How Did Federal Aid to States and Localities Affect Testing and Vaccine Delivery?*

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ABSTRACT

We estimate whether large allocations of federal aid for state and local governments played a role in advancing population testing for COVID-19 and the administration of vaccines. To overcome biases that can result from the endogeneity of federal aid allocations, we use an instrumental-variables estimator reliant on the substantial variation in federal aid predicted by variation in states' congressional representation. We find that federal fiscal assistance dollars had a modest if any impact on the pace of vaccine rollouts, may have improved the equitability of vaccine administration, and had a substantial impact on the volume of tests administered. We observe that the difference in our findings for testing relative to vaccination suggests that surplus funds were more effective at increasing demand for services that exhibit relatively elastic demand, which is socially desirable when those services are associated with substantial public health externalities.

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I Introduction

The COVID-19 pandemic confronted state and local governments with a unique set of pressures. As during more conventional downturns, tax revenues were threatened while strains on states' Medicaid programs and unemployment insurance systems were heightened (Clemens and Veuger, 2020a and 2020b; Clemens, Ippolito, and Veuger, 2021). Unlike conventional recessions, however, the pandemic introduced new demands pertaining to the role of state and local governments in the delivery of COVID-19 tests and vaccines.

Our analysis focuses on the question of whether allocations of federal fiscal assistance to state and local governments played a role in advancing goals associated with population testing and the administration of vaccines. The outcomes we analyze include the total volume of tests and vaccines delivered. We also analyze outcomes related to the equitability of vaccine delivery.

The key challenge to estimating the effects of federal fiscal assistance is a standard endogeneity concern: fiscal assistance may be targeted at the geographic areas that were hardest hit by the pandemic, which may generate a spurious correlation between federal dollars and outcomes like the volume of testing.

We rely on an instrumental-variable estimator to overcome this and other potential sources of bias. In particular, we build on existing evidence showing that the overrepresentation of small states in the US Congress led federal legislation to send disproportionate relief to the state and local governments in those states (Clemens and Veuger, 2021). Importantly, Clemens and Veuger (2021) confirm that variation induced by these predetermined political factors was orthogonal to a rich set of measures of the COVID-19 crisis' direct impact on state-level public health and public finance.

In brief, our analysis finds that federal dollars had a modest if any impact on the pace of vaccine rollouts, had a substantial impact on the volume of tests administered, and may have improved the equitability of vaccine administration. Regarding the total number of vaccines delivered, we estimate a modestly positive but statistically insignificant relationship between federal dollars and vaccines distributed. Our point estimate suggests that, through March 2022, an additional $1,000 per resident translated into just under 1,200 extra vaccine doses being delivered per 100,000 people; the upper bound of our confidence interval suggests that we can rule out effects in excess of 7,030 extra doses per 100,000 people. Regarding tests, our baseline estimate implies that each $1,000 in COVID-19 relief aid per capita generated 55,850 additional tests per 100,000 people, or roughly one additional test for every two people. Here we can reject a null effect at the 95% confidence level.

Finally, we find that federal dollars predict smaller gaps between the vaccination rates of those with a college education and those with a high school education. An additional $1,000 in federal funding per resident reduced the disparity in vaccination rates between college and high school educated adults by a robust and statistically significant 5.4 percentage points. A caveat to this final piece of analysis is that it relies on data from the Household Pulse Survey, which suffers from substantial non-response rates.

Our analyses relate to several lines of thought regarding the role of state and local governments and both the structure and volume of federal fiscal assistance in response to economic and public health emergencies.

First, the federal government's unprecedented allocation of roughly $900 billion in fiscal assistance substantially overshot state and local governments' needs. This was due in part to the surprising resilience of state and local government tax revenues (Clemens and Veuger, 2023; National Association of State Budget Officers, 2021). This raises the question of whether, in the end, federal fiscal assistance advanced outcomes of policy interest. Our findings suggest that the fiscal space created by federal fiscal assistance had a substantive impact on the delivery of COVID-19 tests, and may also have improved the equitability of vaccine distribution, but was ineffective at substantially increasing vaccine distribution in the aggregate.

The contrast between our findings for tests relative to vaccines can be understood with reference to policy's capacity to either shift or move down the demand, or "willingness to pay," curve. Testing is a classic service category for which demand will tend to be elastic, and thus responsive to interventions, due to the long tail of circumstances under which an incremental test has positive value. Vaccine provision, by contrast, had likely reached an inelastic portion of the demand curve by March 2022, as free vaccines were by that time widely available and those who had yet to be vaccinated exhibited substantial resistance.

Our setting thus illustrates an important conceptual point. Absent a public health externality, the standard intuition is that optimal insurance arrangements will more generously insure (or subsidize) health care goods and services for which demand is inelastic, since small elasticities imply modest distortions. In the presence of large public health externalities, this intuition reverses: funds are more effectively spent to subsidize services for which demand is elastic, since the associated rise in demand brings consumption closer to its socially optimal level. Our analysis illustrates, consistent with intuition, that testing against infectious diseases may be more responsive to subsidy than vaccination.

Historically, federally funded vaccine programs have relied on state and local governments and the private sector to distribute and administer vaccinations. Research has linked this decentralized structure to variation across states in population vaccination percentages during various immunization campaigns (Neustadt and Fineberg, 1978; Orenstein, et al., 2005; Schwerzmann, et al., 2017; Kolbe, 2021). In general, vaccination efforts seem to face significant barriers. On the administrative side, these barriers include funding constraints, complexities of managing vaccination locations, training staff, providing accurate information to the public, and the logistics of transporting the vaccine itself (WHO, UNICEF, and World Bank, 2009; Penfold, et al., 2011; Kolbe, 2021).

Obstacles to vaccine take-up include geographical access, insurance coverage, dislike of receiving injections, and inaccurate information and perceptions about vaccine effectiveness and side effects (Alsan and Eichmeyer, 2021; Gonzales, et al., 2021; Brownstein et al., 2022).[2] Correlations between socioeconomic status and vaccination rates were noted in early studies of COVID-19 vaccines (Ali et al., 2021; Biswas, et al., 2021) and prior research on flu vaccination (Lucyk, et al., 2019).

During the COVID-19 pandemic, several studies have found differences in vaccine hesitancy and take-up by race and socioeconomic status (Alsan and Wanamaker, 2018; Balasuriya et al., 2021; Perry et al.,

[2] In previous vaccination efforts, cost has operated as a significant deterrent to uptake (Walsh, Doherty, and O'Neill, 2016). Generous federal assistance throughout the pandemic has removed this constraint for most households; by May 2021, only 3 percent of surveyed unvaccinated individuals recorded cost as a reason for their hesitancy (US Census Bureau, 2022).

2021; Padamsee, et al., 2022; Ndugga, et al., 2022).[3] There is also some evidence that outreach interventions have the potential to increase take-up (Alsan and Eichmeyer, 2021; Gonzales, et al., 2021).[4] We shed light on the extent to which gaps in vaccine receipt across socioeconomic groups were narrowed in states that had more resources available.

The paper is organized at follows. In Section II we introduce our data and sources. We turn to our empirical strategy in Section III. Sections IV presents our empirical results. We conclude with a discussion of our findings in Section V.

II Data

We analyze the fiscal assistance to state and local governments in four major pieces of legislation enacted during the COVID-19 pandemic: the Families First Coronavirus Response Act (FFCRA), the CARES Act, the Response and Relief Act (RRA), and the American Rescue Plan Act (ARPA). Taken together, these packages provided almost $900 billion in funds to state and local governments. We focus on the impact of these funds on the expansion of COVID-19 vaccination and testing programs across the 50 states. Data from the Committee for a Responsible Federal Budget (CRFB, 2021) form the foundation for our fiscal assistance variables.

While the total amount of aid is the most relevant indicator of a relieved budget constraint, each of the four bills mentioned above included specific provisions for testing and vaccination programs. For example, the FFCRA included funding meant to ensure all individuals would have access to COVID testing that was free at the point of service (National Association of Counties, 2021a). The RRA allocated $22.4 billion for testing, contact tracing, and mitigation programs and $8.75 billion for broad-based local vaccination programs (Briggs, 2021). And the ARPA independently distributed $55.3 billion in grants to states, localities, and tribes for testing and vaccines (National Association of Counties, 2021b). In all, the federal government provided at minimum $97.5 billion in such targeted aid. As emphasized and demonstrated below, however, our instrumental variables analysis is designed to estimate the effects of the fiscal space created by general relief funds rather than funds dedicated specifically to the delivery of public health services.

On March 15, 2022, the White House released a statement outlining the risks associated with failing to pass further aid for combatting the pandemic (The White House, 2022). These included an insufficient supply of booster doses and variant-specific vaccines; reduced funding to cover the uninsured; and scaling back domestic and international vaccination and testing efforts. Additional government funding for these purposes would thus need to come out of states' other funds, which raises the question of whether states that received more generous allocations of general fiscal assistance delivered more regular testing and either faster or more equitable vaccination rollouts.

Our main independent variable is the grand total of aid distributed to each state per resident. The distribution of money across states has not been equal, with smaller states receiving relatively more per

[3] See also Hendricks, et al. (2021); Jacobson, et al. (2021); and Dryden-Peterson, et al. (2021).
[4] Differences in vaccine hesitancy among Democrats and Republicans, where the latter group may be harder to convince that the vaccine is safe and effective, complicates the approach health officials must take to get widespread coverage (Khubchandani et al., 2021; Pink et al., 2021; Bolsen and Palm, 2022; Wallace et al., 2022).

person than larger states. As in Clemens, Hoxie, and Veuger (2022), we use a state's number of congressional representatives per million residents to instrument for federal aid per capita. As discussed in Clemens and Veuger (2021) and as shown below, the bias in funds towards relatively small states derived primarily from the formulas used to allocate flexible, general fiscal assistance.

The main outcomes of interest in our analysis are the total number of COVID-19 tests and vaccinations administered throughout the pandemic. We obtain the number of PCR tests administered in each US state from the Johns Hopkins University Centers for Civic Impact (2022), which rely on data from the relevant state health agencies and the US Department of Health & Human Services. Beginning in the fall of 2021, Wisconsin and Washington testing data are missing. As such, we only have 48 observations for the relevant COVID-19 test regressions.

We access the number of vaccines administered in each US state through the US Centers for Disease Control and Prevention (2020). The CDC collect the number of vaccines distributed to and administered at "all vaccine partners including jurisdictional partner clinics, retail pharmacies, long-term care facilities, dialysis centers, Federal Emergency Management Agency and Health Resources and Services Administration partner sites, and federal entity facilities." Cumulative totals from March 2020 (December 2020) through March 2022 are scaled by population to estimate the total number of tests (vaccines) given per 100,000 people.

We additionally examine measures of distributional disparities during the pandemic. Since April 2020, the US Census Bureau (2022) has been publishing data from the Household Pulse Survey (HPS). Vaccination questions have been included in the HPS since January 2021. We estimate the percentage of individuals by race, ethnicity, age, educational attainment and income who have received at least one dose of a COVID-19 vaccine from the pool of respondents to the vaccination section of the surveys. Because the HPS suffers from substantial rates of survey non-response, we have more confidence in our analyses of overall vaccination and testing rates than in our analyses of disparities, which rely on the HPS.

Additionally, we collect data on a number of variables related to the pre-pandemic robustness of state-level health systems. These include: pre-pandemic H1N1 vaccination rates, adult flu vaccination rates, and childhood 7-sequence vaccination rates (CDC 2022a, 2022b); data on pre-pandemic receipt of recommended diabetic eye tests, diabetic HbA1c tests, and mammograms (Dartmouth, 2019); data on the pre-pandemic distribution of pharmacies, pharmacists, and per capita prescription rates (IQVVIA, 2019; Kaiser Family Foundation, 2019; US Bureau of Labor Statistics, 2022a); and the number of non-emergency medical transit (NEMT) rides (US Centers for Medicare and Medicaid Services, 2019; US Department of Health and Human Services, 2021). Finally, to shed light on the cost structure of COVID-19 vaccination programs, we look to data on the number of COVID-19 vaccine distribution sites in each state (CDC, 2022).

Table 1 presents summary statistics on the full set of variables used in our analysis. Because some of the variables we use in our analyses are available for different time periods, not all variables have the same number of observations. Further details on the definitions of key variables can be found in Appendix Table 1.

III Empirical Strategy

We seek to identify the effect of COVID-19 relief funds to state and local governments on testing and vaccination programs. Equation (1) presents a "naïve" OLS model of the relationship between per capita aid and changes in the cumulative number of vaccinations or tests administered per 100,000 people:

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{TotalAid_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + \varepsilon_{s,m,y} \tag{1}$$

In equation (1) and the equations that follow, *m* and *y* correspond with month-year pairs from March 2020 to March 2022. In the equation above, $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month *m* of year *y* scaled per 100,000 people residing in state *s*. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total per capita funding (in thousands of dollars) to state and local governments in state *s* pooled across all four COVID-19 relief bills. For reasons discussed below, total aid enters our specifications as a time-invariant variable that varies cross-sectionally across states. $X_{s,m,y}$ is a vector of additional state-level demographic, economic, and political controls, which we discuss in greater detail below.

OLS estimates of β_1 from equation (1) are subject to potential biases linked to omitted variables and the endogeneity of fiscal assistance allocations. If policymakers allocated more money to states in which individuals were, all else equal, more likely to test or get vaccinated, then federal aid would be correlated with any variations in uptake that were driven by the severity of the pandemic, individual attitudes, or other factors. This would introduce upward bias as it would generate a spurious, positive correlation between aid dollars and our testing and vaccination-related outcomes. A more direct form of reverse causality may also arise if, for example, the capacity of state and local governments to design and promote testing and vaccination shaped federal aid allocations. In this case, early success in testing or vaccinating would determine the amount of aid given, creating a spurious negative relationship if more capable states were to receive less money.

We adopt an instrumental-variable approach to address these challenges. Specifically, we estimate the following set of equations:

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

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid}_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \tag{2b}$$

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 $X_{s,m,y}$., Robust standard errors are clustered at the state level, and we weight observations by state population.[5] Fitted values from the first stage (2a) are used to estimate the second stage (2b).

The outcomes of interest include the cumulative number of tests or vaccines administered, as well as gaps in vaccination rates across population subgroups. Because the primary outcomes we analyze are cumulative, most of the regressions we present are estimated on a sample from March 2022, which is the last month for which we have compiled data on the full set of outcomes we analyze. We also present estimates from sequences of regressions that trace out the accumulation of any impacts of federal dollars on testing and vaccination rates over time. Note that for each of the estimates presented, equation (2b) is run using data from a single time period *(m,y)*. In Figure 1 we report the resulting set of month-specific estimates to trace out how the relationship between $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ and testing or vaccination rates evolved over time.

A valid instrument satisfies both the relevance and exogeneity (or exclusion) restrictions. If the relationship between federal aid and congressional representation is not strong and the relevance restriction is failed, the fitted values will not pick up the exogenous variation needed to estimate a correctly specified second stage. As established by our first-stage results, the relationship between representatives per million and COVID-19 relief aid is very strong. On a per capita basis, small states received much more money than large states.

The exogeneity restriction requires that, conditional on other independent variables, congressional representation be structurally unrelated to other factors that influence rates of testing and vaccination. In our baseline specification, the vector $X_{s,m,y}$ includes state-level data on the log of the 2020 Census population count (the level of which is used to construct other variables that require population), the share of votes won by Donald Trump in the 2020 Presidential election (MIT Election and Data Science Lab, 2017), the change in real GDP per capita from Q4 2018 to Q4 2019 (US Bureau of Economic Analysis, 2022), and the number of cumulative and new COVID-19 cases and deaths per 100,000 people as measured during the previous month (Dong, Du, and Gardner, 2020). We will refer to these controls as the "baseline set." The rationale for this set of controls is to include proxies for attitudes towards the pandemic, pre-pandemic economic trends, and variations in demand for tests and vaccines driven by variations in the pandemic's severity. Recognizing potential concerns associated with the possibility of "endogenous controls," our robustness checks include a set of specifications with sparser control sets. Particularly relevant to the question of endogenous controls is our set of robustness checks in which we exclude all covariates associated with COVID-19 deaths and cases.

