The Fiscal Cost of COVID-19

Evidence from the States

Christos A. Makridis and
Robert M. McNab

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Author Affiliation and Contact Information

Christos A. Makridis
Professor, Arizona State University, MIT Sloan
christos.a.makridis@gmail.com

Robert M. McNab
Professor, Old Dominion University
rmcnab@odu.edu

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In response to the COVID-19 pandemic, the Mercatus Center has commissioned this series of working papers and policy briefs to promote effective ideas among key decisionmakers. To ensure a timely response to the global COVID-19 pandemic, this working paper has been exempted from the Mercatus Center's normal standards and processes for working papers and is being published without peer review. Working papers present an author's provisional findings and may be significantly revised before formal publication. The opinions expressed in Mercatus Working Papers are the authors' and do not represent official positions of the Mercatus Center or George Mason University.

Mercatus Center at George Mason University
3434 Washington Blvd., 4th Floor
Arlington, VA 22201
www.mercatus.org
703-993-4930

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The Fiscal Cost of COVID-19: Evidence from the States

Christos A. Makridis and Robert M. McNab

Abstract: How has the COVID-19 pandemic affected state budgets? Using a quarterly panel of states between 1994 and 2019, we estimate how changes in employment affect tax revenues. We find that a one percentage point (pp) rise in employment is associated with a 1.56pp rise in total tax revenue, which is concentrated among sales taxes (a 1.19pp increase), individual income taxes (a 1.63pp increase), and corporate income taxes (a 4.13pp increase). These results are robust to a wide array of controls, such as state composition and housing price growth, and to instrumental variable specifications. After estimating state-specific elasticities and forecasting counterfactual employment within states using the most recent data, we find that the average state will experience a 6.7% decline in its tax revenues under an optimistic scenario, culminating in $79.9 billion lost in total aggregate revenue for the United States, or a 11.1% decline under a pessimistic scenario, culminating in $125.2 billion lost in total.

JEL codes: E62, H24, H71, H72, J21

Keywords: budgets, COVID-19, employment, state and local tax policy

1. Introduction

In the absence of a vaccine or effective therapeutics, governments responded to the spread of COVID-19 (the disease caused by the severe acute respiratory syndrome coronavirus 2, or SARS-CoV-2) with a range of nonpharmaceutical interventions (NPIs) including but not limited to closing schools, limiting or closing businesses deemed nonessential, and imposing variations of stay-at-home orders. While the benefits of these NPIs are difficult to measure (Ferguson et al., 2020; Flaxman et al., 2020; Hsiang et al., 2020), the economic consequences of COVID-19 have been severe in the United States. Consumer demand, business investment, employment, and consumer and business expectations remain depressed relative to pre-COVID levels, even with many states and localities relaxing NPIs (Bartik et al., 2020; Cajner et al., 2020; Coibion et al., 2020). State governments, which typically experience revenue declines and increases in the demand for public services during periods of economic contraction, have historically petitioned the federal government for financial relief (Campbell & Sances, 2013; Jordan et al., 2015).

To understand the effect of the COVID-19 pandemic and NPIs on state tax revenues, we assemble a quarterly state panel between 1994 and 2019 to recover an elasticity between employment and tax revenues. While there are unobserved factors that might affect tax revenues and employment, we control for time-varying changes in the demographic composition of a state and other potential shocks, including fluctuations in the price of housing. In addition to instrumenting for employment growth using an Arellano and Bond (1991) approach to address reverse causality, we also follow Goldsmith-Pinkham et al. (in press) in constructing a Bartik-like instrument that exploits states' exposure to industries between 2000 to 2003 to different national trends in these sectors. If anything, our estimated elasticities are slightly larger than the baseline results.

Our results suggest that a one percentage point (pp) rise in employment growth is associated with a 1.56pp rise in tax revenue growth, concentrated among sales taxes (1.19pp increase), individual income taxes (1.63pp), and corporate income taxes (4.13pp). We subsequently estimate state-specific elasticities. Drawing on state unemployment insurance claims as of June 5, 2020, we use these elasticities to forecast the implied tax revenue shortfall for each state. Under a counterfactual where each state would have grown its employment according to trend levels between 2014 and 2019, we compute the lost revenues. Our "optimistic" estimate suggests that the average state will have revenues 6.7% lower as a result of the estimated employment declines, which totals to a loss of $79.9 billion nationally in 2012 prices. Our "pessimistic" estimate suggests that the average state will have revenues 11.1% lower, which totals to a loss of $125.2 billion nationally.[1]

While our approach cannot account for spatial reallocation that arises in general equilibrium (Beraja et al., 2019), the COVID-19 economic shock is distinctive given the rapid expansion of a global pandemic, the failure of the federal government to effectively respond to the emerging pandemic, the synchronized economic shock across states, and the heterogeneous implementation of NPIs by states in an attempt to control the spread of virus. Traditional macroeconomic approaches that argue that a union diversifies risk for one unit based on revenues from the whole are not applicable in such an environment (Farhi & Werning, 2017). Moreover, because we use disaggregated state data, our paper improves upon prior literature that may otherwise find evidence of an acyclical response due to reallocation factors across states (Vegh & Vuletin, 2015).

The contribution of our paper is straightforward. First, our work contributes to the rapidly emerging literature regarding the outcomes associated with the COVID-19 pandemic and NPIs. Second, our work is among the first, to our knowledge, to quantify the impact of the pandemic—mediated through employment declines—on state revenues. The literature notes, for example, that mortality benefits from NPIs are large in magnitude and concentrated among older individuals but that a possibility exists that net benefits associated with NPIs may be negative (Greenstone & Nigam, 2020; Thunstrom et al., 2020). Whether net benefits associated with NPIs are negative rests on the severity of the economic downturn and the speed of recovery. As declines in employment and output will undoubtedly surpass those of the Great Recession

[1] To the extent that state budgets are affected in ways not captured by employment, our estimates could be downwards or upwards biased. However, employment is frequently used as a proxy for business cycle shocks and the severity of employment declines. For example, see Hershbein and Kahn (2018).

