes relative to a common month conforms with the conventional approach to estimating local-projection impulse response functions (Ramey, 2016). This contrasts with our baseline approach in that it will not net out seasonal effects. As shown in columns 3 through 5, this change has very little effect on the estimates we obtain for outcomes we construct using seasonally adjusted data from the BEA. By contrast, columns 1 and 2 reveal that the standard errors on our estimates rise for outcomes constructed using QCEW data, which are not seasonally adjusted. Qualitatively, these estimates reinforce the overall impression that federal fiscal assistance dollars had at most a moderate effect on employment by state and local governments, an imprecisely estimated effect on private employment and a modest if any stimulative impact on the overall economy.

In a final robustness check, Appendix Table 16 presents estimates in which we augment the set of controls with an additional set of lags in the five pre-COVID controls. For our estimates of the effect on state GDP, for example, we add the change in the five pre-COVID controls for changes in state and local employment, private employment, total wages and salaries, GDP, and personal income from the fourth quarter of 2017 to the fourth quarter of 2018 in addition to the baseline control set, which included growth from the fourth quarter of 2018 to the fourth quarter of 2019. This robustness check is motivated by insights from Ramey (2022) regarding the desirability of controlling for more rather than fewer lags when estimating impulse response functions. Ramey (2022) draws in part on econometric advances from Montiel Olea and Plagborg-Møller (2021), who show that lag-augmented impulse responses have attractive inference properties. The results in Appendix Table 16 show that the inclusion of an additional lag has modest effects on the point estimates of interest and moderately reduces some of the associated standard errors.

VI Discussion

In this section, we evaluate the fiscal aid to state and local governments as a component of the broader COVID-19 relief effort, place our results in the context of the literature on fiscal multipliers, and discuss some of the caveats typical of our empirical strategy.

Job Creation

In the release of the final rule on State and Local Fiscal Recovery Funds, Deputy Secretary of the Treasury Wally Adeyemo said, “[the COVID-19 relief funds] ensure that governments across the country have the flexibility they need to vaccinate their communities, keep schools open, support small businesses, prevent layoffs, and ensure a long-term recovery.” In this paper, we show that the unprecedented level of transfers from the federal government to the sub-national level has had a modest impact on government employment and has not translated into detectable gains for private businesses or for states’ overall economic recoveries.

Our baseline results imply that \$603,000 in federal spending was needed to preserve a state or local government job-year during the pandemic. The confidence intervals on our estimates are sufficiently precise to rule out estimates of less than \$220,400, while we do not find significant additional effects in the broader labor market. Across a broad set of additional specifications we consider, the implied cost per job year-saved tends to be higher. Because a number of alternative specifications yield moderately smaller standard errors, confidence intervals regularly rule out costs of less than \$400,000 per job year saved.

These estimates do not compare favorably with estimates for the other major elements of the COVID-19 relief packages that had the intent of preserving employment or stimulating economic activity. The PPP, which has itself been criticized for having a modest job-preserving impacts per dollar spent, has been estimated to cost much less per job year saved. Autor et al. (2022a and 2022b), for example, refer to their estimate that the PPP cost between \$169,000 and \$258,000 per worker-year retained as reflecting a “very substantial cost” and “high costs per job.” Autor et al. (2022b) describe their estimates as being “broadly similar” to estimates from Chetty et al. (2020) and Hubbard and Strain (2020), who analyzed the Paycheck Protection Program using complementary data sources. Dalton’s (2021) estimates show significant overlap as well, while Splinter et al.’s (2023) are in fact lower: \$121,000 (or \$92,000 after accounting for fiscal externalities). Faulkender et al. (2020) present even lower estimates of between \$50,000 and \$75,000 per job preserved by the PPP.

The employment effects of other elements of the pandemic relief bills have been less widely studied than those of the Paycheck Protection Program. Haughwout et al. (2021) study the Municipal Liquidity Facility (MLF) and estimate that while the program had desirable effects on secondary market yields and primary issuance, its implications for employment were overshadowed by those of the type of direct federal aid analyzed in this paper. Early on in the pandemic, Chetty et al. (2020) assessed that the Economic Impact Payments or “stimulus checks” had been so ineffective in sustaining or raising employment levels that it “raise[d] the specter of a jobless recovery.”

Minimizing expenditures per job created or preserved is of course not the be all and end all of even explicitly countercyclical policies.²⁶ Unemployment insurance benefits are a particularly salient demonstration of this, and the policy response to the COVID-19 pandemic included dramatic expansions and extensions of such benefits. These were, inter alia, the Federal Pandemic Unemployment Compensation (FPUC) and Pandemic Unemployment Assistance (PUA) programs. Estimates by Holzer et

²⁶ We study the extent to which federal aid to state and local governments affected testing and vaccine delivery during the pandemic in Clemens, Hoxie, Kearns, and Veuger (2022). Clemens and Veuger (forthcoming) provide suggestive evidence of the effects on state corporate tax policy.

al. (2021), who analyzed the termination of enhanced unemployment benefits in the summer of 2021, which varied in timing across states, imply that these programs reduced employment by one job-year for each \$125,000 in spending. The effects of enhanced unemployment benefits were likely smaller during the pandemic's initial months, when pandemic restrictions would have rendered workers' labor supply preferences a less binding constraint.

A comparison with past fiscal relief efforts can be obtained by looking to research on the effects of the American Recovery and Reinvestment Act (ARRA). Ramey (2019) provides a range of ARRA employment multiplier estimates from \$50,000 to \$112,000 per job-year. The estimation approach, an instrumental-variables approach that relies on Medicaid formulas, Department of Transportation formulas, and a combination of multiple agency formulas, as well as the specific estimate of \$50,000 come from Chodorow-Reich (2020); an estimate as low as \$26,000 can be found in Chodorow-Reich et al. (2012). Wilson (2012) follows a similar formula-based approach and arrives at an estimate of \$125,000 per job. Conley and Dupor (2013) use variation in states' budget positions and ARRA highway funding to estimate that the Act's implied cost of creating a job-year was \$202,000. Our estimates of the dollars spent per job-year preserved by COVID-19 era federal support for state and local governments thus far exceed those from the ARRA context.²⁷

Fiscal Multipliers

Turning to our results for output and income, we estimate that relief funds had little if any effect on GDP and income across the 11 quarters that extend from Q2 of 2020 through Q4 of 2022. There is an extensive literature drawing on a wide range of methodological approaches and historical episodes that provides context for our estimate of these spending multipliers. In a review of estimates of government spending multipliers using national data, Ramey (2019) reports that most macroeconomic analyses find a multiplier between 0.5 and 0.8, including for the ARRA. Chodorow-Reich (2020), on the other hand, in a review of multipliers estimated using cross-sectional approaches, argues the findings in that literature translate into national multipliers between 1.5 and 2. Our estimates are most similar to Pennings' (2021) estimated multipliers for temporary household transfer payments financed by the federal government and to Dupor et al.'s (2022) estimates of local consumption multipliers for the ARRA. Below, we discuss several conceptual considerations that are relevant for interpreting our estimates and comparing them with estimates from other contexts.

A first set of factors relates to the fact that our estimates are of subnational multipliers as opposed to aggregate multipliers. As Ramey (2019) points out: "In some instances, the subnational multipliers are expected to be higher than the aggregate multipliers, whereas in other instances they are expected to be lower. There is no general rule." Recent work has illustrated this assessment by complementing estimates of subnational multipliers with time series estimates (Wolf, 2023) and general-equilibrium models (Orchard et al., 2023) to produce estimates of aggregate multipliers.

²⁷ Some of the papers we reference here (some papers analyzing the ARRA, for example) incorporate spillovers onto firms or sectors that are not directly impacted by federal spending, while other papers (papers analyzing the PPP, for example) do not. In a companion paper (Clemens et al., forthcoming) we explicitly allow for cross-state spillovers effects but generally do not find evidence for larger public-sector employment or macroeconomic impacts than the ones estimated here.

The relevant spending in this case is financed by (future) national taxpayers. Whether and how taxpayers in states and localities differ in how they take account of these (future) tax liabilities compared to a situation in which the spending is financed at the state and local level is an open question. To the extent that such differences exist, our setting is probably more similar to one of open-ended deficit financing than one with offsetting (scheduled) tax increases or Ricardian equivalence dynamics. Within a New Keynesian framework, Pennings (2022) finds that the difference between locally and externally financed multipliers are smaller than commonly presumed, in particular when the government spending shock is temporary rather than persistent.

A second set of factors relate to the macroeconomic and public health context. Our estimates do not come from an era of secular stagnation or rampant demand shortfalls (Eichengreen, 2015; Summers, 2015; Eggertsson et al., 2019). This contrasts with papers set in the period immediately following the Global Financial Crisis (e.g. Chodorow-Reich et al., 2012). Our estimates may therefore be lower (cf. Ramey, 2019).

Additionally, the effects of federal fiscal relief may not yet have been fully realized, as pandemic fiscal assistance had not all been spent within the time periods we analyze. That said, it is relevant to emphasize that our analysis extends beyond the period in which it was plausible to think states were in financial dire straits (Clemens and Veuger, 2021b), and into a period of elevated inflation. To the extent that stimulative effects accumulate in subsequent quarters, they will likely affect prices in addition to quantities and will presumably be offset to a degree by monetary policy.²⁸ This would imply that their aggregate, national effect will be smaller than it would be if monetary policy remained passive, as illustrated by Dupor et al.'s (2022) modeling exercise.²⁹ They find that a local consumption multiplier of 0.20 translates into an aggregate multiplier of 0.41 at the zero lower bound, but that the aggregate multiplier turns negative if the monetary authority responds to inflationary pressures.

It is also relevant to note that COVID-19 mitigation measures were in place throughout the period we analyze, though their intensity varied across place and time. Maximizing broader economic activity was thus not necessarily the only or even main goal policymakers had in mind when designing pandemic relief. That said, even conditions of restricted supply may call for demand stimulus, which can then have its normal desirable effects (as in Guerrieri et al., 2022). Additionally, as we have noted above, preventing layoffs and stimulating the economic recovery were explicitly stated goals of the fiscal relief studied here. The assessment presented here is thus a key component of any overall appraisal of the federal government's response to the COVID-19 crisis.

²⁸ This counterproductive time delay is at the heart of a classic critique of fiscal policy as countercyclical policy (Anderson and Jordan, 1968; Friedman and Heller, 1969; Auerbach, 2002). It is also an argument for keeping state and local fiscal assistance linked to formulaic automatic stabilizers less vulnerable to excess.

²⁹ See also Jo and Zubairy (2022).

