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The Impacts of State Tax Structure: A Panel Analysis

Jacob Goss and Chang Liu*

University of Wisconsin-Madison

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Abstract

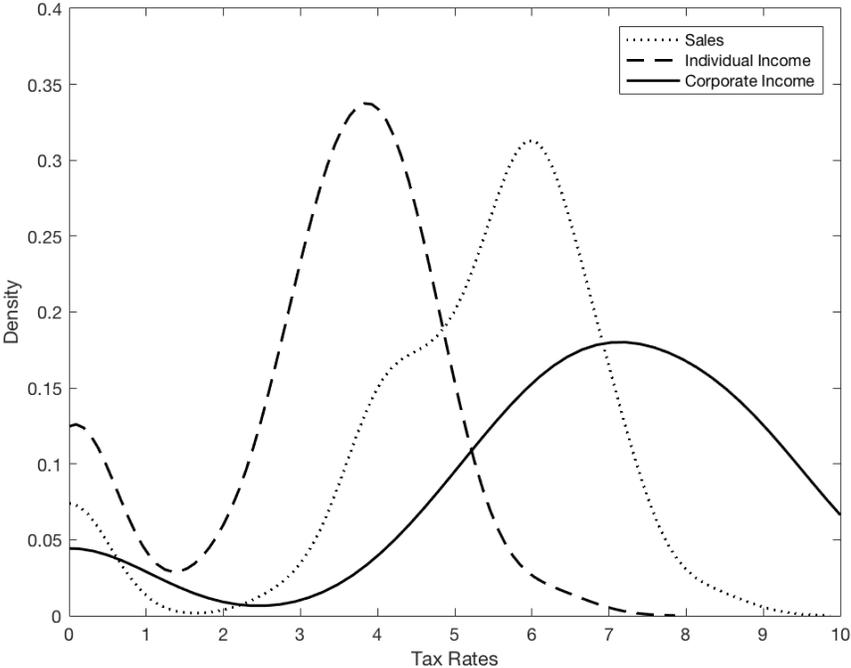
From a panel study of states across the U.S., we find that the individual income tax rate is significantly negatively correlated with per capita personal income growth and contemporaneous state total tax revenue. In particular, a 1% permanent increase in the state individual income tax rate would initially lower per capita personal income growth by about 0.9% and total tax revenue by about 1%-4%. There are no such effects for the corporate income or sales tax, but they are the main sources of tax revenue volatility.

* Jacob Goss is an undergraduate student at University of Wisconsin-Madison. Chang Liu is a Ph.D. Candidate in Economics at the Department of Economics, University of Wisconsin-Madison.

1 Introduction

Tax structure, the source and rates for state taxes, varies a lot across states and time. In Figure 1, we plot the distribution of tax rates across states in 2010 ¹ and tax revenue as share of GDP across states in 2016 to illustrate the heterogeneity in tax structure at the state level. States vary considerably in terms of how they generate tax revenues: some states don't collect individual income tax at all, i.e. AK, FL, NV, SD, TX, WA and WY; some states don't collect corporate income tax at all, i.e. NV, TX, WA and WY; and some states don't collect sales tax, i.e. AK, DE, MT, NH, OR. For the states that collect a certain tax, tax rates vary a lot, as shown in Figure 1, and the distribution of each tax category in our sample varies over time. An alternative measure of average tax rates, tax revenue as share of GDP, is shown in Figure 2 and also shows significant heterogeneity.

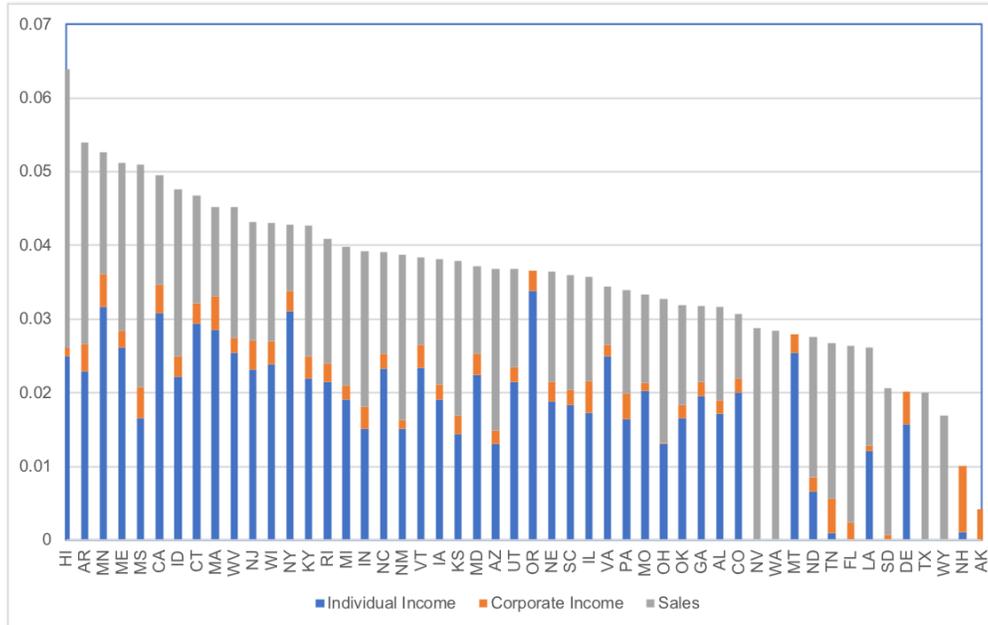
Figure 1: Distribution of Tax Rates Across States in 2010