In further robustness checks, we use as additional controls the share of each state's population that lives in an area eligible for financing through the Federal Reserve's Municipal Liquidity Facility (MLF); changes in state and local government employment per capita and private employment per capita between December 2018 and December 2019; the average of the Oxford Stringency Index (OSI), which is a measure of COVID-19 related restrictions, during March 2020 and during month *m* of year *y*; and finally, the change in retail mobility in the previous month (Google LLC, 2021). These covariates provide additional proxies for potentially relevant factors including states' pre-pandemic economic trends and their policy environments during the pandemic itself.

[5] Weighting by population only modestly impacts our point estimates, as shown in Appendix Table 2.

We advance several other 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). We observe that there is no epidemiological reason to expect these variations in representation to directly impact or otherwise track with the spread and severity of the coronavirus through channels other than the influence of representation on the legislative priorities of Congress. Put differently, there is no reason to expect the structural relationship between state population and the pandemic's spread to exhibit the break from linearity that is observed in the relationship between population and per capita allocations of federal aid and illustrated in Appendix Figure 1.

Furthermore, 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 (2021) analysis of the small-state advantage shows that it is more or less orthogonal to an extensive set of proxies for dimensions of such needs, including states' revenue shocks, economic shocks, the size of their public sector, population density, and acreage of federal land.[6] They show further that the over-representation of small states is less correlated with political partisanship than is commonly assumed.

While it is not possible to analyze pre-pandemic trends in the use of COVID-19 specific tests and vaccines, we can investigate whether our identifying variation predicts a variety of pre-pandemic testing and vaccination outcomes. The set of vaccination and testing variables referenced in Section II enables us to assess, in the spirit of falsification tests, whether our identifying variation is correlated with proxies for states' health system performance in the areas of testing and vaccination. The results, as presented in Table 2, reveal statistically insignificant relationships for all three of the vaccination outcomes and two of the three testing outcomes. The correlation between our identifying variation and rates of HGB testing among diabetics is negative and statistically significant at the 10 percent level, which suggests, if anything, that our estimates may understate the effects of federal fiscal assistance on testing rates.

Finally, it has been shown elsewhere (Brownstein et al., 2022) that proximity to pharmacies may have had substantial effects on vaccination delivery. This leads us to test whether our identifying variation is correlated with any of several proxies for pre-pandemic (2019) pharmacy access. As shown in Appendix Table 4, the correlation between our identifying variation and measures of pharmacy density per capita, the number of pharmacists per million residents, and per capita prescription rates are statistically weak and economically small. A separate but related concern is that if vaccination were highly centralized, the fixed costs of establishing each site might lead high- and low- population states to face meaningfully different cost structures. Even the lowest-population states, however, had hundreds of distinct sites, suggesting that any returns to scale were exhausted even in the smallest states.

[6] See Appendix Table 3, which largely mirrors results from Clemens, Hoxie, and Veuger (2022), for further exogeneity tests on our first stage.

IV Results

In this section we use our instrumental-variable estimator to analyze the extent to which fiscal assistance to state and local governments helped to expand COVID-19 testing and vaccination programs.

Federal COVID-19 Relief, Vaccination, and Testing

Table 3 presents our estimates of the effects of federal aid to state and local governments on state level vaccination and testing programs. Columns 3 and 7 present estimates of our baseline 2SLS specification using data from March 2022 for vaccines and tests, respectively.

In Column 3, the coefficient on total aid per capita implies that an additional $1,000 per resident translated into just under 1,200 extra doses of the vaccine being delivered per 100,000 people. This estimate is statistically indistinguishable from zero.[7] The result in Column 7 implies that by March 2022 residents had received 55,850 additional tests per 100,000 people for every additional $1,000 in COVID-19 relief aid, or roughly one additional test for every two people. This estimate is significant at the 95% confidence level.

Columns 1 and 5 of Table 3 present the OLS estimates of equation (1). The coefficient on aid per resident is substantially greater than the 2SLS estimate, indicating that the OLS estimate is biased in a positive direction.

Columns 2 and 6 of Table 3 present the baseline first-stage estimates of equation (2a). An additional representative per capita predicts roughly $1,200 in federal aid per state resident. The first stage F-statistics are on the order of 100. Following analyses in Clemens and Veuger (2021), Appendix Table 6 divides federal aid into an education component, a transit component, and a general relief component. The estimates reveal that roughly 7/8th of the federal funds tracked by our instrument stem from the formulas used to allocate general fiscal relief, while the remainder involves education-related assistance.

Our baseline estimates of equation (2b) may be biased if our instrument, representatives per million residents, is correlated with state characteristics that shaped states' budgetary positions or attitudes towards COVID-19 tests and vaccines. Potentially relevant characteristics might include access to financial markets, cultural attitudes towards the pandemic, or the stringency of government policies intended to help contain the spread of COVID-19. We present additional results to investigate whether our estimates are robust to the inclusion of controls for such factors.

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[7] According to the New York Times (2022), by March 2022 30% of the US population was boosted, 36% was fully vaccinated, 11% was partially vaccinated, and 23% was not vaccinated. If two doses constitute full vaccination and if boosted individuals had received three doses, these data imply that the average American had received roughly 1.73 vaccine doses. Based on our point estimate, $1,000 in additional aid is thus associated with vaccinating 674 (our point estimate of 1,166 divided by 1.73) more people per 100,000 than otherwise would have been. Appendix Table 5 reports estimates in which the outcome variable is the percentage of the population fully vaccinated. As in Table 3, the estimates are statistically indistinguishable from zero.

Columns 4 and 8 of Table 3 show estimates with additional sets of controls to account for such variables as variations in voluntary and involuntary social distancing and eligibility for Federal Reserve lending.[8] For vaccinations, the point estimate is now negative, has become even smaller in absolute terms, and remains statistically indistinguishable from zero. Our estimate for the impact on the rollout of tests is very little affected and now implies that an increase in federal aid of $1,000 per resident translated into 57,722 additional tests per 100,000 people. We continue to be able to confidently reject the null hypothesis of no effect on tests.

We next consider estimates in which we do not weight states according to population. Weighted and unweighted specifications have different interpretations. Unweighted specifications are more appropriately interpreted as shedding light on the experience of a typical state, while population-weighted estimates are more appropriately interpreted as shedding light on the typical impact of each dollar spent. As shown in Appendix Table 2, unweighted regressions yield estimates that are qualitatively indistinguishable from weighted estimates in our setting. In the unweighted regressions, the coefficients for testing are estimated with substantially greater precision.

Appendix Figures 2 and 3 provide complementary evidence on the reduced form relationship between congressional representation and rates of testing and vaccination. In each figure, Panels A and B present the unadjusted, bivariate relationship between our instrument and rates of vaccination (Panel A) or testing (Panel B), while Panels C and D present plots of data that have been residualized with respect to the covariates in our baseline specifications. The best fit lines reveal that neither the positive effect we estimate for testing nor the null effect we estimate for vaccination is contingent on the covariates included in our baseline estimator. Put differently, the relationships we estimate are present in the unadjusted data. A comparison of Appendix Figures 2 and 3 reveals further that these relationships are not driven by Wyoming and Vermont, which are the very lowest-population states.

Federal COVID-19 Relief and Distributional Effects

Beyond vaccinating the general population, a secondary goal of federal COVID-19 relief aid was to ensure equitable access to medical care and vaccines for disadvantaged groups. The administration reiterated this commitment in March 2021 as access to vaccines expanded across the country (FEMA, 2021). Even if additional funding did not significantly raise aggregate vaccination rates, it may still have helped meet policymakers' goals by closing racial and socioeconomic gaps in vaccination rates.

Table 4 presents estimates of the baseline specification seen in Columns 3 and 7 of Table 3, but replaces March 2022 estimates of the overall vaccination or testing rate with the difference in vaccination rates (in percentage points) between demographic groups. For example, the dependent variable in Column 1 is calculated as the vaccination rate for white Americans minus the vaccination rate for African Americans. A negative coefficient on federal aid per capita represents an increase in the equitability of vaccine distribution.

We find potentially meaningful effects on three of these seven disparities: the white-black gap, the old-young gap, and the college-high school gap, the last of which is statistically significant at the 99% confidence level. The estimate suggests that an additional $1,000 in federal funding per resident

[8] The additional sets of controls are described in detail in Appendix Table 1.

reduced the disparity in vaccination rates between college- and high school-educated adults by 5.4 percentage points. Our estimated distributional effects should be interpreted with caution, however, as the Household Pulse Survey suffered from non-response rates of over 90 percent. That said, the rate at which data are missing is not systematically correlated with our identifying variation.

Evolution of Public Health 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, their disbursement, and the actual spending by state and local governments, it is useful to examine the coefficient on federal aid per capita over the course of the pandemic in order to identify any trends. Further, early advantages for some states may disappear as strategies to handle the pandemic evolve.

Figure 1 begins by presenting the evolution of the correlation between our instrument and the accumulation of funds as appropriated across the pandemic relief bills. Note that the coefficient associated with the last month of the sample, well after the final piece of relief legislation, corresponds with our first stage. Coefficients for earlier months reveal which pieces of legislation contributed to varying degrees to the total cumulative advantage of the more highly represented states. The coefficients reveal that the small state advantage was derived in large part from the March 2020 CARES Act, with additional extra funds arriving through the American Rescue Plan.

We make two points regarding the estimates in Panel A. First, it is noteworthy that some of the excess funds received by small states were appropriated in March 2021, after the arrival of vaccines. Consequently, the absence of evidence that federal funds had a substantial impact on vaccination rates cannot be attributed entirely to the timing of aid appropriations. Second, because state budgets were healthier than initially expected through the entirety of the pandemic, they had no need to spend down their federal funds rapidly; indeed, states entered the summer 2021 budgeting cycle expecting substantial surpluses. This motivates the structure of our analyses, in which we view total federal aid as a stock of funds states could spend at the pace of their choosing.

In Panels B and C, Figure 1 presents month-by-month estimates of the coefficient on federal aid as specified in equation (2b). Panel B presents estimated effects on vaccination rates. Results for the months immediately following the authorization of the Pfizer and Moderna vaccines identify a small but significant relationship between federal aid and vaccination rates. In this period, states prioritized the vaccination of healthcare professionals, essential workers, and the elderly. However, as vaccinations were made available to the general public, the effect plateaued and faded in significance, suggesting that there has been a convergence of vaccination rates across states that benefited from different levels of federal funding. This is in line with the findings of Ho et al. (2022), who establish that pro-vaccination campaigns lost their effectiveness after the early stages of the pandemic.

Panel C shows a steady expansion of the coefficient on federal aid for the cumulative number of tests administered. When tests were scarce in early 2020, additional aid had relatively little effect on testing capacity. As tests became more widely available and states established their testing regimes, these advantages, rooted in federal funding, grew.

Additional Robustness Checks

We next subject estimates for our full set of outcomes to a set of robustness checks that gauges the potential relevance of the covariates we include, of the functional form in which we include those covariates, and the potential role of the largest and smallest states in driving our results. In Appendix Table 7, we replace the log of states' populations with an indicator for whether a state was "small" in the sense that it benefited from the CARES Act's lower limit on statewide funding. In Appendix Table 8 we drop the 3 (Panel A) or 5 (Panel B) most and least represented states from the sample. In Appendix Table 9 we augment the control set to include cubic polynomials in each of the covariates in the baseline control set other than the log of each state's population. In Panel A of Appendix Table 10, the sole control variable is the log of each state's population. In Panel B of Appendix Table 10, the controls include the log of each state's population and Trump's vote share in the 2020 election. In Appendix Table 11 the controls include the log of each state's population, Trump's vote share, and our control for each state's pre-pandemic growth in per capita GDP. These last three sets of specifications exclude all COVID-19 case- and death-related variables, which is relevant for addressing any lingering concerns about biases due to the inclusion of potentially endogenous control variables. Additionally, we investigate whether our estimates are sensitive to controlling for variables associated with the resources of states' Medicaid programs. Specifically, we consider the addition of controls for state Medicaid spending (Appendix Table 12) as well as for access as enabled by Medicaid's provision of Non-Emergency Medical Transportation (NEMT) trips (Appendix Table 13).

Across this set of specifications, the estimated effect of federal aid on overall vaccine administration fluctuates non-trivially but tends to remain statistically indistinguishable from zero. We interpret this set of results as failing to detect systematic evidence of an effect of federal relief dollars on overall vaccination rates. A key caveat to this finding is that our robustness analysis reinforces the conclusion that we are unable to rule out non-trivial effects.

Across our analyses of various dimensions of inequity in vaccine distribution, we find consistent evidence that federal dollars reduced inequity with respect to education. Additional analysis, reported in Appendix Table 14, shows that this result is associated with a moderate rise in the estimated vaccination rate for individuals with low levels of education and a null effect for those with high education. For other dimensions of vaccine equity, our estimates are more sensitive across specifications.

Throughout the analysis, our estimate of the effect of federal aid on COVID-19 testing rates is consistently our strongest finding. The estimated effect of federal aid on rates of testing is positive in all of our robustness checks, with an average point estimate that is modestly larger in magnitude than our baseline estimate. All but two of the estimated coefficients for the effect of federal aid on testing rates are statistically distinguishable from 0 at the 95% confidence level.

V Discussion

Our analysis has assessed whether federal fiscal assistance played a role in advancing goals associated with population testing and the administration of vaccines. We find that federal dollars had a modest, if any, impact on the pace of vaccine rollouts, a substantial impact on the volume of tests administered, and may have improved the equitability of vaccine administration.

The context for our findings can help to shed additional light on their implications. As discussed in Section II, federal assistance included funds targeted directly at the testing and vaccination outcomes we analyze. Our findings suggest that these targeted dollars came far from satiating demand for tests, as we estimate that general fiscal assistance dollars contributed substantially to the number of tests delivered. A key lesson is thus that surplus funds can be effective at increasing the utilization of services, like testing, for which demand is highly elastic.

The opposite is true for vaccines, for which we estimate that general fiscal assistance had little impact on total delivery. While higher overall vaccination rates would certainly have been preferable from a public-health perspective, the evidence suggests that pressures on state and local government budgets were not pivotal in holding back progress towards this objective. On the other hand, our results on the equitability of vaccine distribution suggest that additional fiscal assistance dollars may have been useful for reaching populations with socioeconomic barriers to vaccine uptake.

Our analysis provides one piece of the puzzle for assessing federal fiscal assistance. Were this assistance intended solely for the advancement of states' testing and vaccination campaigns, our estimates would imply that those campaigns were ineffective: $1,791 spent per additional test and $85,763 spent per additional vaccine would fail any reasonable cost-effectiveness analysis. Of course, federal funds were intended to support a much broader set of state and local government activities. An all-inclusive welfare evaluation is beyond this paper's scope.

A concluding caveat is thus that our results shed more light on how state and local governments ultimately used their federal dollars than on the full impact of those dollars. Applying a cost estimate of $100 per test (CMS, 2021), for example, our findings suggest that tests can account for roughly 5 percent of states' marginal federal dollars.

Future research is needed to fully understand the effects of fiscal assistance on economic activity or on the performance and re-opening of schools. In complementary work, Clemens, Hoxie, and Veuger (2022) and Clemens, Kearns, Lee, and Veuger (2022) consider the effects of fiscal assistance as stimulus and find that effect to be modest. The effects of fiscal assistance on education outcomes will be an important subject for future work.