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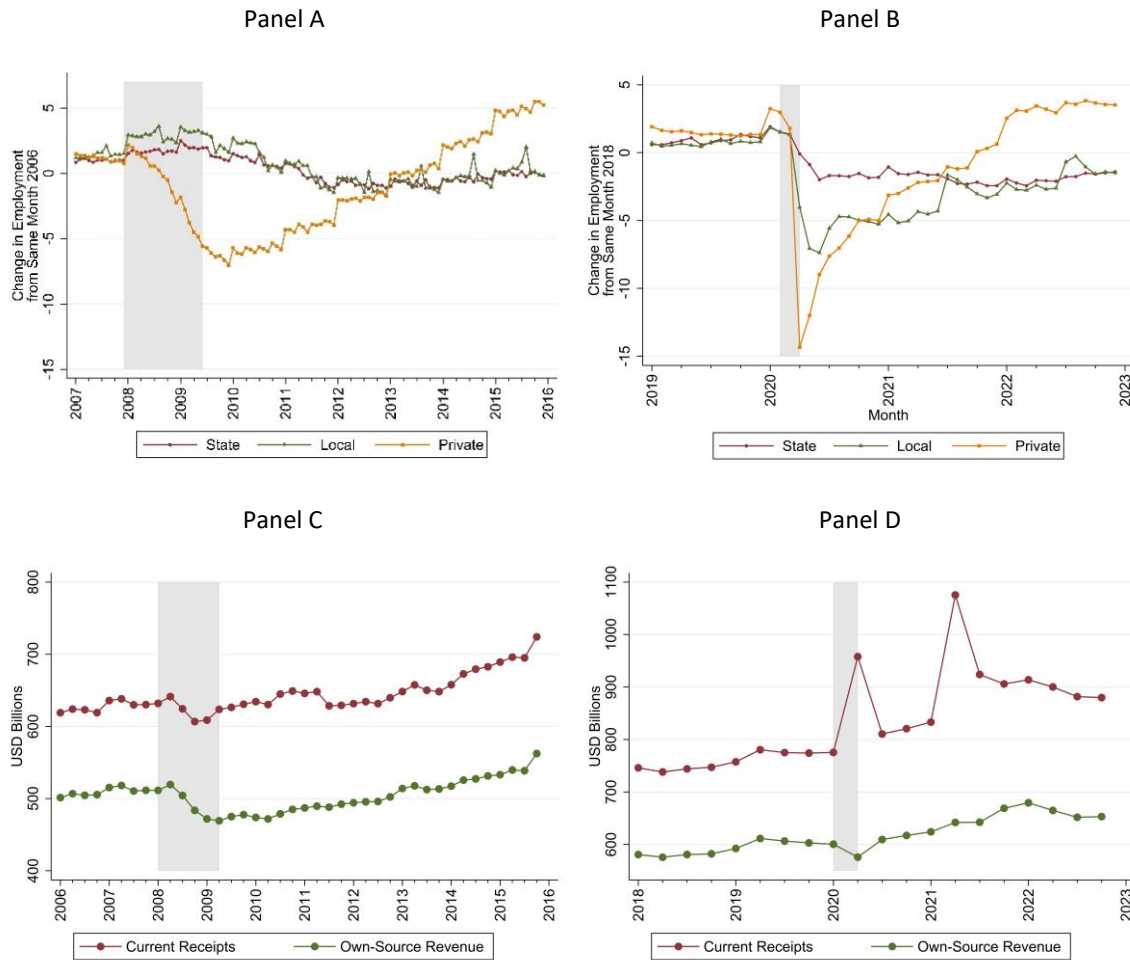
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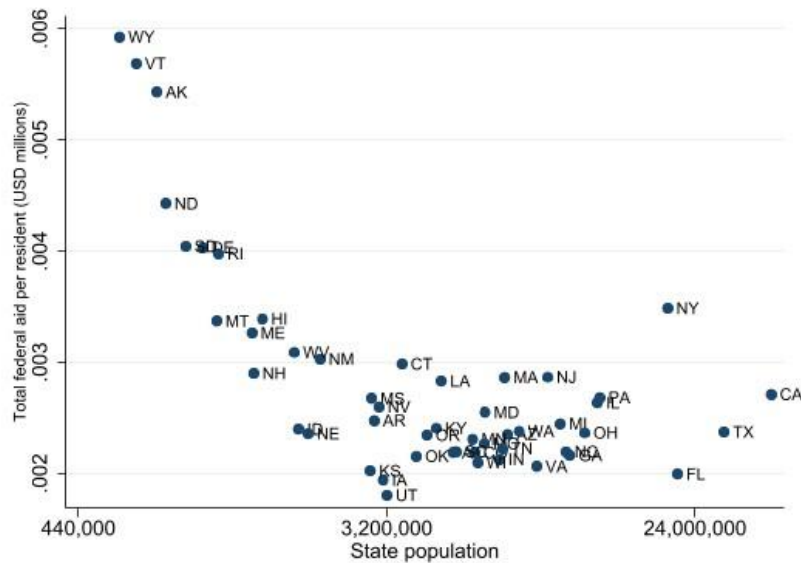
Figure 1: Change in State and Local Government Employment per Capita



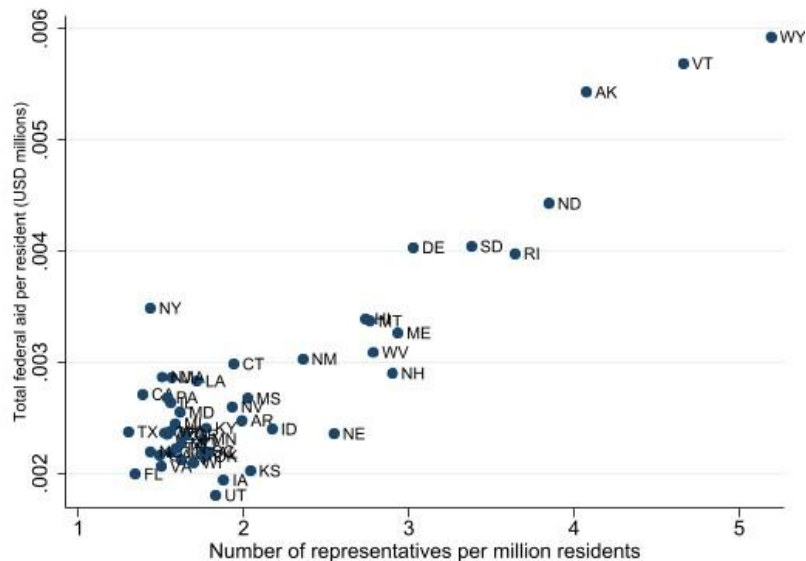
Note: This figure shows the percent change in employment and changes in national receipts during both the period of the Great Recession and COVID-19 pandemic. Panel A shows changes in national state and local government employment and private relative to the same month in 2006, while Panel B show the same changes relative to the same month in 2018. Panel C shows the change in state and local current receipts and own-source revenue in the years before, during, and after the Great Recession, while Panel D shows the same changes for the years before, during, and after the COVID-19 pandemic. The employment data come from the Quarterly Census of Employment and Wages (QCEW). State, local, and state plus local government employment are shown separately. The current receipts and own-source revenue data comes from US Bureau of Economic Analysis (2023b). Panels C and D are expressed in billions of 2022 Q1 USD.

Figure 2: Distribution of COVID-19 Relief Aid per Resident

Panel A: Total Federal Aid to State and Local Governments per Resident and Population



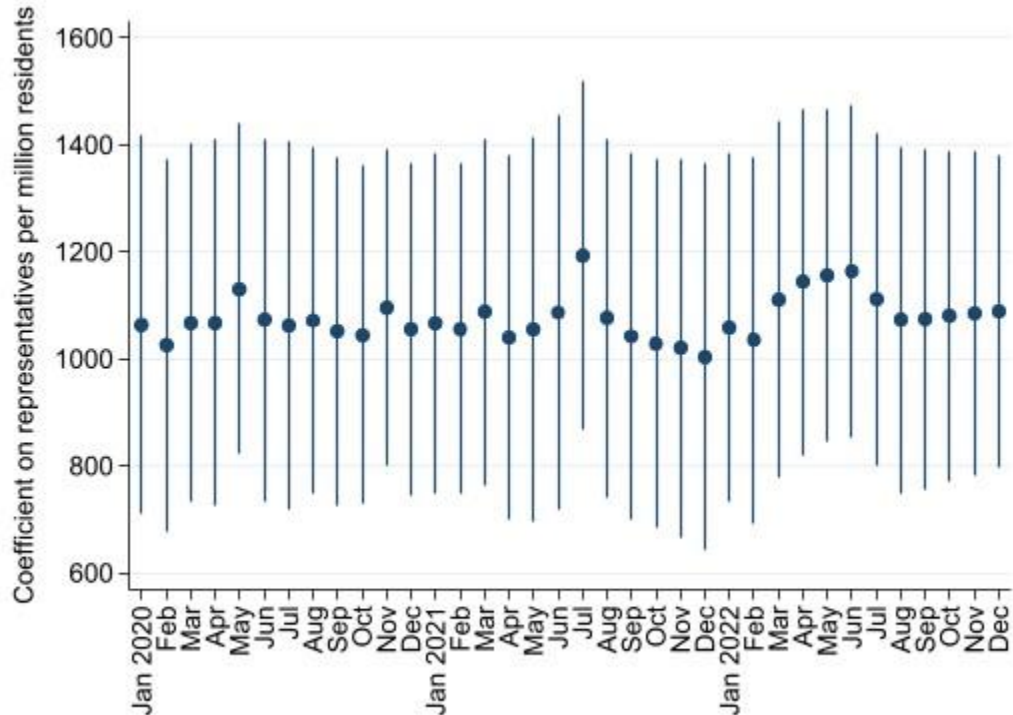
Panel B: Total Federal Aid to State and Local Governments per Resident and Congressional Representation



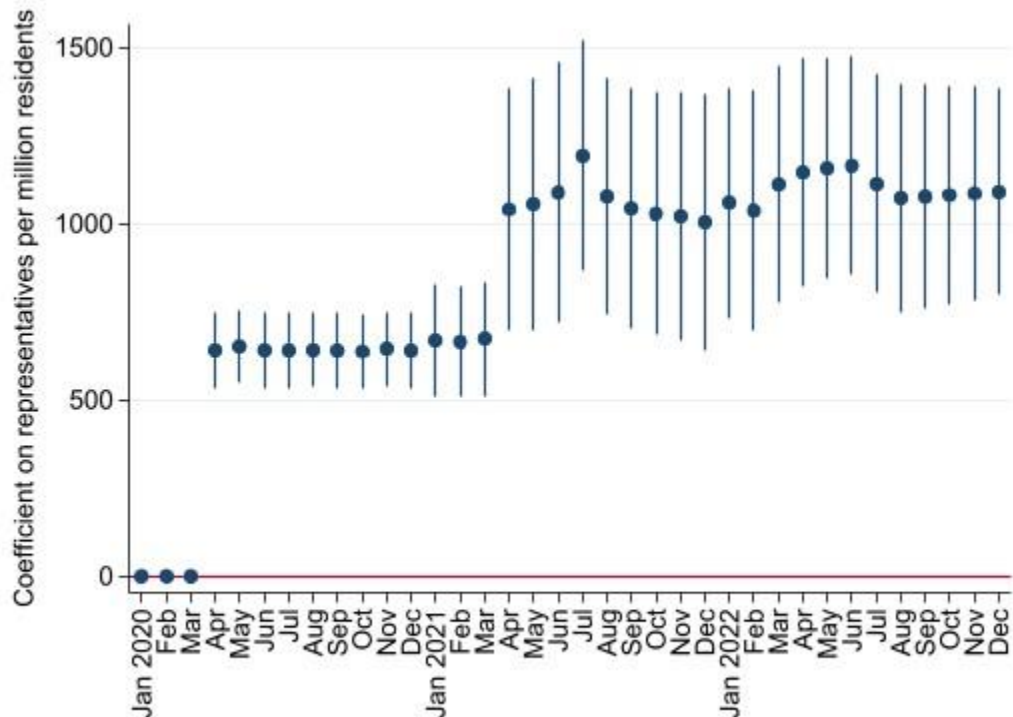
Note: This figure shows the appropriation of COVID-19 relief funds to state and local governments by state. Funds are calculated as the sum across the CARES Act, Families First Coronavirus Response Act, Response and Relief Act, and American Rescue Plan Act on a per resident basis. Panel A displays the total federal aid to state and local governments per resident in USD millions on the y-axis and state population (on a log scale) on the x-axis. Note that any state with a population less than Connecticut is a ‘small state,’ a state that received the floor level of funding mandated in the CARES Act. There are 21 such states. Panel B displays total federal aid to state and local governments per resident in USD millions on the y-axis and the number of congressional representatives per million residents in 2020 on the x-axis. This figure uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021).

Figure 3: Relationship Between Federal Aid to State and Local Governments per Resident and Representatives Per Million Residents

Panel A: Aggregate Total Aid to State and Local Governments



Panel B: Running Total Aid to State and Local Governments



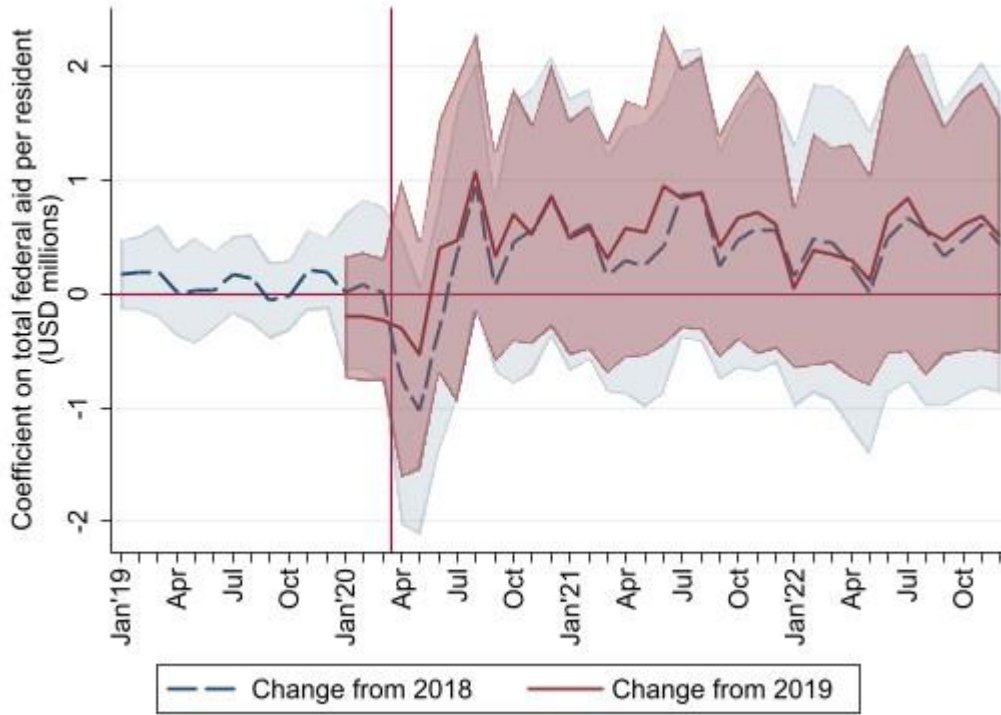
Note: This figure displays the regression coefficient (and its 95% confidence interval) on representatives per million residents in 2020 from a variation of the first stage used to estimate equation (2a):

$$\frac{TotalAid_s}{Pop_{s,y_{2020}}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}$$

where $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total of federal aid to state and local governments per resident in state s pooled across all four bills.

