Online Appendix

I. The Fiscal Gap

The fiscal gap, say Δ, is given by:

$$\Delta = \frac{b_t - \left(\frac{1+g}{1+r}\right)^{(T-t)} b_T + \sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)} d_s}{\sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)}} \quad (1)$$

where g is the GDP growth rate, r is the government interest rate (both assumed to be constant), d_s is the primary deficit as a share of GDP in year s, b_t is the initial debt-GDP ratio, and b_T is the terminal target debt-GDP ratio.

To consider the impact of low interest rates on the size of the fiscal gap, it is useful to decompose the gap into three components, each divided by the denominator, based on terms in the numerator of expression (1): the present value of primary deficits, $\sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)} d_s$; the debt service needed to maintain the initial debt-GDP ratio, $b_t\left[1-\left(\frac{1+g}{1+r}\right)^{(T-t)}\right]$; and the resources needed to reduce the terminal debt-GDP ratio below the initial debt-GDP ratio, $\left(\frac{1+g}{1+r}\right)^{(T-t)}(b_t - b_T)$. Unless $r > g$, the debt service term does not increase the fiscal gap – maintaining the initial debt-GDP ratio requires no resources, because growth is at least sufficient to do so. Indeed, for $r < g$, maintaining the existing debt-GDP ratio reduces the fiscal gap. However, reducing the debt-GDP ratio over time requires more resources, the lower is r, because putting resources aside each year to accomplish this target benefits less from accruing interest.[1] Finally, the impact of a lower value of r on the third component of the fiscal gap, $\sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)} d_s \,/\, \sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)}$, depends on whether primary deficits are generally rising or falling over time as a share of GDP. For example, if d_s is constant, this third component simply equals that constant primary deficit-GDP ratio and does not depend on r. In the current situation, where primary deficits are projected to rise over time as a

[1] That is, the term $\left(\frac{1+g}{1+r}\right)^{(T-t)}(b_t - b_T) / \sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-t)} = (b_t - b_T) / \sum_{s=t+1}^{T}\left(\frac{1+g}{1+r}\right)^{(s-T)}$ is decreasing with respect to r.

share of GDP, lower interest rates increase the fiscal gap, because closing the gap implies accumulating primary surpluses in order to help cover primary deficits later on; lower interest rates increase the resources needed to do so.

II. State and Local Government Revenues: Detailed methodology and state-specific results

This appendix provides more detail on the methodology used to project each source of state and local government revenues and presents results on a state-by-state basis.

1. State and local income taxes

Microsimulation model:

We create a small-scale microsimulation model using data from the Current Population Survey (CPS) and the NBER's Taxsim, which, given a set of inputs about taxable income, calculates individual income tax liabilities by state using each state's tax code. The current version of Taxsim uses 2018 tax codes, but there have been few changes in state income taxes since then.[2] Local taxes are, on average, 9% of state taxes (Census of Governments, 2017). In most states with significant local income tax revenue, taxes are based on the state tax liability or state taxable income, so we simply gross up the state revenues we project to account for local taxes, using data from 2017 on the ratio of local to state income tax revenues. In using Taxsim,

[2] One exception is Tennessee, which has phased out its income tax (which was only on capital income in any case.) We set Tennessee income losses to zero in our analysis.

we calculate annual tax liabilities, as opposed to annual tax payments – e.g. final tax payments are typically not due until April of the following year.

We use the three most recent years of the Annual Social and Economic Supplement to the CPS (2017-2019, with income for the years 2016-2018) in order to have a large enough sample to accurately project revenues at the state level. We adjust wages, dividends, interest, property income, and capital gains by changes in the national aggregates to create a 2018 version of the CPS (including adjustments for inflation). To create 2020-2022 baselines, we simply increase revenues in 2018 by the nominal GDP increases from 2018 in CBO's January 2020 projection. We run this sample through Taxsim to create a baseline projection of tax revenues. We then adjust income to represent post-COVID economics, as discussed in detail below, and run this adjusted CPS through Taxsim. The difference in tax revenues between the baseline and the COVID-adjusted CPS represents our estimate of the effects of the pandemic on income tax revenues.

Calibration:

As a check on the ability of Taxsim and the CPS to calculate state taxes, we compare our estimates of tax revenues with actual tax collections by state from the BEA. In aggregate, our estimates are fairly accurate. For the nation as a whole, we estimate total state income tax revenues in 2018 of $364 billion, relative to actual collections of $394—a miss of about 8 percent.

Appendix Figure 8 compare our estimates of per capita tax collections by state against actual revenues. (The per capita normalization facilitates comparison of states of different sizes.) For the richer states, using Taxsim with the CPS understates tax collections, whereas for lower-income states, it overstates it. We suspect this result is due, at least in part, to the Census method

of "rank proximity swapping" where, in order to preserve privacy, the Census swaps income above some threshold across respondents across states. Thus some very high incomes for respondents living in California, for example, may appear as high incomes of respondents living in South Carolina, lowering California's estimated tax collections and raising South Carolina's. Still, a regression of our estimated per capita tax collections by state on NIPAs per capita state government income tax collections is reassuring – e.g. the R-squared is .86 and the coefficient on NIPA tax collections is .81.[3]

To correct these errors in our Taxsim modeling, we perform the following crude adjustment. We adjust the weights on individuals with income above $250,000 so that our income tax collection estimates exactly match the baseline state income tax collections in the NIPA, and then use these adjusted weights for our COVID estimates. [4] The $250,000 is chosen to be representative of the type of household that might be subject to a swap. (Unfortunately the cutoffs differ across income sources, with alimony greater than $30,000 subject to a swap but wages greater than $300,000, so there is no easy way to reweight.)

Adjusting employment by state and income group:

Opportunity Insights reports daily data on changes in employment relative to January 2020 in each state for three sets of workers: those in the bottom quartile, those in the middle two quartiles, and those in the top quartile.[5] We average these data by month so that we have for every month between April and June, for each state and income group, the decline in

[3] Our baseline estimates are quite inaccurate for New Hampshire and North Dakota's very small income taxes, so we don't include income tax losses for these states in our projections or in our regressions.

[4] We get weighted estimates for households with income below the cutoff and above the cutoff—compare them to the actual BEA collections, and then reweight the top income group to exactly match BEA.

[5] Opportunity Insights states that their quartile cutoffs for the bottom and top cutoffs are 27,000 and 60,000, respectively. When we examined wages in the CPS, we found these cutoffs put far too many people in the top quartile, which would have led unemployment to be understated. Instead, we used the 25% and 75% percentile cutoffs from the CPS data to define these groups.

employment attributable to COVID.[6] We adjust the size of the employment declines each month so that, rather than being relative to January (as the OI data are), they are relative to the employment levels in CBO's January 2020, pre-COVID economic projections (assuming that employment would have increased at a constant rate across the states). That is, we account for the fact that simply reaching January's employment doesn't mean that the economy is back to the pre-COVID baseline.[7]

At the time of the writing of this paper, the OI data went through August and, to calculate Q3, we simply assume that September employment is unchanged from August. To project employment into the future, we assume that the recovery in employment for each state follows the recovery that CBO has in their July 2020 economic projection, updated for incoming data. To compute CBO's shock and subsequent recovery, we compare the path of unemployment in their January 2020 economic projection with that in the July 2020 economic projection. We use the change in the unemployment rate between the two projections as the change in unemployment due to COVID, which we call the "shock."

For example, the unemployment rates for Q3 and Q4 of 2021 in CBO's July 2020 projection are 8 percent and 7.6 percent, respectively, compared to 3.6 percent for both quarters in the January 2020 projection. The difference between CBO's pre- and post-COVID unemployment rates is 4.4 percentage points in 2021 Q3 and 4 percentage points in 2021 Q4, a decline of %. We then assume that the "shock" in all state/income groups declines by 9% in 2021 Q4. With this methodology, every state/income group is converging at the same pace, so

[6] Employment declines were very small in March, so we begin our analysis in the second quarter.