(Makridis & Hartley, 2020; Guerrieri et al., 2020), exploring the impact of COVID-19 on state revenues will shed light on the consequences.

Our paper also contributes to a larger literature about the cyclicality of tax revenues. For example, using a sample of 62 countries from 1960 to 2013, Vegh and Vuletin (2015) find that tax revenues are acyclical in industrial countries and procyclical in developing countries. However, there is much more heterogeneity across states based on differences in, for example, the relative sales tax rates, which are sensitive to cuts in consumption and consumer demand. For example, McGranahan and Mattoon (2012) find that state tax revenues have become more volatile since the 1980s, focusing heavily on the general sales tax and individual income tax as the two primary sources for state budgets. Our paper also complements existing time series approaches to estimating the impact of macroeconomic shocks on state and local budgets, as in Ghysels et al. (2019), who incorporate high and low frequency information into an ADL-MIDAS model.

The structure of our paper is as follows. Section 2 introduces the data and measurement strategy. Section 3 discusses the empirical specification and identifying assumptions. Section 4 presents the main results. Section 5 investigates heterogeneity in the elasticity of tax revenues to employment. Section 6 leverages these elasticities with two scenario forecasts to compute the effects of the pandemic on state budgets. Section 7 concludes.

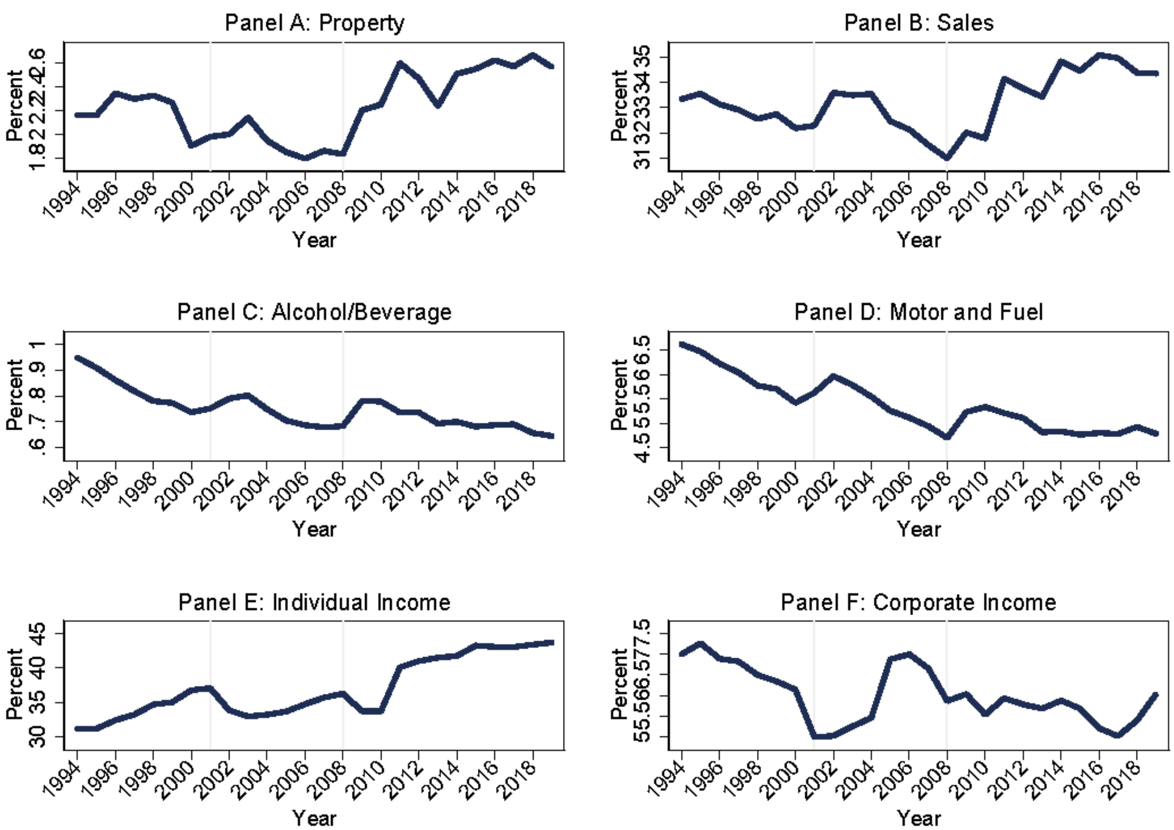
2. Data and Measurement

Quarterly State Employment and Taxes

We construct our panel of quarterly employment and tax revenues from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) and Table 3 of the United States Census Bureau's Quarterly Summary of State and Local Government Tax Revenue

(QTAX). Using non-seasonally-adjusted data, we construct a quarterly panel from 1994 to 2019. Figure 1 illustrates the time series patterns of different categories of tax revenues. First, we see a general increase in the share of tax revenues coming from sales and individual income taxes, compared with a decrease in motor and fuel taxes and corporate income taxes. Second, we see that sales, individual income, and corporate tax revenues are among the most cyclical and responsive to aggregate shocks, such as the 2001 and 2008–2009 recessions.

Figure 1. State Taxes as a Percentage of Total State Revenue, 1994–2019



Note: The figure plots the share of tax revenues coming from category *k* of taxes.

Source: Quarterly Census of Employment and Wages, Census Bureau QTAX, 1994–2019.

Quarterly Housing Values

We obtain monthly housing values from the Zillow Home Value Index (ZHVI). The full ZTRAX dataset contains more than 370 million public records from across the United States and includes information on deed transfers, mortgages, and property characteristics, as well as geographic information for residential and commercial properties. We use mean housing value by quarter and note that this series is highly correlated with the Federal Housing Finance Agency's House Price Index at an annual frequency (Bogin et al., 2019).

State Regulatory Restrictions

While the literature is replete with analyses of the effects of specific regulations, comprehensive measurements of regulation across states, sectors, or time are relatively scarce. However, recent data, made available through the Mercatus Center at George Mason University, estimate regulatory restrictions across industries based on the *Code of Federal Regulations* (C.F.R.) (Al-Ubaydli & McLaughlin, 2017). Al-Ubaydli and McLaughlin conduct natural language searches for the presence of binding constraints and assign these constraints to different sectors of the economy.[2] Together with the regulatory restriction counts, this produces a weighted aggregation of regulatory restrictions annually by state.[3] However, since not all states have made their regulatory registers available for each year, we take an average for those states with multiple observations using data between 2015 and 2019 to create a time-invariant measure that covers 47 states.