$RepsPerMillion_s$ is the number of Representatives and Senators per million residents in 2020. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Panel A uses the total amount of aid allocated across all four spending bills, while Panel B uses the running total of aid given through each month. The passage of the CARES Act and ARPA can be seen in the coefficients for April 2020 and April 2021, respectively. The national appropriation of funds is summarized in Appendix Figure 3. The regressions are weighted by state population and clustered at the state level. Between April 2020 and December 2022, the minimum first stage F-statistic is 31.01 (December 2021) and the maximum is 56.62 (June 2022). This figure uses data from the Committee for a Responsible Federal Budget (2021), US Census Bureau (2021), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), and Hale et al. (2020). 95% confidence intervals are shown for each point estimate.

Figure 4: Event Study of Changes in State and Local Government Employment in Response to COVID-19 Relief Aid

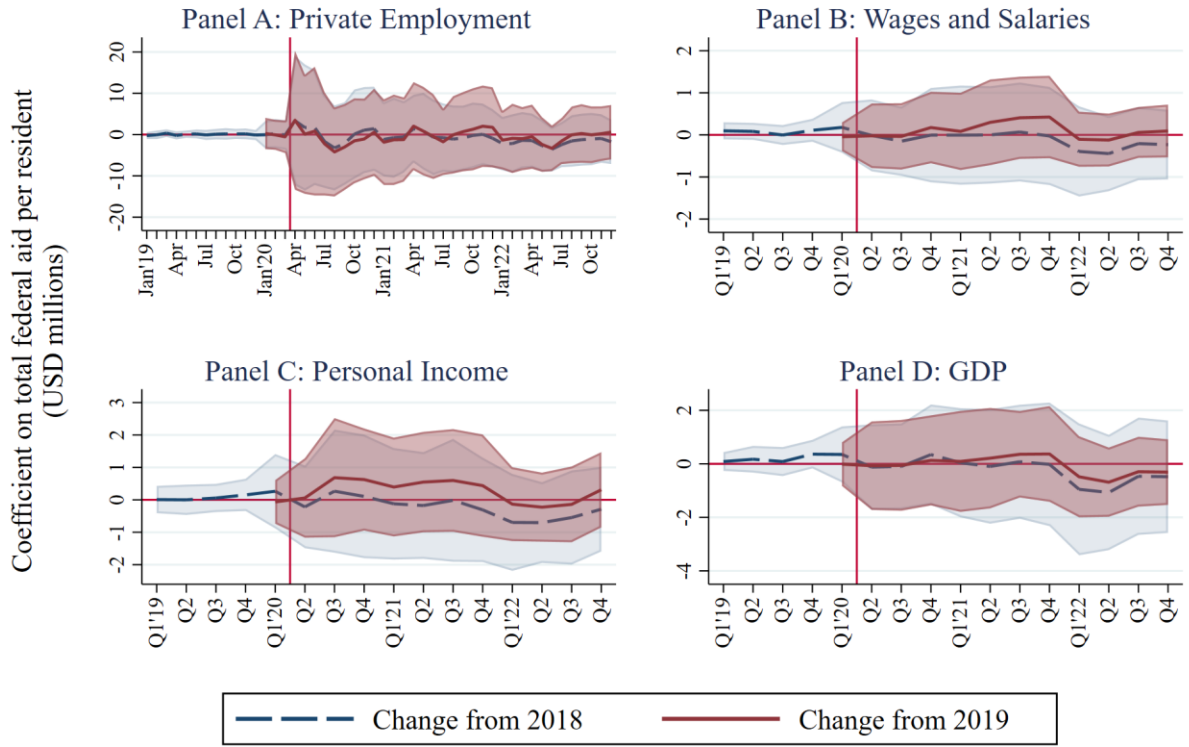


Note: This figure displays the coefficients (and the 95% confidence intervals) on predicted total federal aid to state and local governments per resident (USD millions) in the regression outlined in equation (3b) for specifications using the change from 2018 (blue) and the change from 2019 (red):

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y,2020}} + \beta_2 X_{s,m,y} + u_{s,m,y}$$

where m and y iterate over the month-year pairs from January 2020 to December 2022. $\frac{TotalAid_s}{Pop_{s,y,2020}}$ is the total amount of federal aid allocated to a state per resident in USD millions since the pandemic began. $\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right)$ is the arithmetic change in state and local government employment per capita in state s relative to the same month in 2018. Estimates use the QCEW employment data for the dependent variable. The ratio $\$1,000,000/(\beta_1 * [\frac{MonthsSincePandemic}{12}])$ represents the amount of money spent to save one state or local government job-year. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between Q4 2017 and Q4 2018, change in real incomes per capita between Q4 2017 and Q4 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The specification for changes from 2019 (red) rescales the outcome variable as changes from the same month in 2019 and uses a control set that captures the changes in public employment, private employment, wages, GDP, and income from 2018 to 2019. Observations are weighted by state population in 2020 and standard errors are clustered by state. Tables 3 and 4 show parallel pooled regressions run using data from April 2020 to December 2022 for the change from 2018 and change from 2019 specifications, respectively. The figure uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), and Hale et al. (2020). 95% confidence intervals are shown for each specification.

Figure 5: Event Study of Change in Macroeconomic Outcomes in Response to COVID-19 Relief Aid



Note: This figure displays the coefficients (and the 95% confidence intervals) on predicted total federal aid to state and local governments per resident (USD millions) in the regression outlined in equation (3b) for specifications using the change from 2018 (blue) and the change from 2019 (red):

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}$$

where m and y iterate over the month-year pairs from January 2020 to September 2021. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD millions since the pandemic began. $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ is the arithmetic the outcome variable in state s relative to the same month in 2018. Panel A presents the change in private employment per capita relative to the same month in 2018. Panel B presents the change in annualized real, seasonally-adjusted total wages for all employees per capita relative to the same quarter in 2019. Panels C and D present the changes relative to the same quarter in 2019 in seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions, respectively. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The specification for changes from 2019 (red) rescales the outcome variable as changes from the same month in 2019 and uses a control set that captures the changes in public employment, private employment, wages, GDP, and income from 2018 to 2019. Observations are weighted by state population in 2020 and standard errors (in parentheses) are clustered by state. Tables 3 and 4 show pooled regressions run using data from April 2020 to December 2022 for the change from 2018 and change from 2019 specifications, respectively. The figure uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and

Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), and Hale et al. (2020). 95% confidence intervals are shown for each specification.

Table 1: Summary Statistics

	N	Mean	Std. Dev.	Min	Max
Change in State and Local Employment per Capita Relative to Same Month in 2019 (QCEW)	1650	-0.0029	0.0015	-0.0106	0.0032
Change in State and Local Employment per Capita Relative to Same Month in 2018 (QCEW)	1650	-0.0027	0.0015	-0.0106	0.0041
Change in State and Local Employment per Capita Relative to Same Month in 2019 (CES)	1650	-0.0033	0.0015	-0.0127	0.0023
Change in Private Employment per Capita Relative to Same Month in 2019 (QCEW)	1650	-0.0158	0.0212	-0.1079	0.0207
Change in Private Employment per Capita Relative to Same Month in 2018 (QCEW)	1650	-0.0121	0.0212	-0.1062	0.0256
Total Aid to State and Local Governments per Resident (USD Millions)	1650	0.0025	0.0005	0.0018	0.0059
Senators and Representatives per Million Residents	1650	1.6158	0.4119	1.3021	5.1928
Log of 2020 State Population	1650	16.156	0.9020	13.267	17.494
Share of Population in City Eligible for Municipal Liquidity Facility	1650	0.5074	0.2155	0.1472	0.8393
March 2020 Average Oxford Stringency Index Level	1650	0.4548	0.0587	0.3345	0.5600
Contemporaneous Oxford Stringency Index Level	1650	0.4043	0.1870	0.1735	0.9293
Share of Votes Won by Donald Trump in 2020 Election	1650	0.4698	0.0902	0.3038	0.6950
Final Two Weeks of March 2020 Average Oxford Stringency Index Level	1650	75.344	7.0563	49.073	85.190
Percent Change in Retail Mobility Relative to February 2020 Baseline (Previous Month)	1650	-12.781	11.002	-60.53	34.548
New COVID-19 Deaths per 100,000 (Previous Month)	1650	9.893	10.684	-5.803	112.051
Total COVID-19 Deaths per 100,000 (Previous Month)	1650	187.01	117.90	0.0000	439.398
New COVID-19 Cases per 100,000 (Previous Month)	1650	898.63	1128.5	2.4165	10659
Total COVID-19 Cases per 100,000 (Previous Month)	1650	13561	10332	8.8772	41329
Change in State and Local Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	1650	0.0002	0.0004	-0.0007	0.0010
Change in State and Local Employment per Capita from Dec 2017 to Dec 2018 (QCEW)	1650	0.0000	0.0008	-0.0037	0.0023
Change in Private Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	1650	0.0033	0.0020	-0.0063	0.0060
Change in Private Employment per Capita from Dec 2017 to Dec 2018 (QCEW)	1650	0.0044	0.0019	-0.0009	0.0101

Change in Real State GDP per Capita Relative to Same Quarter in 2019 (USD Millions)	550	0.0003	0.0030	-0.0104	0.0060
Change in Real State GDP per Capita Relative to Same Quarter in 2018 (USD Millions)	550	0.0014	0.0031	-0.0110	0.0076
Change in Real Personal Income per Capita Relative to Same Quarter in 2019 (USD Millions)	550	0.0029	0.0023	-0.0018	0.0113
Change in Real Personal Income per Capita Relative to Same Quarter in 2018 (USD Millions)	550	0.0044	0.0025	-0.0004	0.0137
Change in Real Wages per Capita Relative to Same Quarter in 2019 (USD Millions)	550	0.0008	0.0013	-0.0036	0.0043
Change in Real Wages per Capita Relative to Same Quarter in 2018 (USD Millions)	550	0.0015	0.0014	-0.0031	0.0048
Change in Real State GDP per Capita from Q4 2018 to Q4 2019 (USD Millions)	550	0.0012	0.0008	-0.0004	0.0027
Change in Real State GDP per Capita from Q4 2017 to Q4 2018 (USD Millions)	550	0.0010	0.0007	-0.0007	0.0025
Change in Real Personal Income per Capita from Q4 2018 to Q4 2019 (USD Millions)	550	0.0013	0.0006	-0.0002	0.0026
Change in Real Personal Income per Capita from Q4 2017 to Q4 2018 (USD Millions)	550	0.0013	0.0005	0.0001	0.0031
Change in Real Wages per Capita from Q4 2018 to Q4 2019 (USD Millions)	550	0.0008	0.0004	-0.0007	0.0015
Change in Real Wages per Capita from Q4 2017 to Q4 2018 (USD Millions)	550	0.0004	0.0003	-0.0003	0.0012

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2021a, 2021b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023).

Table 2: Impact of COVID-19 Relief Aid on Changes in Macroeconomic Outcome Variables from 2019

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	0.603 (0.534)	1.003 (5.127)	0.178 (0.409)	-0.005 (0.778)	0.312 (0.725)
Log(2020 Population)	0.0006* (0.0003)	0.0055* (0.0030)	0.0004 (0.0002)	0.0006 (0.0004)	0.0003 (0.0005)
Change in Public Employment, 2018-2019	0.533 (0.412)	2.955 (3.565)	0.0149 (0.258)	0.0006 (0.532)	0.506 (0.454)
Change in Private Employment, 2018-2019	-0.0290 (0.0779)	0.0685 (0.915)	0.0212 (0.0619)	0.0283 (0.150)	0.0507 (0.116)
Change in Real Wages, 2018-2019	0.599 (0.920)	-5.936 (9.809)	0.705 (0.704)	0.967 (1.359)	1.574 (1.099)
Change in Real GDP, 2018-2019	-0.120 (0.613)	-0.709 (5.867)	-0.183 (0.435)	0.0671 (0.749)	-0.584 (0.693)
Change in Real Income, 2018-2019	-0.317 (0.553)	6.181 (5.338)	0.665 (0.421)	1.142 (0.808)	0.517 (0.690)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.0027	-0.0121	0.0008	0.0003	0.0029
Aggregate impact Coef.	1.658	2.758	0.490	-0.014	0.858
Observations	1,650	1,650	550	550	550
R-squared	0.204	0.682	0.591	0.582	0.268
First-Stage F-Statistic	50.11	50.11	49.5	49.5	49.5

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is

instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to

equation (2a). $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period

in 2019. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2019. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of

2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $\left[\frac{\text{MonthsSincePandemic}}{12}\right]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state.

