



The structure of state corporate taxation and its impact on state tax revenues and economic activity[☆]

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ABSTRACT

This paper documents facts about the state corporate tax structure — tax rates, base rules, and credits — and investigates its consequences for state tax revenue and economic activity. We present three main findings. First, tax base rules and credits explain more of the variation in state corporate tax revenues than tax rates do. Second, although states typically do not offset tax rate changes with base and credit changes, the effects of tax rate changes on tax revenue and economic activity depend on the breadth of the base. Third, as states have narrowed their tax bases, the relationship between tax rates and tax revenues has diminished. Overall, changes in state tax bases have made the state corporate tax system more favorable for corporations and are reducing the extent to which tax rate increases raise corporate tax revenue.

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How states tax businesses has received renewed interest in both academic and policy circles? Recent work on state corporate tax rates has investigated their impacts on income growth, employment, and business location.¹ However, state policymakers compete to attract businesses not only by changing tax rates, but also by changing the tax base to enhance several investment incentives, loss provisions, and enforcement mechanisms.² There is a lack of basic facts about the state corporate tax structure, its evolution over recent years, and how it impacts tax revenue and economic activity. This

paper describes the state corporate tax structure, documents how it has changed over time, and investigates the consequences of these changes for state tax collections and economic activity.

Our analysis proceeds in four steps. We first describe recent trends in state corporate tax structure.³ While average state corporate tax rates have remained relatively stable, state corporate tax revenues as a share of economic activity have declined substantially. Some of this decline is due to other factors (e.g., the rise of pass-throughs (Cooper et al., 2016) and corporate losses (Auerbach and Poterba, 1987)), but we show that tax base and credit changes have substantial impacts on state corporate tax collections. Tax base and credit changes are much more frequent than tax rate changes. Contrary to the view that state tax rate changes are often accompanied by offsetting changes in the tax base, we find that the vast majority of tax base changes are not associated with tax rate changes. Some provisions, such as R&D credits, investment tax credits, and loss carryforward rules, have become more favorable for corporations while others (e.g., throwback rules and combined reporting) have led to broader bases.

Second, we estimate the importance of each of these tax base rules for state corporate tax collections from 1980 and 2010. We perform analysis of variance decompositions every five years and

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¹ Recent papers include Heider and Ljungqvist (2015), Giroud and Rauh (2015), Suárez Serrato and Zidar (2016), Fajgelbaum et al. (2015), Ohrn (2016), and Ljungqvist and Smolyansky (2014).

² These tax base rules are important determinants of measures of state business climate indexes (e.g., Tax Foundation, 2016). ALEC (2014) reports that 14 states changed taxes in 2014 with many of the changes affecting both tax rates as well as tax base determinants.

³ The fifteen determinants of the corporate income tax structure that we analyze include tax credits, such as the investment tax credit and the R&D tax credit. For simplicity, we refer to these credits as determinants of the tax base, along with our other tax base measures.

document the importance of tax base rules, relative to tax rates, in explaining the variation in corporate tax revenue across states and over time. Overall, tax base components account for the majority of the explained variation in tax revenues. This result remains relatively stable throughout most of our sample, with only a slight increase in the fraction explained by tax rates in 2010. The importance of different tax base components in explaining tax revenues has evolved over our sample. In particular, sales apportionment weights and loss carryback provisions have waned in importance, while franchise taxes, different depreciation rules, and interactions with federal tax policies, such as adopting the federal tax base or allowing for the deductibility of federal taxes, have increased their share of explained variance.

Third, we analyze how tax base provisions affect the relationship between state tax rates and two outcomes: state corporate tax revenue and state GDP. This analysis has two parts. We first explore the degree to which *controlling for these tax base provisions* affects the relationship between tax rates and revenue and GDP. We find that, while tax base controls explain a large portion of the variation in revenues, the relationships between tax rates and our outcomes of interest are not fundamentally affected by controlling for these tax base measures. This result may be due to the lack of a temporal coincidence between changes to tax rates and determinants of the tax base. However, even if tax base and rate changes do not occur at the same time, the tax base can influence the effects of tax rate changes.