[7] The OI data come from the private sector, whereas we are implementing the shocks for all workers. Because the private sector experienced, on average, somewhat higher employment losses than the public sector, we view the shocks to wages as an upper bound.

that one with a larger initial shock will experience larger increases in employment and a stronger recovery over time, but will remain weaker in terms of the level of employment relative to its pre-pandemic value than other state/income groups throughout the recovery.[8]

One issue we had to contend with is that the incoming data have been far stronger than anticipated by CBO in their July projection. For example, CBO projected that the unemployment rate would be 14 percent in the third quarter, and then begin to decline, hitting 8.6 percent by the second quarter of 2021. In fact, the unemployment rate was 10.2 percent in July and 8.4 percent in August. We assume that CBO simply missed the timing of the recovery, and, rather than assuming the shock continues to dissipate over the remainder of the year, we have chosen to keep it constant at its current value through the middle of 2021, and then allow it to follow the CBO path. Accordingly, in our simulation, employment remains a constant fraction of its pre-COVID baseline through the second quarter of 2021, and then begins to rise as the "employment shock" dissipates.

Capturing the distribution of wage shocks within income groups:

Because we are interested in accurately capturing the progressivity of each state's tax system and in accurately measuring unemployment benefits, we attempt to accurately measure the distribution of wage reductions across the population. We also attempt to properly quantify unemployment spells. A 10% unemployment rate for six months does not imply that 10% of the workers are unemployed for six months. Instead, there will be various spells of unemployment embedded in that unemployment rate—from very short spells to spells lasting the full six months. That is, people are becoming unemployed even as the unemployment rate is coming

[8] For example, compare a state/income group that lost 30% of employment from COVID with one that lost 5%. A 20% improvement would mean a gain of 6% of employment in the first state, but only 1% in the second.

down, and many of the unemployed find jobs despite high unemployment rates. With progressive tax systems, more shorter spells may have different effects on income tax revenues than fewer longer spells. In addition, in order to calculate unemployment benefits, it is important to account for the fact that these benefits are time-limited, and thus more shorter spells will lead to higher unemployment benefits in the aggregate. Our method for capturing these flows in and out of unemployment is as follows. For April through June, we use the national job finding rate out of unemployment from the BLS Labor Force Status Flows data to determine how many of the previously unemployed have entered employment. The job finding rate is defined as the number of people employed next month who were unemployed the previous month, divided by the number of people unemployed the previous month. We then calculate the newly unemployed as the number of people who must become unemployed given the aggregate unemployment numbers by state derived above:

(1) Newly unemployed = Total unemployed - Previously unemployed workers who remain unemployed.

From July on, we assume a constant job finding rate of 20%, about the rate expected given the level of unemployment in CBO's projection.[9] Of course, in reality job finding rates likely depend on the duration of unemployment—with those with long spells of unemployment less likely to find a job, but we doubt that pinning those relationships down would have much effect on our results.

Thus, from the Opportunity Insight data, projected forward with the CBO projections, we calculate, for each group of workers (low, medium, and high income) a distribution of

[9] The higher the job finding rate given a level of unemployment, the lower the average duration of unemployment, and the lower the likelihood of people exhausting unemployment insurance benefits.

unemployment outcomes: no unemployment, unemployment for one month, unemployment for two months, etc.[10] We also track the date of unemployment spells so that we can appropriately adjust unemployment benefits for the temporary additional $600 benefit per week from the Pandemic Unemployment Compensation (PUC) program in the Cares Act.

Applying these shocks to the CPS:

With these shocks in hand, it is straightforward to create a "shocked" CPS file to compare with the baseline. We first expand the data set using the CPS weights so that each respondent in a state has the same weight, sort the workers into groups based on the Opportunity Insights cutoffs, sort the workers within groups randomly, and then apply the shocks to the correct fraction of the population. For example, if our results indicate that, for the lowest income group in Minnesota, 70% experience no unemployment, 5% experience a 1-month unemployment spell, 10% experience a 2-month spell, etc., we simply lower wages in the baseline CPS to represent the # months of wages lost—e.g., workers with one month of unemployment lose $1/12^{th}$ of their wages. We do this separately for respondent and spouse wages (so the probabilities that both respondent and spouse lose their jobs are independent) and then group respondents by household.

Calculating unemployment benefits:

We use the unemployment benefits calculator in Ganong, Noel, and Vavra (2020) to calculate weekly unemployment insurance benefits by state. We assume that the unemployed can receive a maximum of 9 months (39 weeks) of benefits. For those unemployed in April, May,

[10] We follow unemployment spells for up to 18 months, at which point almost no one is still unemployed using our 20% job finding rate.

June, and July of 2020, we increase the unemployment benefit by $2600 per month (52/12*$600) to capture the PUC) benefits.[11]

Adjusting wage rates and capital income:

We use CBO economic projections to shock income, pensions, dividends, and business income (which includes income for sole proprietorships, S-corps, and partnerships) on a national basis, weighting their changes to proprietor's income, interest, and corporate profits (which include S-corps) by their weight in the Statistics of Income tax return data for 2018.[12] We use the change in CBO's July economic projection relative to its January 2020 projection to measure the impact of COVID. CBO has lowered their projection of nonwage income substantially. For example, dividends are down 8%, 24%, and 22% in 2020, 2021, and 2022, respectively, interest income is down 3%, 7%, and 11%, and proprietor's income—which is boosted by PPP payments

[11] We assume a 100% take-up rate for unemployment benefits, which is likely to be too high, particularly after the additional $600 per week expired. On the other hand, we are not capturing benefits that the CARES act made available to self-employed workers and are not capturing the additional benefits that those who would have been unemployed absent COVID received. We estimate total UI benefit of $350 billion in 2020, which will likely be an underestimate of the total benefits paid during the year, indicating that our estimates of the tax losses from unemployment are likely to be a bit too high.

[12] Table 1.3: https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-returns-publication-1304-complete-report#_pt1

in 2020—is down 6%, 11%, and 11%.[13] Finally, we assume that taxable pensions (withdrawals from IRAs and DC pension plans) suffer ¼ of the reduction of dividends.[14] [15]

State-specific declines in income taxes:

Appendix Table 1 provides our results of the effects of the pandemic on state and local personal income tax collections. There is a lot of variation across the states in the income tax revenue losses associated with COVID, driven by the variation in unemployment rates, the generosity in unemployment insurance benefits, and the important of non-wage income to the tax base. Examining only 2020, California, New Jersey, and New York experience the largest 2020 percentage declines, with income taxes falling 10%, 8%, and 7%, respectively. In contrast, Illinois, Kansas, Kentucky, and West Virginia suffer declines of less than 1.5%. Declines converge over time as the states with the largest drop recover more quickly.

[13] Our method simply uses CBO's reduction in the growth rate of NIPA proprietor income—which includes their estimate of the effects of PPP— and applies it to CPS business income. Because the amount of proprietor's income in the NIPAs is far larger than that reported on tax returns or in the CPS, this method implicitly assumes that most of the PPP money will be untaxed. The Treasury estimated that much of the shortfall in proprietor income between the NIPAs and the tax data represents misreporting of income on the taxes (Foertsch, 2016). Because the federal government knows who received PPP loans, it is possible that a larger share will be taxed. On the other hand, to the extent that some business received loans and then ultimately went out of business, taxes on PPP may be lower than estimated here.

[14] Much of the withdrawal from pension plans represent withdrawal of principal and minimum required distributions, so it shouldn't necessarily vary with asset returns. Examining historical data from the SOI, there seems to be some cyclicality of taxable pension withdrawals, but to a much lesser degree than dividends or other forms of asset income.

[15] In part, these reductions—as well as the reduction in wages noted above—represent sharp declines in inflation. Whether lower revenues from lower inflation represent a fiscal strain in the near-term depends on whether the prices of the things the state and local sector buys—mostly state and local employee wages—also decline.

2. Corporate income taxes

We use national data to assess changes in corporate profits, so there is no variation by state. We rely on CBO estimates of corporate profits adjusted, as noted in the main text, for legislative changes that likely affect only federal corporate tax collections. After these adjustments, our state government corporate taxes decline 3% in 2020, 50% in 2021, and 20% in 2022.

3. Sales taxes

We approximate changes in taxable consumption for each state by using a combination of changes in spending by consumption category from the Opportunity Insights data, calibrated using national data for the second quarter from the NIPA, and state-by-state variation in the sales tax base.