In this report, we utilize the variation in tax structure across space and time and conduct a panel analysis of the effect of three major sources of tax revenue: personal income, corporate

¹The most recent data on state average corporate tax rate in Serrato and Zidar (2016) is 2010.

Figure 2: Tax Revenue Share as Share of GDP Across States in 2016



income and sales taxes. As is documented in Fajgelbaum et al. (2018), the revenue raised by the three taxes accounted for 35%, 5% and 47% of total states' tax revenue in 2012, and collectively amounted to 4% of U.S. GDP. In particular, we investigate how the three tax rates affect the state economy (measured by GDP growth), personal income (measured by per capita real personal income growth), the labor market (focusing on the unemployment rate) and the state government revenue (focusing on total tax revenue and tax volatility).

State tax structure matters to the individuals, the state economy and the state government. Individual income tax affects disposable household income, and may have an effect on household labor supply. What's more, pass-through businesses (S corporations and partnerships), which are a sizable part of the overall business activity, are also subject to individual income tax. In our analysis, we confirm a negative relationship between the individual income tax rate and growth of GDP and personal income. Theoretically, the corporate tax directly influences corporate operations, negatively impacting total output and labor earnings. We empirically confirm this relationship, although the effect is not as large as that of individual income tax. The effect of sales tax on GDP or personal income growth is essentially zero (not statistically nor economically significant) in our exercise. In addition, we study the effect of tax structure on state tax revenue collection. Among the three tax

sources, only individual income tax matters to total revenue; only corporate and sales taxes matter to state tax revenue volatility.

Our study is mostly related to two previous ones. Lee and Gordon (2005) study the effect of tax structure on economic growth using cross-country data. They find from a cross-sectional regression that statutory corporate tax rates are significantly negatively correlated with economic growth rates, while the effects of personal tax rates are less clear. This echoes the work in this paper in finding higher tax rates to be negatively correlated with economic growth, with corporate income tax being the most significant, although in our study the effect of corporate income tax is much less. Gale et al. (2015) find that neither tax revenues nor top income tax rates bear stable relationships to economic growth or employment. Our finding on the effect of the individual income tax on economic growth, especially the personal income growth, is inconsistent with theirs as we use different data sources and made different parametric assumptions. However, our study is in accord with the finding in Gale et al. (2015) that tax rates have unstable effects on employment.

2 Empirical Strategy

2.1 Empirical Specification

We focus on the effects of tax structure on five economic indicators at the state level: growth of per capita personal income, real GDP growth, unemployment rate, total tax revenue (as a percentage of GDP to control for the size effect) , and tax revenue volatility (the volatility of tax revenue’s share of real GDP). There are two views of “tax structure”: tax rate of each category, and share of each category in realized total tax revenue. The former captures the level of ex ante “tax rate” of a tax structure, without regard to “tax base”; the latter concerns the ex-post composition of total tax revenue, which however is endogenous. From the point of view of policy analysis, tax rates are the tools that policy makers are able to use to change tax structure so it’s our primary concern throughout this report.

The baseline empirical specification is a panel regression with time and state fixed effects. For GDP growth and personal income growth, the corresponding explanatory variables are

changes in tax rates; for unemployment, total tax revenue and tax revenue volatility, we use their *levels* on the right hand side. States rely mainly on three sources of taxes: individual income, corporate income, and sales. Individual income, corporate income and sales tax rates are denoted by τ_i , τ_c , and τ_s respectively, which we index by state s and time t .