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[2] The binding constraint terms include binding constraints, specifically through the following words: "shall," "must," "may not," "required," and "prohibited." Using a logit-based classifier, they obtain probabilities for each code section.

[3] Other aggregations of the data exist, especially at a NAICS year level, but we focus on the state aggregation so that we can test for heterogeneity in states with high versus low levels of regulatory restrictions. We also recognize that there are other ways of measuring regulation, including page counts from the Code of Federal Regulation (C.F.R.) as in Mulligan and Shleifer (2005) and Dawson and Seater (2013).

Quarterly State Demographics

To control for the composition in a state over time, we use the monthly Current Population Survey (CPS) Outgoing Rotation Group (ORG). The CPS-ORG files provide quarterly samples that report weekly earnings and hours worked, in addition to the standard CPS information on demographics. We specifically control for the log of the state population, the share who are male, the share who are White, the share who are Black, the share who are Hispanic, and the age distribution (share under 18, 18–29, 30–44, and 65+, normalized to ages 45–64).

3. Empirical Strategy

To understand the relationship between tax revenues and employment growth, we estimate panel regressions of the following form:

$$r_{st}^{k} = \gamma \Delta e_{st} + \beta D_{st} + \varphi_{s} + \lambda_{t} + \epsilon_{st}, \tag{1}$$

where r^k denotes the measure of tax revenues for category k in state s and quarter t, e denotes our measure of employment, D denotes a vector of demographic controls (e.g., population), and φ and λ denote fixed effects on state and year-quarter. Standard errors are clustered at the state level to allow for arbitrary degrees of autocorrelation (Bertrand et al., 2004). We present estimates of Equation (1) using both logged levels and year-to-year growth rates for tax revenues and employment to highlight the robustness of our main results.

There are at least two potential concerns with estimating the elasticity of employment to tax revenues in Equation (1) that could bias γ in either direction. First, reverse causality could generate upward bias if increases in tax revenues lead to an expansion of government services, which not only raises state and local employment but also generates a fiscal multiplier that spills over to other sectors (Chodorow-Reich et al., 2012). Second, the presence of time-varying omitted variables could generate either upward or downward bias depending on the specific unobserved factors. On one hand, a decrease in housing wealth could generate a decline in employment (Mian & Sufi, 2014). On the other hand, a decline in the marginal tax rate (or other state taxes) could generate a surge in business activity that raises employment.[4]

We address these concerns in three ways. First, we control directly for potential confounding effects, such as population growth (e.g., migration out of a state) and housing price growth. We show that our main estimates are fairly invariant to the inclusion of these controls, which we interpret as a comforting diagnostic that our estimates do not reflect omitted variables bias. Second, we instrument employment or employment growth with one-, two-, three-, and four-quarter lags of either employment or employment growth following Arellano and Bond (1991). Third, we implement a classic Bartik-like instrument that exploits the exposure of states to different national employment trends across industries. Following Goldsmith-Pinkham et al. (in press), we show that our main test of the exogeneity in the employment shares holds.[5]

While our two instrumental variables approaches have very strong first-stage results, they are susceptible to potential violations over the exclusion restriction. For example, persistent shocks to state employment and revenue growth could bias the Arellano and Bond (1991) instrument. Similarly, a correlation between industry employment shares as of 2000–2003 and unobserved shocks to tax revenues from 2004–2009 could bias the Bartik instrument. These concerns are possible, but we present these instrumental variables results as additional robustness checks. Moreover, we have investigated correlates of the state industry employment shares and potential

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[4] While tax revenues could increase in the long run as a result of a broadened tax base, the short-run effect on tax revenues could still be negative.

[5] Specifically, we compute the IV as follows: $BARTIK = \sum_j (e_{s,j,2000}/\Delta e_{jt})$ where j denotes the industry, s denotes the state, $e_{s,j,2000}$ denotes the employment share of an industry in a state between 2000–2003, and $\Delta e_{j,t}$ denotes national year-to-year employment growth in an industry.

unobserved shocks to tax revenues. We find no correlation between these state employment shares and average per capita income or year-to-year per capita income growth between 1994 and 2019.

4. Main Results

Table 1 (page 24) documents the results associated with Equation (1). We present the results using both logged levels and growth rates of tax revenues and income for three measures of tax revenues— total taxes, sales tax, and the individual income tax—because these are the most relevant and largest quantities that would respond to the national quarantine shock.

Starting with total tax revenues, we see that a 1% rise in employment is associated with a 1.3%–1.65% rise in total tax revenues depending on whether we control for time-varying state demographics. If, for example, increases in employment also attract lower-skilled workers—since increasing employment opportunities attracts a more diverse set of workers—then failing to control for these composition effects could create downward bias, much like the literature on estimating the cyclicality of real wages (Solon et al., 1994; Haefke et al., 2013).

Turning towards estimates of Equation (1) in terms of growth rates of tax revenues and employment, we find almost identical results: a 1pp rise in employment growth is associated with a 1.56pp rise in tax revenues. The difference between the estimate obtained with and without controls is statistically insignificant since identification is coming off of deviations from the trend growth rate, rather than deviations from the trend levels.

We also see similar elasticities for sales tax revenues. For example, a 1% rise in employment is associated with a 1.29% increase in sales tax revenues (column 6). Similarly, a 1pp rise in employment growth is associated with a 1.19pp rise in sales tax growth. We also see a slight increase in the magnitude of our coefficient estimate on employment when we control for state demographics, but the estimates are not statistically different from one another.

Finally, we turn toward potential effects on individual income tax revenues. While there is only a statistically and economically weak association when we focus on tax revenues and employment levels, we find a similar economically and statistically significant effect when focusing on their growth rates: a 1pp rise in employment growth is associated with a 1.63pp rise in individual tax revenues. Unlike overall and sales tax revenues, individual income tax revenues might be more inelastic in the short run, meaning that level differences take more time to respond, whereas the growth rates are more elastic. We will also present results in Section 5 that corporate income tax revenues exhibit a similar pattern.