The sales tax base:

In very broad terms, the tax base for the sales tax is sales of goods plus sales of goods and services at drinking and eating establishments. States typically impose a sales tax on telecommunications services as well. Some items—like gasoline, alcohol, motor vehicles, and lodging—are sometimes subject to sales taxes and sometimes to special excise taxes, and often to both. Finally, some states exempt groceries or tax it at a lower rate and some exempt clothing, or exempt clothing items below a certain dollar cap. We gather the rules for each state and then estimate spending changes by category due to the COVID pandemic. We use data on personal consumption expenditures in the NIPAs on a national basis to calculate categories of spending that are subject to the consumption tax. As shown in Table 5, 22% of NIPA household

consumption spending is on items that are generally subject to the sales tax, and an additional 13% is on items that are sometimes subject to the sales tax.

We assume that the shares of total consumptions for the categories listed in column 2 of Appendix Table 2 are constant across states. Call ss_{iiii} the share of spending on category *i* in state *j*, tt_{iiii} the sales tax rate on category *i* in state *j* (equal to zero if an item is exempt), and aa_{iiii} the percent decline in spending in category *i* due to COVID in state *j*. Our estimate of the reduction in sales tax revenue due to COVID is then:

$$\text{(2) Percent Sales Tax Revenue Loss in state } j = \frac{\sum_{ii} tt_{iiii} ss_{iiii} aa_{iiii}}{\sum_{ii} tt_{iiii} ss_{iiii}}$$

Calculating the change in spending by spending category:

We use a variety of source to calculate the changes in consumption due to COVID. For spending on restaurants and hotels, apparel, and grocery stores, we rely on the data from Opportunity Insights, which partnered with credit-card processor Affinity to track changes in daily spending by state relative to January of 2020.[16] The data are constantly updated and now go through the beginning of September. The data are also roughly adjusted for seasonal variation. For gasoline sales, we use the change in miles driven in each state provided by the Department of Transportation, which we have through June, plus the change in national gas prices. We use state-by-state regressions of miles driven on time spent away from home, as measured in the google mobility data (also provided by Opportunity Insights), which have R-

[16] We can't distinguish between restaurants and hotels in the OI data, but this distinction is important because hotel spending fell much more than restaurant spending in the NIPA data and not all states subject lodging to sales taxes. In the aggregate, food and accommodations services were 40% lower in the second quarter than in the fourth quarter of 2019, with food services 33% lower and accommodations 76% lower. As a rough estimate, we multiply the state-level Opportunity Insights estimate for the decline in food and accommodation services by about 2 (76/40) to estimate the decline in accommodation spending and by about ¾ (33/40) to estimate the decline in food services. We use the decline in spending for apparel and general merchandise for apparel spending.

squareds ranging from 73% to 99%, to extend our estimates of miles driven by state through September. For motor vehicle sales, we only have national data on seasonally-adjusted vehicle sales by month which we use for all states.[17] Car sales plunged in March and April—April seasonally adjusted sales were down almost by 50% from January—but have recovered since then. At the beginning of August, however, they remained 10% below January's level. We assume that sales tax collections in all other categories of consumer spending were initially unaffected by the pandemic, as suggested by the data in Appendix Table 2.

Projecting tax revenues forward:

The unusual pattern of consumption declines observed since the start of the pandemic—the plunge in car sales, driving, and hotel occupancy, for example— likely reflects the effects of social distancing much more than the effects of lower income and underlying demand. The CBO projection assumes a gradual easing of social distancing that subsides fully by the middle of 2021. After that, the economy slowly recovers, no longer held down by social distancing but by the damage done to the economy during the pandemic.

Our projections of sales tax revenues take the easing of social distancing into account. In particular, we assume that the shock to spending (the change in spending relative to its pre-COVID baseline) abates over time. By the middle of 2021, we assume that the shock to consumption no longer reflects social distancing but, instead, only reflects the overall state of the economy.

To gauge that shock, we again use the change in the CBO projection between January and July of 2020. CBO's July projection of 2021 Q3 nominal consumption is 9.4% below what they had written down in January. Thus, we assume that all consumption—including

[17] Data are at https://fred.stlouisfed.org/series/TOTALSA.

consumption that has not shown signs of declining yet—is 9.4% below its pre-COVID baseline by the third quarter of next year. After that, consumption rises in step with CBO's aggregate consumption. However, with low inflation, CBO does not have much of a recovery in nominal consumption between mid-2021 and the end of 2022.

To calculate the tax losses in dollars, we multiply our projected declines by a counterfactual sales tax baseline, which is calculated as the total sales taxes collected by state and local governments from the 2017 Census of Governments, increased to 2020-2022 levels using the average growth rate in national state and local sales tax collections from the NIPAs between 2018 and 2019.

State-specific results:

Appendix Table 3 shows our results for each state. Looking across the states, the largest percentage declines are in the District of Columbia (18%) and Rhode Island. (16%) while the smallest declines are in Alabama, Idaho, and Oklahoma (4%, 5%, and 5%).

4. Other Taxes and Fees

We assign each individual revenue source a tax base measured at the monthly frequency. Appendix Table 4 lists the tax base for each revenue source. For most categories of spending, we do not have state-specific information, and simply assume that the declines in the tax bases in the NIPA are uniform across the states. The exceptions to this are for our estimates of motor fuel tax collections and hospital fees. For motor fuel taxes, we use the method discussed above in the sales tax section to use state-specific projections of miles driven. We apply a similar procedure for hospital fees using the OI data on consumer health care spending.

To calculate the COVID shock, we first estimate a counterfactual no-COVID tax base by simply growing each tax base out by its average national growth rate over 2018 and 2019. The tax base under COVID is simply the actual value through its latest available month (typically June).[18] We then project this COVID tax base forward. In doing so, we distinguish between revenues that we judge have been directly and significantly affected by social distancing and those that have not. Taxes and fees related to health care, amusement and gambling, and transportation are assumed to be depressed now because of social distancing. For these revenue sources (identified in Online Appendix Table 4) we follow the same procedure as described above for sales taxes: we assume that these tax bases rise fairly rapidly over the next few quarters, as the effects of social distancing abate, so that they are just 9.4% below the pre-COVID baselines by the middle of the next year, the same as CBO's projection of PCE, and then recover at the same pace as CBO's PCE shock. For the other sources of revenues, we assume that they recover from their current "shock" at the same pace as CBO's projection of PCE. With COVID and no-COVID tax base projections in hand, we simply grow out tax collections by the growth in these two tax bases and then take the difference as our measure of the COVID revenue shock in dollars.[19] Appendix Table 5 shows our results by specific revenue source for the nation as a whole. Appendix Tables 6 and 7 show our results for each state.

5. Federal Aid

[18] For motor fuel taxes and hospital fees, the COVID tax base is defined by applying the percent decline in miles driven or consumer health care spending, measured relative to January, to the counterfactual tax base.

[19] Taxes and fees are extrapolated from the 2017 Census of Governments through 2019 by simply applying the average growth rate of the tax base over 2018 and 2019.

We estimate that state and local governments received a total of $211 billion in aid in 2020, excluding aid to hospitals and higher education. The state-by-state allocations can be found in Online Appendix Table 9. The largest portion of that aid is $150 billion through the Coronavirus Relief Fund, which is allocated on the basis of population but for a minimum distribution of $1.25 billion per state. (See here for the allocations.) The state allocations for the $25 billion in aid to public transit agencies can be found here, and those for the $13 billion to K-12 education here. The roughly $6.5 billion in aid to public universities was part of a broader package of aid to higher education, including both public and private institutions. The allocations by university can be found here, and the identification of higher education institutions as public can be found here. Finally, the CARES Act also provided funding to public hospitals and community health centers. We allocate these funds by state using the BEA's breakdown of provider spending in the second quarter. [20]

In addition, the Families First Coronavirus Response Act raised the federal share of Medicaid spending (the FMAP) by 6.2 percentage points for the duration of the public health emergency. That increase in the FMAP appears to be more than enough to fund the higher Medicaid expenditures expected as a result of the pandemic, leaving about $23 billion of flexible funding in 2020, $16 billion in 2021 and $12 billion 2022.