For per capita personal income and real GDP, we estimate the following specification.

$$\Delta y_{s,t} = \beta_0 + \beta_i \cdot \Delta \tau_{i,s,t} + \beta_c \cdot \Delta \tau_{c,s,t} + \beta_s \cdot \Delta \tau_{s,s,t} + f_s + f_t + \varepsilon_{s,t}$$

where f_s and f_t denote state and time fixed effects.

For the other three dependent variables, we use the tax rate levels as explanatory variables in the panel regression specified as follows:

$$y_{s,t} = \beta_0 + \beta_i \cdot \tau_{i,s,t} + \beta_c \cdot \tau_{c,s,t} + \beta_s \cdot \tau_{s,s,t} + f_s + f_t + \varepsilon_{s,t}$$

Apart from the baseline results, we conduct two sets of robustness checks. First, we add lagged tax rates to our linear regression to account for the fact that agents’ decision making is rather persistent: consumption this year, for example, may depend on consumption last year which is dependent on tax policy last year. We report this result together with the baseline result in Table 1 and 2. Secondly, instead of using tax rates from the sources we discuss before, we take the simplified approximation in Gale et al. (2015) using the share of tax revenue in each category as a percentage of personal income. The results are reported in Table 3 and 4. However, it should be pointed out that only Individual Income Tax/Personal Income makes sense as a proxy for the income tax rate². Although we also put “Corporate Tax Revenue/Personal Income” and “Sales Tax Revenue/Personal Income” in the regressions just to follow Gale et al. (2015), we do not attempt to explain or interpret the coefficients on these two regressors (and their lags).

2.2 Data

State GDP and personal income data are from the BEA Regional Accounts. Unemployment rate data comes from BLS Local Area Unemployment Statistics. Tax revenue data comes

²Proper denominators constructing corporate tax rate and sales tax rate are total corporate profits and total sales, which are not available.

from Census Annual Survey of State Government Tax Collections.

We collect the individual income tax rates from the NBER TAXSIM dataset. In particular, we take the “average income tax rate” as our measure of state-level income tax rate. The corporate tax data comes from Serrato and Zidar (2016). And the sales tax rate is copied from the Book of States.

To construct a reasonable series of tax revenue volatility, we apply McConnell and Perez-Quiros (2000)’s method of instantaneous standard deviation using the residuals ε_t of an AR(1) regression of the tax revenue series. An unbiased estimator of the standard deviation of ε_t is $\sqrt{\frac{\pi}{2}}|\varepsilon_t|$, which is our measure of tax revenue volatility.

3 Main Results

3.1 Baseline Results

First, we look at the how state tax rates may affect state GDP and personal income growth in a baseline regression. These results are shown in the first columns of panel (1) and (2) in Table 1. Coefficients on the corporate tax rate change are significant for GDP growth and per capita personal income growth; the coefficient on the individual income tax rate is significant for personal income growth only; and the coefficient on the sales tax rate is not significant in either regressions. These results imply that raising the corporate income tax rate by 1% would on average lower GDP and personal income growth by about 0.01%. Raising the individual income tax rate by 1% will lower personal income growth by a commensurate magnitude of 0.93%. The effect on GDP growth is also large in magnitude, although the p-value of the coefficient on individual income tax rate change is narrowly less than 10% level. Changing the sales tax rate does not matter for either GDP or income.

Now let’s turn to tax revenue, volatility and unemployment with results shown in Table 2. We find that none of the three tax categories have a significant relationship with unemployment. These results prove robust when the lagged tax rates are included, and they suggest that tax rates do not have a direct impact on unemployment rate at the state level. Panel (1) suggests that raising the individual income tax rate raises total tax revenue as a

percentage in GDP by a significant amount while raising corporate or sales tax rates has no such effect. However, when it comes to tax revenue volatility, Panel (3) shows that what matters is corporate and sales taxes, instead of the income tax rate. This result indicates corporate income and sales revenue are more volatile sources of state tax revenue while the individual income tax is more stable when a state wishes to change its tax structure.

While the tax revenue-GDP *ratio* is a useful statistic making the tax collection comparable across states, policy makers are interested in how varying tax structure affects the tax revenue *levels*. We run a separate regression of log tax revenue on tax rates in Panel (2). The coefficients on this regression are interpreted as the percentage change in total tax revenue when there is a 1% increase in each tax rate, the other two held constant. Still, corporate or sales tax rate does not significantly affect total tax collection, but the individual income tax rate is negatively correlated with it. In particular, raising income tax rate permanently by 1% would lower contemporaneous tax revenue by as much as 1%. These results indicate that the negative impacts of raising income tax rate on GDP and personal income growth dominate its positive effect on tax revenue per unit of output, leading to a negative effect on total tax revenue.