References

Ali, Shahmir H., Yesim Tozan, Abbey M. Jones, Joshua Foreman, Ariadna Capasso, and Ralph J. DiClemente (2021) "Regional and Socioeconomic Predictors of Perceived Ability to Access Coronavirus Testing in the United States: Results from a Nationwide Online COVID-19 Survey," *Annals of Epidemiology* 58: 7-14.

Alsan, Marcella and Sarah Eichmeyer (2021) "Experimental Evidence on the Effectiveness of Non-Experts for Improving Vaccine Demand," NBER Working Paper 28593.

Alsan, Marcella, and Marianne Wanamaker (2018) "Tuskegee and the Health of Black Men," *The Quarterly Journal of Economics* 133(1): 407-455.

Balasuriya, Lilanthi, Alycia Santilli, Jennifer Morone, Jessica Ainooson, Brita Roy, Anuli Njoku, Andrea Mendiola-Iparraguirre, Kathleen O'Connor Duffany, Bernard Macklin, Jackson Higginbottom, Celina Fernández-Ayala, Genesis Vicente, and Arjun Venkatesh (2021) "COVID-19 Vaccine Acceptance and Access Among Black and Latinx Communities," *Jama Network Open* 4(10).

Biswas, Nirbachita, Toheeb Mustapha, Jagdish Khubchandani, and James H. Price (2021) "The Nature and Extent of COVID-19 Vaccination Hesitancy in Healthcare Workers," *Journal of Community Health* 46(6): 1244-1251.

Bolsen, Toby, and Risa Palm (2022) "Politicization and COVID-19 Vaccine Resistance in the U.S." *Progress in Molecular Biology and Translational Science* 188(1): 81-100.

Briggs, Eli (2021) "Congress Passes COVID-19 Relief Deal," National Association of County and City Health Officials, January 27. https://www.naccho.org/blog/articles/congress-passes-covid-19-relief-deal.

Brownstein, John, Jonathan H. Cantor, Benjamin Rader, Kosali I. Simon and Christopher M. Whaley (2022) "If You Build it, Will They Vaccinate? The Impact of COVID-19 Vaccine Sites on Vaccination Rates and Outcomes," NBER Working Paper 30429.

Centers for Medicare & Medicaid Services (2021) "Medicare Administrative Contractor (MAC) COVID-19 Test Pricing," Guidance Document, Centers for Medicare & Medicaid Services. January 25.

Chidambaram, Priya and MaryBeth Musumeci (2021) "Potential Impact of Additional Federal Funds for Medicaid HCBS for Seniors and People with Disabilities," Kaiser Family Foundation, March 15. https://www.kff.org/medicaid/issue-brief/potential-impact-of-additional-federal-funds-for-medicaid-hcbs-for-seniors-and-people-with-disabilities/.

Clemens, Jeffrey, and Stan Veuger (2020a) "Implications of the COVID-19 Pandemic for State Government Tax Revenues," *National Tax Journal* 73(3): 619-644.

Clemens, Jeffrey, and Stan Veuger (2020b) "The COVID-19 Pandemic and the Revenues of State and Local Governments: An Update," *AEI Economic Perspectives* 2020-07.

Clemens, Jeffrey, and Stan Veuger (2021) "Politics and the Distribution of Federal Funds: Evidence from Federal Legislation in Response to COVID-19," *Journal of Public Economics* 204: 104554.

Clemens, Jeffrey, and Stan Veuger (2023) "Lessons from COVID-19 Aid to State and Local Governments for the Design of Federal Automatic Stabilizers." In: Kearney, Melissa S., and Amy Ganz (ed.) *Economic Policy in a More Uncertain World*. Washington, DC: Aspen Institute Press.

Clemens, Jeffrey, Benedic Ippolito, and Stan Veuger (2021) "Medicaid and Fiscal Federalism During the COVID-19 Pandemic," *Public Budgeting & Finance* 41(4): 94-109.

Clemens, Jeffrey, Philip G. Hoxie, and Stan Veuger (2022) "Was Pandemic Fiscal Relief Effective Fiscal Stimulus? Evidence from Aid to State and Local Governments," NBER Working Paper 30168.

Clemens, Jeffrey, John Kearns, Beatrice Lee, and Stan Veuger (2022) "Spatial Spillovers and the Effects of Fiscal Stimulus: Evidence from Pandemic-Era Federal Aid for State and Local Governments," AEI Working Paper 2022-14.

Committee for a Responsible Federal Budget (2021) "COVID-19 Money Tracker," Accessed on August 19, 2021. https://www.covidmoneytracker.org/.

Coronavirus Relief Fund for States, Tribal Governments, and Certain Eligible Local Governments (2021) "Final Guidance," 86 Fed. Reg. 10, January 15. https://home.treasury.gov/system/files/136/CRF-Guidance-Federal-Register_2021-00827.pdf.

Coronavirus State and Local Fiscal Recovery Funds (2022) "Final Rule," 87 Fed. Reg. 18, January 27. https://www.govinfo.gov/content/pkg/FR-2022-01-27/pdf/2022-00292.pdf.

Dartmouth (2019) "Selected Primary Care Access and Quality Measures." *Dartmouth Atlas DATA* (blog). 2019. https://data.dartmouthatlas.org/primary-care/.

Dong, Ensheng, Hongru Du, and Lauren Gardner (2020) "An Interactive Web-Based Dashboard to Track COVID-19 in Real Time," *The Lancet Infectious Diseases* 20(5): 533-534.

Dryden-Peterson, Scott, et al. (2021) "Disparities in SARS-CoV-2 Testing in Massachusetts During the COVID-19 Pandemic," *Jama Network Open* 4(2).

Federal Reserve Board (The Board of Governors of the Federal Reserve System) (2021) "Municipal Liquidity Facility," August 11.

Gonzales, Aldren, Euny C. Lee, Violanda Grigorescu, Scott R. Smith, Nancy De Lew, and Benjamin D. Sommers (2021) "Overview of Barriers and Facilitators in COVID-19 Vaccine Outreach," Assistant Secretary for Planning and Evaluation, Office of Health Policy Research Report HP-2021-19.

Google LLC (2021) "Google COVID-19 Community Mobility Reports," Accessed on April 14, 2022.

Hale, Thomas, Noam Angrist, Rafael Goldszmidt, Beatriz Kira, Anna Petherick, et al. (2021) "A Global Panel Database of Pandemic Policies (Oxford COVID-19 Government Response Tracker)," *Nature Human Behavior* 5: 529-538.

Haughwout, Andrew, Benjamin Hyman, and Or Shachar (2021) "The Option Value of Municipal Liquidity: Evidence from Federal Lending Cutoffs During Covid-19," Mimeo: Federal Reserve Bank of New York.

Hendricks, Brian, Paul Rajib, Cassie Smith, et al. (2021) "Coronavirus Testing Disparities Associated with Community Level Deprivation, Racial Inequalities, and Food Insecurity in West Virginia," *Annals of Epidemiology* 59: 44-49.

Ho, Lisa Y., Emily Breza, Marcella Alsan, Abhijit Banerjee, Arun G. Chandrasekhar, Fatima Cody Stanford, Renato Fior, Paul Goldsmith-Pinkham, Kelly Holland, Emily Hoppe, Louis-Maël Jean, Lucy Ogbu-

Nwobodo, Benjamin A. Olken, Carlos Torres, Pierre-Luc Vautrey, Erica Warner, and Esther Duflo (2022) "The Impact of Large-Scale Social Media Advertising Campaigns on COVID-19 Vaccination: Evidence from Two Randomized Controlled Trials," NBER Working Paper 30618.

IQVIA (2019) "U.S. National Pharmacy Market Summary." https://www.onekeydata.com/downloads/reports/IQVIA_Report_US_Pharmacy_Market_Report_2019.pdf.

Jacobson, Mireille, Tom Chang, Manisha Shah, et al. (2021) "Racial and Ethnic Disparities in SARS-CoV-2 Testing and COVID-19 Outcomes in a Medicaid Managed Care Cohort," *American Journal of Preventive Medicine* 61(5): 644-651.

Jagdish Khubchandani, Sushil Sharma, James H. Price, Michael J. Wiblishauser, Manoj Sharma, and Fern J. Webb (2021) "COVID-19 Vaccination Hesitancy in the United States: A Rapid National Assessment." *Journal of Community Health* 46: 270–277.

Johns Hopkins University Centers for Civic Impact (2022) "Coronavirus Resource Center," Johns Hopkins University, Accessed April 14, 2022. https://github.com/govex/COVID-19.

Kaiser Family Foundation (2019) "Retail Prescription Drugs Filled at Pharmacies per Capita." Kaiser Family Foundation Blog. 2019. https://www.kff.org/health-costs/state-indicator/retail-rx-drugs-per-capita/.

Kolbe, Allison (2021) "Factors Influencing Variation Between States in Efficiency of COVID-19 Vaccine Administration," Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services.

Lewis, Jeffrey B., Keith Poole, Howard Rosenthal, Adam Boche, Aaron Rudkin, and Luke Sonnet (2021) *Voteview: Congressional Roll-Call Votes Database*. https://voteview.com/.

Lucyk, Kelsey, Kimberley A. Simmonds, Diane L. Lorenzetti, Steven J. Drews, Lawrence W. Svenson, and Margaret L. Russell (2019) "The Association Between Influenza Vaccination and Socioeconomic status in High Income Countries Varies by the Measure Used: A Systematic Review," *BMC Medical Research Methodology* 19(153).

Medicaid and Chip Payment Access Commission (2021) "Annual Analysis of Disproportionate Share Hospital Allotments to States," US Department of Health and Human Services, March.

MIT Election Data and Science Lab (2017) "U.S. President 1976–2020," Harvard Dataverse, V6.

Moss, Kellie (2020) "The Paycheck Protection Program and Health Care Enhancement Act: Summary of Key Health Provisions," Kaiser Family Foundation, May 1. https://www.kff.org/coronavirus-covid-19/issue-brief/the-paycheck-protection-program-and-health-care-enhancement-act-summary-of-key-health-provisions/.

National Association of Counties (2021a) "NACo Brief: Summary of Legislative Action on COVID-19," National Association of Counties, January 13. https://www.naco.org/sites/default/files/documents/Summary%20of%20COVID%20Legislation_Jan%202021.pdf.

National Association of Counties (2021b) "American Rescue Plan Act Funding Breakdown," National Association of Counties, April 12. https://www.naco.org/resources/featured/american-rescue-plan-act-funding-breakdown.

National Association of State Budget Officers (2021) "The Fiscal Survey of the States: Fall 2021. An Update of State Fiscal Conditions," National Association of State Budget Officers.

Ndugga, Nambi, Latoya Hill, Samantha Artiga, and Sweta Haldar (2021) "Latest Data on COVID-19 Vaccinations by Race/Ethnicity," Kaiser Family Foundation. Available from: https://www.kff.org/coronavirus-covid-19/issue-brief/latest-data-on-covid-19-vaccinations-by-race-ethnicity/.

Neustadt, Richard E., and Harvey V. Fineberg (1978) *The Swine Flu Affair: Decision-Making on a Slippery Disease*. Washington, D.C.: National Academies Press (US).

New York Times (2022) "See How Vaccinations Are Going in Your County and State," *New York Times*. https://www.nytimes.com/interactive/2020/us/covid-19-vaccine-doses.html

Orenstein, Walter A., R. Gordon Douglas, Lance E. Rodewald, and Alan R. Hinman (2005) "Immunizations in the United States: Success, Structure, and Stress," *Health Affairs* 24(3): 599-610.

Padamsee, Tasleem J. Et al. (2022) "Changes in COVID-19 Vaccine Hesitancy Among Black and White Individuals in the US," *Jama Network Open* 5(1).

Penfold, Robert B., Donna Rusinak, Tracy A. Lieu, Abigail Shefer, Mark Messonnier, and Grace M. Lee (2011) "Financing and Systems Barriers to Seasonal Influenza Vaccine Delivery in Community Settings," *Vaccine* 29(52): 9632-9639.

Perry, Brea L., Brian Aronson, Ashley F. Railey, and Christina Ludema (2021) "If You Build It, Will They Come? Social, Economic, and Psychological Determinants of COVID-19 Testing Decisions," *PLOSOne* 16(7).

Pink, Sophia L., James Chu, James N. Druckman, David G. Rand, and Robb Willer (2021) "Elite Party Cues Increase Vaccination Intentions Among Republicans," *Proceedings of the National Academy of Sciences* 118(32): e2106559118.

Schwerzmann, Joy, Samuel B. Graciter, Barbara Jester, David Krahl, Daniel Jernigan, Carolyn B. Bridges, and Joseph Miller (2017) "Evaluating the Impact of Pharmacies on Pandemic Influenza Vaccine Administration," *Disaster Medicine and Public Health Preparedness* 11(5): 587-593.

The White House (2022) "Fact Sheet: Consequences of Lack of Funding for Efforts to Combat COVID-19 if Congress Does Not Act," The White House, March 15. https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/15/fact-sheet-consequences-of-lack-of-funding-for-efforts-to-combat-covid-19-if-congress-does-not-act/.

US Bureau of Economic Analysis (2022) "Quarterly Gross Domestic Product (GDP) By State," US Department of Commerce.

US Bureau of Labor Statistics (2022a) "Local Area Unemployment Statistics," US Department of Labor.

US Bureau of Labor Statistics (2022b) "Quarterly Census of Employment and Wages," US Department of Labor.

US Census Bureau (2021) "2020 Census Apportionment Results," April 16. Accessed on September 14, 2021.

US Census Bureau (2022) "Household Pulse Survey: Measuring Social and Economic Impacts during the Coronavirus Pandemic," March. Accessed on April 14, 2022. https://www.census.gov/programs-surveys/household-pulse-survey.html

US Centers for Disease Control and Prevention (CDC) (2020) "COVID-19 Vaccinations in the United States,Jurisdiction," US Centers for Disease Control and Prevention, Accessed April 14, 2022. https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-Jurisdi/unsk-b7fc.

US Centers for Disease Control and Prevention (CDC) (2022a) "Influenza Vaccination Coverage for All Ages (6+ Months)" Accessed June 28, 2023. https://data.cdc.gov/Flu-Vaccinations/Influenza-Vaccination-Coverage-for-All-Ages-6-Mont/vh55-3he6.

US Centers for Disease Control and Prevention (CDC) (2022b) "Vaccination Coverage among Young Children (0-35 Months)." Accessed June 28, 2023b. https://data.cdc.gov/Child-Vaccinations/Vaccination-Coverage-among-Young-Children-0-35-Mon/fhky-rtsk.

US Centers for Disease Control and Prevention (CDC) (2022c) "Vaccines.gov: COVID-19 Vaccinating Provider Locations," United Stated Department of Health and Human Services. https://web.archive.org/web/20210720122539/https:/data.cdc.gov/Vaccinations/Vaccines-gov-COVID-19-vaccinating-provider-locatio/5jp2-pgaw. Accessed on June 15, 2023.

US Centers for Medicare and Medicaid Services (2019) "Annual Medicaid & CHIP Expenditures." 2019. https://www.medicaid.gov/state-overviews/scorecard/annual-medicaid-chip-expenditures/index.html.

US Department of Health and Human Services (2021) "Non-Emergency Medical Transportation in Medicaid, 2018–2020."

US Department of the Treasury (2021a) "Allocations for States, District of Columbia, and Puerto Rico," August.

US Department of the Treasury (2021b) "Coronavirus State and Local Fiscal Recovery Funds," Interim Final Rule. *Federal Register* 86(93): 26786-26824.

US Federal Emergency Management Agency (FEMA) (2021) "FEMA Ensures Equitable Distribution of COVID-19 Vaccines," US Department of Homeland Security, March 9.