Our Medicaid calculations were as follows. While CBO only projects federal Medicaid spending, we can use the revised FMAP to back out what it is projecting for overall Medicaid spending and to calculate the state share, and compare that to the pre-COVID Medicaid

[20] They note: "Of the $80 billion provided to health providers in the second quarter, $50 billion went to non-profit hospitals, $30 billion was categorized as subsidies to for-profit hospitals, and $20 billion was classified as a grant to state and local governments." Thus we assume that 20% of $175 billion in aid to health providers included in the CARES Act will accrue to state and local governments. https://www.bea.gov/sites/default/files/2020-08/effects-of-selected-federal-pandemic-response-programs-on-federal-government-receipts-expenditures-and-saving-2020q2-second.pdf

expenditures using the pre-COVID FMAP. That calculation requires knowing how long the public health emergency will last. While CBO has not included a specific end date for the public health emergency in its most recent budget outlook, it has noted that the public health emergency will continue at least through part of 2022. We have assumed that the emergency is declared over in June of 2022. We also assume that the percentage increase in Medicaid spending due to the pandemic is the same in each state. We include the net revenues available from the higher FMAP in our aid figures, recognizing that this is somewhat inconsistent with the way we have treated other aid. For example, the Coronavirus relief fund was also intended to cover higher expenditures due to COVID. Because we do have a good idea of the magnitude of the additional Medicaid spending, but don't have any information on the magnitude of other COVD-related spending, we have chosen to treat the two categories of aid differently.

Appendix Table 1. Projected Declines in State and Local Personal Income Tax Revenues

	2020	2021	2022		2020	2021	2022
AL	-5%	-5%	-7%	MT	-6%	-6%	-7%
AK				NE	-3%	-6%	-7%
AZ	-3%	-6%	-6%	NV			
AR	-4%	-8%	-9%	NH			
CA	-10%	-10%	-10%	NJ	-8%	-8%	-8%
CO	-2%	-5%	-5%	NM	-2%	-5%	-6%
CT	-3%	-7%	-7%	NY	-7%	-10%	-10%
DE	-3%	-6%	-7%	NC	-2%	-5%	-5%
DC				ND	-3%	-6%	-7%
FL				OH	-2%	-5%	-5%
GA	-2%	-5%	-6%	OK	-2%	-6%	-7%
HI	-5%	-14%	-13%	OR	-4%	-7%	-7%
ID	-2%	-5%	-6%	PA	-5%	-5%	-5%
IL	0%	-3%	-4%	RI	-3%	-6%	-6%
IN	-2%	-4%	-4%	SC	-2%	-4%	-4%
IA	-3%	-7%	-8%	SD			
KS	-1%	-4%	-5%	TN			
KY	-1%	-4%	-4%	TX			
LA	-2%	-6%	-6%	UT	-3%	-5%	-6%
ME	-3%	-7%	-7%	VT	-5%	-9%	-9%
MD	-3%	-5%	-6%	VA	-6%	-7%	-7%
MA	-2%	-5%	-6%	WA			
MI	-2%	-6%	-6%	WV	-1%	-5%	-6%
MN	-4%	-8%	-9%	WI	-3%	-6%	-7%
MS	-3%	-6%	-6%	WY			
MO	-2%	-5%	-6%				
Total	-5.2%	-7.4%	-7.5%				

Appendix Table 2. State Sales Tax Bases

	Nominal $ 2019 Q4 (billions)	Share of PCE	2020 Q2 Level Relative to Q4 of 2019
Usually Subject to Sales Tax			
Motor vehicles and parts	528	3.6%	-8%
Food services (Restaurants)	853	5.8%	-33%
Other durable and nondurable goods (excluding prescription drugs) and telecommunication services	1857	12.6%	-1%
Sometimes Subject to Sales Tax			
Accommodations	159	1.1%	-76%
Gasoline and other energy goods	340	2.3%	-44%
Clothing and footwear	405	2.7%	-29%
Food and beverages for off-premises consumption (Groceries)	1032	7.0%	10%
Rarely Subject to Sales Tax			
Other Services	8585	58.2%	-16%
Consumption of nonprofits	438	3.0%	54%
Pharmaceuticals and other medical products	562	3.8%	1%
Total	**$14,759**	**100.0%**	**-11.8%**

Appendix Table 3. Projected Declines in General Sales Tax Revenues

	2020	2021	2022
AL	-4%	-8%	-9%
AK	-13%	-11%	-11%
AZ	-11%	-9%	-9%
AR	-6%	-8%	-9%
CA	-12%	-10%	-9%
CO	-13%	-10%	-9%
CT	-12%	-10%	-9%
DE			
DC	-18%	-11%	-9%
FL	-11%	-9%	-9%
GA	-10%	-9%	-9%
HI	-7%	-10%	-10%
ID	-5%	-8%	-9%
IL	-13%	-11%	-10%
IN	-13%	-11%	-10%
IA	-12%	-10%	-9%
KS	-6%	-8%	-9%
KY	-9%	-9%	-9%
LA	-8%	-8%	-9%
ME	-11%	-10%	-9%
MD	-12%	-10%	-9%
MA	-10%	-9%	-9%
MI	-12%	-11%	-10%
MN	-12%	-10%	-9%
MS	-5%	-8%	-9%
MO	-9%	-9%	-9%
MT			
NE	-9%	-9%	-9%
NV	-11%	-9%	-9%
NH			
NJ	-12%	-10%	-9%
NM	-14%	-10%	-9%
NY	-15%	-11%	-11%
NC	-13%	-10%	-9%
ND	-10%	-9%	-9%
OH	-9%	-9%	-9%
OK	-5%	-8%	-9%
OR			
PA	-9%	-9%	-9%
RI	-16%	-11%	-9%
SC	-9%	-9%	-9%
SD	-8%	-9%	-9%
TN	-6%	-8%	-9%
TX	-9%	-9%	-9%
UT	-9%	-9%	-9%
VT	-10%	-9%	-9%
VA	-10%	-9%	-9%
WA	-13%	-10%	-9%
WV	-6%	-8%	-9%
WI	-12%	-10%	-9%
WY	-10%	-9%	-9%
Total	-11%	-10%	-9%

Appendix Table 4. Tax Base Assumptions for Other Taxes, Fees, and Miscellaneous General Revenues

Revenue Source	Assumed Tax Base	Social Distancing
	A. Other Taxes	
Other Select Sales Tax	NIPA Table 2.4.5U: personal consumption expenditures	
Motor Fuels Tax	NIPA Table 2.4.5U: gasoline and other motor fuel; state-level miles driven*	X
Other License Taxes	NIPA Table 2.4.5U: personal consumption expenditures	
Taxes NEC	NIPA Table 2.4.5U: personal consumption expenditures	
Motor Veh & Oper Lic	NIPA Table 2.4.5U: motor vehicle transportation services	
Public Utility Tax	NIPA Table 2.4.5U: household utilities	
Insurance Premium Tax	NIPA Table 2.4.5U: life insurance	
Tobacco Tax	NIPA Table 2.4.5U: tobacco	
Amusement Tax	NIPA Table 2.4.5U: membership clubs & participant sports centers	X
Alcoholic Beverage Tax	NIPA Table 2.4.5U: alcohol (in purchased meals and for off-premises consumption)	
Corporation License	NIPA Table 2.4.5U: personal consumption expenditures	
Alcoholic Beverage Lic	NIPA Table 2.4.5U: alcohol (in purchased meals and for off-premises consumption)	
Parimutuels Tax	NIPA Table 2.4.5U: pari-mutuel net receipts	X
	B. Fees	
Hospitals	NIPA Table 2.4.5U: government hospitals; state-level health care spending**	X
High Ed-Other	NIPA Table 2.4.5U: proprietary & public higher education	
All Other NEC	NIPA Table 2.4.5U: personal consumption expenditures	
Sewerage	NIPA Table 2.4.5U: water supply & sewage maintenance	
High Ed-Aux Enterp	NIPA Table 2.4.5U: proprietary & public higher education	
Air Transportation	NIPA Table 2.4.5U: air transportation	X
Solid Waste Mgmt	NIPA Table 2.4.5U: garbage and trash collection	
Toll Highways	NIPA Table 2.4.5U: parking fees and tolls	X
Parks & Recreation	NIPA Table 2.4.5U: amusement parks, campgrounds & related	X
Education NEC	NIPA Table 2.4.5U: education services	
Housing & Comm Dev	NIPA Table 2.4.5U: rental of tenant-occupied nonfarm housing	
Water Transport	NIPA Table 2.4.5U: water transportation	X
Elem Ed-Sch Lunch	NIPA Table 2.4.5U: elementary & secondary school lunches	
Total Nat Res	WTI oil, price per barrel	
Parking	NIPA Table 2.4.5U: parking fees and tolls	X
Regular Highways	NIPA Table 2.4.5U: parking fees and tolls	X
	C. Non-interest Miscellaneous General Revenue	
Total	NIPA Table 2.4.5U: personal consumption expenditures	

Note. Social distancing denotes a tax or fee assumed to be directly influenced by social distancing.
* FHWA Traffic Volume Trends, all roads; projected for unavaliable months using Opportunity Insights state-level data on time away from home. ** Opportunity Insights, state-level consumption of health services.