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

Table 3: OLS Estimates of the Impact of COVID-19 Relief Aid on Changes in Macroeconomic Outcome Variables from 2019

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	-0.671* (0.369)	-12.02*** (3.773)	-0.851*** (0.254)	-1.891*** (0.471)	-1.196*** (0.430)
Log(2020 Population)	0.0001 (0.0002)	0.0004 (0.002)	-0.0001 (0.0002)	-0.0002 (0.0003)	-0.0002 (0.0003)
Change in Public Employment, 2018-2019	0.420 (0.364)	1.803 (2.852)	-0.0761 (0.204)	-0.166 (0.449)	0.373 (0.379)
Change in Private Employment, 2018-2019	-0.0134 (0.0865)	0.228 (0.900)	0.0338 (0.0631)	0.0513 (0.152)	0.0691 (0.111)
Change in Real Wages, 2018- 2019	0.691 (0.823)	-5.001 (8.045)	0.779 (0.602)	1.102 (1.186)	1.682* (0.999)
Change in Real GDP, 2018-2019	0.195 (0.380)	2.506 (3.647)	0.0708 (0.256)	0.533 (0.472)	-0.212 (0.445)
Change in Real Income, 2018- 2019	-0.608 (0.455)	3.208 (4.273)	0.430 (0.346)	0.712 (0.692)	0.172 (0.589)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.0027	-0.0121	0.0008	0.0003	0.0029
Aggregate impact Coef.	-1.845*	-33.06***	-2.228***	-5.200***	-3.289***
Observations	1,650	1,650	550	550	550
R-squared	0.311	0.734	0.677	0.639	0.330

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 1 for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills and scaled by the state population in 2020. $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2019. For example, Column 1 uses the change in state and local government employment per capita, identical to Table 2 Column 2, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2019. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and

public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $\left[\frac{\text{MonthsSincePandemic}}{12}\right]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state.

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

Table 4: Impact of COVID-19 Relief Aid on Changes in Macroeconomic Outcome Variables from 2018

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	0.432 (0.588)	0.371 (4.491)	-0.0760 (0.513)	-0.213 (1.002)	-0.242 (0.775)
Log(2020 Population)	0.0005 (0.0003)	0.0051* (0.0026)	0.0003 (0.0003)	0.0006 (0.0006)	0.0001 (0.0005)
Change in Public Employment, 2017-2018	-0.204 (0.221)	-4.629** (1.892)	-0.185 (0.213)	-0.417 (0.450)	-0.384 (0.321)
Change in Private Employment, 2017-2018	0.140 (0.0908)	-0.444 (0.853)	-0.0472 (0.0774)	-0.118 (0.148)	-0.0718 (0.103)
Change in Real Wages, 2017-2018	1.262 (0.969)	28.20*** (6.028)	2.541*** (0.691)	4.674*** (1.168)	3.489*** (1.017)
Change in Real GDP, 2017-2018	-0.499 (0.348)	-5.003** (2.142)	-0.00525 (0.208)	0.243 (0.479)	-0.123 (0.302)
Change in Real Income, 2017-2018	0.511 (0.365)	-6.578* (3.584)	-0.535* (0.312)	-1.720** (0.698)	-0.375 (0.502)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.00271	-0.01209	0.000523	-0.001	0.005622
Aggregate impact Coef.	1.188	1.020	-0.209	-0.586	-0.666
Observations	1,650	1,650	550	550	550
R-squared	0.303	0.769	0.620	0.595	0.374
First-Stage F-Statistic	56.93	56.93	56.24	56.24	56.24
P-value on Test for Pre-Trends	0.627	0.936	0.518	0.445	0.724

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta\left(\frac{Y_{s,m,y}}{Pop_{s,y}}\right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y,2020}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y,2020}}$ is

instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a). $\Delta\left(\frac{Y_{s,m,y}}{Pop_{s,y}}\right)$ represents the change in a given macroeconomic variable per capita relative to the same time period

in 2018. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2018. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted,

annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $[\frac{MonthsSincePandemic}{12}]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state. The last row of the table presents a pre-trends test, which runs the specification shown in the main table on the period from January 2019 to March 2020 and reports the p-value associated with the coefficient on $\frac{TotalAids}{Pop_{s,y2020}}$ in the pooled regression.

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

Table 5: Impacts of COVID-19 Relief Aid on Macroeconomic Variables across Alternate Specifications

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
<i>Panel A: Changes from 2018</i>	(1)	(2)	(3)	(4)	(5)
A1 Simple Controls (Population only)	0.498 (0.406) [\$730,194]	-3.792 (3.296) [-\$95,896]	0.284 (0.494)	0.194 (0.861)	0.650 (0.897)
A2 Sparse Controls (+ Changes in economic outcomes from 2017-2018)	0.297 (0.462) [\$1,224,365]	-2.602 (3.140) [-\$139,753]	0.247 (0.482)	0.402 (0.905)	0.674 (0.856)
A3 Baseline Controls (+COVID policy variables)	0.432 (0.588) [\$841,751]	0.371 (4.491)	-0.0760 (0.513)	-0.213 (1.002)	-0.242 (0.775)
A4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.0670 (0.451) [\$5,427,408]	-1.502 (3.721) [-\$242,101]	-0.211 (0.376)	-0.592 (0.771)	-0.0138 (0.640)
<i>Panel B: Changes from 2019</i>					
B1 Simple Controls (Population only)	0.240 (0.332) [\$1,515,152]	-4.679 (3.134) [-\$77,717]	0.0893 (0.405)	-0.181 (0.707)	0.393 (0.737)
B2 Sparse Controls (+ Changes in economic outcomes from 2018-2019)	0.333 (0.377) [\$1,092,001]	-2.779 (3.627) [-\$130,852]	-0.009 (0.271)	-0.498 (0.479)	0.139 (0.484)
B3 Baseline Controls (+COVID policy variables)	0.603 (0.534) [\$603,045]	1.003 (5.127) [\$362,549]	0.178 (0.409)	-0.005 (0.778)	0.312 (0.725)
B4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.196 (0.321) [\$1,855,288]	-2.608 (2.983) [-\$139,431]	-0.105 (0.255)	-0.515 (0.534)	0.106 (0.541)
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Observations	1,650	1,650	550	550	550

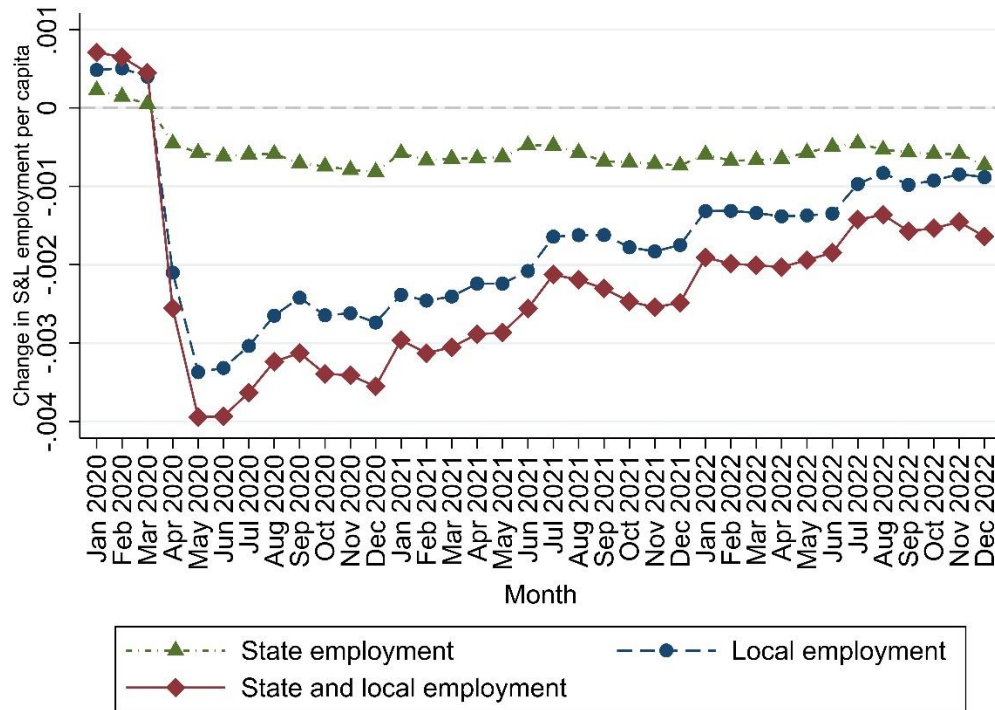
Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y2020}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a). $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018 in Panel A. Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Row 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Finally, Row 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. Panel A shows regressions that use outcome variables scaled as changes from 2018 and the five pre-COVID controls measuring growth between 2017 and 2018, whereas panel B uses outcome variables scaled as changes from 2019 and the five pre-COVID controls measuring growth between 2018 and 2019. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y2020}}$ from a separate regression specification and outcome variable. For specifications that estimate changes in public and private employment, we present the aggregate impact coefficients scaled to reflect dollars per job years in square brackets. The dollars per job figure is given by $\frac{1,000,000}{\beta_1 * \left[\frac{MonthsSincePandemic}{12} \right]}$. This table shows pooled regressions run using data from April 2020 to December 2022, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state and presented in parentheses.

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

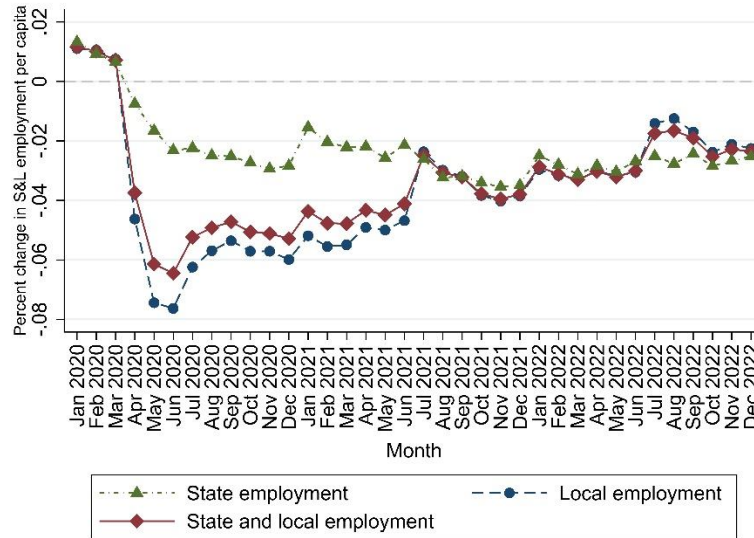
Appendix Figure 1: Change in State and Local Employment per Capita: CES Data



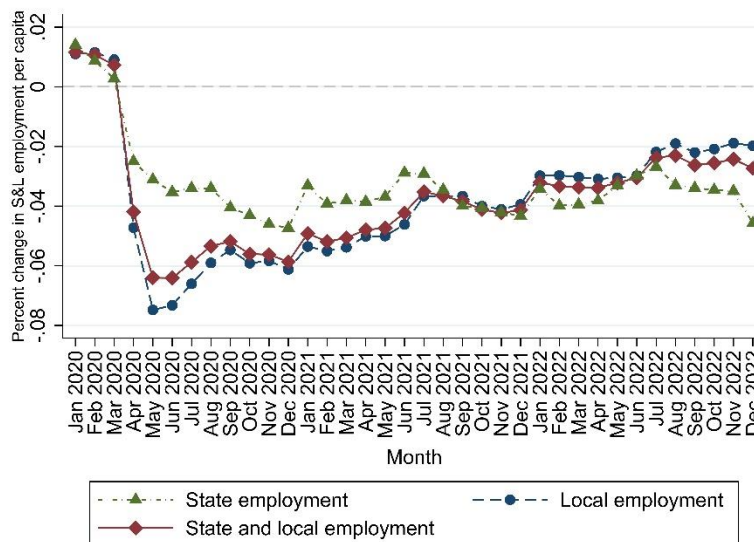
Note: This figure shows the change in national state and local government employment per capita relative to the same month in 2019 over the course of the pandemic. The variable shown is calculated for a given job category as the arithmetic difference in employment in a given month and the same month in 2019 divided by a state's year-specific population. This figure displays Current Employment Statistics (CES) estimates. State, local, and state plus local employment are shown separately. This figure uses data from the US Bureau of Labor Statistics (2022a) and US Census Bureau (2019, 2021, 2022).