Taken together, our result shows that raising the personal income tax rate leads to both lower economic growth and contemporaneous state tax revenue collection, while the effects of corporate or sales tax rates are not significant. However, corporate and sales taxes are the major sources of a volatile tax system, rather than the income tax.

3.2 Robustness Checks

In our first set of robustness checks, we find that adding lagged tax rates does not alter any of the baseline results. Most of the previous regression results hold both qualitatively and quantitatively. In particular, the coefficients on the individual income tax in regressions of GDP, personal income, tax/GDP ratio, and log tax revenue remain the same sign and significance. The only exception is the regression of unemployment, where contemporaneous effect of the individual income tax becomes stronger and more significant when lagged tax rates are included. This indicates that the impacts of changing tax rates may be prolonged.

In fact, the robustness check in Panel (2), Table 2 also implies different impacts of a

permanent change of the individual income tax rate in the short and longer run. Raising this rate permanently by 1% would lead to an initial negative impact on tax revenue by 3.8%, while this impact reverses its sign one year ahead with a magnitude of around 3.3%.

In the second set of robustness checks, we use tax revenue over personal income as a proxy for tax rate with in mind the caveat that only the coefficient on “individual income tax revenue/personal income” is worth exploring. The impact of changing individual income tax rate on GDP growth or personal income growth is no longer significant, albeit negative in both. Results in Table 4 reinforces the role of individual income tax in the level and volatility of tax revenue: personal income tax rates lead to high and stable tax revenue (as a percentage of GDP).

4 Policy Implications

To sum up, we find that raising the state individual income tax rate lowers the state GDP and personal income growth: a 1% increase in the state individual income tax rate lowers per capita personal income growth by about 0.9%. The impact on tax revenue is more complex: a permanent increase of the individual income tax would initially lower the state total tax revenue and then increase it, while it increases state tax revenue per unit of GDP both in the short and long run. The effects of the corporate income or sales tax rate on economic growth and total tax revenue are not significant. However, they are the main sources of tax revenue volatility.

Taken together, our results tell a compelling story. Increases in income taxes lower personal income growth and contemporaneous tax revenues, but income tax revenues might provide a stable tax base. Corporate and sales taxes, on the other hand, do not directly harm personal income or tax revenue, but they do give a significantly volatile tax base. This suggests that states may be able to rely on cutting income taxes to effectively generate GDP growth, and that they should avoid relying solely on corporate and sales taxes in order to maintain a stable tax base.

Table 1: GDP Growth and Per Capita Income Growth

	(1)		(2)	
	GDP Growth		Per Capita Income Growth	
$\Delta\tau_i$	-3.687 (2.392)	-3.858 (2.847)	-0.933*** (0.313)	-0.899*** (0.241)
$\Delta\tau_c$	-0.0131* (0.00737)	-0.0231** (0.0105)	-0.0129*** (0.00224)	-0.0125*** (0.00271)
$\Delta\tau_s$	0.0000709 (0.0134)	-0.00417 (0.0137)	-0.0138 (0.0116)	-0.0176 (0.0115)
$L.\Delta\tau_i$		-0.623 (0.621)		-0.629** (0.290)
$L.\Delta\tau_c$		-0.0186** (0.00725)		0.00114 (0.00277)
$L.\Delta\tau_s$		0.0346 (0.0288)		0.0284*** (0.00653)
Constants	0.0359*** (0.00773)	-0.0137** (0.00511)	0.108*** (0.00379)	0.0597*** (0.00262)
N	1500	1450	1500	1450
adj. R^2	0.123	0.124	0.655	0.616