Appendix Table 5. Other Taxes and Fees

	Covid-19 Declines (billons of $)			2017 Collections	
	2020	2021	2022	Billions of $	Percent
Other Taxes and Fees Excluding Public Hospitals and Higher Ed					
Transportation *Gas tax, Airport fees, Highway Tolls, Motor Vehicle Licence fees, Parking, Water Transport*	46.4	23.1	14.8	131.1	19%
Severance Taxes, Natural Resources, and all other NEC fees	9.5	10.2	10.2	82.6	12%
Parks & Recreation, Amusement and Parimutuels Tax	9.0	4.0	2.3	20.3	3%
Sewerage, Solid Waste, Housing & Comm Devel, Public Utility Taxes	9.0	-0.7	-0.7	27.1	4%
Alcohol and Tobacco Tax and Licenses	0.5	0.6	0.6	27.2	4%
All other NEC	7	18	18	408	59%
Total	**$82**	**$55**	**$45**	$697	100%
Public Hospitals and Higher Ed					
Hospitals	29	18	18	160.0	
Higher Education	3	4	4	129	
Total	**$33**	**$22**	**$22**	289	

Appendix Table 6. Projected Declines in Other Taxes and Fees Other than Fees for Higher Education and Hospitals

	2020	2021	2022		2020	2021	2022
AL	10.3%	7.4%	6.1%	MT	11.4%	8.7%	7.5%
AK	14.5%	9.4%	7.5%	NE	12.7%	9.8%	8.3%
AZ	13.4%	8.5%	6.4%	NV	16.7%	9.8%	7.2%
AR	11.0%	7.9%	6.6%	NH	12.1%	8.6%	7.3%
CA	12.8%	9.0%	7.5%	NJ	13.6%	8.4%	6.6%
CO	17.1%	10.1%	7.6%	NM	11.2%	8.4%	7.2%
CT	12.0%	8.5%	7.1%	NY	16.0%	9.4%	7.1%
DE	11.9%	8.7%	7.4%	NC	13.2%	9.2%	7.4%
DC	7.0%	5.8%	5.2%	ND	11.2%	9.5%	8.6%
FL	14.1%	8.5%	6.5%	OH	11.3%	7.6%	6.2%
GA	13.2%	8.2%	6.2%	OK	12.0%	8.5%	7.1%
HI	15.1%	8.6%	6.3%	OR	12.6%	9.1%	7.7%
ID	12.2%	9.4%	8.2%	PA	14.2%	8.7%	6.7%
IL	16.1%	9.3%	7.0%	RI	10.2%	7.3%	6.1%
IN	12.9%	8.4%	6.8%	SC	13.1%	9.2%	7.5%
IA	13.4%	9.5%	8.0%	SD	12.0%	9.5%	8.3%
KS	11.4%	8.1%	6.8%	TN	10.8%	7.9%	6.6%
KY	11.6%	7.8%	6.4%	TX	13.8%	9.0%	7.1%
LA	14.6%	8.4%	6.0%	UT	13.1%	8.8%	7.2%
ME	13.9%	9.1%	7.4%	VT	10.5%	8.3%	7.4%
MD	14.2%	8.7%	6.7%	VA	15.0%	9.2%	7.0%
MA	16.1%	9.4%	7.1%	WA	12.7%	8.2%	6.4%
MI	12.1%	8.6%	7.2%	WV	11.0%	8.0%	6.8%
MN	12.3%	8.9%	7.5%	WI	12.2%	8.7%	7.3%
MS	11.3%	8.0%	6.6%	WY	10.6%	9.0%	8.2%
MO	13.4%	8.6%	6.7%				
TOTAL	**6.5**	**4.4**	**3.6**				

Appendix Table 7. Projected Declines in Fees for Higher Education and Hospitals

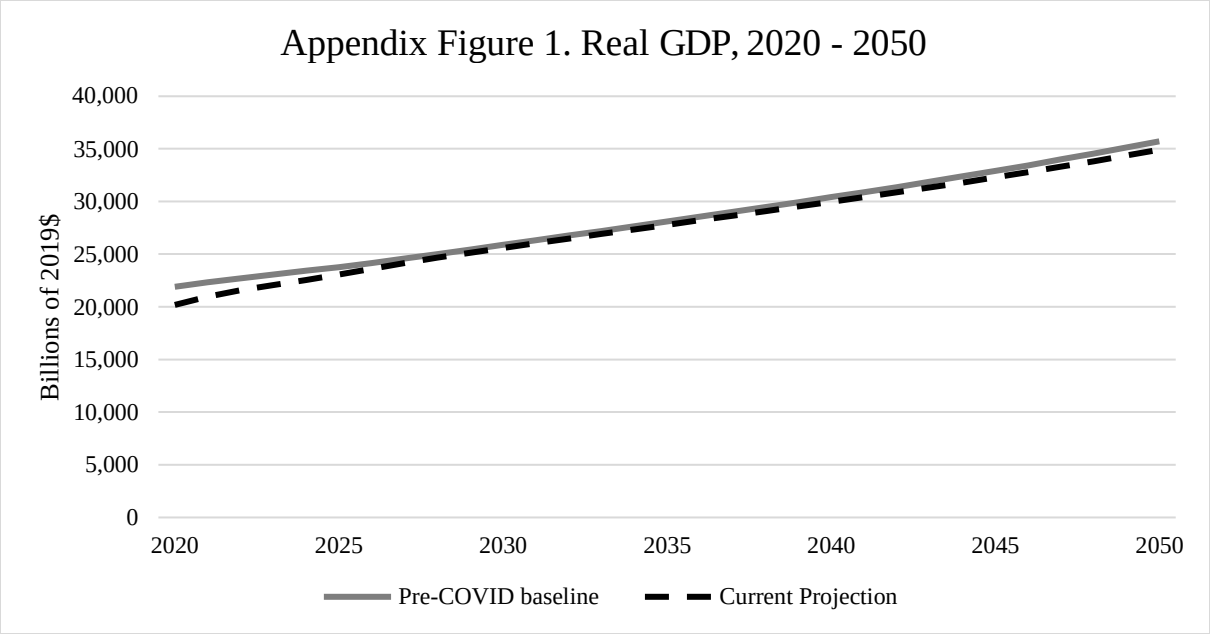
	2020	2021	2022		2020	2021	2022
AL	11.5%	7.4%	7.1%	MT	6.0%	4.2%	3.8%
AK	33.5%	15.2%	7.1%	NE	6.0%	5.7%	6.0%
AZ	4.5%	4.1%	4.1%	NV	8.9%	6.2%	6.5%
AR	1.7%	4.1%	6.5%	NH	2.8%	3.0%	2.9%
CA	11.9%	7.2%	7.2%	NJ	7.0%	4.8%	4.6%
CO	9.9%	6.4%	5.5%	NM	11.6%	7.3%	7.0%
CT	8.0%	5.3%	4.4%	NY	14.7%	7.7%	7.5%
DE	2.7%	2.9%	2.9%	NC	13.9%	8.5%	7.4%
DC	13.0%	7.6%	7.8%	ND	2.8%	3.0%	2.9%
FL	10.2%	7.1%	7.3%	OH	10.6%	7.1%	6.1%
GA	9.6%	6.5%	6.7%	OK	3.8%	4.4%	5.3%
HI	0.6%	3.1%	6.8%	OR	10.3%	6.6%	6.4%
ID	6.1%	5.4%	6.1%	PA	6.9%	4.8%	5.5%
IL	8.2%	5.4%	4.9%	RI	2.8%	3.0%	2.9%
IN	19.9%	10.2%	6.4%	SC	7.0%	6.0%	7.5%
IA	19.4%	10.2%	7.1%	SD	5.8%	4.8%	4.2%
KS	11.0%	7.7%	7.2%	TN	9.1%	7.3%	6.9%
KY	9.4%	7.1%	6.7%	TX	7.3%	5.7%	6.6%
LA	5.2%	5.0%	6.5%	UT	18.2%	10.4%	6.5%
ME	7.1%	5.1%	4.7%	VT	2.6%	2.9%	2.8%
MD	3.5%	3.3%	3.2%	VA	10.1%	6.6%	6.2%
MA	4.9%	3.9%	3.6%	WA	7.3%	5.8%	6.7%
MI	14.3%	7.8%	5.9%	WV	3.7%	4.2%	4.8%
MN	10.7%	6.8%	5.9%	WI	9.8%	6.6%	5.6%
MS	10.3%	7.1%	7.6%	WY	16.8%	11.0%	8.3%
MO	10.0%	7.1%	6.5%				
TOTAL	**4.6**	**3.2**	**3.0**				