US Federal Transit Administration (2021a) "Fiscal Year 2021 American Rescue Plan Act Supplemental Public Transportation Apportionments and Allocations," US Department of Transportation.

US Federal Transit Administration (2021b) "Fiscal Year 2021 CRRSAA Act Supplemental Public Transportation Apportionments and Allocations," US Department of Transportation.

US Office of Elementary and Secondary Education (2021) "Emergency Assistance for Non-Public Schools," US Department of Education.

Vincent, Carol H., and Laura A. Hanson (2020) "Federal Land Ownership: Overview and Data," Congressional Research Service Report R42346. Updated February 21.

Wallace, Jacob, Paul Goldsmith-Pinkham, and Jason L. Schwartz (2022) "Excess Death Rates for Republicans and Democrats During the COVID-19 Pandemic," NBER Working Paper 30512.

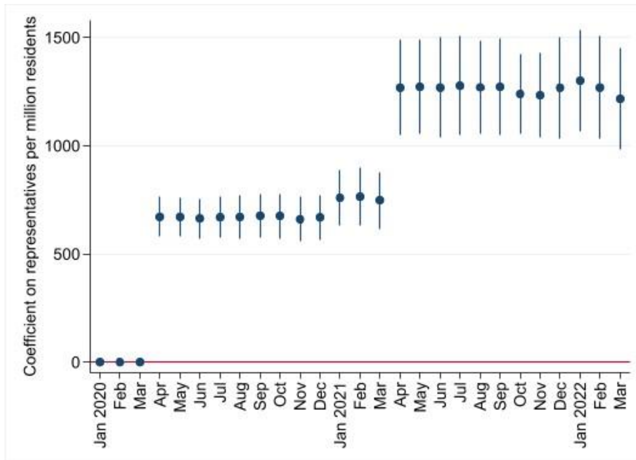
Walsh, Brendan, Edel Doherty, and Ciaran O'Neill (2016) "Since the Start of the Vaccines for Children Program, Uptake Has Increased, and Most Disparities Have Decreased," *Health Affairs* 35(2): 356-64.

Whitaker, Stephan D. (2020) "How Much Help Do State and Local Governments Need? Updated Estimates of Revenue Losses from Pandemic Mitigation," District Data Brief, Federal Reserve Bank of Cleveland, June 29. https://www.clevelandfed.org/newsroom-and-events/publications/cfed-district-data-briefs/cfddb-20200629-updated-estimates-of-revenue-losses-from-pandemic-mitigation.aspx.

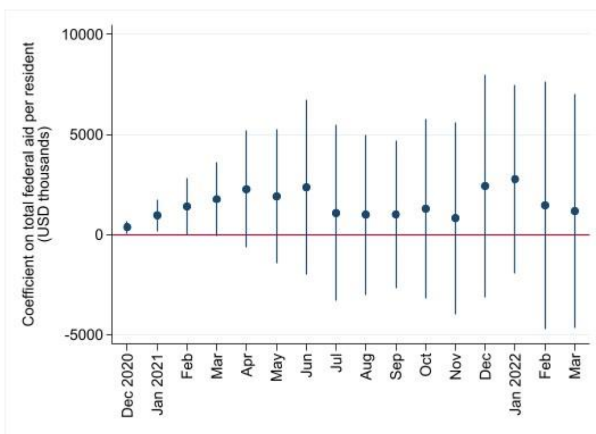
WHO, UNICEF, World Bank (2009) "State of the World's Vaccines and Immunization," 3rd ed., World Health Organization, Geneva.

Figure 1: Dynamic Effects of COVID-19 Relief Aid on Vaccinations and Testing

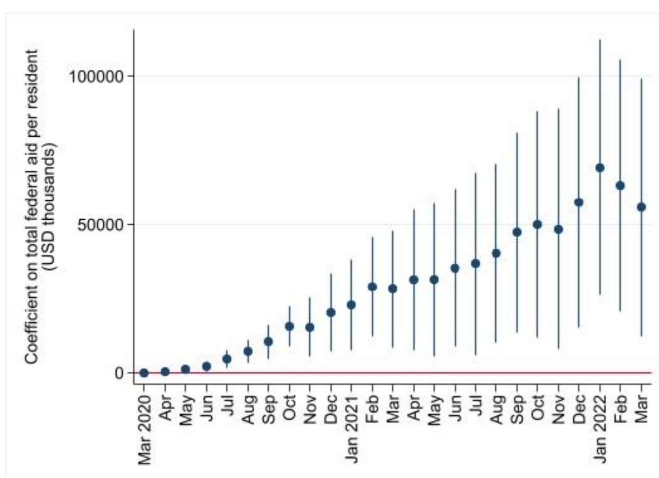
Panel A: Running Total of Federal Aid to State and Local Governments per Resident



Panel B: Effects of Federal Aid to State and Local Governments on Vaccinations Administered



Panel C: Effects of Federal Aid to State and Local Governments on COVID-19 Tests Administered



Note: Panel A of this figure displays the monthly estimates (and the 95% confidence interval) of the relationship between the running total of federal aid to state and local governments and representatives per million residents for each month between January of 2020 and March of 2022. The running total aid per resident tracks the funds as they are appropriated. The funds for the CARES and FFCRA can be seen in the coefficients for April 2020, the funds for the RRA can be seen in the January 2021 coefficient, and the ARP funds can be seen in the April 2021 coefficient. These regressions use our baseline controls and are weighted by state population and standard errors are clustered by state. Panels B and C display the coefficient (and the 95% confidence interval) on predicted total federal aid to state and local governments per resident (USD thousands) in the regression outlined in equation (2b):

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid}_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y},$$

where *m* and *y* iterate over the month-year pairs from March 2020 through March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month m of year y scaled per 100,000 people residing in state s. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. The 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), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), and US Department of the Treasury (2021a).

Table 1: Summary Statistics

	N	Mean	Std. Dev.	Min	Max
Total Aid to State and Local Governments per Resident (USD Thousands)	50	2.83	0.94	1.80	5.93
Senators and Representatives per Million Residents	50	2.14	0.893	1.30	5.19
Total Vaccinations per 100,000 (March 2022)	50	164,741	24,530	125,706	218,039
Total Tests Administered per 100,000 (March 2022)	48	267,034	13,700	60,476	695,553
Log of 2020 State Population	50	15.22	1.02	13.27	17.49
Share of Votes Won by Donald Trump in 2020 Election	50	0.50	0.10	0.30	0.70
Change in Real State GDP per Capita from 2018 to 2019	50	1,162.88	773.44	-768.45	2,812.25
New COVID-19 Deaths per 100,000 (February 2022)	50	18.78	6.74	9.02	37.22
Total COVID-19 Deaths per 100,000 (February 2022)	50	277.02	78.042	94.81	405.79
New COVID-19 Cases per 100,000 (February 2022)	50	1,380.63	662.97	411.32	3,845.90
Total COVID-19 Cases per 100,000 (February 2022)	50	24,310.94	3,863.75	16,360.44	33,669.15
Share of Population in City Eligible for Municipal Liquidity Facility	50	0.42	0.19	0.15	0.84
Change in State and Local Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	50	0.00040	0.0005	-0.0008	0.002
Change in Private Employment per Capita from Dec 2018 to Dec 2019 (QCEW)	50	0.0039	0.0037	-0.007	0.01
March 2020 Average Oxford Stringency Index Level	50	0.43	0.05	0.32	0.55
March 2022 Oxford Stringency Index Level	50	0.32	0.06	0.25	0.57
Percent Change in Retail Mobility Relative to February 2020 Baseline (February 2022)	50	-10.39	5.22	-22.68	-1.25
White Minus Black Vaccination Rate (March 2022)	50	2.59	9.49	-12.50	38.02
White Minus Hispanic Vaccination Rate (March 2022)	50	1.08	8.24	-19.26	24.62
White Minus Asian Vaccination Rate (March 2022)	50	-9.32	10.33	-23.74	30.98
$200,000+ minus <$25,000 Household Income Vaccination Rate (March 2022)	50	13.12	7.78	-9.71	29.28
College Degree minus High School Degree Vaccination Rate (March 2022)	50	14.95	5.00	6.66	29.84
Aged 65+ minus 40-54 Vaccination Rate (March 2022)	50	11.51	5.53	0.98	28.16
Aged 65+ minus 18-24 Vaccination Rate (March 2022)	50	14.88	12.46	-6.94	56.07
Percentage of population fully vaccinated (March 2022)	50	64.03	8.874	50.7	81.6
Tax Shortfall per Capita	50	972.67	380.65	621.60	2,565.08
Average Q4 2020 Unemployment per Capita	50	0.03	0.01	0.02	0.06
Percent Change in Personal Income Q4 2019 to Q4 2020	50	4.66	1.93	-0.06	10.61

Total State and Local Spending per Capita	50	11,569.09	2,463.31	8,306.06	20,373.53
Acres of Federal Land per Capita	50	9.36	43.16	0.003	302.50
Log Population Density	50	4.56	1.40	0.25	7.14
Total COVID Cases per 100K (March 2020)	50	42.41	62.31	8.88	392.27
Total COVID Deaths per 100K (March 2020)	50	1.07	2.17	0.00	14.31
Average Adult Flu Vaccine Rate, 2010-2019 (%)	50	42.64	4.060	33.50	51.88
Adult H1N1 Vaccine Rate, 2009-2010 (%)	50	24.49	5.400	12.40	37.60
Childhood 7-Sequence Vaccine Rate, 2011-2018 (%)	50	69.90	3.929	61.50	79.30
Diabetic Eye Test Rate, 2019 (%)	50	0.69	0.046	0.57	0.79
Diabetic HGB Test Rate, 2019 (%)	50	0.87	0.033	0.77	0.91
Biennial Mammogram Rate, 2019 (%)	50	0.66	0.047	0.55	0.76
Pharmacies per million (2019)	50	270.54	52.607	190.15	378.32
Pharmacists per million (2019)	50	998.35	186.78	628.81	1574.68
Drugs filled at pharmacies per capita (2019)	50	11.81	2.46	6.50	18.10
Annual ride days per resident (2019)	50	0.25	0.23	0.000086	1.076
NEMT expenditure per resident (2019)	50	10.64	21.78	0.00	151.27
Percent of residents using NEMT (2019)	50	0.05	0.029	0.00	0.14
Percent of residents using preventative NEMT (2019)	50	0.01	0.006	0.00	.028
Total Medicaid spending per resident (2019)	50	1905.03	566.90	924.87	3098.35

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), US Bureau of Labor Statistics (2022a, 2022b), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Hale et al. (2021), Google LLC (2021), MIT Election and Data Science Lab (2017, 2022), Dong, Du, and Gardner (2020), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020; 2022a; 2022b), Whitaker (2020), National Association of State Budget Officers (2021), Vincent and Hanson (2020), the US Bureau of Economic Analysis (2022), US Department of Health and Human Services (2021), US Centers for Medicare and Medicaid Services (2019), Kaiser Family Foundation (2019), IQVIA (2019), and Dartmouth (2019).

Table 2: Falsification Checks

	Vaccination Falsification Checks			Testing Falsification Checks		
	Average Adult Flu Vaccine Rate, 2010-2019 (%)	Adult H1N1 Vaccine Rate, 2009-2010 (%)	Childhood 7-Sequence Vaccine Rate, 2011-2018 (%)	Diabetic Eye Test Rate, 2019 (%)	Diabetic HGB Test Rate, 2019 (%)	Biennial Mammogram Rate, 2019 (%)
	(1)	(2)	(3)	(4)	(5)	(6)
Reps per million	-1.529 (1.73)	0.443 (1.56)	-0.808 (1.91)	-0.0157 (.02)	-0.0251* (.01)	-0.0246 (.02)
Log(Population)	-2.690** (1.10)	-1.998* (1.09)	-0.912 (1.29)	-0.0241* (.01)	-0.00854 (.01)	-0.0124 (.01)
Change in real GDP per capita (‘18-‘19)	1.86E-05 (.00)	-0.000295 (.00)	-0.00139** (.00)	-2.98e-07 (.00)	-1.22e-05** (.00)	-2.27e-05*** (.00)
Trump vote share	-4.923 (7.35)	-23.32** (9.30)	-11.38 (9.76)	-0.209** (.09)	-0.0162 (.06)	-0.117 (.11)
New COVID-19 deaths per 100K, February 2022	0.0307 (.14)	-0.000784 (.10)	0.136 (.13)	0.00084 (.00)	1.77E-05 (.00)	0.00127 (.00)
Total COVID-19 deaths per 100K, February 2022	-0.0112 (.01)	-0.0334*** (.01)	-0.0226** (.01)	-5.64E-05 (.00)	-0.000109 (.00)	-0.000168 (.00)
New COVID-19 cases per 100K, February 2022	-0.000947 (.00)	-0.000693 (.00)	-0.00221 (.00)	-2.15E-05 (.00)	-9.45E-06 (.00)	-2.24E-05 (.00)
Total COVID-19 cases per 100K, February 2022	-7.68E-05 (.00)	0.000401* (.00)	0.00035 (.00)	3.42E-06 (.00)	2.08E-06 (.00)	6.57e-06** (.00)
Observations	50	50	50	50	50	50
R^2	0.31	0.6	0.24	0.31	0.27	0.36

Note: This table 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), Lewis et al. (2021), US Bureau of Labor Statistics (2022a), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Dong, Du, and Gardner (2020), Whitaker (2020), National Association of State Budget Officers (2021), Vincent and Hanson (2020), the US Bureau of Economic Analysis (2022), CDC (2022a, 2022b), and Dartmouth (2019) to estimate an equation of the following form:

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

where Y_s is average adult flu vaccine rate, adult H1N1 vaccine rate, childhood 7-sequence vaccination rate, diabetic eye test rate, diabetic HBG test rate, or biennial mammogram rate in state s. Y_s is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020 and a set of additional covariates, as in equation (2a) in the text. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state.
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Vaccinations and Testing Impact of COVID-19 Relief Aid (March 2022)

	Total Vaccinations Administered per 100K				Total Tests Administered per 100K			
	OLS	First Stage	IV Second Stage		OLS	First Stage	IV Second Stage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total Aid per Resident (USD thousands)	3,027		1,166	-995.8	81,028***		55,850**	57,722***
	(4,228)		(2,989)	(3,742)	(22,319)		(22,263)	(22,279)
Reps per million		1.217***				1.224***		
		(0.117)				(0.121)		
Log(Population)	-2,960	0.195***	-3,498	-4,303	11,426	0.202***	3,898	-8,013
	(2,599)	(0.0640)	(2,701)	(2,949)	(15,965)	(0.0692)	(15,903)	(11,611)
Trump vote share	-206,547***	-2.638***	-212,628***	-192,179***	-1.069e+06***	-2.645***	-1.15e+06***	-737,291***
	(24,636)	(0.489)	(21,574)	(29,769)	(215,991)	(0.496)	(216,966)	(226,934)
Change in Real GDP per Capita (2018 – 2019)	0.632	9.80e-05*	0.902	4.490	-24.31	9.17e-05	-20.33	-32.81
	(2.326)	(5.40e-05)	(2.142)	(3.624)	(14.93)	(5.85e-05)	(14.82)	(25.29)
New COVID-19 deaths per 100K, previous month	107.7	-0.0225**	31.03	378.7	-141.0	-0.0225**	-1,145	985.8
	(546.6)	(0.00863)	(534.9)	(533.7)	(2,209)	(0.00889)	(2,064)	(2,171)
Total COVID-19 deaths per 100K, previous month	-19.57	0.00466***	-9.556	-17.21	-205.3	0.00469***	-78.41	-153.7
	(48.46)	(0.00103)	(45.27)	(43.51)	(309.8)	(0.00113)	(317.6)	(286.7)
New COVID-19 cases per 100K, previous month	-2.690	5.59e-05	-2.125	-4.496	-6.225	5.66e-05	0.650	23.53
	(5.025)	(6.77e-05)	(4.470)	(4.842)	(21.91)	(7.11e-05)	(19.22)	(20.04)
Total COVID-19 cases per 100K, previous month	0.723	-1.81e-05	0.703	0.496	22.58***	-1.70e-05	22.34***	18.13***
	(0.752)	(1.47e-05)	(0.682)	(0.582)	(3.598)	(1.73e-05)	(3.133)	(3.517)
Robustness controls	N	N	N	Y	N	N	N	Y
Dep. Var Mean	164,741	2.83	164,741	165,521	267,034	2.85	267,034	270,056
Observations	50	50	50	48	48	48	48	46
R^2	0.775	0.815	0.774	0.835	0.792	0.813	0.787	0.848