Standard errors in parentheses

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

Table 2: Tax Revenue, Tax Volatility and Unemployment

	(1)		(2)		(3)		(4)	
	Tax Revenue/GDP		Log Tax Revenue		Tax Revenue Volatility		Unemployment	
τ_i	0.226** (0.0967)	0.163* (0.0943)	-0.937*** (0.353)	-3.796*** (1.365)	-0.0161 (0.0216)	0.0189 (0.0675)	0.0195 (0.195)	0.876*** (0.272)
τ_c	-0.00288 (0.00491)	-0.00357 (0.00427)	-0.056 (0.0953)	-0.0383 (0.0875)	0.00340** (0.00143)	0.00295** (0.00126)	0.000187 (0.00708)	0.000114 (0.00638)
τ_s	0.0175 (0.0144)	0.00815 (0.00852)	0.322 (0.247)	0.168 (0.143)	0.00675** (0.00318)	0.00559*** (0.00188)	-0.00350 (0.0113)	0.000756 (0.0101)
$L.\tau_i$		0.0758 (0.0776)		3.133*** (1.856)		-0.0402 (0.0822)		-0.918*** (0.276)
$L.\tau_c$		0.00359 (0.00520)		0.0584 (0.0857)		0.00645*** (0.00145)		-0.00210 (0.00538)
$L.\tau_s$		0.0151* (0.00844)		0.294 (0.140)		0.00218 (0.00357)		-0.0216** (0.00876)
Constants	0.0164*** (0.00250)	0.0172*** (0.00262)	21.251*** 0.0528	21.330*** (0.0536)	0.00130*** (0.000455)	0.000872 (0.000541)	0.0679*** (0.00453)	0.0743*** (0.00523)
N	1550	1500	1550	1500	1550	1500	1550	1500
adj. R^2	0.624	0.608	0.2095	0.1962	0.046	0.044	0.664	0.675

Standard errors in parentheses

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

References

- [1] Fajgelbaum, Pablo D., Eduardo Morales, Juan Carlos Suárez Serrato, and Owen M. Zidar. “State Taxes and Spatial Misallocation”. *manuscript*, May 2018.
- [2] Gale, William G., Aaron Krupkin, and Kim Rueben. “The Relationship between Taxes and Growth at the State Level: New Evidence”. *National Tax Journal*, 68(4):919–942, 2015.
- [3] Lee, Young and Roger H. Gordon. “Tax Structure and Economic Growth”. *Journal of Public Economics*, 89(5-6):1027–1043, 2005.
- [4] McConnell, Margaret M. and Gabriel Perez-Quiros. “Output Fluctuations in the United States: What Has Changed Since the Early 1980’s?”. *American Economic Review*, 90(5):1464–1476, 2000.
- [5] Suárez Serrato, Juan Carlos and Owen Zidar. “Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms”. *American Economic Review*, 106(9):2582–2624, September 2016.

Appendix A Robustness Check Results

Table 3: Robustness: GDP and Per Capita Income Growth

	(1)		(2)	
	GDP Growth		Per Capita Income Growth	
Δ Individual Tax Rev/Personal Income	-0.913 (0.809)	-0.637 (0.754)	-0.588 (0.489)	-0.477 (0.527)
Δ Corporate Tax Rev/Personal Income	1.824*** (0.309)	1.897*** (0.316)	-0.0279 (0.0822)	-0.000974 (0.0779)
Δ Sales Tax Rev/Personal Income	1.237 (0.896)	1.236 (0.903)	-2.076* (1.058)	-2.003* (1.029)
Lag Δ Individual Tax Rev/Personal Income		-0.0299 (0.605)		-0.181 (0.332)
Lag Δ Corporate Tax Rev/Personal Income		2.033*** (0.130)		0.612*** (0.0485)
Lag Δ Sales Tax Rev/Personal Income		0.412 (0.626)		0.500 (0.473)
Constants	0.0483*** (0.00393)	0.0479*** (0.00403)	0.0333*** (0.00458)	0.0246*** (0.00413)
N	2650	2650	2850	2800
adj. R^2	0.161	0.167	0.637	0.645

Standard errors in parentheses

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

Table 4: Robustness: Tax Revenue and Tax Volatility

	(1)		(2)	
	Tax Revenue as Share of GDP		Tax Revenue Volatility	
Individual Tax Rev/Personal Income	0.309** (0.152)	0.506*** (0.0668)	-0.115 (0.0966)	-0.0172 (0.0412)
Corporate Tax Rev/Personal Income	0.440*** (0.0603)	0.338*** (0.0428)	0.0699*** (0.0107)	0.0167 (0.0128)
Sales Tax Rev/Personal Income	0.276 (0.198)	0.306** (0.142)	0.00429 (0.0384)	0.0112 (0.0443)
Lag Individual Tax Rev/Personal Income		-0.197 (0.170)		-0.0973 (0.0942)
Lag Corporate Tax Rev/Personal Income		0.157*** (0.0521)		0.0822*** (0.0121)
Lag Sales Tax Rev/Personal Income		-0.0288 (0.109)		-0.00552 (0.0767)
Constants	0.000544 (0.00278)	0.000358 (0.00282)	0.00247*** (0.000882)	0.00235** (0.000895)
N	2700	2700	2650	2650
adj. R^2	0.816	0.816	0.075	0.078

Standard errors in parentheses

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