Before continuing, we pause to consider the role of fluctuations in the housing market as a potential omitted variable. When our outcome is logged total tax revenues, the inclusion of the logged housing price, on top of existing controls and fixed effects, changes the gradient on logged employment from 1.65 to 1.46. While they are both significant at the 1% level, we fail to reject the null that the specifications produce identical estimates. Furthermore, when our outcome variable is the year-to-year growth in tax revenues, the inclusion of year-to-year growth in housing prices, on top of existing controls and fixed effects, does not alter the coefficient on employment growth: it remains at 1.56. Because of the invariance of our estimates to the inclusion of housing prices, we omit it in our baseline specification.

We now turn toward several instrumental variables specifications in Table 2 (page 25) under our two different approaches for total tax and sales tax revenues as our outcome variables. The one difference is that we restrict our sample to 2004–2019 since our Bartik-like instrument is constructed using average employment shares from 2000–2003. Columns 1–2 and 6–7 present our elasticities without instruments as a point of comparison for our IV specifications.

Starting with our lagged Arellano and Bond (1991) instrument, we find little change: a 1% rise in employment is associated with a 1.78% increase in total tax revenues, rather than a 1.98% increase. This is consistent with reverse causality creating some upward bias. We also find little difference when we use the growth rate of tax revenues and employment: a 1pp rise in employment growth is associated with a 1.54pp increase in tax revenues, rather than a 1.74pp increase. These same results go through for sales taxes as the outcome variable both in terms of levels and growth rates.

Turning toward our Bartik-like instrument in columns 5 and 10, we see a slightly larger elasticity: a 1pp rise in employment growth is associated with a 1.98pp and 2.07pp rise in total tax revenues and sales tax revenues, respectively, rather than a 1.74pp and 1.61pp rise. One reason for the higher elasticity here stems from potential omitted variables. On one hand, if increases in employment growth also attract higher skilled workers who pay more in taxes—buying more expensive homes that deliver greater property tax revenues or purchasing more goods that deliver greater sales tax revenues—then we might obtain an upward biased estimate. On the other hand, if declines in the marginal tax rate increase business activity and decrease tax revenues, then we might obtain a downward biased estimate.

One of the important concerns (and frequent limitations) to Bartik instruments is that the employment shares are correlated with unobserved time-varying shocks to the outcome variable of interest. That is, if states have higher employment shares in industries that have higher productivity growth, then the Bartik instrument could generate upward bias. While the exclusion restriction is impossible to test, we investigate the correlation between the state × NAICS2 employment shares and the growth in real output between 2005 and 2019. If anything, we find a negative correlation of −0.15, which would generate downward bias in our estimate, leading us to conclude that this is not a major threat to identification.