We then explore the extent to which *interactions between the tax base and tax rates* induce heterogeneous effects of state corporate tax rate changes. Intuitively, when the tax base is narrow, a tax rate increase mechanically raises less revenue since taxable income is a smaller portion of overall income. In addition, tax changes have smaller incentive effects, so the behavioral responses to tax rate increases are likely attenuated. Empirically, we first confirm that states with narrower tax bases collect less revenue from marginal increases in tax rates. The main finding is about tax-base-driven heterogeneity in the time series. While some states have broadened the base (e.g., Michigan, Ohio, Illinois), we observe narrower tax bases on average over the last thirty years. These trends in state tax bases over time have made the state corporate tax system more generous towards corporations, and are reducing the extent to which increases in tax rates raise corporate tax revenue. In addition, we find that including interactions between the state tax base and state tax rates also increases the estimate of the average treatment effect (ATE) of state corporate tax rate changes on state corporate tax revenue.⁴

We conclude by investigating the implications of these results for revenue-maximizing-state-tax rates and for the claim that state corporate tax rate cuts pay for themselves.⁵ We estimate a regression in which tax rates have linear (β_0) and quadratic (δ_0) effects on tax revenue. The revenue-maximizing-state-corporate-tax rate equals the ratio of these effects: $\frac{\beta_0}{-2\delta_0}$. The estimate of the quadratic effect ($\hat{\delta}_0$), which measures decreasing returns from tax rate increases, is not substantially larger than the linear effect ($\hat{\beta}_0$). Our point estimates imply that the tax rate that maximizes state corporate tax revenue is close to 30%. In Suárez Serrato and Zidar (2016), we note that state corporate taxes may have fiscal externalities and may affect tax

revenue from sales and personal income taxes. Even when we allow for this externality by considering total state tax revenue instead of only corporate tax revenue, our estimates imply a total-state-tax-revenue-maximizing rate of close to 10%. Since the estimated revenue-maximizing rate is greater than the majority of state corporate tax rates, we reject the hypothesis that tax cuts tend to pay for themselves.

This paper contributes to three literatures. First, relative to recent work on the effects of changes in state business tax rates on economic activity (Heider and Ljungqvist, 2015; Giroud and Rauh, 2015; Suárez Serrato and Zidar, 2016; Fajgelbaum et al., 2015; Ohrn, 2016, and Ljungqvist and Smolyansky, 2014), we explore how the relationships between tax rates and revenues and economic activity depend on the structure of the corporate tax system. A contribution of this paper is the collection and description of a comprehensive set of variables that describe the structure of the corporate tax system across all U.S. states since 1980, which we hope will aid future researchers in this literature. In a contemporaneous contribution, Bartik (2017) simulates the tax consequences of locating a new plant in 32 states and 45 industries that cover roughly 90% of U.S. economic activity since 1990. These simulations are highly detailed and capture complex interactions between several rules. We view this paper as highly complementary to ours, which takes a reduced-form empirical approach. Specifically, we do not conduct similar simulations at the plant level, but do variance decompositions of observed state corporate tax revenue as a share of state GDP to understand the quantitative importance of different base provisions for state tax revenue. Bartik (2017) also documents several facts about changes in incentives and finds that business incentives are large, vary substantially across states, and have become increasingly generous. Consistent with these results, we document substantial variation across states and a general narrowing of the base on average in the full panel of 50 states since 1980.

Second, this paper is also related to a set of papers that explore whether the tax base affects the relationship between corporate tax rates and corporate income tax revenues. In particular, Clausen (2007), Devereux (2007), and Kawano and Slemrod (2015) study this relationship across 29 OECD member countries, and Dahlby and Ferde (2012) perform a similar analysis across Canadian provinces. We follow Kawano and Slemrod (2015) by collecting a comprehensive set of variables that describe the breadth of the tax base and by controlling for this tax base vector in our estimations. In contrast to Kawano and Slemrod (2015), who focus on the international corporate tax structure, we find that state tax rate changes are not often offset by base and credit changes.

Finally, we find that the relationship between state tax rates and economic activity depends on the structure of the tax base. This point is related to work by Kopczuk (2005), who finds that the elasticity of reported taxable income for individuals depends on the availability of deductions. In our setting, this dependence on the tax base is important for revenue forecasts and assessments of the incidence and efficiency of state corporate taxation.

The paper is organized as follows. Section 1 describes the dataset of tax base determinants, and Section 2 describes trends in the structure of the state corporate tax system. Section 3 performs the variance decomposition analysis, and Section 4 explores the effects of controlling for tax base determinants on various outcomes of economic interest. Section 5 explores tax-base-driven treatment effect heterogeneity across states and over time, Section 6 analyzes the revenue-maximizing-tax rate, and Section 7 concludes with a discussion of policy implications.