First-Stage F-Statistic	N/A	N/A	108.78	84.05	N/A	N/A	102.44	75.18

Note: The table 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), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Google LLC (2021), US Bureau of Labor Statistics (2022b), and Hale et al. (2021) to estimate the following equations for March 2022:

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

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid}_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \tag{2b}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month m of year y scaled per 100,000 people residing in state s. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 1 and 5 present OLS results of equation (2b), which corresponds to equation (1) in the main text; Columns 2 and 6 present the first-stage results of equation (2a); Columns 3 and 7 present baseline second-stage results of equation (2b); Columns 4 and 8 present equation (2b) with added robustness controls. Robustness controls include the share of a state's population living in a town eligible for financing through the MLF, the change in state and local and private employment per capita (QCEW) between December 2018 and December 2019, the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index, and the change in retail mobility in the previous month relative to pre-pandemic baseline.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: COVID-19 Relief Aid and Vaccine Disparities (March 2022)

	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	$200,000+ minus <$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Aid per Capita (USD thousands)	-4.452*	-0.962	1.478	-0.941	-5.351***	-1.949	-7.246*
	(2.419)	(2.607)	(3.204)	(2.432)	(2.017)	(1.224)	(3.886)
Log(Population)	-2.687*	-2.215	-1.695	0.168	-2.571***	-2.327***	-3.059
	(1.447)	(1.659)	(1.230)	(1.211)	(0.856)	(0.590)	(2.645)
Share of 2020 votes cast for Donald Trump	-28.00	-5.311	-49.58***	20.90	-1.985	25.84***	29.68
	(17.19)	(31.25)	(18.53)	(15.62)	(12.09)	(6.853)	(29.88)
Change in Real GDP per Capita (2018 – 2019)	0.00211	0.000948	-0.000359	-0.00149	0.00109	0.000321	0.000915
	(0.00133)	(0.00206)	(0.00091)	(0.00124)	(0.00080)	(0.00084)	(0.00241)
New COVID-19 deaths per 100K, previous month	-0.620***	-0.577	0.416	0.245	-0.0767	0.0164	-0.364
	(0.235)	(0.376)	(0.308)	(0.228)	(0.168)	(0.126)	(0.373)
Total COVID-19 deaths per 100K, previous month	0.0659**	0.0286	-0.0307	-0.0277	0.0127	0.0241*	0.0690*
	(0.0280)	(0.0245)	(0.0261)	(0.0205)	(0.0196)	(0.0123)	(0.0391)
New COVID-19 cases per 100K, previous month	0.00538	0.00105	-0.00263	-0.00136	0.00168	0.000230	0.00303
	(0.00333)	(0.00273)	(0.00297)	(0.00201)	(0.00159)	(0.00106)	(0.00371)
Total COVID-19 cases per 100K, previous month	-0.000316	-0.000296	0.00109***	-0.000473	0.000153	-0.000114	-0.000631
	(0.00044)	(0.00058)	(0.00029)	(0.00037)	(0.00026)	(0.00016)	(0.00073)
Dep. Var Mean	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	50	50	50	50	50	50
R^2	0.180	0.105	0.273	0.268	0.307	0.714	0.274
First-Stage F- Statistic	108.77	108.77	108.77	108.77	108.77	108.77	108.77

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$V_{s,m,y} - W_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \quad (2b)$$

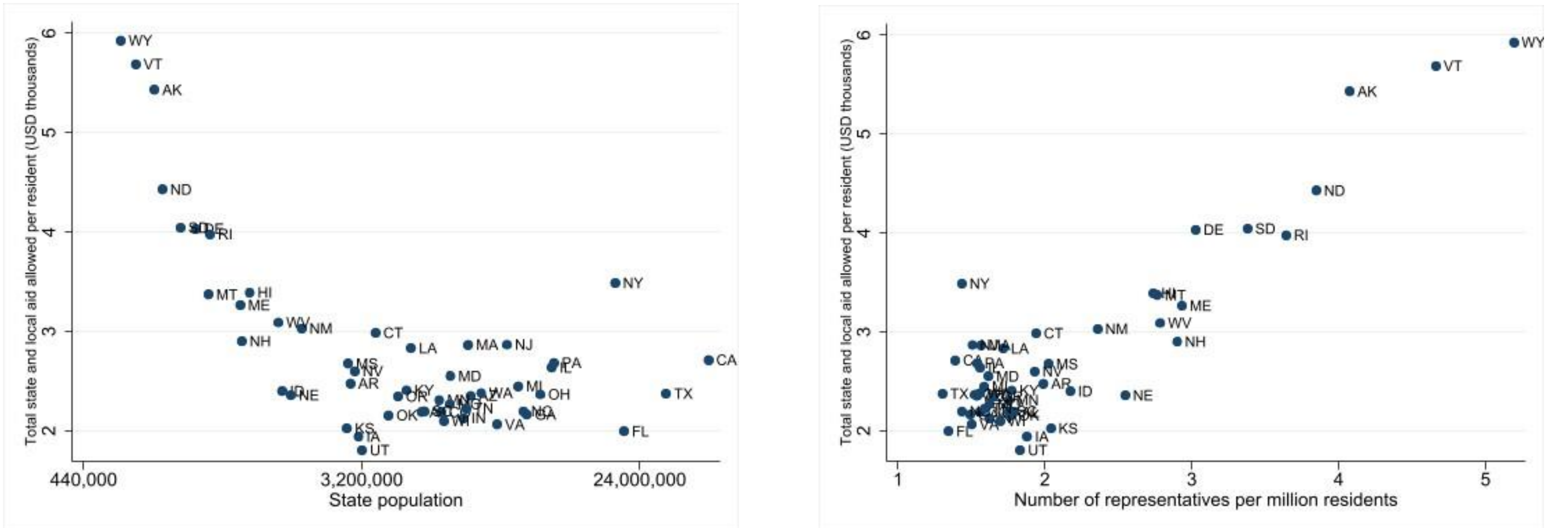
where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ and $W_{s,m,y}$ are the vaccination rates for high-socioeconomic status and low-socioeconomic status groups for a given category, respectively, in state s. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 1 through 3 present the vaccination gaps between white Americans and Black, Hispanic, and Asian Americans; Column 4 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 5 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 6 and 7 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24).

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

Appendix Figure 1: Distribution of COVID-19 Relief Funds per Resident

Panel A: Federal Funding and State Population

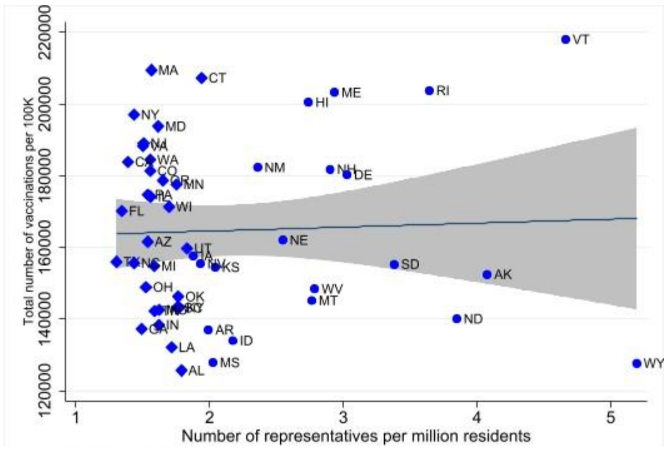
Panel B: Federal Funding and Congressional Representation per State Resident



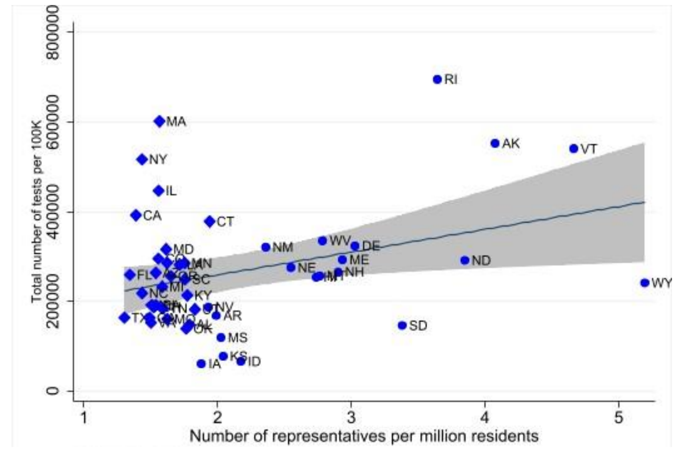
Note: Note: Panel A shows the relationship between state population and federal funds per state resident. Population is presented on a log scale. Panel B shows the relationship between representation per state resident and federal funds per state resident. Federal funding is the sum of state and local fiscal assistance across the CARES Act, Families First Act, Recovery and Relief Act, and American Rescue Plan Act. 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). We note that this figure presents the same data as Appendix Figure A3 of Clemens and Veuger (2021); relative to the earlier figure, the only modifications are to formatting.

Appendix Figure 2: Distribution of COVID-19 Relief Funds per Resident

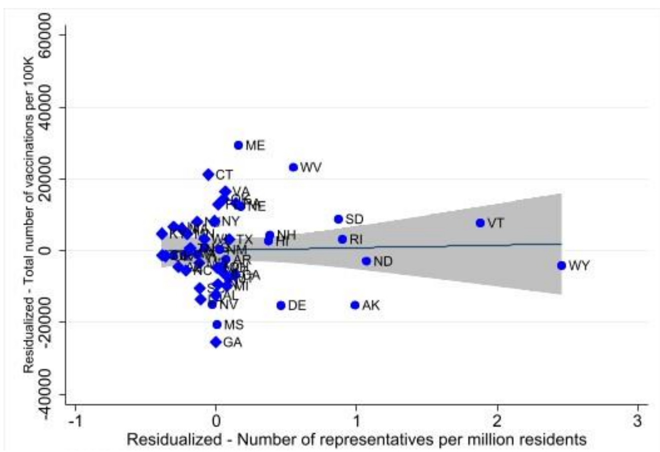
Panel A: Vacc. per 100K vs Cong. Representation (March 2022)



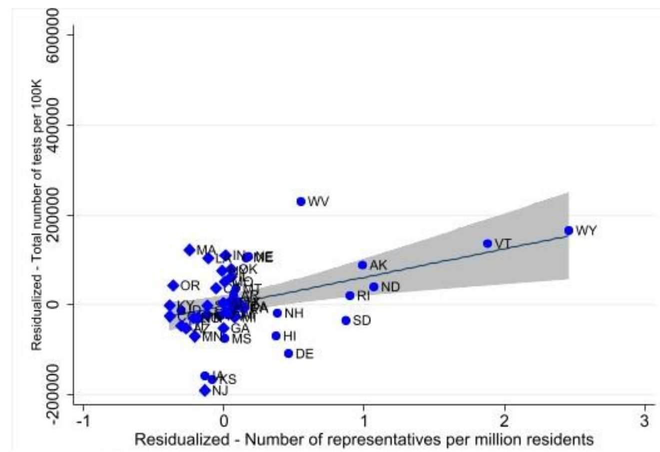
Panel B: Tests per 100K vs Congressional Representation (March 2022)



Panel C: Residualized Vaccinations per 100K vs Congressional Representation (March 2022)



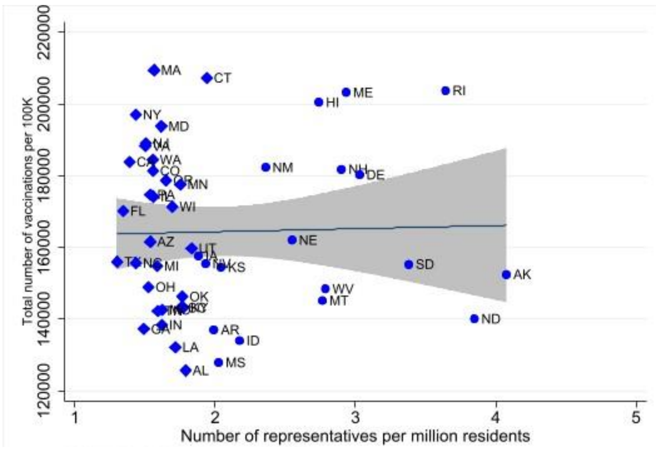
Panel D: Residualized Tests per 100K vs Congressional Representation (March 2022)



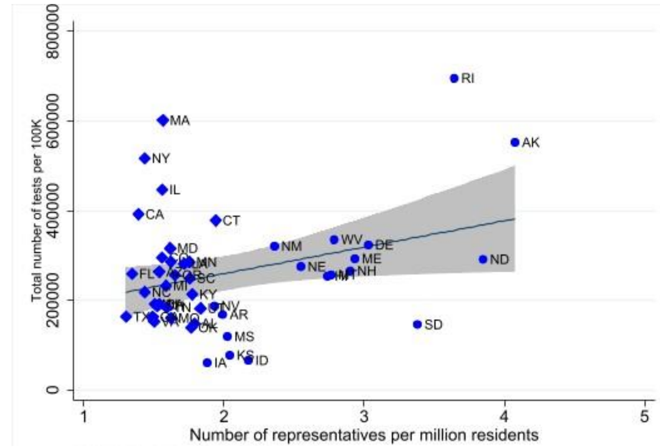
Note: Panels A and B plot congressional representation against total vaccinations and tests per 100,000 residents. Panels C and D regresses the remaining variation in representation, vaccines, and tests after controlling for our baseline variables excluding the instrument, mirroring the results in Table 3 Columns 3 and 7. 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). The slope coefficients for displayed regressions are 1,097 in Panel A, 50,687 in Panel B, 712 in Panel C, and 63,241 in Panel D.

Appendix Figure 3: Distribution of COVID-19 Relief Funds per Resident – Excluding WY and VT

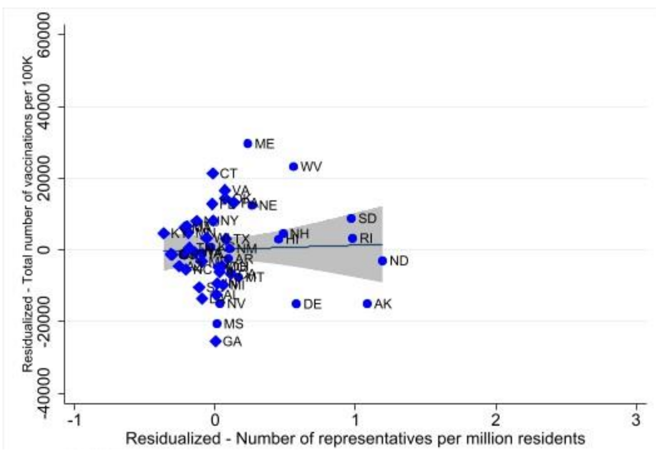
Panel A: Vacc. per 100K vs Cong. Representation (March 2022)



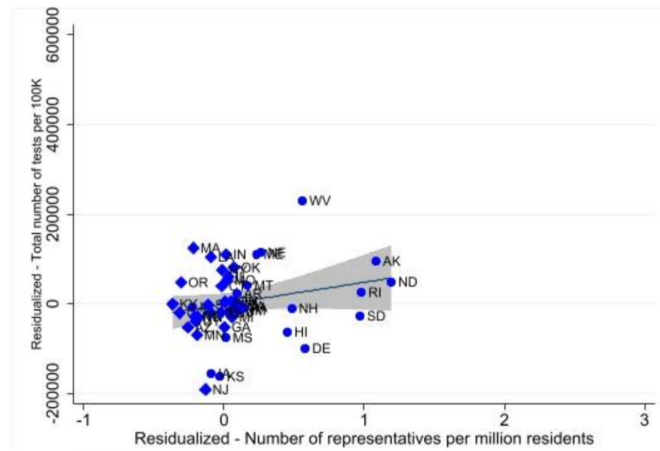
Panel B: Tests per 100K vs Congressional Representation (March 2022)



Panel C: Residualized Vaccinations per 100K vs Congressional Representation (March 2022)



Panel D: Residualized Tests per 100K vs Congressional Representation (March 2022)



Note: Panels A and B plot congressional representation against total vaccinations and tests per 100,000 residents. Panels C and D regresses the remaining variation in representation, vaccines, and tests after controlling for our baseline variables excluding the instrument, mirroring the results in Table 3 Columns 3 and 7. 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). The slope coefficients for displayed regressions are 861 in Panel A, 58,900 in Panel B, 1,281 in Panel C, and 49,019 in Panel D.