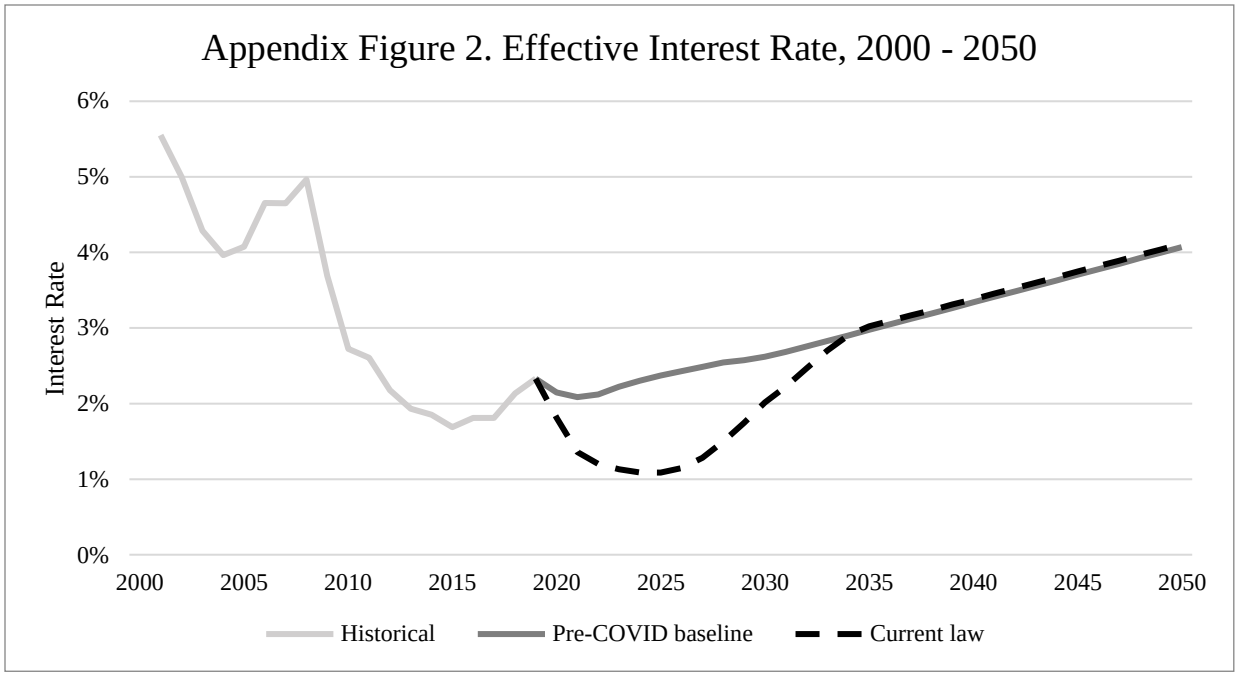
Appendix Table 8. Projected Declines in Revenues as Share of Own Source Revenue, excluding Fees to Hospitals and Higher Ed

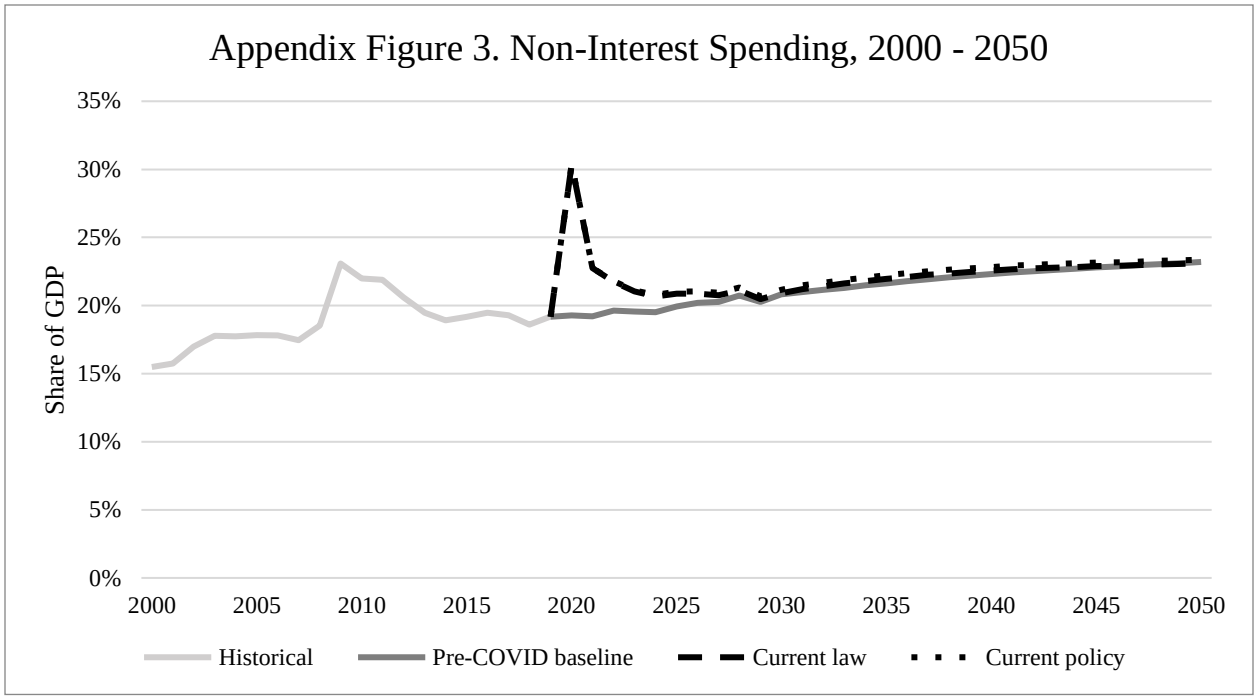
	2020	2021	2022		2020	2021	2022
AL	3.6%	4.8%	4.3%	MT	4.7%	4.7%	4.0%
AK	4.3%	3.1%	2.4%	NE	4.4%	5.0%	4.5%
AZ	6.0%	5.3%	4.6%	NV	10.0%	6.7%	5.6%
AR	4.4%	6.2%	5.7%	NH	3.4%	5.3%	3.3%
CA	7.4%	7.7%	6.3%	NJ	5.3%	5.2%	4.1%
CO	6.3%	5.2%	4.4%	NM	6.1%	5.0%	4.5%
CT	4.4%	6.0%	4.7%	NY	6.9%	8.0%	6.3%
DE	5.5%	6.0%	4.9%	NC	5.0%	4.7%	4.1%
FL	6.9%	5.7%	4.5%	ND	6.4%	5.8%	5.4%
GA	4.9%	5.1%	4.4%	OH	4.4%	4.3%	4.1%
HI	6.6%	7.7%	6.5%	OK	4.2%	4.8%	4.6%
ID	4.5%	6.0%	5.3%	OR	4.5%	5.7%	4.6%
IL	5.9%	5.4%	4.2%	PA	5.9%	5.7%	4.5%
IN	5.4%	5.6%	4.6%	RI	4.7%	4.5%	3.7%
IA	4.1%	4.5%	3.8%	SC	3.9%	3.9%	3.3%
KS	3.2%	4.3%	3.8%	SD	5.3%	5.1%	4.7%
KY	4.2%	5.0%	4.2%	TN	4.7%	7.6%	5.8%
LA	5.8%	5.3%	4.8%	TX	5.2%	4.1%	3.7%
ME	5.5%	5.7%	4.8%	UT	4.7%	5.0%	4.4%
MD	5.7%	5.8%	4.9%	VT	4.1%	5.2%	4.3%
MA	4.5%	5.7%	4.4%	VA	5.5%	5.0%	4.3%
MI	4.7%	5.4%	4.5%	WA	7.8%	5.4%	4.7%
MN	5.8%	6.7%	5.7%	WV	4.4%	4.7%	4.4%
MS	3.5%	4.5%	4.1%	WI	4.8%	5.4%	4.6%
MO	4.8%	4.7%	4.3%	WY	3.5%	3.1%	2.9%
TOTAL	**5.8%**	**5.9%**	**4.9%**				