1. Measuring the state corporate tax structure

We use fifteen measures of the corporate tax base for the main analysis in the paper. Details on each of the variables, sources, and

⁴ As is well known (Wooldridge, 2005; Gibbons et al., 2014), in the presence of heterogeneous treatment effects, regressions that control for the drivers of heterogeneity estimate a weighted-average of the heterogeneous treatment effects that may not be a consistent estimate of the average treatment effect. In this context, the source of heterogeneous effects is the tax base. We discuss treatment effect heterogeneity in Section 5.

⁵ See, for instance, claims by Sam Brownback (McLean, 2017), Thom Tillis (The News & Observer Editorial Board, 2017), and Mitt Romney (Romney, 2010) for the cases of Kansas, North Carolina, and Massachusetts, respectively, and Rand Paul (Kessler, 2015) for a similar claim at the federal level.

coverage are available in Appendix A.⁶ The following variables comprise our state-year panel dataset of tax base and credit components: an indicator of having throwback rules, an indicator of having combined reporting rules, investment tax credit rates, research and development (R&D) tax credit rates, an indicator for whether the R&D tax credit applies to an incremental base that is a moving average of past expenditures, an indicator for whether the R&D tax credit applies to an incremental base that is fixed on a level of past expenditures, the number of years for loss carryback, number of years for loss carryforward, an indicator for franchise taxes, an indicator for federal income tax deductibility, an indicator for federal income tax base as the state tax base, an indicator for follows federal accelerated depreciation, an indicator for follows accelerated cost recovery system (MACRS) depreciation, an indicator for federal bonus depreciation, and corporate tax apportionment weights.

Most of the variables are indicators of whether a state allows a particular policy. Throwback and combined reporting rules come from Bernthal et al. (2012) and describe whether a state requires a unitary business to submit combined reporting and, in the case of throwback rules, whether a state eliminates “nowhere income” that would be untaxed by either the state with the corporation’s nexus or the state in which the relevant sales were being made.

Data on state investment tax credits and R&D tax credits come from Chirinko and Wilson (2008), and Wilson (2009) provides the rate of each of these credits. For the R&D credit, we use the statutory credit rate adjusted for recapture and type of credit. States vary in how they implement R&D tax credits. States determine whether the R&D tax credit applies to all qualified expenditures, or whether the base is incremental based on previous expenditures. In addition, the basis of previous expenditures may be fixed in time or may be a moving average of recent activity. We control for two indicators for whether the base is incremental and fixed, or whether it is incremental and based on a moving average.

Loss rules specify the number of years that a corporation may carry back net operating loss prior to the loss as well as the number of years a corporation may carry forward any excess loss following the loss year. The depreciation indicators describe whether a state conforms to federal depreciation rules and adopts federal bonus depreciation policies that accelerate investment incentives (see Zwick and Mahon, 2017 for policy details). Finally, we use apportionment weights for payroll, property, and sales that were digitized from CSG Book of the State (1976–2011). These weights determine the share of national profits of multi-state firms that is taxable in a given state (see section IV.B of Suárez Serrato and Zidar (2016) for policy details on apportionment).

In addition to our data on tax base measures, we use a few other data sources in the analysis. We use statutory state corporate income tax rates from CSG Book of the State (1976–2011), top statutory personal income tax rate from NBER TAXSIM, GDP from the U.S. Bureau of Economic Analysis (1967–2016), and tax revenue data from the U.S. Department of Commerce (1942–2012).⁷

Table 1 provides summary statistics of our main base measures. In the pooled sample from 1980 to 2010, roughly half of the states had throwback rules and franchise taxes. Most used federal income as the state tax base and followed accelerated depreciation schedules (although some states stopped allowing for bonus depreciation

Table 1
Summary statistics.