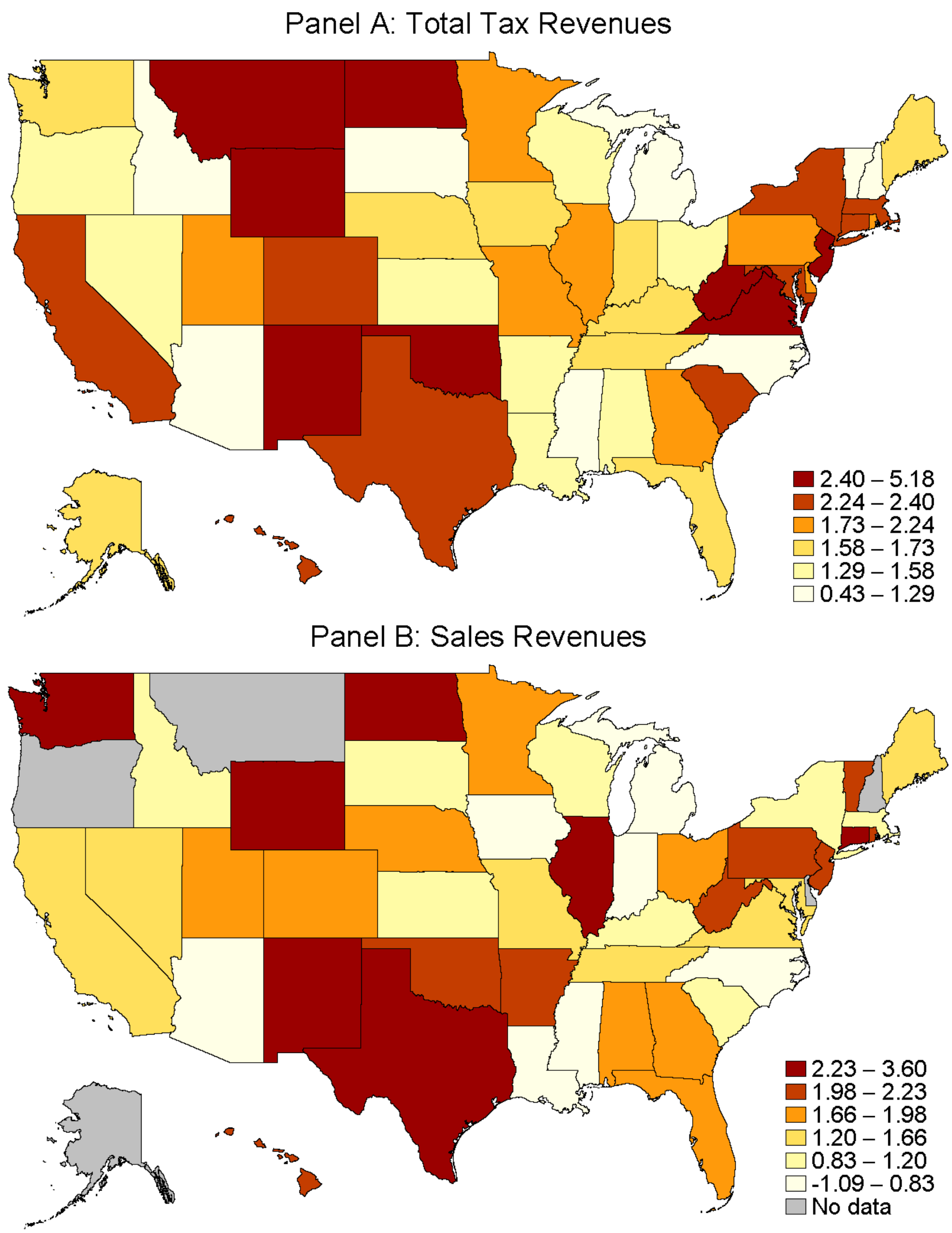
5. Heterogeneity

We now allow for much greater heterogeneity in the elasticity of tax revenue growth to employment growth by estimating Equation (1). We present two sets of exercises. The first begins by estimating separate elasticities for each tax revenue category. While there are more categories of taxes than we can enumerate accessibly here, we focus on five salient ones: property, sales, motor and fuels, individual income, and corporate income. We include sales and individual income taxes for reference.

Table 3 (page 26) documents these results. We see a positive association between employment and property tax revenue (column 1), but the estimate is statistically insignificant. Moreover, once we put the regression in terms of growth rates, we find an even more insignificant elasticity (column 2). Turning toward motor and fuel taxes, we see that a 1% rise in employment and a 1pp rise in employment growth is associated with a 1.17% rise in motor and fuel tax revenue and a 0.72pp rise in its growth rate. While smaller in magnitude than sales, individual income, and corporate income tax bases, the elasticity is still economically and statistically significant. Finally, we see that corporate income has the greatest elasticity, which is consistent with prior literature about the sensitivity of corporate income to the business cycle (McGranahan & Mattoon, 2012).

We now turn toward geographic heterogeneity by estimating the elasticity of tax revenue *growth* to employment *growth* separately for each state. These elasticities are summarized in Figure 2. We see significant heterogeneity with states having an elasticity of tax revenue growth as low as 0.43 and as high as 5.18. These differences imply that some state budgets are much more responsive than others to employment fluctuations.

Figure 2. State-Specific Elasticities of Tax Revenues to Employment (Growth)



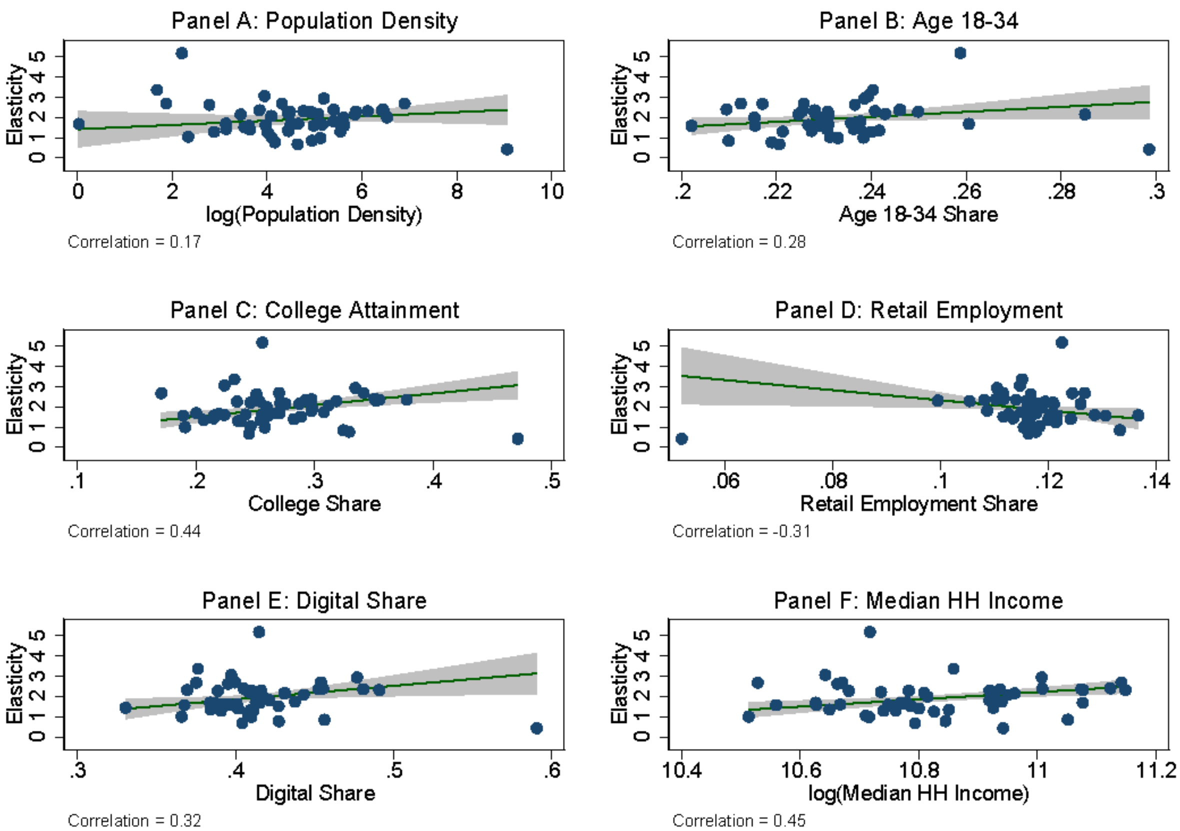
Note: The figures report the coefficients associated with state-specific regressions of total tax revenues and sales tax revenues on employment all in year-to-year growth rates.

Source: Quarterly Census of Employment and Wages, Census Bureau QTAX, 1994–2019 (quarterly).

To understand the dispersion in these elasticities, we estimate cross-sectional regressions of these elasticities on six geographic characteristics: logged population density, the share of individuals between age 18 and 34, the share of individuals with at least a college degree, the share working in retail trade, the share of digitally-intensive workers (Gallipoli & Makridis, 2018), and logged median household income. We focus on these characteristics because there exists a larger literature on heterogeneity in the responsiveness of consumption to macroeconomic shocks. We present these correlations across states, weighted by population.