Appendix Figure 2: Percent Change in State and Local Employment per Capita, QCEW and CES

Panel A: Percent Change in State and Local Government Employment per Capita Relative to Same Month in 2019, QCEW

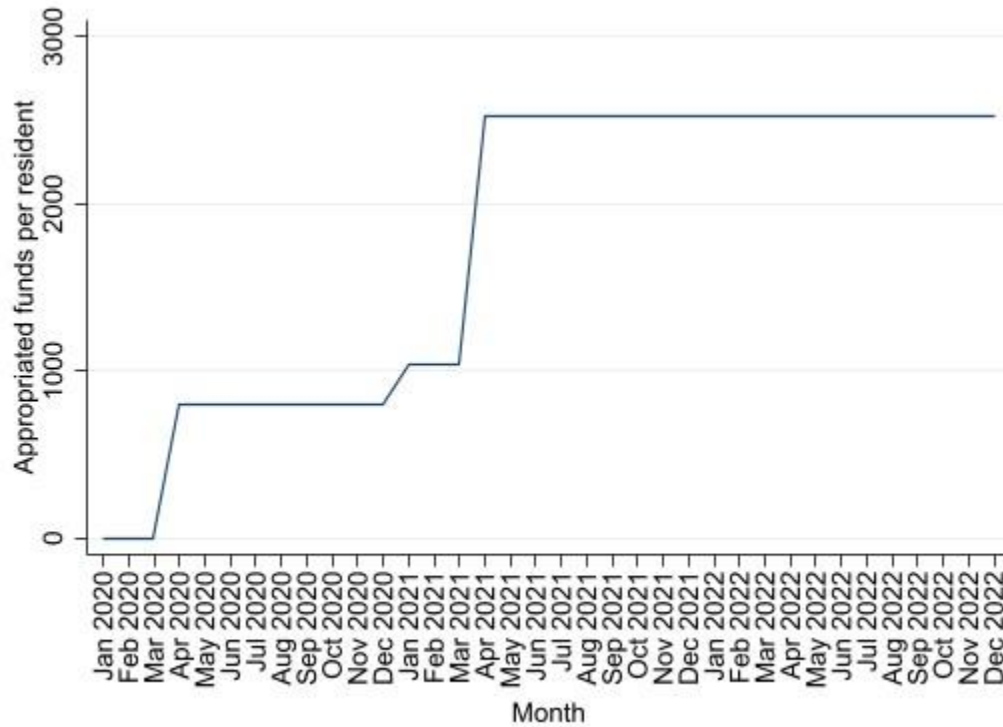


Panel B: Percent Change in State and Local Government Employment per Capita Relative to Same Month in 2019, CES



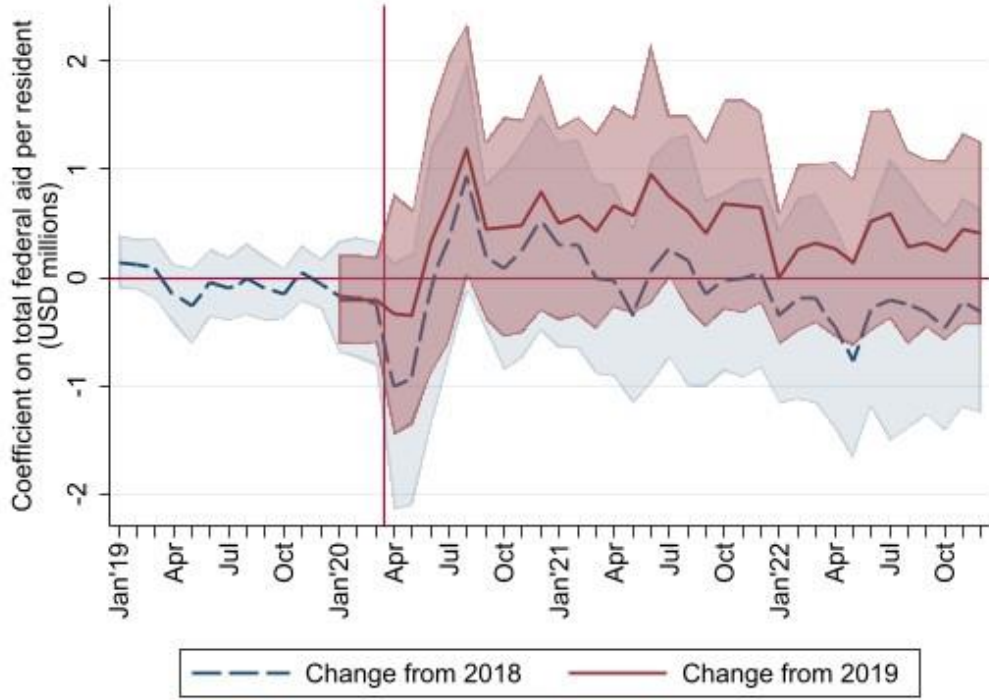
Note: This figure shows the percent change in national state and local government employment per capita relative to the same month in 2019 over the course of the pandemic. Panel A shows this variable using the QCEW estimates of employment while Panel B displays the CES estimates. State, local, and state plus local employment are shown separately. This figure uses data from the US Bureau of Labor Statistics (2021a, 2021b) and US Census Bureau (2019, 2021, 2022).

Appendix Figure 3: Federal Funds to State and Local Governments Appropriated per Resident Nationally Over Time



Note: This figure shows the appropriation of COVID-19 relief funds to state and local governments over time. Funds are shown for the CARES Act, Families First Coronavirus Response Act, Response and Relief Act, and American Rescue Plan Act on a per resident basis. The charts displays the national average aid per resident over the course of the pandemic. Increases in funds are matched with the first QCEW sample period following the passage of a COVID-19 relief bill. For instance, since the CARES Act was passed in late March 2020, the first observed employment data since its passage is during the second week of April 2020. Unlike the variable used in our baseline regressions, the variable in the figure is not scaled in USD millions.

**Appendix Figure 4: Event Study of State and Local Government Employment to COVID-19 Relief Aid:
Green and Loualiche (2020) Specification**



Note: This figure displays the coefficient (and the 95% confidence interval) on predicted total federal aid to state and local governments per capita (USD millions). The instrument used in the first stage presented below (equation A) differs from the specification outlined in equation (3a); federal aid to state and local governments per capita is instrumented using the interaction between the log of 2020 state population and an indicator for state size, akin to the strategy employed in Green and Loualiche (2020):

$$\frac{TotalAid_s}{Pop_{s,2020}} = \alpha + \beta_1 (\ln(Pop)_{s,y2020} * SmallState_s) + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y} \quad (A)$$

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y2020}} + \beta_2 X_{s,m,y} + u_{s,m,y} \quad (B)$$

where m and y iterate over the month-year pairs from January 2020 to September 2021. $\frac{TotalAid_s}{Pop_{s,y2020}}$ is the total amount of federal aid to state and local governments per resident (USD millions) allocated to state s . $SmallState_s$ equals 1 for state s if it received the minimum CARES Act funding and 0 otherwise. $\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right)$ is the arithmetic change in state and local government employment per capita in state s relative to the same month in 2018. Estimates use the QCEW employment data for the dependent variable. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between Q4 2017 and Q4 2018, change in real incomes per capita between Q4 2017 and Q4 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The specification for changes from 2019 (red) rescales the outcome variable as changes from the same month in 2019 and uses a control set that captures the changes in public employment, private employment, wages, GDP, and income from 2018 to 2019. The regressions are weighted by state population and clustered at the state level. 95% confidence intervals are shown as the shaded regions for each specification. The ratio $\$1,000,000 / (\beta_1 * [\frac{MonthsSincePandemic}{12}])$ represents the amount of money spent to save one state or local government job-year. The figure uses data from the Committee for a Responsible Federal Budget (2021), US Federal

Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), and Hale et al. (2020).

Appendix Table 1: Variable Descriptions and Sets of Control Variables

Variable	Description	Source
Change in State and Local Employment per Capita Relative to Same Month in 2019	The arithmetic change in state and local government employment between a given month in 2020, 2021, or 2022 and the same month in 2019, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in State and Local Employment per Capita Relative to Same Month in 2018	The arithmetic change in state and local government employment between a given month in 2020, 2021, or 2022 and the same month in 2018, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in Private Employment per Capita Relative to Same Month in 2019	The arithmetic difference in private employment between a given month in 2020, 2021, or 2022 and the same month in 2019, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in Private Employment per Capita Relative to Same Month in 2018	The arithmetic difference in private employment between a given month in 2020, 2021, or 2022 and the same month in 2018, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Total Aid to State and Local Governments per Resident (USD Millions)	Funds appropriated to each state by Congress in COVID-19 relief bills divided by the 2020 state population, in nominal USD millions.	Committee for a Responsible Federal Budget (2021); US Federal Transit Administration (2021a, 2021b); US Census Bureau (2019, 2022); Chidambaram and Musumeci (2021); Medicaid and Chip Payment Access Commission (2021); US Office of Elementary and Secondary Education (2021)
Senators and Representatives per Million Residents	Number of House plus the number of Senate seats per 1,000,000 people in each state, according to the 2020 estimate of population and Congressional seats.	US Census Bureau (2019, 2022); Lewis et al. (2021)
Log of 2020 State Population	The natural logarithm of 2020 state population	US Census Bureau (2019, 2022)
Share of Population in City Eligible for Municipal Liquidity Facility	The share of a state's 2020 population living in a city or town deemed eligible for financing through the Federal Reserve's Municipal Liquidity Facility.	US Census Bureau (2019, 2022); Federal Reserve Board (2021)
March 2020 Average Oxford Stringency Index Level	The monthly average level of a state's Oxford Stringency Index during March 2020, divided by 100.	Hale et al. (2023)
Contemporaneous Oxford Stringency Index Level	The monthly average level of a state's Oxford Stringency Index, divided by 100.	Hale et al. (2023)

Share of Votes Won by Donald Trump in 2020 Election	The percentage of votes cast in a state for Donald Trump in the 2020 US Presidential election. Proxy for attitudes toward COVID-19.	MIT Election and Data Science Lab (2017)
Final Two Weeks of March 2020 Average Oxford Stringency Index Level	The monthly average level of a state's Oxford Stringency Index during the final fourteen days in March, divided by 100. Proxy for seriousness with which states initially responded to COVID-19.	Hale et al. (2023)
Percent Change in Retail Mobility Relative to February 2020 Baseline (Previous Month)	Monthly-average percentage change in foot traffic in retail and recreation areas relative to the median level of traffic during the January 3, 2020 to February 6, 2020 baseline period.	Google LLC (2022)
New COVID-19 Cases/Deaths per 100,000 (Previous Month)	The number of reported COVID-19 cases and deaths, divided by state population in hundred-thousands.	Dong, Du, and Gardner (2023)
Total COVID-19 Cases/Deaths per 100,000 (Previous Month)	The number of cumulative COVID-19 cases and deaths, divided by state population in hundred-thousands.	Dong, Du, and Gardner (2023)
Change in State and Local Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	The arithmetic change in state and local government employment from a December 2018 to December 2019, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in State and Local Employment per Capita from Dec 2017 to Dec 2018 (QCEW)	The arithmetic change in state and local government employment from a December 2017 to December 2018, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in Private Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	The arithmetic change in state and local government employment from a December 2018 to December 2019, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in Private Employment per Capita from Dec 2017 to Dec 2018 (QCEW)	The arithmetic change in state and local government employment from a December 2017 to December 2018, divided by a state's year-specific population.	US Bureau of Labor Statistics (2021a, 2021b); US Census Bureau (2019, 2022)
Change in Real State GDP per Capita Relative to Same Quarter in 2019 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized gross state product between a given quarter in 2020, 2021, or 2022 and the same month in 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real State GDP per Capita Relative to Same Quarter in 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized gross state product between a given quarter in 2020, 2021, or 2022 and the same month in 2018 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real State GDP per Capita from	The arithmetic change in real, seasonally-adjusted and annualized gross state product between Q4	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)