Appendix Table 1: Variable Descriptions and Sets of Control Variables

Variable	Description	Source
Total Aid to State and Local Governments per Resident (USD Thousands)	Funds appropriated to each state by Congress in COVID-19 relief bills divided by the 2020 state population, in nominal USD thousands.	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 Department of the Treasury (2021a, 2021b); 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 (2021) ; Lewis et al. (2021)
Total Vaccinations per 100,000	Total number of COVID-19 vaccines administered in the US per 100,000 people in each state.	CDC (2020)
Total Tests Administered per 100,000	Total number of COVID-19 tests administered in the US per 100,000 people in each state.	Johns Hopkins University Centers for Civic Impact (2022), US Census Bureau (2021)
Log of 2020 State Population	The natural logarithm of 2020 state population	US Census Bureau (2021)
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)
Change in Real State GDP per Capita from 2018 to 2019	The arithmetic change in real gross state product per capita from Q4 2018 to Q4 2019, in 2012 US dollars.	US Bureau of Economic Analysis (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 (2020)
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 (2020)
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. Access to the Federal Reserve's MLF has been described as a major contributor to settling municipal bond markets during the coronavirus's initial outbreak (Haughwout, Hyman, and Shachar, 2021).	US Census Bureau (2021); Federal Reserve Board (2021)
Change in State and Local Employment per Capita from Dec 2018 to Dec 2019	The arithmetic difference in state and local government employment between December 2018 and December 2019, divided by the 2020 state population, as measured by the QCEW.	US Bureau of Labor Statistics (2022b); US Census Bureau (2021)
Change in Private Employment per Capita from Dec 2018 to Dec 2019	The arithmetic difference in private employment between December 2018 and 2019, divided by the 2020 state population, as measured by the QCEW.	US Bureau of Labor Statistics (2022b); US Census Bureau (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. This variable ranges from 0 (no restrictions) to 100 (the highest possible level of restrictions across all eight dimensions). In all regressions, OSI is rescaled by dividing by 100 so that it ranges from 0 to 1.	Hale et al. (2021)
Contemporaneous Oxford Stringency Index Level	The monthly average level of a state's Oxford Stringency Index, divided by 100.	Hale et al. (2021)
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 (2021)
White Minus Black Vaccination Rate (%)	Percentage of white survey respondents minus the percentage of Black respondents with at least one vaccination, as surveyed by the US Census Bureau.	US Census Bureau (2022)
White Minus Hispanic Vaccination Rate (%)	Percentage of white survey respondents minus the percentage of Hispanic respondents with at least one vaccination, as surveyed by the US Census Bureau.	US Census Bureau (2022)
White Minus Asian Vaccination Rate (March 2022)	Percentage of white survey respondents minus the percentage of Asian respondents with at least one vaccination, as surveyed by the US Census Bureau.	US Census Bureau (2022)
$200,000+ minus <$25,000 Household Income Vaccination Rate (March 2022)	Percentage of survey respondents with a household income of $200,000 or greater minus the percentage of respondents with a household income less than $25,000 with at least one vaccination, as surveyed by the US Census Bureau.	US Census Bureau (2022)
College Degree minus High School Degree Vaccination Rate (March 2022)	Percentage of survey respondents with a college degree or greater minus the percentage of respondents with only a high school degree with at least one vaccination, as measured by the US Census Bureau.	US Census Bureau (2022)
Aged 65+ minus 40-54 Vaccination Rate (March 2022)	Percentage of respondents aged 65 or older minus the percentage of respondents aged 40 through 54 with at least one vaccination, as measured by the US Census Bureau.	US Census Bureau (2022)
Aged 65+ minus 18-24 Vaccination Rate (March 2022)	Percentage of respondents aged 65 or older minus the percentage of respondents aged 18 through 24 with at least one vaccination, as measured by the US Census Bureau.	US Census Bureau (2022)
Percentage of population fully vaccinated (March 2022)	Percentage of US population that has received at least two doses of a Pfizer/Moderna COVID-19 vaccine or one dose of the Johnson and Johnson vaccine.	CDC (2020)
Tax Shortfall per Capita	Federal Reserve Bank of Cleveland estimates of state and local revenue shortfalls due to the pandemic, divided by 2020 state population.	Whitaker (2020); US Census Bureau (2021)

Average Q4 2020 Unemployment per Capita	Average number of unemployed persons during Q4 2020, divided by the 2020 state population.	US Bureau of Labor Statistics (2022a); US Census Bureau (2021)
Percent Change in Personal Income Q4 2019 to Q4 2020	Percent change in real personal income per capita from Q4 2019 to Q4 2020.	US Bureau of Economic Analysis (2022)
Total State and Local Spending per Capita	Total state and local government expenditures divided by 2020 state population.	National Association of State Budget Officers (2021); US Census Bureau (2021)
Acres of Federal Land per Capita	Acres of federally-owned land, divided by 2020 state population.	Vincent and Hanson (2020)
Log Population Density	2020 state population divided by land area (in square miles).	Vincent and Hanson (2020); US Census Bureau (2021)
Average Adult Flu Vaccine Rate, 2010-2019 (%)	Average percentage of adults 18 and older receiving the annual flu vaccine between 2010 and 2019.	CDC (2022a)
Adult H1N1 Vaccine Rate, 2009-2010 (%)	Percentage of adults 18 and older that received the H1N1 vaccine between 2009 and 2010.	CDC (2022a)
Childhood 7-Sequence Vaccine Rate, 2011-2018 (%)	Average share of children aged 0 to 35 months with the complete 7 vaccine sequence from 2011 through 2018.	CDC (2022b)
Diabetic Eye Test Rate, 2019 (%)	Percent of diabetic Medicare enrollees who received an eye exam in 2019.	Dartmouth (2019)
Diabetic HGB Test Rate, 2019 (%)	Percent of diabetic Medicare enrollees who received a HbA1c test in 2019.	Dartmouth (2019)
Biennial Mammogram Rate, 2019 (%)	Percent of female Medicare enrollees age 67-69 that have at least one mammogram every two years, as of 2019.	Dartmouth (2019)
Pharmacies per million (2019)	The number of pharmacies in a state per million residents.	IQVIA (2019)
Pharmacists per million (2019)	The number of pharmacies in a state per million residents	US Bureau of Labor Statistics (2022a)
Drugs filled at pharmacies per capita (2019)	The number of retail prescriptions filled at pharmacies per capita in 2019	Kaiser Family Foundation (2019)
Annual ride days per resident (2019)	Number of NEMT rides in 2019 divide by state population	US Department of Health and Human Services (2021)
NEMT expenditure per resident (2019)	Total NEMT expenditures in 2019 divided by state population	US Department of Health and Human Services (2021)
Percent of residents using NEMT (2019)	Percentage of residents that used NEMT at least once in 2019	US Department of Health and Human Services (2021)
Percent of residents using preventative NEMT (2019)	Percentage of residents that used NEMT at least once in 2019 for preventative services	US Department of Health and Human Services (2021)
Total Medicaid spending per resident (2019)	Total Medicaid spending in 2019 divided by state population	US Centers for Medicare and Medicaid Services (2019)

Appendix Table 2: Vaccinations and Testing Impact of COVID-19 Relief Aid (March 2022), Unweighted

	Total Vaccinations Administered per 100K				Total Tests Administered per 100K			
	OLS	First Stage	Baseline	Robust	OLS	First Stage	Baseline	Robust
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total Aid per Resident (USD thousands)	-326.6		1,247	-1,539	61,621***		63,376***	44,402***
	(1,993)		(1,872)	(2,446)	(13,559)		(10,909)	(14,053)
Reps per million		1.363***				1.364***		
		(0.0687)				(0.0686)		
Robustness controls	N	N	N	Y	N	N	N	Y
Dep. Var Mean	164,741	2.83	164,741	165,521	267,034	2.85	267,034	270,056
Observations	50	50	50	48	48	48	48	46
R^2	0.817	0.914	0.816	0.869	0.754	0.913	0.754	0.808
First-Stage F-Statistic	N/A	N/A	393.77	241.14	N/A	N/A	394.88	213.84

Note: The table 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), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Google LLC (2021), US Bureau of Labor Statistics (2022b), and Hale et al. (2021) to estimate the following equations for March 2022:

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

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid}_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \quad (2b)$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month m of year y scaled per 100,000 people residing in state s. Included in all columns is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are *not* weighted by state population and standard errors (in parentheses) are clustered by state. Columns 1 and 5 present OLS results of equation (2b), which corresponds to equation (1) in the main text; Columns 2 and 6 present the first-stage results of equation (2a); Columns 3 and 7 present baseline second-stage results of equation (2b); Columns 4 and 8 present equation (2b) with added robustness controls. Robustness controls include the share of a state's population living in a town 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, and the change in retail mobility in the previous month relative to pre-pandemic baseline.

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

Appendix Table 3: Estimates of the Relationship Between Total State and Local Funds per Resident and Congressional Representation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Representatives and Senators per Million Residents	1,334***	995.1***	1,105***	1,367***	902.0***	1,286***	1,417***	1,366***	1,332***	1,149***
	(114.8)	(181.3)	(134.7)	(137.3)	(159.3)	(116.7)	(138.1)	(89.19)	(94.05)	(117.9)
Log(Population)	419.5***	262.0***	165.1	443.6***	153.5	411.2***	366.8***	390.5***	375.0***	206.8***
	(91.99)	(96.93)	(101.9)	(116.0)	(107.9)	(92.96)	(68.11)	(53.29)	(54.04)	(64.42)
Tax Shortfall per Capita		0.853**								-0.345
		(0.356)								(0.267)
Average Q4 2020 Unemployment per Capita			37,186***							19,992***
			(10,768)							(6,202)
Percent Change in Personal Income Q4 2019 to Q4 2020				-42.48						-18.40
				(50.56)						(19.32)
Total State and Local Spending per Capita					0.104***					0.0494
					(0.0257)					(0.0330)
Acres of Federal Land per Capita						2.574***				2.153*
						(0.751)				(1.222)
Log Population Density							166.6**			8.691
							(67.34)			(46.35)
Total COVID Cases per 100K (March 2020)								3.063***		2.645**
								(0.243)		(1.027)
Total COVID Deaths per 100K (March 2020)									79.62***	-19.92
									(6.348)	(29.12)
Observations	50	50	50	50	50	50	50	50	50	50
R^2	0.496	0.635	0.709	0.518	0.758	0.501	0.572	0.838	0.797	0.916
First-Stage F-Statistic	135.18	30.14	67.20	99.24	32.07	121.31	105.31	234.71	200.44	95.04

Note: This table 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), Lewis et al. (2021), US Bureau of Labor Statistics (2022a), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Dong, Du, and Gardner (2020), Whitaker (2020), National Association of State Budget Officers (2021), Vincent and Hanson (2020), and the US Bureau of Economic Analysis (2022) to estimate an equation of the following form for March 2022:

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

where $TotalAid_s$ is the total federal aid per resident to state and local governments (USD) in state s pooled across all four bills. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020, according to equation (2a) in the text. 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 in the fourth quarter of 2020 per capita, the percent change in personal income between the fourth quarter of 2019 and the fourth quarter of 2020, the total direct expenditures of state and local governments per capita in 2019, the acres of federal lands per capita, the log of population density for state s, and the cumulative number of COVID-19 cases and deaths per 100,000 people through March 2020. This table largely mirrors Appendix Table 2 from Clemens, Hoxie, and Veuger (2022). Observations are weighted by state population and standard errors (in parentheses) are clustered by state.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4: Pharmacy Access Falsification Checks

	Pharmacies per million (2019)	Pharmacists per million (2019)	Drugs filled at pharmacies per capita (2019)
	(1)	(2)	(3)
Reps per million	21.72	-18.15	-0.678
	(19.46)	(55.64)	(1.009)
Log(Population)	7.836	-62.57*	-0.617
	(13.70)	(31.98)	(0.573)
Change in real GDP per capita ('18-'19)	-0.0159	-0.0356	-0.000512
	(0.0114)	(0.0283)	(0.000396)
Trump vote share	56.70	-130.4	2.912
	(115.6)	(289.2)	(3.975)
New COVID-19 deaths per 100K,	-0.994	-9.882**	-0.0523
February 2022	(1.461)	(4.508)	(0.0767)
Total COVID-19 deaths per 100K,	0.495**	1.130**	0.0212**
February 2022	(0.200)	(0.440)	(0.00831)
New COVID-19 cases per 100K,	0.00916	0.0485	0.000552
February 2022	(0.0155)	(0.0421)	(0.000937)
Total COVID-19 cases per 100K,	-0.000860	0.00391	-8.08e-06
February 2022	(0.00226)	(0.00830)	(8.11e-05)
Observations	50	50	50
R-squared	0.51	0.44	0.58
First-stage F-statistics	7.15	7.00	9.95

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2019, 2021), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), US Bureau of Labor Statistics (2019, 2022a), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Dong, Du, and Gardner (2020), Whitaker (2020), National Association of State Budget Officers (2021), Vincent and Hanson (2020), the US Bureau of Economic Analysis (2022), IQVIA (2019), and Kaiser Family Foundation (2019) to estimate an equation of the following form:

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

where Y_s is the number of pharmacies per million in 2019, number of pharmacists per million in 2019, or number of retail prescription drugs filled at pharmacies per capita in 2019 in state s. Y_s is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020 and a set of additional covariates, as in equation (2a) in the text. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5: Vaccinations Impact of COVID-19 Relief Aid (March 2022)

	Percentage of Population Fully Vaccinated (%)			
	OLS	First Stage	Baseline	Robust
	(1)	(2)	(3)	(4)
Total Aid per Resident (USD thousands)	1.260		0.669	-0.558
	(1.584)		(1.167)	(1.432)
Reps per million		1.217***		
		(0.117)		
Log(Population)	-0.949	0.195***	-1.120	-1.691
	(0.969)	(0.0640)	(1.025)	(1.126)
Trump vote share (%)	-73.79***	-2.638***	-75.72***	-68.43***
	(9.083)	(0.489)	(7.920)	(10.88)
Change in Real GDP per Capita (2018 – 2019	0.000124	9.80e-05*	0.000210	0.00131
	(0.000837)	(5.40e-05)	(0.000786)	(0.00132)
New COVID-19 deaths per 100K, previous month	-0.0103	-0.0225**	-0.0346	0.103
	(0.214)	(0.00863)	(0.208)	(0.206)
Total COVID-19 deaths per 100K, previous month	-0.00580	0.00466***	-0.00262	-0.00488
	(0.0199)	(0.00103)	(0.0185)	(0.0181)
New COVID-19 cases per 100K, previous month	-0.000834	5.59e-05	-0.000655	-0.00138
	(0.00197)	(6.77e-05)	(0.00175)	(0.00189)
Total COVID-19 cases per 100K, previous month	0.000242	-1.81e-05	0.000236	0.000133
	(0.000286)	(1.47e-05)	(0.000260)	(0.000225)
Robustness controls	N	N	N	Y
Dep. Var. Mean	64.03	2.83	64.03	64.33
Observations	50	50	50	48
R^2	0.770	0.815	0.770	0.826
First-Stage F-Statistic	N/A	N/A	108.78	84.05

Note: The table 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), Lewis et al. (2021), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Google LLC (2021), US Bureau of Labor Statistics (2022b), and Hale et al. (2021) to estimate the following equations for March 2022:

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

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \quad (2b)$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is the percentage of the population in state s that is fully vaccinated (two doses of Pfizer or Moderna, or one dose of Janssen). Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state.