Figure 3 documents these correlations. We see a positive correlation between the elasticity of tax revenues and population density, the share of individuals between age 18 and 34, college attainment, and median household income. These correlations are expected because of a literature about consumption in cities (Glaeser et al., 2001)—younger, higher skilled, and higher income individuals adjusting consumption more in response to macroeconomic shocks (Wong, 2020; Graham & Makridis, 2020). Surprisingly, the retail and digital shares of employment are correlated in the opposite direction with the elasticity. For example, areas with greater shares of retail employment could respond more elastically because of the closer correspondence between output and consumption (e.g., in-person services), whereas areas with greater shares of digital employment could respond less elastically since the digital economy is less dependent on what happens locally. However, retail employment is negatively correlated and digital employment is positively correlated with income. Workers in retail sectors may have less disposable income to allocate towards consumption, thereby generating lower elasticities.

Figure 3. Correlations between State Elasticities and Characteristics



Note: The figure plots the correlation (weighted by state population) obtained from the state-specific elasticities estimated in Figure 2 with the logged population density, the share of individuals age 18 to 34, the share of college degree workers (or more), and the share of retail workers.

Source: US Census Bureau, Five-Year American Community Survey (2005–2009) and authors' calculations.

In addition to these demographic and industry factors, we also investigate three additional dimensions of heterogeneity: state dependence based on the size of the employment change and the time period, the stringency of state regulation, and the dependency of the state on taxation. We find fairly weak evidence of heterogeneity. For example, while there is an added 0.16pp effect on an interaction for employment growth above 1pp, it is not statistically significant (*p*-value = 0.491). Similarly, we find that states above the median ratio of regulatory restrictions to words in their regulatory documents (a way of normalizing for the size of regulation across states) have an additional 0.19 for every additional increase in employment growth; the *p*-value is 0.373.

We do not find evidence of state dependence when we interact an indicator for recessions in years 2001 and 2008–2009 with employment growth. However, we do find that a 1pp rise in employment growth is associated with an additional 0.40pp rise in tax revenue growth (*p*-value = 0.064) in states with above the median tax revenues per capita, producing an overall 1.72pp rise in tax revenue growth. These results provide suggestive evidence that state regulations, and to a larger extent the fiscal institutions, play an important mediating effect in understanding the responsiveness of tax revenues to business cycle fluctuations.

6. Aggregation and Implications for COVID-19

Although data on state tax revenues will take months to be made publicly available, we can use our estimated elasticities to conduct a back-of-the-envelope exercise on the aggregate and state-level effects of the pandemic and resulting national quarantine on state budgets, drawing on recent state-specific data on unemployment insurance claims and continuing claims.

First, we estimate counterfactual employment for 2020 by computing the average trend year- to-year growth on quarterly employment data for each state between 2010 and 2019. We use that growth rate to project state employment into 2020. This represents the employment that would have prevailed in the absence of the COVID-19 pandemic. Second, we use state employment from January to June 2020, focusing on the most recent round of data from May to June, to estimate the likely level of employment that will prevail for 2020 under current conditions.

To do the latter, we compute an "optimistic" scenario that allows for continued economic recovery, as well as a "pessimistic" scenario that allows for a slower rise in economic activity.

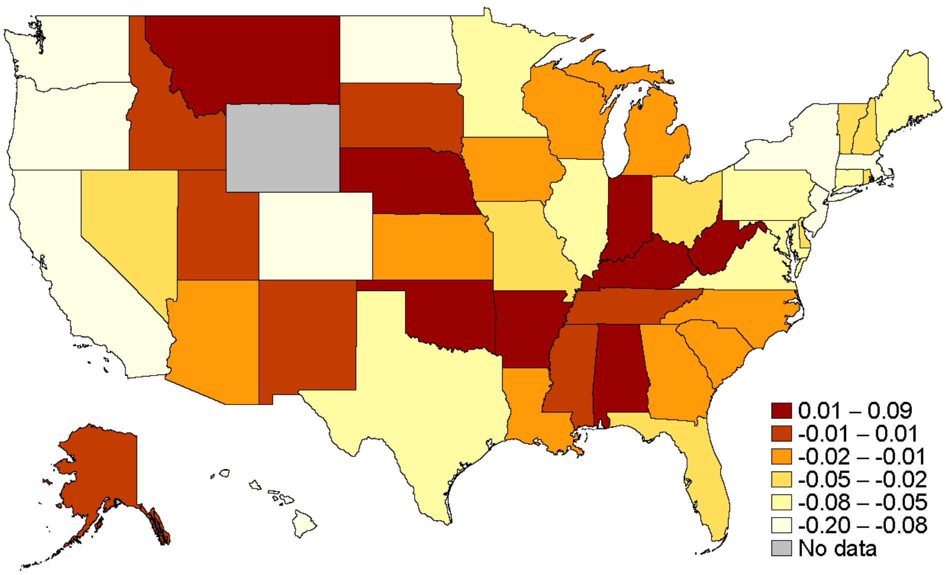
Since we only observe employment for the first two quarters of 2020, we must forecast the third and fourth quarters. In our optimistic scenario, we assume that third and fourth quarter employment grow at 75% and 50% the rate of the growth between May and June. This reflects the fact that we may continue seeing a recovery in employment, but the rebound will begin to slow down. In our pessimistic scenario, we assume that third and fourth quarter employment grow at 25% and 50% the rate of growth between May and June. This reflects the fact that some states may decide to introduce new business closure and stay-at-home policies that dampen economic activity if the virus does not subside. Admittedly, we realize these assumptions are fragile and merely illustrative.