Q4 2018 to Q4 2019 (USD Millions)	2018 and Q4 2019 divided by a state's year-specific population, in 2012 USD millions.	
Change in Real State GDP per Capita from Q4 2017 to Q4 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized gross state product between Q4 2017 and Q4 2018 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Personal Income per Capita Relative to Same Quarter in 2019 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized real personal income between a given quarter in 2020, 2021, or 2022 and the same month in 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Personal Income per Capita Relative to Same Quarter in 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized real personal income between a given quarter in 2020, 2021, or 2022 and the same month in 2018 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Personal Income per Capita from Q4 2018 to Q4 2019 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized real personal income between Q4 2018 and Q4 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Personal Income per Capita from Q4 2017 to Q4 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized real personal income between Q4 2017 and Q4 2018 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Total Wages per Capita Relative to Same Quarter in 2019 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized total wages for all employees in a state between a given quarter in 2020, 2021, or 2022 and the same month in 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Total Wages per Capita Relative to Same Quarter in 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized total wages for all employees in a state between a given quarter in 2020, 2021, or 2022 and the same month in 2018 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Total Wages per Capita from Q4 2018 to Q4 2019 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized total wages for all employees in a state between Q4 2018 and Q4 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)
Change in Real Total Wages per Capita from Q4 2017 to Q4 2018 (USD Millions)	The arithmetic change in real, seasonally-adjusted and annualized total wages for all employees in a state between Q4 2018 and Q4 2019 divided by a state's year-specific population, in 2012 USD millions.	US Bureau of Economic Analysis (2023); US Census Bureau (2019, 2022)

Appendix Table 2: First-Stage Robustness to One-By-One Addition of Baseline Controls

	Total Aid per Resident (USD)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Representatives and Senators per Million Residents	1,334*** (112.5)	1,337*** (113.6)	1,320*** (114.6)	1,240*** (124.0)	1,194*** (134.5)	1,298*** (123.0)	1,097*** (135.8)	1,067*** (150.7)
Log(2020 Population)	419.5*** (90.14)	421.2*** (94.77)	339.9*** (75.93)	293.5*** (93.03)	276.0*** (98.54)	385.6*** (88.80)	218.0** (84.57)	126.7 (104.5)
Change in Public Employment, 2018-2019		-8,547 (105,322)						-116,588 (118,565)
Change in Private Employment, 2018-2019			56,324* (30,657)					29,321 (26,188)
Change in Real Wages, 2018-2019				378,412* (196,521)				62,990 (286,843)
Change in Real GDP, 2018-2019					212,351 (136,577)			175,095 (183,416)
Change in Real Income, 2018-2019						113,507 (79,159)		-159,830 (157,217)
COVID-19 Policy Controls							Y	Y
Frequency	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Dep. Var. Mean	2528	2528	2528	2528	2528	2528	2528	2528
Observations	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
R-squared	0.496	0.496	0.534	0.550	0.576	0.516	0.565	0.632
F-Statistic	140.8	138.6	132.6	100.1	78.76	111.3	65.17	50.11

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\frac{TotalAid_s}{Pop_{s,y2020}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD) in state s pooled across all four bills. $\frac{TotalAid_s}{Pop_{s,y2020}}$ is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020, according to equation (2a). Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020

official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. This table shows pooled regressions run using data from April 2020 to December 2022, the period during which the federal government appropriated money to state and local governments.

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

Appendix Table 3: First-Stage Robustness across Alternative Controls Sets

	Total Aid per Resident (USD)			
	Simple (1)	Sparse (2)	Baseline (3)	Augmented (4)
Representatives and Senators per Million Residents	1,334*** (112.5)	1,211*** (131.8)	1,067*** (150.7)	1,197*** (101.5)
Log(2020 Population)	419.5*** (90.14)	263.4*** (97.98)	126.7 (104.5)	187.0*** (67.32)
Change in Public Employment, 2018-2019		-58,962 (125,554)	-116,588 (118,565)	-54,173 (82,586)
Change in Private Employment, 2018-2019		8,149 (30,736)	29,321 (26,188)	13,438 (20,080)
Change in Real Wages, 2018-2019		131,641 (276,110)	62,990 (286,843)	-47,954 (192,362)
Change in Real GDP, 2018-2019		198,579 (227,001)	175,095 (183,416)	173,675 (116,638)
Change in Real Income, 2018-2019		-71,856 (152,380)	-159,830 (157,217)	-149,126 (89,742)
COVID-19 Policy Controls			Y	Y
Augmented Controls				Y
Frequency	Monthly	Monthly	Monthly	Monthly
Dep. Var. Mean	2528	2528	2528	2528
Observations	1,650	1,650	1,650	1,650
R-squared	0.496	0.583	0.632	0.798
First-Stage F-Statistic	140.8	84.41	50.11	139.1

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the Bureau of Economic Analysis (2021) to estimate an equation of the following form for all months pooled:

$$\frac{TotalAid_s}{Pop_{s,y2020}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}$$

where $\frac{TotalAid_s}{Pop_{s,y2020}}$ is the total of federal aid to state and local governments per resident (USD) in state s pooled across all four bills.

$RepsPerMillion_s$ is the number of Representatives and Senators per million residents in 2020. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and private employment per capita (QCEW) between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Each column includes a different set of state-level controls $X_{s,t,y}$. Column 1 shows the simplest specification, which only uses log of 2020 official Census population. Column 2 adds in economic controls, including the change in state and local and public employment per capita between December 2018 and December 2019, the change in private employment per capita between December 2018 and December 2019, the change in real wages per capita between December 2018 and December 2019, the change in real GDP per capita between December 2018 and December 2019, and the change in real incomes per capita between December 2018 and December 2019. Column 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous

month averages of a state's Oxford Stringency Index. Finally, Column 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. This table shows pooled regressions run using data from April 2020 to December 2022, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state and presented in parentheses.

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

Appendix Table 4: Total State and Local Funds per Resident, Congressional Representation, and Proxies for Funding Needs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Representatives and Senators per Million Residents	1,334*** (112.5)	995.1*** (175.8)	1,105*** (122.5)	1,346*** (114.0)	902.0*** (154.5)	1,286*** (113.2)	1,417*** (133.9)	959.2*** (121.9)
Log(Population)	419.5*** (90.14)	262.0*** (94.00)	156.2* (87.78)	427.1*** (96.02)	153.5 (104.6)	411.2*** (90.15)	366.8*** (66.05)	79.01 (50.05)
Tax Shortfall per Capita		0.853** (0.345)						-0.372 (0.262)
Average Q4 2020 Unemployment per Capita			40,178*** (9,979)					19,328*** (5,748)
Percent Change in Personal Income Q4 2019 to Q4 2020				-34.84 (39.30)				-56.69*** (17.91)
Total State and Local Spending per Capita					0.104*** (0.0249)			0.104*** (0.0269)
Acres of Federal Land per Capita						2.574*** (0.728)		1.731 (1.348)
Log Population Density							166.6** (65.31)	70.27* (36.48)
Dep. Var. Mean	2826.21	2826.21	2826.21	2826.21	2826.21	2826.21	2826.21	2826.21
Observations	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
R ²	0.496	0.635	0.720	0.513	0.758	0.501	0.572	0.869
First-Stage F-Statistic	140.76	32.05	81.29	139.38	34.1	128.99	111.98	61.92

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\frac{TotalAid_s}{Pop_{s,y2020}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD) in state s pooled across all four bills. $\frac{TotalAid_s}{Pop_{s,y2020}}$ is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020, according to equation (2a). Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the predicted tax shortfall for state and local governments divided by the state population, the average number of unemployed persons each month in the fourth quarter of 2020 per capita, the percentage change in personal income between the fourth quarter of 2019 and the fourth quarter of 2020, the total direct expenditures from state and local governments per capita in 2019, the acres of federal lands per capita, and the log of population density for state s . These controls are inspired by the analysis in Clemens and Veuger (2021a). Observations are weighted by state population and standard errors (in parentheses) are clustered by state. This table shows pooled regressions run using data from April 2020 to December 2022, the period during which the federal government appropriated money to state and local governments. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 5: COVID-19 Relief Aid and Other Federal Stimulus Efforts

	PPP Funds per Resident (USD Millions)	UI Funds per Resident (USD Millions)	EIP Funds per Resident (USD Millions)
	(1)	(2)	(3)
Total Aid per Resident (USD millions)	0.140 (0.138)	0.0462 (0.314)	0.0337 (0.0463)
Baseline Controls	Y	Y	Y
Frequency	Monthly	Monthly	Monthly
Observations	1,650	1,650	1,650
R-squared	0.491	0.547	0.481
First-Stage F-Statistic	50.1132	50.1132	50.1132

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), the US Bureau of Economic Analysis (2023), Walczak and Funkhouser (2021), the US Small Business Administration (2022) to estimate an equation of the following form for all months pooled:

$$\frac{Y_s}{Pop_{s,y_{2020}}} = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}.$$

Where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\frac{Y_s}{Pop_{s,y_{2020}}}$ presents the total amount allocated per resident in millions USD through the Paycheck Protection Program (column 1), Unemployment Insurance (column 2), and Economic Impact Payments (column 3). Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. This table shows pooled regressions run using data from April 2020 to December 2022.

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

Appendix Table 6: Reduced Form Relationship Between Congressional Representation and Other Federal Aid

	Federal Aid per Resident (USD Millions)		
	PPP	UI	EIP
	(1)	(2)	(3)
Representatives per Million Residents	0.0001 (0.0002)	0.0000 (0.0003)	0.0000 (0.0000)
Log(2020 Population)	-0.0000 (0.0001)	-0.0000 (0.0003)	-0.0000 (0.0000)
Change in Public Employment, 2017-2018	-0.139 (0.131)	-0.0264 (0.251)	0.0181 (0.0424)
Change in Private Employment, 2017-2018	-0.0405 (0.0364)	0.0874 (0.0801)	0.0056 (0.0122)
Change in Real Wages, 2017-2018	0.727** (0.274)	1.040 (0.729)	-0.290*** (0.0975)
Change in Real GDP, 2017-2018	-0.0950 (0.161)	-0.0024 (0.332)	0.0344 (0.0412)
Change in Real Income, 2017-2018	-0.102 (0.135)	-0.165 (0.348)	-0.0189 (0.0568)
COVID-19 Policy Controls	Y	Y	Y
Dep. Var. Mean	0.0024	0.0020	0.0024
Observations	1,650	1,650	1,650
R ²	0.424	0.534	0.538
F-Statistic	0.92	0.02	0.57

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), the US Bureau of Economic Analysis (2023), Walczak and Funkhouser (2021), the US Small Business Administration (2022) to estimate an equation of the following form for all months pooled:

$$\frac{Y_s}{Pop_{s,y_{2020}}} = \alpha + \beta_1 RepsPerMillion_s + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y}$$

where $\frac{Y_s}{Pop_{s,y_{2020}}}$ represents the total amount allocated per resident in millions USD through the Paycheck Protection Program (column 1), Unemployment Insurance (column 2), and Economic Impact Payments (column 3). $RepsPerMillion_s$ is the number of Representatives and Senators per million residents in 2020. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Regressions are run using data spanning April 2020 to December 2022.

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

Appendix Table 7: Pre-trend Test for Employment and COVID-19 Relief Aid

		State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
<i>Panel A: Weighted</i>		(1)	(2)	(3)	(4)	(5)
A1	Simple Controls (Population only)	0.241 (0.155) [0.120]	0.828 (0.680) [0.223]	0.224 (0.146) [0.124]	0.393 (0.256) [0.124]	0.283 (0.276) [0.305]
A2	Sparse Controls (+ Changes in economic outcomes from 2017-2018)	0.0885 (0.182) [0.627]	0.0466 (0.580) [0.936]	0.0932 (0.144) [0.518]	0.212 (0.278) [0.445]	0.0973 (0.276) [0.724]
<i>Panel B: Unweighted</i>						
B1	Simple Controls (Population only)	0.0999 (0.112) [0.373]	0.800 (0.773) [0.300]	0.118** (0.0600) [0.0489]	0.0631 (0.124) [0.611]	0.199 (0.150) [0.184]
B2	Sparse Controls (+ Changes in economic outcomes from 2017-2018)	-0.0126 (0.0982) [0.898]	0.298 (0.454) [0.511]	0.0815 (0.0637) [0.200]	0.128 (0.138) [0.356]	0.191 (0.150) [0.203]
Frequency Observations		Monthly 750	Monthly 750	Quarterly 250	Quarterly 250	Quarterly 250

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}$$

where $TotalAid_s$ is the total federal aid to state and local governments per resident (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018 throughout.

Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Panel A shows regressions that are weighted by the state population in 2020, whereas panel B shows unweighted regressions. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ from a separate regression specification and outcome variable. For specifications that estimate changes in public and private employment, we present the aggregate impact coefficients scaled to reflect dollars per job years in square brackets. The dollars per job figure is given by $\frac{1,000,000}{\beta_1 * \left[\frac{MonthsSincePandemic}{12} \right]}$. This table shows pooled regressions run using data from January 2019 to march 2020, the periods before which the federal government appropriated

money to state and local governments. Standard errors are clustered by state and presented in parentheses. P-values associated with the coefficient β_1 are presented in square brackets as a pre-trends test.