Column 1 presents OLS results of equation (2a), which corresponds to equation (1) in the main text; Column 2 presents the first-stage results of equation (2a); Column 3 presents baseline second-stage results of equation (2b); Column 4 presents equation (2b) with added robustness controls. Robustness controls include the share of a state's population living in a town 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, and the change in retail mobility in the previous month relative to pre-pandemic baseline.

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

Appendix Table 6: Estimates of the Relationship Between State and Local Funds per Resident and Congressional Representation by Aid Category

	Total Aid per Resident	General Aid per Resident	Education Aid per Resident	Transit Aid per Resident
	(1)	(2)	(3)	(4)
Reps per million	1.217***	1.063***	0.181***	-0.0271
	(0.117)	(0.0723)	(0.0371)	(0.0633)
Log(Population)	0.195***	0.148***	0.104***	-0.0569
	(0.0640)	(0.0408)	(0.0257)	(0.0402)
Change in real GDP per capita ('18-'19)	9.80e-05*	5.22e-05*	4.65e-06	4.12e-05
	(5.40e-05)	(2.73e-05)	(2.02e-05)	(3.11e-05)
Trump vote share	-2.638***	-1.358***	0.171	-1.451***
	(0.489)	(0.341)	(0.183)	(0.328)
New COVID-19 deaths per 100K, previous month	-0.0225**	-0.00931**	-0.00365	-0.00955*
	(0.00863)	(0.00409)	(0.00325)	(0.00568)
Total COVID-19 deaths per 100K, previous month	0.00466***	0.00180***	0.00143***	0.00144**
	(0.00103)	(0.000459)	(0.000338)	(0.000661)
New COVID-19 cases per 100K, previous month	5.59e-05	2.16e-05	6.58e-05*	-3.15e-05
	(6.77e-05)	(3.41e-05)	(3.28e-05)	(4.25e-05)
Total COVID-19 cases per 100K, previous month	-1.81e-05	-1.32e-05	-8.92e-06*	3.94e-06
	(1.47e-05)	(9.23e-06)	(5.24e-06)	(6.30e-06)
Constant	-2.050*	-1.887**	-1.684***	1.521**
	(1.222)	(0.788)	(0.484)	(0.727)
Observations	50	50	50	50
R^2	0.815	0.882	0.560	0.655
First-Stage F-Statistic	108.77	216.25	23.87	0.18

Note: This table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2019, 2021), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), US Bureau of Labor Statistics (2019, 2022a), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Dong, Du, and Gardner (2020), Whitaker (2020), National Association of State Budget Officers (2021), Vincent and Hanson (2020), the US Bureau of Economic Analysis (2022), IQVIA (2019), and Kaiser Family Foundation (2019) to estimate an equation of the following form for March 2022:

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

where $\frac{TotalAid_{s,t}}{Pop_{s,y_{2020}}}$ is the total federal aid per resident in thousands of USD of funding category *t* for state *s*. We present estimates for four funding categories. Column 1 reports the total amount of federal aid, Columns 2 through 4 report estimates for the three broad categories of funds as described in Clemens and Veuger (2021). Column 2 present estimates for general aid to states and local governments, which includes Medicaid funds and election grants, Column 3 reports estimates for education funds, and Column 4 reports estimates for transit funds. $\frac{TotalAid_{s,t}}{Pop_{s,y_{2020}}}$ is regressed on $RepsPerMillion_s$, the number of Representatives and Senators per million residents in 2020 and a set of additional covariates, as in equation (2a) in the text. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new

COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 7: Impact of COVID-19 Relief Aid – Small State Indicator (March 2022)

	Total Vaccinations Administered per 100K	Total Tests Administered per 100K	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	$200,000+ minus <$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Aid per Resident	6,679	86,158***	-1.834	1.664	3.502	-4.270**	-1.412	1.467	-3.827
(USD thousands)	(4,337)	(18,055)	(2.182)	(2.893)	(3.910)	(1.998)	(1.539)	(1.359)	(4.623)
=1 if 'small state'	234.5	-59,217**	2.810	1.555	1.168	4.972*	0.355	0.566	2.486
	(4,313)	(24,043)	(3.362)	(3.620)	(4.775)	(2.714)	(1.624)	(2.334)	(6.310)
Share of 2020 votes cast	-189,418***	-1.06e+06***	-15.24	6.678	-40.36*	10.19	14.72	40.49***	45.58
for Donald Trump	(29,761)	(145,268)	(13.02)	(28.50)	(20.60)	(14.27)	(11.33)	(9.056)	(31.13)
Change Real GDP per	-0.967	-21.00**	0.000811	-0.000162	-0.00121	-0.00114	-0.000278	-0.000901	-0.000602
Capita (2018 – 2019)	(1.903)	(10.61)	(0.000923)	(0.00203)	(0.000761)	(0.00119)	(0.000878)	(0.000784)	(0.00209)
New COVID-19 deaths per	263.7	-228.2	-0.493*	-0.457	0.508	0.137	0.0907	0.163	-0.205
100K, previous month	(496.9)	(2,093)	(0.260)	(0.403)	(0.342)	(0.243)	(0.182)	(0.145)	(0.389)
Total COVID-19 deaths	-46.69	-192.2	0.0440*	0.00861	-0.0461	-0.0133	-0.0141	0.000426	0.0423
per 100K, previous month	(39.41)	(253.3)	(0.0238)	(0.0270)	(0.0287)	(0.0228)	(0.0182)	(0.0115)	(0.0346)
New COVID-19 cases per	-3.650	3.743	0.00413	4.06e-05	-0.00340	-0.00144	0.000550	-0.000797	0.00162
100K, previous month	(4.870)	(19.61)	(0.00320)	(0.00246)	(0.00284)	(0.00221)	(0.00162)	(0.00114)	(0.00366)
Total COVID-19 cases per	0.789	22.00***	-0.000242	-0.000237	0.00114***	-0.000461	0.000217	-5.54e-05	-0.000548
100K, previous month	(0.669)	(3.198)	(0.000430)	(0.000624)	(0.000306)	(0.000374)	(0.000284)	(0.000174)	(0.000767)
Dep. Var. Mean	164,741	267,034	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	48	50	50	50	50	50	50	50
R^2	0.767	0.805	0.142	0.096	0.260	0.295	0.289	0.669	0.247
First-Stage F-Statistic	75.00	76.52	75.00	75.00	75.00	75.00	75.00	75.00	75.00

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), CDC (2020), Johns Hopkins University Centers for Civic Impact (2022), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid}_s}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}, \tag{2b}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is either the cumulative number of COVID-19 vaccines (Column 1) or tests administered (Column 2) up to month m of year y scaled per 100,000 people residing in state s or the vaccination rate gap between high and low socioeconomic status groups (Columns 3 through 9) in percentage points, as noted by the column headings. Included is a set of state-level controls $X_{s,m,y}$. This includes an indicator for if state *s* is considered a 'small state,' the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 3 through 5 present the vaccination gaps between white Americans and Black, Hispanic, and Asian Americans; Column 6 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 7 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 8 and 9 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24).

*** p<0.01, ** p<0.05, * p<0

Appendix Table 8: Impact of COVID-19 Relief Aid – Drop Most- & Least-Represented States (March 2022)

	Total Vaccinations Administered per 100K (March 2022)	Total Tests Administered per 100K (March 2022)	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	\$200,000+ minus <\$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Drop 3 Most- & Least-Represented States									
Total Aid per Resident (USD thousands)	9,433	87,887*	-14.86***	3.392	-5.736**	2.363	-4.796**	-3.477*	-3.769
	(6,045)	(49,933)	(3.801)	(4.502)	(2.558)	(3.583)	(2.080)	(1.895)	(7.166)
Dep. Var. Mean	164,290	254,054	2.20	1.04	-10.08	13.85	15.18	11.56	15.53
Observations	44	42	44	44	44	44	44	44	44
R^2	0.826	0.751	0.159	0.150	0.174	0.215	0.339	0.578	0.176
First-Stage F-Statistic	35.71	34.70	35.71	35.71	35.71	35.71	35.71	35.71	35.71
P-value on Test for Pre-Trends	-	0.002	-	-	-	-	-	-	-
Panel B: Drop 5 Most- & Least-Represented States									
Total Aid per Resident (USD thousands)	8,597	48,587	-16.87***	4.251	-11.66**	-0.706	-8.695***	-6.404**	-10.56
	(10,271)	(54,639)	(6.341)	(8.931)	(5.149)	(5.753)	(3.250)	(2.681)	(11.72)
Dep. Var. Mean	163,306	235,491	2.58	0.56	-10.31	13.80	15.24	11.59	15.11
Observations	40	38	40	40	40	40	40	40	40
R^2	0.797	0.607	0.136	0.122	0.185	0.208	0.330	0.573	0.221
First-Stage F-Statistic	22.78	21.60	22.78	22.78	22.78	22.78	22.78	22.78	22.78

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \tag{2b}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is either the cumulative number of COVID-19 vaccines (Column 1) or tests administered (Column 2) up to month m of year y scaled per 100,000 people residing in state s or the vaccination rate gap between high and low socioeconomic status groups (Columns 3 through 9) in percentage points, as noted by the column headings. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 3 through 5 present the vaccination gaps between White Americans and Black, Hispanic, and Asian Americans; Column 6 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 7 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 8 and 9 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24). 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).

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

Appendix Table 9: Impact of COVID-19 Relief Aid – Saturated Specifications (March 2022)

	Total Vaccinations Administered per 100K	Total Tests Administered per 100K	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	$200,000+ minus <$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Aid per Resident (USD thousands)	-2,496	11,436	-4.240	0.244	1.324	-1.072	-3.304*	-0.705	-6.263
	(4,738)	(27,663)	(2.867)	(3.319)	(2.897)	(3.806)	(1.722)	(1.620)	(4.654)
Log(Population)	-870.7	736.8	-4.482***	-0.752	-0.233	0.351	-2.254***	-2.104***	-1.574
	(2,253)	(12,442)	(1.303)	(1.422)	(0.763)	(1.134)	(0.730)	(0.558)	(2.382)
Share of 2020 votes cast for Donald Trump	2.95e+06***	-8.212e+06	-693.7	51.45	1,091	398.1	659.2	-590.1**	-411.6
	(984,421)	(9.387e+06)	(572.4)	(754.3)	(666.4)	(729.1)	(418.8)	(282.0)	(902.2)
Change Real GDP per Capita (2018 – 2019)	4.761	-137.1***	0.00556	0.00894	0.00710	-0.00786	0.00654**	0.00329**	0.00847
	(6.934)	(45.86)	(0.00418)	(0.00794)	(0.00484)	(0.00514)	(0.00264)	(0.00162)	(0.00758)
New COVID-19 deaths per 100K, previous month	3,582	-29,769	6.190*	-2.918	8.493***	10.19***	2.797	3.767**	14.91**
	(5,168)	(66,273)	(3.662)	(5.578)	(2.694)	(3.623)	(3.021)	(1.843)	(7.478)
Total COVID-19 deaths per 100K, previous month	-1,093*	-4,080	0.0242	-0.144	0.717*	0.570	-0.0780	-0.240	-1.168*
	(562.1)	(5,044)	(0.446)	(0.484)	(0.410)	(0.365)	(0.213)	(0.182)	(0.677)
New COVID-19 cases per 100K, previous month	-2.576	319.2	-0.00944	-0.0131	0.0335**	-0.0189	-0.00894	-0.0127*	-0.0331
	(27.88)	(276.4)	(0.0173)	(0.0243)	(0.0165)	(0.0180)	(0.0119)	(0.00681)	(0.0353)
Total COVID-19 cases per 100K, previous month	-22.04	62.82	0.00290	0.0316	-0.0205	-0.0121	-0.0202	0.00374	-0.00896
	(38.60)	(207.2)	(0.0203)	(0.0264)	(0.0150)	(0.0194)	(0.0125)	(0.00834)	(0.0468)
Dep. Var. Mean	164,741	267,034	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	48	50	50	50	50	50	50	50
R^2	0.837	0.847	0.379	0.296	0.687	0.512	0.484	0.825	0.434
First-Stage F-Statistic	78.69	61.35	78.69	78.69	78.69	78.69	78.69	78.69	78.69

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), US Census Bureau (2022), CDC (2020), Johns Hopkins University Centers for Civic Impact (2022), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

$$\frac{TotalAid_s}{Pop_{s,y_{2020}}} = \alpha + \beta_1\ RepsPerMillion_s + \beta_2 X_{s,m,y} + \beta_3 X_{s,m,y}^2 + \beta_4 X_{s,m,y}^3 + \varepsilon_{s,m,y} \quad \text{(3a)}$$

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + \beta_3 X_{s,m,y}^2 + \beta_4 X_{s,m,y}^3 + u_{s,m,y} \quad \text{(3b)}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is either the cumulative number of COVID-19 vaccines (Column 1) or tests administered (Column 2) up to month m of year y scaled per 100,000 people residing in state s or the vaccination rate gap between high and low socioeconomic status groups (Columns 3 through 9) in percentage points, as noted by the column headings. Included is a set of state-level controls $X_{s,m,y}$. This includes This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. $X_{s,m,y}^2\ and\ X_{s,m,y}^3$ denote the squared and cubed terms of the variables contained in $X_{s,m,y}$. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 3 through 5 present the vaccination gaps between White Americans and Black, Hispanic, and Asian Americans; Column 6 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 7 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 8 and 9 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24).

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

Appendix Table 10: Impact of COVID-19 Relief Aid – Simple Specifications (March 2022)

	Total Vaccinations Administered per 100K	Total Tests Administered per 100K	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	$200,000+ minus <$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Log of Population									
Total Aid per Resident	10,739*	121,736***	-0.643	1.201	2.765	-3.297	-4.283***	-3.857**	-8.585**
(USD thousands)	(6,497)	(36,398)	(2.008)	(1.793)	(2.912)	(2.008)	(1.393)	(1.767)	(3.826)
Dep. Var. Mean	164,741	267,035	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	48	50	50	50	50	50	50	50
R^2	0.227	0.432	0.027	0.027	0.065	0.162	0.264	0.391	0.168
First-Stage F-Statistic	135.18	132.63	135.18	135.18	135.18	135.18	135.18	135.18	135.18
Panel B: Log of Population and Trump Vote Share									
Total Aid per Resident	1,871	83,576**	-1.466	0.443	1.403	-2.967	-4.003***	-2.491**	-7.076**
(USD thousands)	(3,516)	(32,563)	(2.085)	(2.005)	(2.980)	(2.347)	(1.510)	(1.169)	(3.412)
Dep. Var. Mean	164,741	267,034	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	48	50	50	50	50	50	50	50
R^2	0.768	0.630	0.027	0.046	0.169	0.166	0.285	0.643	0.225
First-Stage F-Statistic	81.27	74.54	81.27	81.27	81.27	81.27	81.27	81.27	81.27

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}, \quad (2b)$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is either the cumulative number of COVID-19 vaccines (Column 1) or tests administered (Column 2) up to month m of year y scaled per 100,000 people residing in state s or the vaccination rate gap between high and low socioeconomic status groups (Columns 3 through 9) in percentage points, as noted by the column headings. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population (Panel A), plus the share of votes won by Donald Trump in 2020 (in Panel B). Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 3 through 5 present the vaccination gaps between White Americans and Black, Hispanic, and Asian Americans; Column 6 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 7 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 8 and 9 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24).