	Observations	Mean	Std. dev.
<i>Panel A. 1980–2010 Pooled sample</i>			
Corp tax revenue as share of GDP (%)	1550	0.355	0.284
Throwback rules	1550	0.492	0.500
Combined reporting	1550	0.281	0.450
Investment tax credit	1550	1.062	2.323
R&D tax credit	1550	2.629	4.369
Loss carryback rules	1550	1.183	1.381
Loss carryforward rules	1550	11.379	6.707
Franchise tax	1550	0.534	0.499
Fed income tax deductible	1550	0.105	0.306
Fed income as state tax base	1550	0.814	0.389
Fed accelerated depreciation	1550	0.851	0.356
ACRS depreciation	1550	0.802	0.399
Federal bonus depreciation	1550	0.692	0.462
Sales apportionment weight	1550	51.043	23.856
Incremental R&D credit, base is fixed	1550	0.203	0.402
Incremental R&D credit, base is moving average	1550	0.097	0.296
<i>Panel B. 2010 Cross section</i>			
Corp tax revenue as share of GDP (%)	50	0.259	0.214
Throwback rules	50	0.480	0.505
Combined reporting	50	0.500	0.505
Investment tax credit	50	2.120	3.280
R&D tax credit	50	5.695	5.608
Loss carryback rules	50	0.700	1.055
Loss carryforward rules	50	14.220	7.081
Franchise tax	50	0.560	0.501
Fed income tax deductible	50	0.080	0.274
Fed income as state tax base	50	0.860	0.351
Fed accelerated depreciation	50	0.820	0.388
ACRS depreciation	50	0.860	0.351
Federal bonus depreciation	50	0.380	0.490
Sales apportionment weight	50	66.142	27.984
Incremental R&D credit, base is fixed	50	0.400	0.495
Incremental R&D credit, base is moving average	50	0.160	0.370

Notes: This table provides summary statistics for state corporate tax revenue as a share of GDP and the main fifteen tax base measures described in Section 1. Panel A provides pooled summary statistics. Data range from 1980 to 2010 and include all 50 states. Panel B summarizes the tax base measures for the 2010 cross-section. Indicators for throwback rule and combined reporting equal zero for states with no corporate income tax rate.

for budgetary reasons). Roughly a quarter of states in the pooled sample used combined reporting rules, although this share has been increasing over time.⁸

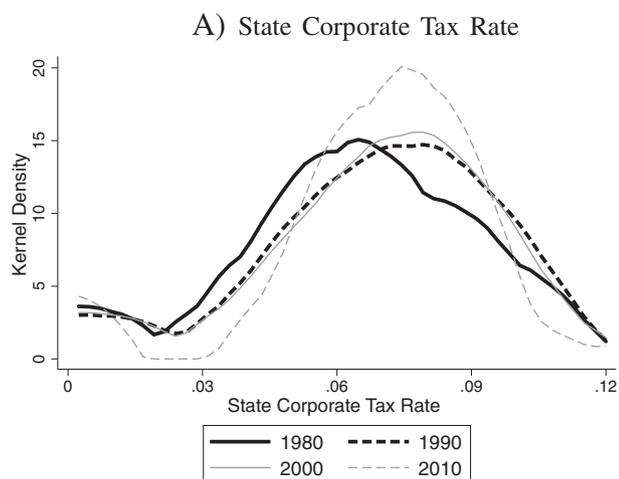
2. Trends and changes in the state corporate tax structure

The structure of state corporate taxation varies widely across states and over time. Fig. 1 shows that the statutory corporate income tax rate varies between 0 and 12%. Five states (Nevada, South Dakota, Texas, Washington, and Wyoming) currently have no taxes on corporate income. As of 2012, another five states (Alaska, Illinois, Iowa, Minnesota, and Pennsylvania) had tax rates above 9%. Fig. 1 shows that over the past few decades, very modest increases in the state corporate tax rate distribution across states have been accompanied by substantial declines in state corporate tax revenue as a share of economic activity. Panel A of Fig. 2 shows this pattern directly – average state corporate tax rates are quite stable, but the average state corporate tax revenue as a share of GDP has declined nearly 40%. While part of this decline arises from the shift away from

⁶ Most of the data used in this paper were digitized from a variety of sources including CCH State Tax Handbook (1980–2010) and CSG Book of the State (1976–2011), but we also rely on data collected and generously provided by Chirinko and Wilson (2008), Wilson (2009), and Bernthal et al. (2012). Unless otherwise indicated, we exclude the District of Columbia from the analysis.

⁷ See Feenberg and Coutts (1993) for more details on NBER TAXSIM. In robustness analysis, we also use annual payroll from County Business Patterns (2010), and, for a subset of states and year, additional base controls from Bartik (2017), such as property taxes and job creation tax credits.