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

Appendix Table 8: Unweighted Estimates of the Impacts of COVID-19 Relief Aid on Macroeconomic Variables across Alternate Specifications

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
<i>Panel A: Changes from 2018</i>	(1)	(2)	(3)	(4)	(5)
A1 Simple Controls (Population only)	-0.0366 (0.366) [-\$9,935,420]	-4.762 (3.036) [-\$76,362]	-0.197 (0.190)	-0.685* (0.416)	-0.087 (0.307)
A2 Sparse Controls (+ Changes in economic outcomes from 2017-2018)	-0.396 (0.307) [-\$918,274]	-6.049*** (2.309) [-\$60,115]	-0.150 (0.210)	-0.256 (0.442)	-0.085 (0.330)
A3 Baseline Controls (+COVID policy variables)	-0.394 (0.367) [-\$922,935]	-3.820 (3.219) [-\$95,193]	-0.217 (0.245)	-0.387 (0.511)	-0.302 (0.358)
A4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	-0.338 (0.283) [-\$1,075,847]	-3.009 (2.789) [-\$120,850]	-0.276 (0.228)	-0.401 (0.511)	-0.271 (0.348)
<i>Panel B: Changes from 2019</i>					
B1 Simple Controls (Population only)	-0.159 (0.316) [-\$2,287,021]	-5.794** (2.647) [-\$62,761]	-0.324** (0.164)	-0.785** (0.369)	-0.301 (0.233)
B2 Sparse Controls (+ Changes in economic outcomes from 2018-2019)	-0.192 (0.263) [-\$1,893,939]	-5.771** (2.446) [-\$63,011]	-0.373*** (0.115)	-0.884*** (0.239)	-0.409** (0.181)
B3 Baseline Controls (+COVID policy variables)	-0.115 (0.280) [-\$3,162,055]	-3.687 (2.540) [-\$98,627]	-0.320*** (0.122)	-0.681** (0.282)	-0.312 (0.209)
B4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	-0.158 (0.221) [-\$2,301,496]	-4.538*** (1.558) [-\$80,131]	-0.354*** (0.100)	-0.698** (0.279)	-0.348 (0.239)
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Observations	1,650	1,650	550	550	550

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y2020}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a). $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2019. Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Row 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Finally, Row 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. Panel A shows regressions that use outcome variables scaled as changes from 2018 and the five pre-COVID controls measuring growth between 2017 and 2018, whereas panel B uses outcome variables scaled as changes from 2019 and the five pre-COVID controls measuring growth between 2018 and 2019. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y2020}}$ from a separate regression specification and outcome variable. For specifications that estimate changes in public and private employment, we present the aggregate impact coefficients scaled to reflect dollars per job years in square brackets. The dollars per job figure is given by $\frac{1,000,000}{\beta_1 * \left[\frac{MonthsSincePandemic}{12} \right]}$. This table shows pooled regressions run using data from April 2020 to December 2022, the periods during which the federal government appropriated money to state and local governments. Regressions are unweighted and standard errors are clustered by state and presented in parentheses.

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

Appendix Table 9: Impacts of COVID-19 Relief Aid on Macroeconomic Variables across Alternate Specifications using a Two Year Window

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
<i>Panel A: Changes from 2018</i>	(1)	(2)	(3)	(4)	(5)
A1 Simple Controls (Population only)	0.299 (0.343) [\$1,216,175]	-4.852 (3.412) [-\$74,946]	0.306 (0.535)	0.186 (0.874)	0.781 (0.963)
A2 Sparse Controls (+ Changes in economic outcomes from 2017-2018)	0.114 (0.396) [\$3,189,793]	-3.107 (3.407) [-\$117,038]	0.314 (0.520)	0.479 (0.894)	0.843 (0.925)
A3 Baseline Controls (+COVID policy variables)	0.341 (0.529) [\$1,066,382]	0.393 (4.734) [\$925,283]	-0.021 (0.545)	-0.050 (0.992)	-0.148 (0.831)
A4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.016 (0.393) [\$22,446,689]	-1.227 (3.859) [-\$296,362]	-0.190 (0.353)	-0.418 (0.730)	-0.014 (0.590)
<i>Panel B: Changes from 2019</i>					
B1 Simple Controls (Population only)	0.0391 (0.298) [\$9,300,163]	-5.735* (3.268) [-\$63,407]	0.104 (0.447)	-0.185 (0.725)	0.519 (0.805)
B2 Sparse Controls (+ Changes in economic outcomes from 2018-2019)	0.256 (0.370) [\$1,420,455]	-3.593 (3.864) [-\$101,207]	-0.0153 (0.291)	-0.452 (0.514)	0.221 (0.513)
B3 Baseline Controls (+COVID policy variables)	0.541 (0.501) [\$672,156]	0.648 (5.351) [\$561,167]	0.196 (0.433)	0.121 (0.831)	0.403 (0.767)
B4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.180 (0.282) [\$2,020,202]	-2.801 (3.014) [-\$129,824]	-0.105 (0.238)	-0.417 (0.520)	0.0909 (0.506)
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Observations	1,200	1,200	400	400	400

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018 in Panel A. Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Row 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Finally, Row 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. Panel A shows regressions that use outcome variables scaled as changes from 2018 and the five pre-COVID controls measuring growth between 2017 and 2018, whereas panel B uses outcome variables scaled as changes from 2019 and the five pre-COVID controls measuring growth between 2018 and 2019. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ from a separate regression specification and outcome variable. For specifications that estimate changes in public and private employment, we present the aggregate impact coefficients scaled to reflect dollars per job years in square brackets. The dollars per job figure is given by $\frac{1,000,000}{\beta_1 * \left[\frac{MonthsSincePandemic}{12} \right]}$. This table shows pooled regressions run using data from April 2020 to March 2022, the first 2 year period during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state and presented in parentheses.

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

Appendix Table 10: Unweighted Impacts of COVID-19 Relief Aid on Macroeconomic Variables across Alternate Specifications using a Two Year Window

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
<i>Panel A: Changes from 2018</i>	(1)	(2)	(3)	(4)	(5)
A1 Simple Controls (Population only)	-0.0649 (0.385) [-\$7,704,160]	-5.306 (3.252) [-\$942,32.9]	-0.216 (0.198)	-0.718* (0.388)	-0.0314 (0.327)
A2 Sparse Controls (+ Changes in economic outcomes from 2017-2018)	-0.435 (0.320) [-\$1,149,425]	-6.633** (2.614) [-\$753,80.7]	-0.161 (0.217)	-0.336 (0.412)	-0.00617 (0.345)
A3 Baseline Controls (+COVID policy variables)	-0.394 (0.394) [-\$1,269,036]	-3.994 (3.495) [-\$125,188]	-0.212 (0.254)	-0.405 (0.483)	-0.241 (0.371)
A4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	-0.286 (0.281) [-\$1,748,252]	-2.930 (2.927) [-\$170,648]	-0.248 (0.229)	-0.380 (0.476)	-0.231 (0.347)
<i>Panel B: Changes from 2019</i>					
B1 Simple Controls (Population only)	-0.194 (0.343) [-\$2,577,320]	-6.353** (2.871) [-\$78,703]	-0.350** (0.172)	-0.816** (0.343)	-0.254 (0.252)
B2 Sparse Controls (+ Changes in economic outcomes from 2018-2019)	-0.200 (0.300) [-\$2,500,000]	-6.242** (2.706) [-\$80,102.5]	-0.398*** (0.123)	-0.909*** (0.238)	-0.366* (0.194)
B3 Baseline Controls (+COVID policy variables)	-0.0925 (0.323) [-\$5,405,405]	-4.015 (2.730) [-\$124,533]	-0.344*** (0.130)	-0.696** (0.275)	-0.282 (0.218)
B4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	-0.106 (0.230) [-\$4,716,981]	-4.639*** (1.676) [-\$107,782]	-0.350*** (0.107)	-0.678** (0.279)	-0.351 (0.241)
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Observations	1,200	1,200	400	400	400

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate Equation 2b for Q2 2020 to Q4 2022 pooled, which takes the following form:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018 in Panel A. Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Row 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Finally, Row 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. Panel A shows regressions that use outcome variables scaled as changes from 2018 and the five pre-COVID controls measuring growth between 2017 and 2018, whereas panel B uses outcome variables scaled as changes from 2019 and the five pre-COVID controls measuring growth between 2018 and 2019. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ from a separate regression specification and outcome variable. For specifications that estimate changes in public and private employment, we present the aggregate impact coefficients scaled to reflect dollars per job years in square brackets. The dollars per job figure is given by $\frac{1,000,000}{\beta_1 * \left[\frac{MonthsSincePandemic}{12} \right]}$. This table shows pooled regressions run using data from April 2020 to March 2022, the first 2 year period during which the federal government appropriated money to state and local governments. Regressions are unweighted and standard errors are clustered by state and presented in parentheses.

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

Appendix Table 11: State and Local Government Employment and COVID-19 Relief Aid: CES Employment

Data		
	State and Local Govt Employment per Capita (QCEW)	State and Local Govt Employment per Capita (CES)
<i>Panel A: Changes from 2018</i>	(1)	(2)
A1 Simple Controls (Population only)	0.498 (0.406) [\$730,194]	0.0370 (0.320) [\$9,828,010]
A2 Sparse Controls (+ Changes in economic outcomes from 2017-2018)	0.297 (0.462) [\$1,224,365]	-0.329 (0.314) [-\$-1,105,278]
A3 Baseline Controls (+COVID policy variables)	0.432 (0.588) [\$841,751]	-0.0208 (0.422) [-\$17,482,517]
A4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.0670 (0.451) [\$5,427,408]	-0.247 (0.365) [-\$1,472,212]
<i>Panel B: Changes from 2019</i>		
B1 Simple Controls (Population only)	0.240 (0.332) [\$1,515,152]	-0.123 (0.291) [-\$2,956,393]
B2 Sparse Controls (+ Changes in economic outcomes from 2018-2019)	0.333 (0.377) [\$1,092,001]	0.123 (0.339) [\$2,956,393]
B3 Baseline Controls (+COVID policy variables)	0.603 (0.534) [\$603,045]	0.271 (0.437) [\$1,341,832]
B4 Augmented Controls (+COVID disease variables, Trump vote share, and retail mobility)	0.196 (0.264) [\$1,855,288]	0.0193 (0.348) [\$18,841,262]
Frequency	Monthly	Monthly
Observations	1,650	1,650

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021b), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022a) US Bureau of Labor Statistics (2022a), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the Bureau of Economic Analysis (2021) to estimate an equation of the following form:

$$\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}$$

where $TotalAid_s$ is the total federal aid to state and local governments per capita (USD millions) in state s pooled across all four bills. In a first stage regression, $TotalAid_s$ is instrumented using $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020, according to equation (2a). $\Delta \left(\frac{S\&LEmployment_{s,m,y}}{Pop_{s,y}} \right)$ is the arithmetic change in state and local employment per capita in state s relative to the same month in 2018, as measured by the CES, in Panel A. The ratio

$\$1,000,000/(\beta_1 * [\frac{MonthsSincePandemic}{12}])$ represents the amount of money spent to save one state or local government job-year, and these values are shown in square brackets. Each row includes a different set of state-level controls $X_{s,t,y}$. Row 1 shows the simplest specification, which only uses log of 2020 official Census population. Row 2 adds in economic controls, including the change in state and local and public employment per capita between December 2017 and December 2018, the change in private employment per capita between December 2017 and December 2018, the change in real wages per capita between December 2017 and December 2018, the change in real GDP per capita between December 2017 and December 2018, and the change in real incomes per capita between December 2017 and December 2018. Row 3 shows our baseline set of controls, which adds the share of a state's population living in a jurisdiction eligible for financing through the MLF, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. Finally, Row 4 adds additional controls including a set of COVID disease variables, which include the new cases, new deaths, total cases, and total deaths for the previous period, the Trump 2020 vote share in the state, and a measure for the change in mobility around retail locations in the state. Panel A shows regressions that use outcome variables scaled as changes from 2018 and the five pre-COVID controls measuring growth between 2017 and 2018, whereas panel B uses outcome variables scaled as changes from 2019 and the five pre-COVID controls measuring growth between 2018 and 2019. Each cell represents the coefficient β_1 for $\frac{TotalAid_s}{Pop_{s,y2020}}$ from a separate regression specification and outcome variable. This table shows pooled regressions run using data from April 2020 to December 2022, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state and presented in parentheses.