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

Appendix Table 11: Impact of COVID-19 Relief Aid – Dropping COVID-19 Variables (March 2022)

	Total Vaccinations Administered per 100K	Total Tests Administered per 100K	White minus Black Vaccination Rate (%)	White minus Hispanic Vaccination Rate (%)	White minus Asian Vaccination Rate (%)	$200,000+ minus <$25,000 Household Income Vaccination Rate (%)	College Degree minus High School Degree Vaccination Rate (%)	Aged 65+ minus 40-54 Vaccination Rate (%)	Aged 65+ minus 18-24 Vaccination Rate (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Aid per Resident	1,521	88,994**	-2.142	0.155	1.481	-2.483	-4.455***	-2.392*	-7.015**
(USD thousands)	(3,621)	(35,516)	(2.230)	(2.044)	(2.960)	(2.264)	(1.491)	(1.221)	(3.553)
Log(Population)	-3,251	9,348	-1.590	-1.750	-1.709	-0.649	-2.272***	-1.882***	-1.999
	(2,490)	(21,456)	(1.289)	(1.556)	(1.088)	(1.269)	(0.754)	(0.648)	(2.332)
Share of 2020 votes cast	-206,733***	-787,570***	-17.98	-17.21	-32.02**	6.809	7.391	31.78***	35.17**
for Donald Trump	(18,637)	(238,735)	(11.16)	(16.05)	(13.30)	(14.30)	(8.226)	(5.817)	(17.78)
Change Real GDP per	0.816	-10.10	0.00158	0.000671	-0.000182	-0.00113	0.00105	-0.000230	-0.000144
Capita (2018 – 2019)	(1.878)	(21.56)	(0.00119)	(0.00196)	(0.000777)	(0.00142)	(0.000703)	(0.000894)	(0.00228)
Dep. Var. Mean	164,741	267,034	2.59	1.08	-9.32	13.12	14.95	11.51	14.88
Observations	50	48	50	50	50	50	50	50	50
R^2	0.769	0.635	0.043	0.046	0.169	0.174	0.296	0.647	0.226
First-Stage F-Statistic	82.75	70.28	82.75	82.75	82.75	82.75	82.75	82.75	82.75

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$V_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y} \quad (2b)$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $V_{s,m,y}$ is either the cumulative number of COVID-19 vaccines (Column 1) or tests administered (Column 2) up to month m of year y scaled per 100,000 people residing in state s or the vaccination rate gap between high and low socioeconomic status groups (Columns 3 through 9) in percentage points, as noted by the column headings. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of population, the share of votes won by Donald Trump in 2020, and the change in state real GDP per capita from Q4 2018 to Q4 2019. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 3 through 5 present the vaccination gaps between White Americans and Black, Hispanic, and Asian Americans; Column 6 presents the gap between individuals with a household income over $200,000 and less than $25,000; Column 7 presents the gap between those with a bachelor's degree or higher and those with only a high school diploma; Columns 8 and 9 present the gap between the elderly (65+) and the middle-aged (40-54) and young (18-24).

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

Appendix Table 12: Vaccinations and Testing Impact of COVID-19 Relief Aid, Controlling for Medicaid Spending (March 2022)

	Total Vaccinations Administered per 100K				Total Tests Administered per 100K			
	OLS	First Stage	Baseline	Robust	OLS	First Stage	Baseline	Robust
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total aid per resident (USD thousands)	1,842 (2,650)		781.3 (3,020)	-1,338 (4,070)	56,667** (23,486)		48,223** (21,292)	58,163*** (22,517)
Reps per million		1.169*** (0.113)				1.173*** (0.116)		
Log(Population)	-2,973 (2,662)	0.215*** (0.0622)	-3,230 (2,785)	-5,153* (3,089)	10,819 (16,390)	0.220*** (0.0630)	8,697 (15,723)	-7,080 (12,988)
Trump vote share	-200,333*** (34,099)	-1.478** (0.583)	-202,282*** (29,625)	-204,708*** (30,835)	-944,045*** (228,763)	-1.473** (0.589)	-958,929*** (222,270)	-726,526*** (249,874)
Change in real GDP per capita ('18-'19)	0.640 (2.186)	8.06e-05 (5.14e-05)	0.770 (2.008)	7.348** (3.702)	-24.09 (18.59)	7.32e-05 (5.57e-05)	-22.98 (16.80)	-35.58 (29.35)
New COVID-19 deaths per 100K, previous month	159.4 (562.1)	-0.0114* (0.00627)	130.8 (514.4)	175.7 (493.5)	961.3 (2,475)	-0.0111* (0.00640)	749.6 (2,333)	1,169 (2,414)
Total COVID-19 deaths per 100K, previous month	-27.67 (57.84)	0.00299*** (0.000779)	-24.14 (52.32)	17.73 (46.34)	-388.8 (342.2)	0.00290*** (0.000880)	-364.7 (329.9)	-186.6 (342.7)
New COVID-19 cases per 100K, previous month	-3.267 (5.334)	-4.43e-05 (6.10e-05)	-3.085 (4.649)	-1.323 (5.476)	-19.80 (25.04)	-5.29e-05 (6.41e-05)	-18.71 (22.60)	20.54 (21.25)
Total COVID-19 cases per 100K, previous month	0.778 (0.757)	-9.85e-06 (1.28e-05)	0.777 (0.679)	0.171 (0.539)	23.99*** (4.089)	-7.07e-06 (1.52e-05)	24.01*** (3.658)	18.48*** (3.338)
Total Medicaid spending per resident, 2019 (USD)	2.395 (5.687)	0.000281*** (7.66e-05)	2.755 (5.376)	-7.088 (5.638)	48.19 (29.84)	0.000283*** (7.69e-05)	51.10** (24.18)	6.564 (28.21)
Robustness controls	N	N	N	Y	N	N	N	Y
Dep. var mean	164,741	2.83	164,741	165,521	267,034	2.85	267,034	270,056
Observations	50	50	50	48	48	48	48	46
R^2	0.777	0.873	0.776	0.844	0.814	0.872	0.814	0.849
First-stage F-statistic	N/A	N/A	106.10	78.89	N/A	N/A	101.64	70.55

Note: The table 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), Lewis et al. (2021), Johns Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), US Department of the Treasury (2021a, 2021b), Federal Reserve Board (2021), Google LLC (2021), US Bureau of Labor Statistics (2022b), Hale et al. (2021), and US Centers for Medicare and Medicaid Services (2019) to estimate the following equations for March 2022:

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

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}. \tag{2b}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month m of year y scaled per 100,000 people residing in state s. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 1 and 5 present OLS results of equation (2b), which corresponds to equation (1) in the main text; Columns 2 and 6 present the first-stage results of equation (2a); Columns 3 and 7 present baseline second-stage results of equation (2b); Columns 4 and 8 present equation (2b) with added robustness controls. Robustness controls include the share of a state's population living in a town eligible for financing through the MLF, the change in state and local and private employment per capita (QCEW) between December 2018 and December 2019, the March 2020 and contemporaneous month averages of a state's Oxford Stringency Index, and the change in retail mobility in the previous month relative to pre-pandemic baseline.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 13 Vaccinations and Testing Impact of COVID-19 Relief Aid, NEMT Controls (March 2022)

	Total Vaccines Administered per 100K					Total Tests Administered per 100K				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total aid per resident	1,166	5,663*	1,293	2,753	2,810	55,850**	81,191***	55,676***	68,490***	68,965***
(USD thousands)	(2,989)	(2,970)	(2,990)	(2,843)	(2,746)	(22,263)	(18,564)	(20,653)	(23,009)	(21,945)
Log(Population)	-3,498	78.18	-3,248	-1,982	-2,045	3,898	25,895**	3,463	16,620	15,999
	(2,701)	(2,528)	(2,468)	(2,349)	(2,231)	(15,903)	(12,855)	(12,257)	(17,034)	(16,100)
Trump vote share	-212,628***	-168,197***	-210,830***	-192,365***	-194,001***	-1.150e+06***	-879,850***	-1.154e+06***	-978,881***	-996,597***
	(21,574)	(20,921)	(22,635)	(23,181)	(22,073)	(216,966)	(165,170)	(182,390)	(229,939)	(214,743)
Change in real GDP per	0.902	-1.040	0.832	0.553	0.515	-20.33	-35.39**	-20.22	-23.97	-24.42
capita (‘18-‘19)	(2.142)	(2.044)	(2.119)	(1.987)	(1.939)	(14.82)	(14.07)	(14.42)	(14.72)	(14.96)
New COVID-19 deaths per 100K, previous	31.03	154.3	26.56	127.4	143.3	-1,145	-30.47	-1,139	-226.2	-124.3
month	(534.9)	(463.0)	(537.3)	(486.3)	(498.8)	(2,064)	(2,142)	(2,072)	(2,183)	(2,115)
Total COVID-19 deaths per 100K, previous	-9.556	-46.68	-10.77	-36.01	-34.02	-78.41	-426.1	-75.03	-337.9	-311.3
month	(45.27)	(45.10)	(44.54)	(45.54)	(44.44)	(317.6)	(329.2)	(293.5)	(355.2)	(342.6)
New COVID-19 cases per	-2.125	-2.160	-2.376	-3.262	-3.428	0.650	-11.21	1.241	-12.39	-13.06
100K, previous month	(4.470)	(4.056)	(4.608)	(4.283)	(4.393)	(19.22)	(18.53)	(21.27)	(19.50)	(19.62)
Total COVID-19 cases per	0.703	0.152	0.691	0.526	0.549	22.34***	21.51***	22.35***	21.53***	21.72***
100K, previous month	(0.682)	(0.734)	(0.697)	(0.714)	(0.717)	(3.133)	(2.662)	(3.113)	(2.911)	(2.916)
Annual ride days per		18,946***					115,396**			
resident (2019)		(6,215)					(47,720)			
NEMT expenditure per			44.99					-85.61		
resident (2019)			(143.4)					(1,167)		
Percent of residents				292,287					2.480e+06**	
using NEMT (2019)				(210,881)					(1.176e+06)	
Percent of enrollees					401,156					3.312e+06*
using preventative NEMT (2019)					(309,515)					(1.793e+06)
Dep. var. mean	164,741	164,741	164,741	164,741	164,741	267,034	267,034	267,034	267,034	267,034
Observations	50	50	50	50	50	48	48	48	48	48
R-squared	0.774	0.804	0.774	0.782	0.781	0.787	0.814	0.787	0.805	0.802
First-stage F-statistic	108.78	117.158	158.666	158.256	162.008	102.44	122.012	148.078	158.517	168.002

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2019, 2021), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), Johns

Hopkins University Centers for Civic Impact (2022), CDC (2020), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), US Department of the Treasury (2021a, 2021b), and US Department of Health and Human Services (2021) to estimate the following equations for March 2022:

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

$$\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}. \qquad (2b)$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $\frac{V_{s,m,y}}{(Pop_{s,y_{2020}}/100{,}000)}$ is the cumulative number of COVID-19 vaccines or tests administered up to month m of year y scaled per 100,000 people residing in state s. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. Columns 1 and 6 present OLS results of equation baseline second-stage results of equation (2b); Columns 2 and 7 present equation (2b) with an additional control for annual NEMT ride days per resident in 2019; Columns 3 and 8 present equation (2b) with an additional control for NEMT Expenditure per resident in 2019; Columns 4 and 9 present equation (2) with an additional control for percentage of residents who used NEMT in 2019; Columns 5 and 10 present equation (2b) with an additional control for percentage of residents who used NEMT for preventative services in 2019.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 14: COVID-19 Relief Aid and Detailed Vaccine Disparities

	Black Vaccination Rate (%)	Hispanic Vaccination Rate (%)	Asian Vaccination Rate (%)	<$25,000 Household Income Vaccination Rate (%)	High School Degree Vaccination Rate (%)	40-54 Vaccination Rate (%)	18-24 Vaccination Rate (%)
Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Aid per Capita (USD thousands)	5.157*	1.667	-0.773	0.507	4.645**	0.761	6.058*
	(2.776)	(2.902)	(3.482)	(1.465)	(1.918)	(1.143)	(3.631)
R^2	0.327	0.185	0.220	0.551	0.625	0.771	0.307
	White Vaccination Rate (%)	White Vaccination Rate (%)	White Vaccination Rate (%)	$200,000+ Household Income Vaccination Rate (%)	College Degree Vaccination Rate (%)	Aged 65+ Vaccination Rate (%)	Aged 65+ Vaccination Rate (%)
Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Aid per Capita (USD thousands)	0.705	0.705	0.705	-0.433	-0.706	-1.188	-1.188
	(0.854)	(0.854)	(0.854)	(2.228)	(0.476)	(0.742)	(0.742)
R^2	0.766	0.766	0.766	0.285	0.706	0.372	0.372
Baseline Controls	Y	Y	Y	Y	Y	Y	Y
Observations	50	50	50	50	50	50	50

Note: The table uses data from the Committee for a Responsible Federal Budget (2021), US Federal Transit Administration (2021a, 2021b), US Census Bureau (2021, 2022), Chidambaram and Musumeci (2021), Medicaid and Chip Payment Access Commission (2021), US Office of Elementary and Secondary Education (2021), Lewis et al. (2021), MIT Election and Data Science Lab (2017), US Bureau of Economic Analysis (2022), Dong, Du, and Gardner (2020), and the US Department of the Treasury (2021a, 2021b) to estimate the following equations for March 2022:

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

$$Y_{s,m,y} = \alpha + \beta_1 \frac{\widehat{TotalAid_s}}{Pop_{s,y_{2020}}} + \beta_2 X_{s,m,y} + u_{s,m,y}, \tag{2b}$$

where regressions are estimated only for March 2022. $\frac{TotalAid_s}{Pop_{s,y_{2020}}}$ is the total amount of federal aid allocated to a state per resident in USD thousands since the pandemic began. $Y_{s,m,y}$ is the vaccination rates for select socioeconomic groups, respectively, in state s. In Panel, we estimates for relatively low socioeconomic groups, while in Panel B we present estimates for relatively high socioeconomic groups. For ease of comparison to Table 4, some socioeconomic group estimates in Panel B are repeated. Included is a set of state-level controls $X_{s,m,y}$. This includes the log of 2020 official Census population, the share of votes won by Donald Trump in 2020, the change in state GDP per capita from Q4 2018 to Q4 2019, and the number of cumulative and new COVID-19 cases and deaths per 100,000 in the previous month. Observations are weighted by state population and standard errors (in parentheses) are clustered by state. In Panel A, Columns 1 through 3 present the vaccination rates for Black, Hispanic, and Asian Americans; Column 4 presents the vaccination rates for individuals with a household income less than $25,000; Column 5 presents vaccination rates for those with only a high school diploma; Columns 6 and 7 present vaccination rates for the middle-aged (40-54) and young (18-24). In Panel B, Columns 1 through 3 present the vaccination rates for white Americans, which are repeated for ease of comparison with Panel A; Column 4 presents the vaccination rates for individuals with a household income over $200,000; Column 5 presents vaccination rate for those with a bachelor's degree or higher; Columns 6 and 7 present the vaccination rates for the elderly (65+), which are duplicated to facilitate comparisons with Panel A.

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