⁸ Panel B in Table 1 provides summary statistics for the cross section of states in 2010 and shows that roughly half the states had combined reporting in 2010. Appendix Table A1 provides summary stats of the additional (Bartik, 2017) controls for the subset of states and years for which these data are available.



B) State Corporate Tax Revenue as a Share of GDP

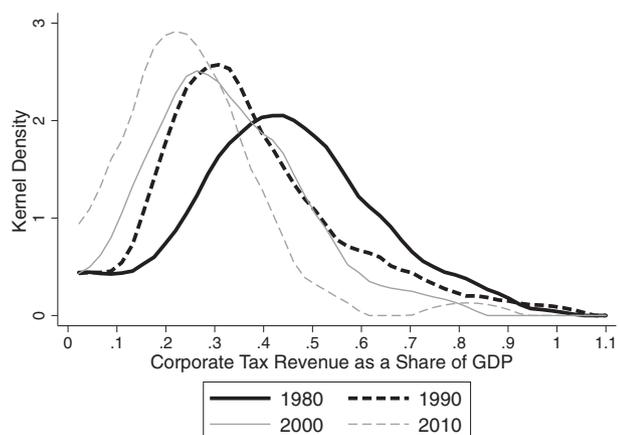


Fig. 1. Densities of state corporate tax rate and state corporate revenue-to-GDP ratio by decade.

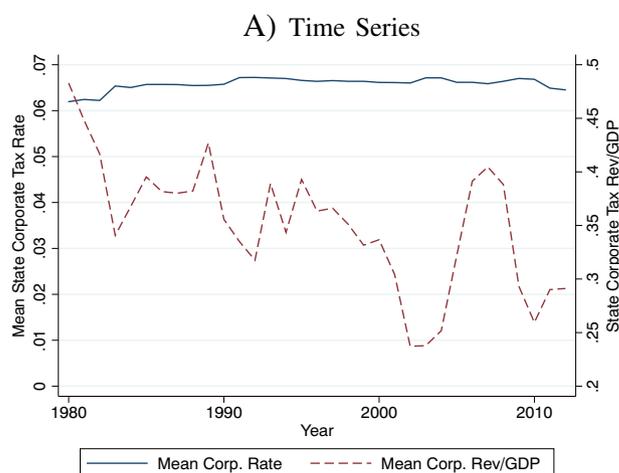
Notes: This figure presents kernel density functions for the state corporate tax rate and the state revenue-to-GDP ratio by decade. See Section 1 for details on data sources.

the traditional corporate form (Cooper et al., 2016), losses and other factors (Auerbach and Poterba, 1987), part of this decline is due to changes in the state corporate tax base.⁹

Table 2 describes the number of changes to each of our tax base measures. This table shows that there are more changes categorized as tax base narrowing than broadening, which suggests that an aggregate trend towards narrower bases is partly responsible for the patterns in Figs. 1–2. Of these changes, the increase in the number of years allowed for carrying losses forward and the increased reliance on sales as a factor for apportionment are the most frequently reformed measures in our data.

Table 3 compares changes in the tax base with changes in the tax rate. As the resurgent literature studying the effects of state corporate taxes on economic activity has noted, there have been a considerable number of changes to states' tax rates. This table shows that states have decreased rates in 70 occasions, while increasing rates 103 times, for a total of 173 changes. However, this considerable policy activity pales in comparison to changes to the states' tax bases. Table 3 shows that states have adopted changes that narrow

⁹ Ideally, one could decompose the importance of these different channels as in Auerbach and Poterba (1987). However, the necessary state level inputs for this exercise are not publicly available. See Bartik (2017) for a detailed industry-state level analysis of business tax incentives since 1990.



B) Frequency of Changes

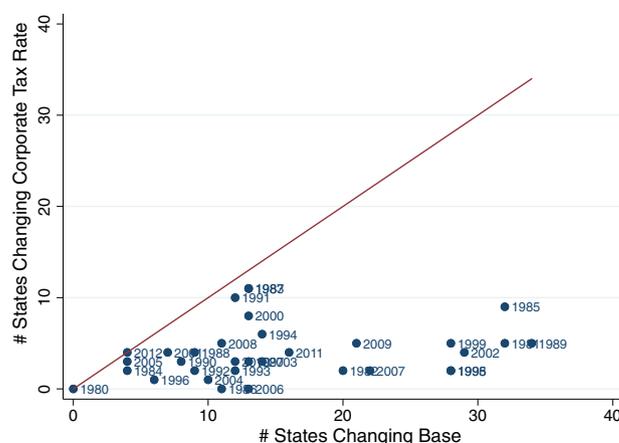


Fig. 2. Changes in state corporate tax structure.