Using these two quantities, we compute the percent change between actual and counterfactual employment for 2020 and multiply it by the elasticity obtained from our state-specific regressions of tax revenue growth on employment growth. Figure 4 documents these results. The population-weighted average decline in state tax revenues under the optimistic scenario is 6.7%, whereas it is 11.1% under the pessimistic scenario. Summing across all states, the optimistic and pessimistic scenarios imply national revenue declines of $79.9 and $125.2 billion, respectively. While these estimates are broadly in line with some of the calculations from the National Conference of State Legislatures, they are smaller than the $150 billion that was set aside for states and local governments through the Coronavirus Relief Fund.[6]

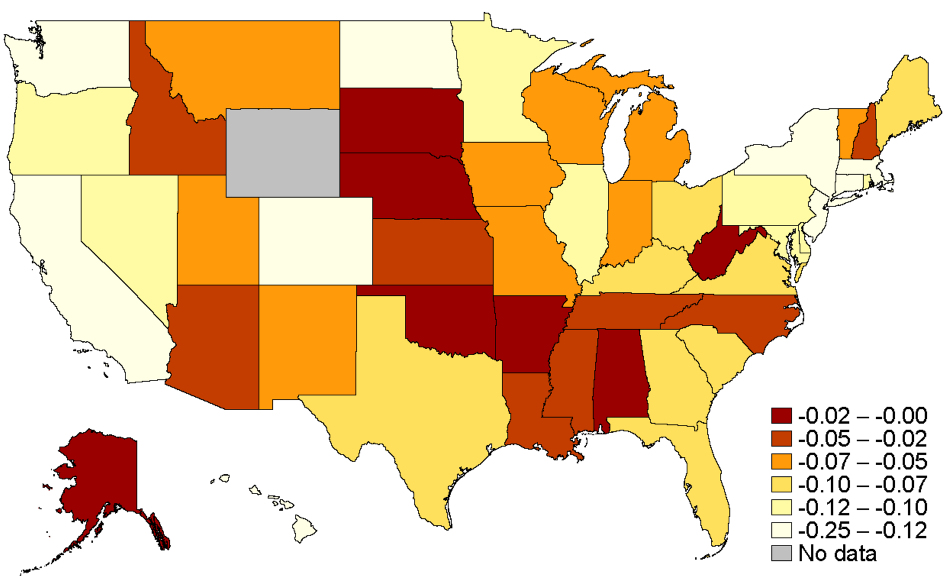
[6] National Conference of State Legislatures. (n.d.). *COVID-19 revised state revenue declines percent of pre-COVID projections fiscal year*. NCSL Fiscal Policy. Retrieved July, 2020, from https://www.ncsl.org/research/fiscal-policy/coronavirus-covid-19-state-budget-updates-and-revenue-projections637208306.aspx.

Figure 4. Counterfactual Estimation of State Tax Revenue Declines from the Pandemic

Panel A: Baseline Scenario



Panel B: Pessimistic Scenario



Note: The figure plots the estimated decline in tax revenue across states under the baseline and pessimistic scenarios. First, we estimate counterfactual employment for 2020 by projecting 2019 state-level employment forward using the average trend year-to-year growth on quarterly employment data for each state between 2010 and 2019. Second, we use state employment from January to June 2020, focusing on the most recent round of data from May to June, to estimate the likely level of employment that will prevail for 2020 under current conditions. To do the latter, we compute an "optimistic" scenario that allows for continued economic recovery, as well as a "pessimistic" scenario that allows for a slower rise in economic activity. Since we only observe employment for the first two quarters of 2020, we must forecast the third and fourth quarters. In our optimistic scenario, we assume that third and fourth quarter employment grow at 75% and 50% the rate of the growth between May and June. In our pessimistic scenario, we assume that third and fourth quarter employment grow at 25% and 50% the rate of growth between May and June. Third, using these two quantities, we compute the percent change between actual and counterfactual employment for 2020 and multiply it by the elasticity obtained from our state-specific regressions of tax revenue growth on employment growth.

Source: Authors' calculations.

How do our projections for employment line up with alternative forecasts? The Congressional Budget Office (CBO) projected that nonfarm payrolls would fall from 151.8 million in the fourth quarter of 2019 to 128.8 million in the second quarter of 2020 and then rise to 130.3 million in the third quarter of 2020 (CBO, 2020).[7] However, employment rose to 137.2 million in June, beating market and CBO expectations. While our optimistic projection of 144 million by the third quarter is admittedly more optimistic than the CBO estimate, it seems reasonable when put into perspective with the fact that their forecast for the second quarter was too pessimistic.

As states grapple with the immediate revenue impacts of the COVID-19 pandemic and recession, there remains the question of how to accurately project the nascent recovery through the remainder of 2020. Employment data from May and June may lead one to an overly optimistic conclusion as these months saw the relaxation of stay-at-home orders and other social distancing measures. These increases in employment and retail sales, for example, might suggest a relatively robust recovery through the end of 2020. Our most optimistic projections thus assume that the gains in May and June will continue through the remainder of the year. This assumption undoubtedly places an upper bound on the recovery in economic activity and state revenues.

Yet as with everything else, COVID-19 gets a vote, so to speak, on the pace and scope of economic recovery. The rapid increases in infections, hospitalizations, and deaths in Arizona, Florida, Texas, and other states have illustrated that reopening is a dynamic process. Monthly employment data reflect the reference week of the Current Population Survey and, in this case, may be relatively "stale" with regard to current economic conditions. Data from Chetty et al. (2020) suggest that employment and output are contracting in the highest infection states, so our

[7] Clemens and Veuger (2020) also provide an extension of the CBO estimates for state budgets under different scenarios, discussing the various policy options to fill the anticipated gap.

optimistic scenario must be tempered by this fact. Without concerted action with respect to universal masking, increased testing, tracing, and isolating known cases, it is probable that COVID-19 infections will increase in the coming months. In response, states may roll back reopening plans, further decreasing economic activity. And this does not account for the impact of influenza season, which may further strain public health resources and the ability of hospitals to accommodate patient demand. In this environment, our pessimistic projection is that growth effectively stalls through summer and mildly appreciates in the fall of 2020.

We recognize that our projections are subject to a great deal of uncertainty. If vaccine trials are successful, we would likely see increased economic activity at the end of 2020 and into 2021, assuming that supply chains can bring the vaccine to market. If more effective therapeutics become available, we would likely observe a similar impact. There is also the possibility that COVID-19 will mutate to a less virulent form. Of course, the converse of these optimistic events is also possible. Vaccine trials may fail, effective therapeutics may not come to market, and COVID-19 could become more infectious. Our inclusion of both pessimistic and optimistic scenarios is an attempt to provide a credible estimate for policy evaluation under the uncertainty in the following months.