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

Appendix Table 12: Macroeconomic Impact of COVID-19 Relief Aid – Small State Indicator

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	0.139 (0.421)	-1.972 (4.178)	-0.235 (0.402)	-0.712 (0.743)	-0.314 (0.573)
Small State	0.0008 (0.0006)	0.0065 (0.0041)	0.0004 (0.0005)	0.0014 (0.0010)	0.0002 (0.0008)
Log(2020 Population)	0.0006* (0.0004)	0.0064** (0.0029)	0.0004 (0.0004)	0.0009 (0.0008)	0.0002 (0.0007)
Change in Public Employment, 2017-2018	-0.172 (0.207)	-4.376** (1.771)	-0.168 (0.204)	-0.364 (0.434)	-0.377 (0.301)
Change in Private Employment, 2017-2018	0.154* (0.0837)	-0.331 (0.789)	-0.0395 (0.0739)	-0.0942 (0.139)	-0.0683 (0.0971)
Change in Real Wages, 2017- 2018	1.106 (0.862)	26.95*** (5.662)	2.456*** (0.654)	4.408*** (1.136)	3.451*** (0.981)
Change in Real GDP, 2017-2018	-0.469 (0.325)	-4.765** (1.948)	0.0109 (0.204)	0.294 (0.474)	-0.116 (0.308)
Change in Real Income, 2017- 2018	0.507 (0.376)	-6.604* (3.532)	-0.537* (0.316)	-1.725** (0.706)	-0.376 (0.504)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.0027	-0.0121	0.0015	0.0014	0.0044
Aggregate impact Coef.	0.3823	-5.423	-0.6463	-1.958	-0.8635
Observations	1,650	1,650	550	550	550
R-squared	0.334	0.779	0.627	0.608	0.375
First-Stage F-Statistic	79.31	79.31	78.25	78.25	78.25
P-value on Test for Pre-Trends	0.400	0.615	0.464	0.634	0.569

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018. For

example, Column 1 uses the change in state and local government employment per capita, identical to Table 2 Column 2, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2018. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes an indicator for if state s is considered a ‘small state,’ the log of 2020 official Census population, the share of a state’s population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, and the March 2020 and contemporaneous month averages of a state’s Oxford Stringency Index. A small state is defined as a state that receives the floor level of funding in the CARES Act. This includes the 21 least populous states. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $\left[\frac{MonthsSincePandemic}{12}\right]$ as described above). This table shows pooled regressions run using data from April 2020 to September 2021 for monthly dependent variables or Q2 2020 to Q3 2021 for quarterly variables, the periods during which the federal government appropriated money to state and local governments.

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

Appendix Table 13: Macroeconomic Impact of COVID-19 Relief Aid – Saturated Specification

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	-0.0454 (1.250)	-22.38*** (4.463)	-0.916* (0.549)	-1.664* (0.909)	-0.837 (0.997)
Log(2020 Population)	0.0488 (0.304)	-2.473** (1.075)	-0.0904 (0.133)	-0.178 (0.203)	-0.0643 (0.250)
Change in Public Employment, 2017-2018	0.393 (0.277)	-3.651 (3.242)	0.0712 (0.234)	-0.167 (0.507)	-0.0745 (0.304)
Change in Private Employment, 2017-2018	-0.229 (0.361)	3.351 (2.677)	0.192 (0.309)	0.0237 (0.513)	0.0306 (0.426)
Change in Real Wages, 2017- 2018	-0.0868 (3.058)	-2.772 (11.96)	0.586 (1.294)	2.257 (1.994)	2.979 (2.277)
Change in Real GDP, 2017-2018	0.130 (0.634)	-6.693 (5.674)	0.0333 (0.406)	0.236 (1.081)	0.349 (0.591)
Change in Real Income, 2017- 2018	-4.070 (4.064)	-19.52 (32.32)	-3.795 (2.841)	-6.529 (6.584)	-1.664 (4.251)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Saturated Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.00271	-0.0121	0.00152	0.00136	0.00443
Aggregate impact Coef.	-0.125	-61.55***	-2.519*	-4.576*	-2.302
Observations	1,650	1,650	550	550	550
R-squared	0.472	0.832	0.781	0.765	0.497
First-Stage F-Statistic	27.07	27.07	26.21	26.21	26.21
P-value on Test for Pre-Trends	0.0287	0.206	0.781	0.549	0.895

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + \beta_3 X_{s,t,y}^2 + \beta_4 X_{s,t,y}^3 + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020. $\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2018. All employment variables use QCEW estimates. Column 3 uses the annualized

real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. $X_{s,t,y}^2$ and $X_{s,t,y}^3$ denote the squared and cubed terms of the variables contained in $X_{s,t,y}$. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $[\frac{MonthsSincePandemic}{12}]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments.

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

Appendix Table 14: Macroeconomic Impact of COVID-19 Relief Aid – Drop Most- & Least-Represented States

	State and Local Govt Employment per Capita	Private Employment per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Panel A: Drop 3 Most- & Least-Represented States					
Total Aid per Resident (USD millions)	0.0919 (0.666)	-9.389* (5.702)	-0.746 (0.602)	-0.592 (1.502)	-0.644 (0.772)
Baseline Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.003	-0.015	0.001	0.001	0.004
Aggregate Impact Coef.	0.253	-25.82	-2.052	-1.628	-1.771
Observations	1,452	1,452	484	484	484
R ²	0.271	0.769	0.551	0.550	0.343
First-Stage F-Statistic	36.92	36.92	36.42	36.42	36.42
P-value on Test for Pre-Trends	0.858	0.301	0.343	0.730	0.366
Panel B: Drop 5 Most- & Least-Represented States					
Total Aid per Resident (USD millions)	0.287 (0.978)	-8.103 (8.190)	-0.882 (0.857)	-0.584 (1.916)	-1.002 (1.124)
Baseline Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.003	-0.014	0.001	0.001	0.004
Aggregate Impact Coef.	0.789	-22.28	-2.426	-1.606	-2.756
Observations	1,320	1,320	440	440	440
R ²	0.279	0.735	0.550	0.531	0.346
First-Stage F-Statistic	16.27	16.27	16.02	16.02	16.02
P-value on Test for Pre-Trends	0.940	0.211	0.143	0.375	0.174

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2018. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2018. All employment variables use QCEW

estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December 2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $[\frac{MonthsSincePandemic}{12}]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Panel A excludes observations for the three most over-represented and under-represented states (Wyoming, Vermont, Alaska; Texas, Florida, California), while Panel B excludes the five most over- and under-represented states (Wyoming, Vermont, Alaska, North Dakota, Rhode Island; Texas, Florida, California, New York, North Carolina). Regressions are weighted using the state population in 2020 and standard errors are clustered by state.

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

Appendix Table 15: Macroeconomic Impact of COVID-19 Relief Aid – Relative to End-2019

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	0.759 (0.828)	4.138 (5.721)	0.182 (0.378)	-0.0806 (0.730)	0.317 (0.687)
Log(2020 Population)	0.0008* (0.0005)	0.0051 (0.0031)	0.000323 (0.000221)	0.000433 (0.000417)	0.000317 (0.000442)
Change in Public Employment, 2018-2019	0.656 (0.609)	4.247 (3.815)	-0.0139 (0.233)	-0.0289 (0.464)	0.500 (0.420)
Change in Private Employment, 2018-2019	-0.0521 (0.102)	-0.228 (1.010)	0.0286 (0.0591)	0.0895 (0.140)	0.0688 (0.110)
Change in Real Wages, 2018-2019	1.335 (1.392)	-1.037 (10.51)	0.383 (0.626)	0.704 (1.217)	1.358 (0.999)
Change in Real GDP, 2018-2019	-0.158 (0.930)	-2.284 (6.437)	-0.133 (0.379)	-0.179 (0.611)	-0.585 (0.632)
Change in Real Income, 2018-2019	-0.429 (0.854)	5.258 (5.564)	0.603 (0.381)	1.088 (0.750)	0.365 (0.636)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.004	-0.020	0.001	-0.0002	0.0025
Aggregate impact Coef.	2.087	11.38	0.501	-0.222	0.872
Observations	1,650	1,650	550	550	550
R-squared	0.044	0.649	0.589	0.608	0.261
First-Stage F-Statistic	50.11	50.11	49.50	49.50	49.50

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\left(\frac{Y_{s,m,y}}{Pop_{s,y}} - \frac{Y_{s,12,2019}}{Pop_{s,2019}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y,2020}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y,2020}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\left(\frac{Y_{s,m,y}}{Pop_{s,y}} - \frac{Y_{s,12,2019}}{Pop_{s,2019}} \right)$ represents the change in a given macroeconomic variable per capita relative to the last measured value in 2019, which is December 2019 in Columns 1 and 2, and Q4 2019 in Columns 3 through 5. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the last period of 2019. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of

state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $[\frac{MonthsSincePandemic}{12}]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state.

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

Appendix Table 16: Macroeconomic Impact of COVID-19 Relief Aid – Adding Additional Lags

	State and Local Govt Employment per Capita	Private Employment Per Capita	Total Wages per Capita (USD millions)	State Real GDP per Capita (USD Millions)	State Real Personal Income (USD Millions)
	(1)	(2)	(3)	(4)	(5)
Total Aid per Resident (USD millions)	0.233 (0.378)	-0.487 (4.017)	0.0121 (0.261)	-0.145 (0.474)	0.0752 (0.510)
Log(2020 Population)	0.0005* (0.0002)	0.0053** (0.0027)	0.0003* (0.0002)	0.0006* (0.0003)	0.0003 (0.0004)
Change in Public Employment, 2018-2019	0.0202 (0.349)	-1.785 (2.715)	-0.316 (0.209)	-0.520 (0.509)	0.0264 (0.415)
Change in Private Employment, 2018-2019	-0.112 (0.0907)	-1.436 (1.028)	-0.0779 (0.0692)	-0.183 (0.154)	-0.0765 (0.124)
Change in Real Wages, 2018-2019	0.722 (0.687)	-1.312 (7.302)	0.976* (0.511)	1.652 (1.094)	1.858** (0.938)
Change in Real GDP, 2018-2019	0.461** (0.227)	4.671** (2.185)	0.257 (0.185)	0.807* (0.450)	0.0916 (0.356)
Change in Real Income, 2018-2019	-0.652* (0.357)	2.573 (3.192)	0.402 (0.272)	0.692 (0.570)	0.113 (0.493)
COVID-19 Policy Controls	Y	Y	Y	Y	Y
Additional Lags	Y	Y	Y	Y	Y
Frequency	Monthly	Monthly	Quarterly	Quarterly	Quarterly
Dep. Var. Mean	-0.003	-0.016	0.001	0.0003	0.003
Aggregate impact Coef.	0.641	-1.339	0.067	-0.083	0.067
Observations	1,650	1,650	550	550	550
R-squared	0.406	0.785	0.745	0.679	0.382
First-Stage F-Statistic	71.55	71.55	70.24	70.24	70.24

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a), US Census Bureau (2019, 2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), and Lewis et al. (2021), US Bureau of Labor Statistics (2022b), US Department of the Treasury (2021a), Federal Reserve Board (2021), Hale et al. (2020), Google LLC (2022), MIT Election and Data Science Lab (2017), Dong, Du, and Gardner (2023), and the US Bureau of Economic Analysis (2023a) to estimate an equation of the following form for all months pooled:

$$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right) = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y2020}} + \beta_2 X_{s,t,y} + u_{s,t,y}$$

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD millions) in state s pooled across all four bills. Equation (2b) is modified to reflect the wider range of outcome variables. In a first stage regression, $\frac{TotalAid_s}{Pop_{s,y2020}}$ is instrumented using $RepsPerMillion_s$, the number of representatives and senators per million residents in 2020, according to equation (2a).

$\Delta \left(\frac{Y_{s,m,y}}{Pop_{s,y}} \right)$ represents the change in a given macroeconomic variable per capita relative to the same time period in 2019. For example, Column 1 uses the change in state and local government employment per capita, while Column 4 uses the change in annualized state GDP per capita in USD millions relative to the same quarter in 2019. All employment variables use QCEW estimates. Column 3 uses the annualized real total wages in USD millions, for all employees, as measured by the BEA. Columns 4 and 5 use seasonally-adjusted, annualized real state GDP per capita in USD millions and seasonally-adjusted, annualized real personal income per capita in USD millions. Included is a set of state-level controls $X_{s,t,y}$. This includes the log of 2020 official Census population, the share of a state's population living in a jurisdiction eligible for financing through the MLF, the change in state and local and public employment per capita between December 2017 and December 2018, change in private employment per capita between December 2017 and December 2018, change in real wages per capita between December 2017 and December

2018, change in real GDP per capita between December 2017 and December 2018, change in real incomes per capita between December 2017 and December 2018, the change in state and local and public employment per capita between December 2018 and December 2019, change in private employment per capita between December 2018 and December 2019, change in real wages per capita between December 2018 and December 2019, change in real GDP per capita between December 2018 and December 2019, change in real incomes per capita between December 2018 and December 2019, and the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index. The aggregate impact coefficient denotes the total impact over the pandemic implied by the annualized coefficient (scaled by $\left[\frac{MonthsSincePandemic}{12}\right]$ as described above). This table shows pooled regressions run using data from April 2020 to December 2022 for monthly dependent variables or Q2 2020 to Q4 2022 for quarterly variables, the periods during which the federal government appropriated money to state and local governments. Regressions are weighted using the state population in 2020 and standard errors are clustered by state.

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