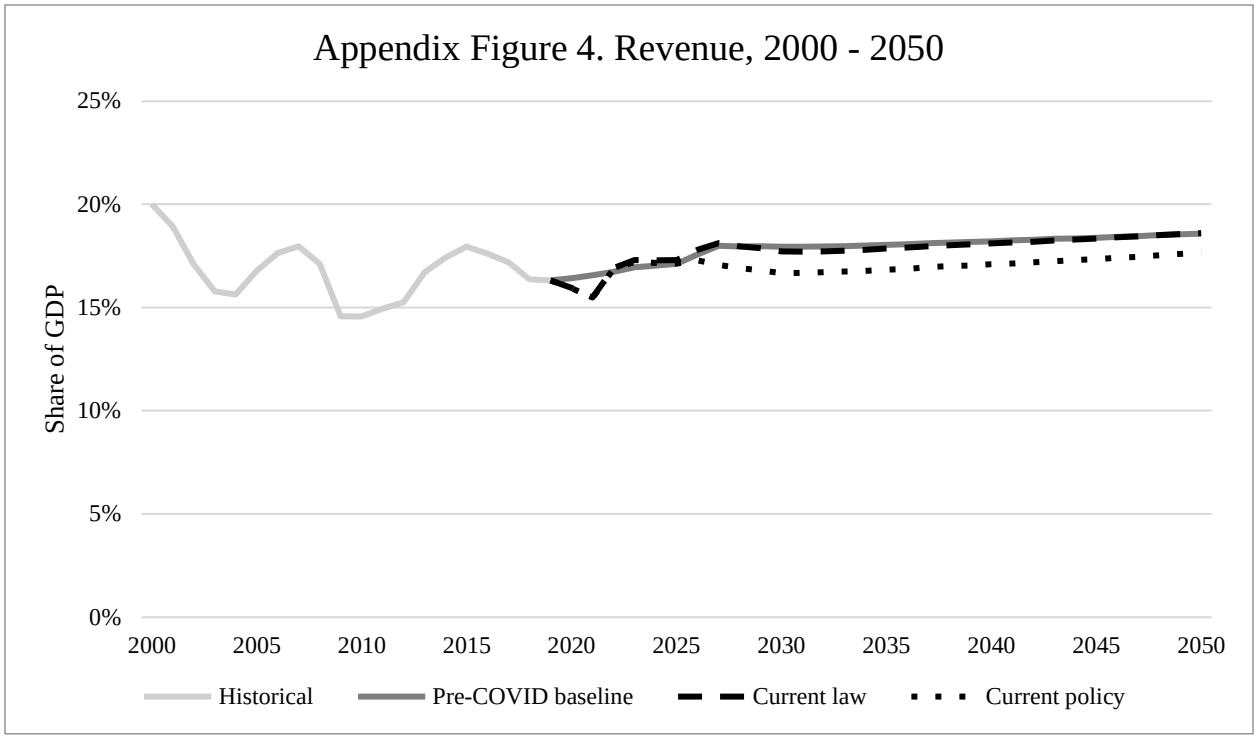
Appendix Table 9. Distribution of Aid as a Share of Own Source General Revenues, 2020

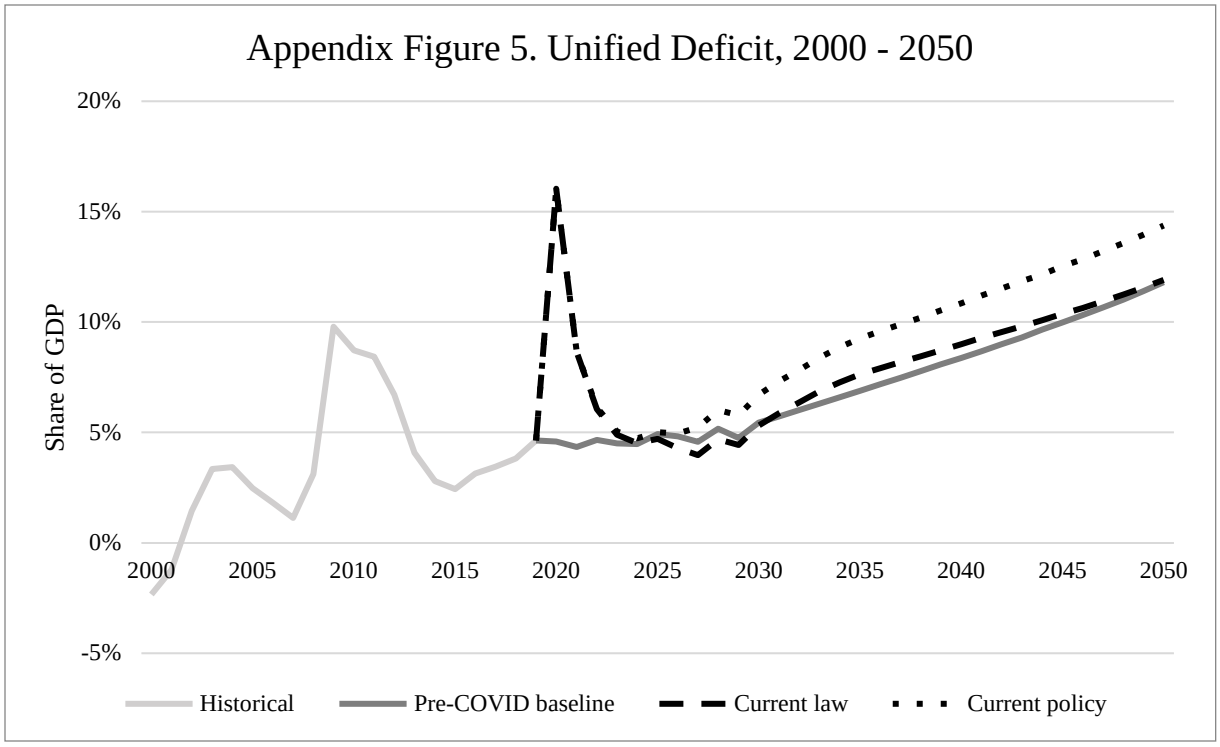
	Aid Excluding Hospitals and Higher Ed	Aid to Hospitals and Higher Ed		Aid Excluding Hospitals and Higher Ed	Aid to Hospitals and Higher Ed
AL	7.7%	2.0%	MT	20.6%	3.8%
AK	16.1%	0.9%	NE	9.1%	2.1%
AZ	9.2%	1.7%	NV	7.9%	1.2%
AR	8.5%	2.4%	NH	13.2%	1.7%
CA	5.8%	0.9%	NJ	6.4%	1.9%
CO	6.2%	1.1%	NM	10.8%	1.7%
CT	5.8%	1.2%	NY	6.0%	1.9%
DE	16.5%	1.9%	NC	7.4%	1.5%
DC	11.2%	0.9%	ND	16.6%	1.9%
FL	7.7%	1.5%	OH	6.9%	1.3%
GA	8.7%	2.1%	OK	8.1%	2.4%
HI	9.0%	0.8%	OR	6.2%	1.2%
ID	13.6%	1.6%	PA	7.2%	1.2%
IL	7.1%	1.6%	RI	15.6%	1.1%
IN	7.6%	1.8%	SC	7.1%	1.5%
IA	5.0%	1.5%	SD	22.5%	3.1%
KS	6.2%	2.0%	TN	9.3%	2.2%
KY	8.5%	2.2%	TX	7.7%	1.3%
LA	8.0%	2.5%	UT	6.9%	0.9%
ME	14.4%	1.9%	VT	23.5%	1.5%
MD	6.4%	1.3%	VA	6.2%	1.1%
MA	6.6%	1.5%	WA	6.0%	1.2%
MI	6.9%	2.1%	WV	12.2%	3.1%
MS	5.7%	1.1%	WI	6.8%	1.3%
MN	14.3%	3.4%	WY	19.8%	1.6%
MO	5.5%	1.8%			
TOTAL	7%	1.5%			