7. Conclusion

The COVID-19 pandemic has had a significant impact on economic activity. While there is increasing empirical work regarding the effects on employment, consumption, and output, there is not yet any evidence on the consequences for state and local governments. After compiling new quarterly data across states from 1994 to 2019, we estimate the relationship between employment (and its growth) on tax revenues (and its growth). Our identification strategy controls for time-invariant differences across state and time, as well as time-varying state composition effects. Moreover, our results are robust to both an Arellano and Bond (1991) and Bartik approach.

We find that a 1% rise in employment and a 1pp rise in employment growth are associated with a 1.65% rise in tax revenue and a 1.56pp rise in tax revenue growth, respectively. These elasticities are slightly larger when we use a Bartik-like instrument to address the potential for time-varying unobserved shocks and slightly lower when we use lagged employment to address the potential for reverse causality. We find that these effects are driven primarily by sales, individual income, and corporate income taxes. We also find that the elasticity is greater in states with greater density, younger and more educated populations, higher income households, and more skilled workers. We also find some evidence that more regulated and higher taxation states exhibit greater sensitivity to labor market shocks.

Assuming our elasticity estimates from 1994 to 2019 are applicable to the most recent pandemic, a back-of-the-envelope calculation suggests that the average state will experience a 6.7% decline in lost revenues under an optimistic scenario, but a 11.1% decline in a pessimistic one. These new estimates provide direct guidance on an ongoing policy debate about the appropriate federal response to state and local budget deficits. Additional research is needed to assess whether the elasticity estimates obtained from 1994 to 2019 are externally valid for the COVID-19 period. Moreover, further research is needed to assess different trajectories for the recovery of tax revenues if the economy returns to trend more quickly than anticipated.

Appendix: Tables

Table 1. The Elasticity of Tax Revenue to Employment, 1994–2019

Dep. var. =	Total taxes				Sales tax				Individual income tax			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
log(Employment)	1.30***	1.65***			1.11***	1.29***			.17	.34		
	[.32]	[.39]			[.33]	[.44]			[.34]	[.36]		
Δ log(Employment)			1.57***	1.56***			1.22***	1.19***			1.61***	1.63***
			[.25]	[.24]			[.34]	[.33]			[.25]	[.27]
R^2	.97	.97	.20	.20	.99	.99	.13	.13	.98	.98	.18	.19
Sample size	5,304	5,304	4,906	4,906	5,124	5,124	4,421	4,421	5,057	5,057	4,245	4,245
State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Outcome var.	level	level	growth	growth	level	level	growth	growth	level	level	growth	growth

Note: The table reports the coefficients associated with regressions of logged tax revenues and their growth rate on logged employment and its growth rate, conditional on state, year, and quarter fixed effects, as well as a vector of time-varying demographic controls: logged state population, the share male, the share White, the share Black, the share Hispanic, the share college, and the age distribution (under 18, 18–29, 30–44, and 65+, normalized to ages 45–64).

Source: Current Population Survey, Quarterly Census of Employment and Wages, Census Bureau QTAX, 1994–2019 (quarterly).

Table 2. Robustness in the Elasticity of Tax Revenues to Employment, 2004–2019

Dep. var. =	Total taxes					Sales tax				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(Employment)	1.98***		1.78***			1.61***		1.47***		
	[.47]		[.46]			[.43]		[.46]		
Δ log(Employment)		1.74***		1.54***	1.98***		1.61***		1.69***	2.07***
		[.30]		[.31]	[.32]		[.47]		[.49]	[.47]
R^2	.96	.26	.96	.26	.26	.99	.18	.99	.19	.18
Sample size	3,264	3,141	3,264	3,045	3,141	3,086	2,849	3,086	2,756	2,849
F-statistic			4098	479	364			364	426	375
State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Outcome var.	level	growth	level	growth	growth	level	growth	level	growth	growth
Instrument	no	no	Blundell-Bond	Blundell-Bond	Bartik	no	no	Blundell-Bond	Blundell-Bond	Bartik

Note: The table reports the coefficients associated with regressions of logged tax revenues and their growth rate on logged employment and its growth rate, conditional on state, year, and quarter fixed effects, as well as a vector of time-varying demographic controls: logged state population, the share male, the share White, the share Black, the share Hispanic, the share college, and the age distribution (under 18, 18–29, 30–44, and 65+, normalized to ages 45–64). We consider instruments with one, two, three, and four quarter lags of employment or employment growth following Arellano and Bond (1991) and separately the classic Bartik-like approach following Goldsmith-Pinkham et al. (in press). We restrict the sample to 2004 and onward since we use the employment shares as of the average 2000 to 2003 employment shares.

Source: Current Population Survey, Quarterly Census of Employment and Wages, Census Bureau QTAX, 2004–2019 (quarterly).

Table 3. Heterogeneity in Employment Elasticities, by Tax Category, 1994–2019

Dep. var. =	Property		Sales		Motor and Fuel		Individual income		Corporate income	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(Employment)	.64		1.29***		1.17***		.34		1.50**	
	[1.03]		[.44]		[.33]		[.36]		[.71]	
Δ log(Employment)		−.10		1.19***		.72***		1.63***		4.13***
		[1.10]		[.33]		[.17]		[.27]		[.85]
R^2	.74	.03	.99	.13	.94	.04	.98	.19	.88	.09
Sample size	4,803	2,778	5,124	4,421	5,299	4,892	5,057	4,245	5,073	4,523
State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Outcome var.	level	growth	level	growth	level	growth	level	growth	level	growth

Note: The table reports the coefficients associated with regressions of logged tax revenue for category *k* and their growth rate on logged employment and its growth rate, conditional on state, year, and quarter fixed effects, as well as a vector of time-varying demographic controls: logged state population, the share male, the share White, the share Black, the share Hispanic, the share college, and the age distribution (under 18, 19–29, 30–44, and 65+, normalized to ages 45–64). The tax revenue categories are property tax, sales tax, motor and fuel taxes, individual income taxes, and corporate income taxes.

Source: Current Population Survey, Quarterly Census of Employment and Wages, Census Bureau QTAX, 1994–2019 (quarterly).

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