Notes: This figure shows annual trends in both the mean state corporate tax rate across states and state corporate tax revenue as a share of state GDP in Panel A. Panel B shows by year the number of states that changed rates and tax base provisions. It illustrates that these pairs are not on a 45 degree line, so most years in which many states change base provisions are not years in which many states also change rates. See Section 1 for details on data sources.

the tax base in 283 occasions, while increasing the base 163 times, for a total of 446 tax base changes.

A widespread belief among economists and policy analysts is that increases in tax rates have relatively small effects on firms' tax obligations, since legislatures often change tax rates and tax bases simultaneously.¹⁰ In particular, if tax increases are accompanied by the narrowing of tax bases, firms' effective tax rates will be less susceptible to changes in the statutory rate. Panel B of Fig. 2 shows for each year the number of states that change their corporate tax rates and base provisions. Most points fall below the red 45 degree line, illustrating that in almost all years in which states change their tax base, most of them do not change their tax rates.¹¹

¹⁰ This belief is supported by cross-country studies, as in Devereux and Sørensen (2006) and Kawano and Slemrod (2015). At the subnational level, however, other authors have noted cases where the tax base is set at the federal level, while the tax rates are set at the sub-national level (Fuest et al., 2018).

¹¹ Appendix Fig. A1 shows that this finding is also consistent in recent years and states that coincide with the analysis sample in Bartik (2017).

Table 2
Summary of base changes.

Base narrowing/broadening:	-1	+1	Total changes	No change
Sales apportionment weight	92	33	125	1375
Loss carryback	23	42	65	1435
Loss carryforward	85	15	100	1400
Franchise tax	3	3	6	1494
Federal income tax deductible	2	4	6	1494
Federal income tax as state tax base	0	8	8	1492
Federal accelerated depreciation	2	5	7	1493
ACRS depreciation	57	14	71	1429
Federal bonus depreciation	18	43	61	1439
Throwback	23	23	46	1454
Combined reporting	2	20	22	1478
Investment credit	34	9	43	1457
R&D credit	51	8	59	1441
Incremental R&D credit, base is moving average	10	18	28	1472
Incremental R&D credit, base is fixed	2	22	24	1476

Notes: This table reports the number of state-year observations from 1980 to 2010 where there was a change in tax base and tax rate. A change that represents a narrowing of the base is counted in the -1 column, while a year that represents a broadening of the base is counted as +1. An increase in the rate of investment credits, R&D credits, or sales apportionment weight corresponds to a narrowing of the base, while a decrease corresponds to a broadening. An increase in the number of years allowed for both loss carryforward and loss carryback corresponds to a narrowing of the base, while a decrease corresponds to a broadening. For franchise taxes, federal income tax deductibility, federal accelerated depreciation and ACRS depreciation, the rule being turned off corresponds to a narrowing of the base, while it being turned on corresponds to a narrowing. For instance, if a state adopts MACRS depreciation, then we say that the tax base has narrowed. For throwback rules, combined reporting, moving average base for incremental R&D, fixed base for incremental R&D and federal income as state tax base, the rule being turned off corresponds to a narrowing of the base, while it being turned on corresponds to a broadening. For instance, if a state adopts combined reporting, then we say that the tax base has broadened. If that state gets rid of combined reporting, then the tax base has narrowed. See Section 1 for details on data sources, and Appendix A for definitions of broadening and narrowing for each measure. Appendix Table A3 provides a more detailed breakdown along with the co-movement of tax rates.