Appendix Figure 1. Real GDP, 2020 - 2050
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Billions of 2019$
2020
2025
2030
2035
2040
2045
2050
Pre-COVID baseline
Current Projection

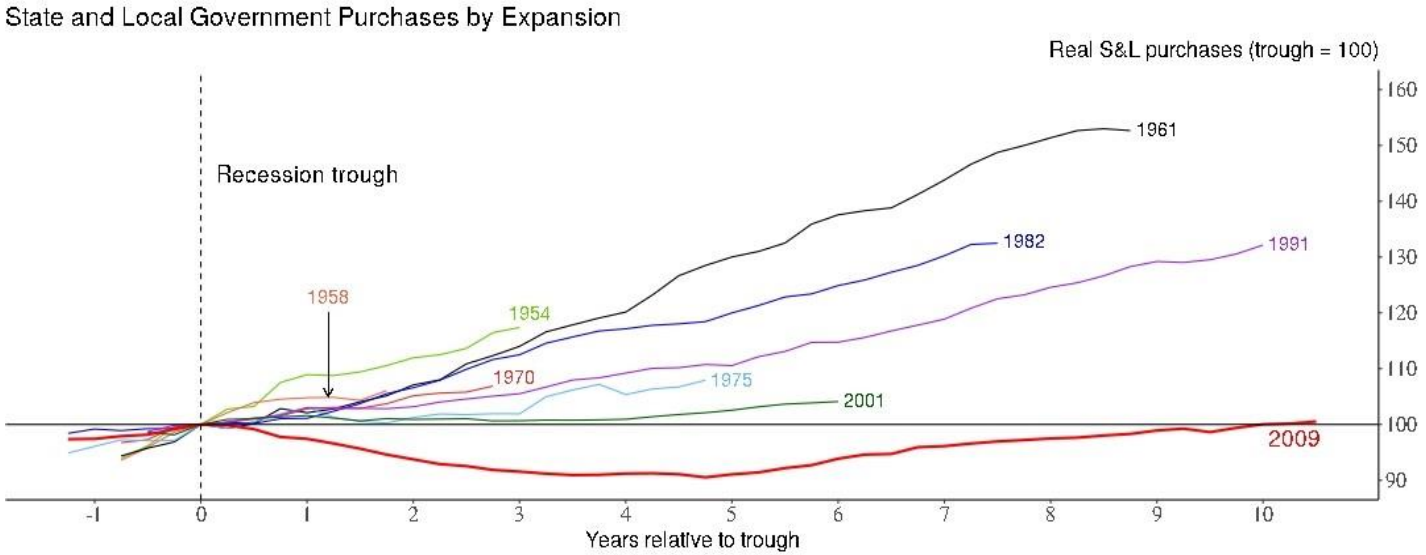

Appendix Figure 2. Effective Interest Rate, 2000 - 2050
Interest Rate
6%
5%
4%
3%
2%
1%
0%
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Historical
Pre-COVID baseline
Current law


Appendix Figure 3. Non-Interest Spending, 2000 - 2050
Share of GDP
35%
30%
25%
20%
15%
10%
5%
0%
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Historical
Pre-COVID baseline
Current law
Current policy


Appendix Figure 4. Revenue, 2000 - 2050
25%
20%
15%
10%
5%
0%
Share of GDP
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Historical
Pre-COVID baseline
Current law
Current policy

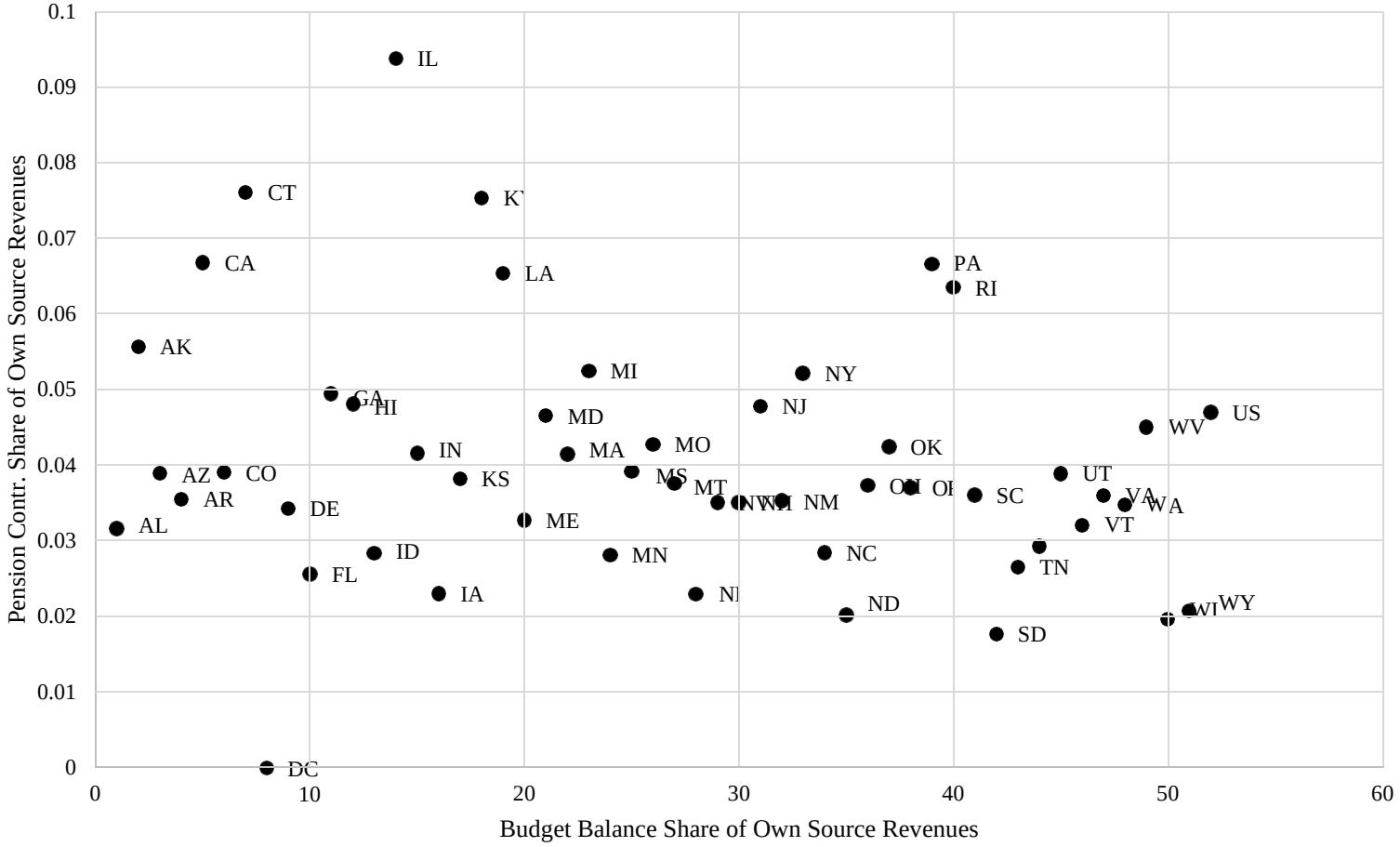

Appendix Figure 5. Unified Deficit, 2000 - 2050
20%
15%
10%
5%
0%
-5%
Share of GDP
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Historical
Pre-COVID baseline
Current law
Current policy

Appendix Figure 6. State and Local Government Purchases by Expansion



Note: The year labels attached to each line refer to the starting year of the expansion as defined by the National Bureau of Economic Research.
Source: Bureau of Economic Analysis.

Appendix Figure 7. State Pension Contribution Shares and Budget Balances



Appendix Figure 8. Ratio of Taxsim/CPS per Capita to Actual Tax Revenues (Dollars)