Table 3 provides additional evidence that state tax rates and tax bases are not typically temporally related, by showing the number of times that states changed rates and tax bases. This table shows that in most occasions (43 out of 70) when states lowered tax rates, these changes were not accompanied by a tax base change. Similarly, when states increased tax rates, there were relatively few occasions when states also changed the tax base (only 9 out of 103). Conversely, Table 3 also finds that when states changed tax bases, these changes were very seldom accompanied by changes in the tax rates (23 out of 283 for base-narrowing changes, and 22 out of 163 for base-broadening changes).¹²

Table 4 formalizes this point by presenting probit estimates of the likelihood of a coincidence in base and rate changes. The first panel estimates the probability of a change in tax base as a function of a rate change. This panel shows that changes in tax rates are not predictive of changes in tax bases, and that this pattern is robust to splitting the dependent variable into base-narrowing and broadening events. Panel B estimates the converse relation using changes in tax bases to predict changes in tax rates. In particular, when we estimate the likelihood of a tax increase, we observe that there is no statistical relation with a state also narrowing the tax base. We only find a modest correlation between the likelihood of a tax change and a broadening of the base. The third column shows that this result is driven by tax decreases and base broadenings. However, it is sensitive to a

Table 3
Frequency of state tax rate and base changes.

Base change	Rate decrease	No change	Rate increase	Total
Narrowing	20.0 (14.0)	18.9 (260.0)	8.7 (9.0)	18.3 (283.0)
No change	61.4 (43.0)	70.9 (976.0)	82.5 (85.0)	71.2 (1104.0)
Broadening	18.6 (13.0)	10.2 (141.0)	8.7 (9.0)	10.5 (163.0)
Total	100.0 (70.0)	100.0 (1377.0)	100.0 (103.0)	100.0 (1550.0)

Notes: This table reports the fraction of state-year observations that saw a simultaneous change in tax base and in tax rate. Numbers in parenthesis report the number of state-year observations that correspond to a given cell. See Section 1 for details on data sources, and Appendix A for definitions of broadening and narrowing for each measure. Overall, this table shows that the majority of times when there is a change in the tax base (either a narrowing or a broadening) there is no accompanying change in the tax rate.

Table 4
Probit estimates of the coincidence of base and rate changes.

Panel A: Base change			
	Any base change	Base broadening	Base narrowing
Rate decrease	0.1885 (0.2306)	0.1240 (0.2662)	0.1827 (0.3165)
No rate change	-0.0983 (0.1850)	-0.2728 (0.2347)	0.0955 (0.2040)
Panel B: Tax rate change			
	Any tax change	Tax increase	Tax decrease
Base narrowed	0.0705 (0.1440)	-0.0558 (0.1734)	0.1293 (0.1949)
Base broadened	0.3102* (0.1322)	0.1835 (0.2187)	0.3142* (0.1310)

Notes: This table estimates the coincidence of corporate tax base and tax rate changes. Panel A reports coefficients from a probit model estimating the probability of a change in the tax base using changes in tax rates. Panel B reports coefficients from a probit model estimating the probability of a change in the tax rate using changes in the tax base. See Section 1 for details on data sources and Appendix A for definitions of broadening and narrowing for each measure. Year fixed effects are included in each panel. Standard errors are clustered by state (* $p < .1$, ** $p < .05$, *** $p < .01$). Overall, this table shows that tax rate changes and tax base changes do not occur simultaneously.

few number of observations.¹³ These results contrast with those of Kawano and Slemrod (2015), who estimate similar models for OECD countries and find statistically significant relations in all categories.

We now describe trends in specific tax base and credit provisions. Fig. 3 shows how tax credits, loss rules, other base provisions and apportionment weights have evolved over time. Panel A of Fig. 3 shows that tax credits, especially R&D credits, have become much more generous. Panel B shows that loss carryforward provisions have become more favorable, and loss carryback provisions have remained relatively stable. Fig. 4 shows how the distributions of many of these provisions have tended to become more generous over the past few decades. In 1980, research and development credits were rare. Beginning in 1990, some states introduced credits, but the vast majority of these were small – below 5%. R&D tax credits have become more common in the twenty-first century. Many states have increased the size of the credit; as of 2010, a large share of states offer credits even more generous than the most generous provisions in 1990. However, the generosity of these credits has been reduced

¹² Appendix Table A3 provides more detail by describing the co-movement of tax rates and each individual tax base measure.

¹³ In particular, the adoption of throwback rules in 2007 by a small number of states is responsible for this result. In Appendix Table A4 we show that this result is not robust to ignoring these changes.

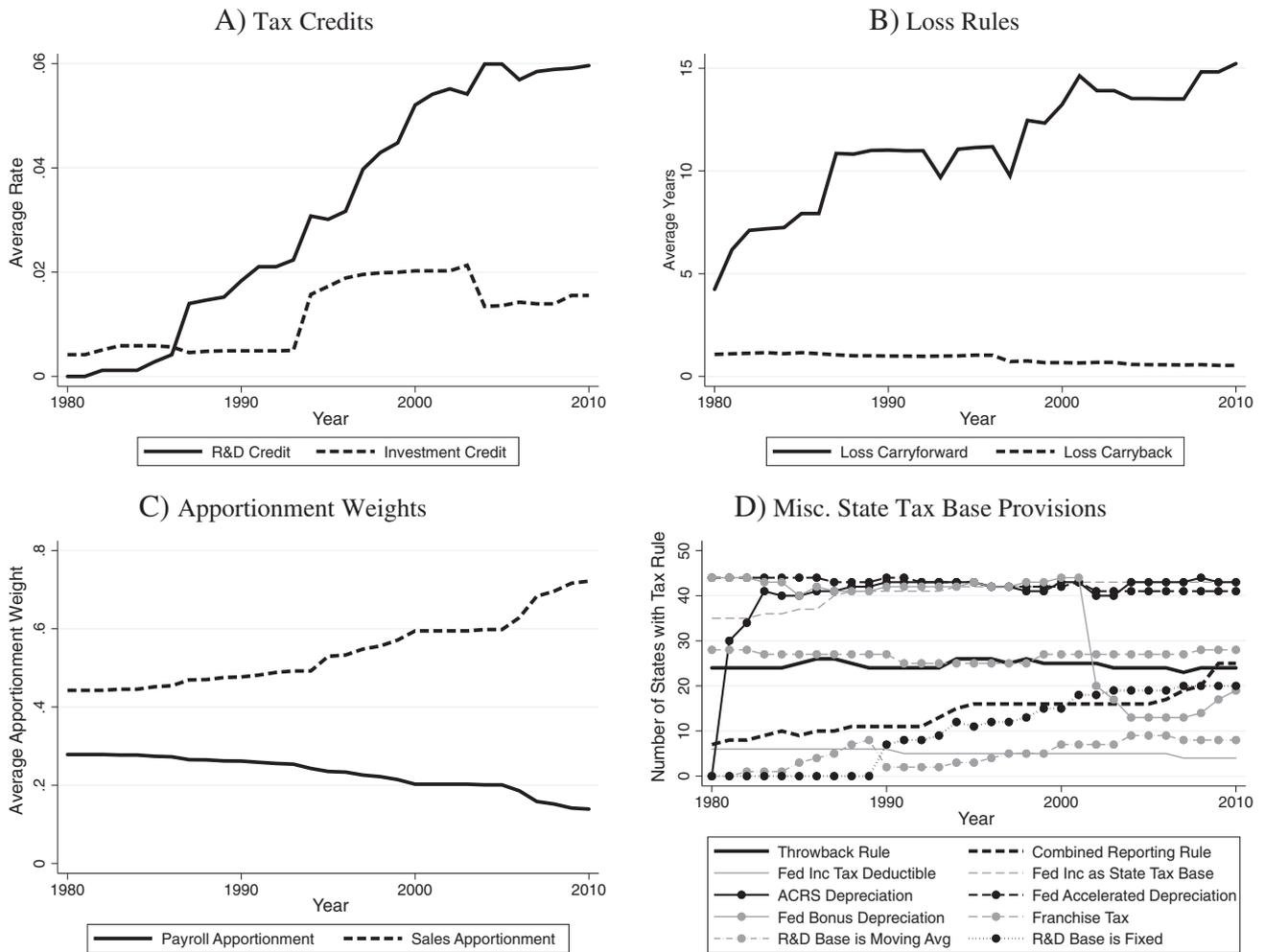


Fig. 3. Base rules and credits over time. Notes: This figure shows state averages of various base rules between 1980 and 2010. Panels A, B, and C use the mean tax credit rate, loss carry allowance, and apportionment weights across all states, respectively. The value is weighted by mean state GDP across the sample period. Panel C does not include property apportionment weights because they are almost always the same as payroll weights. Panel D shows annual state averages for the following indicator variables: throwback rule, combined reporting rule, federal income tax deductibility, federal bonus depreciation, federal income as state tax base, federal accelerated depreciation, ACRS depreciation, franchise tax, base of incremental R&D credit is a moving average, and base of incremental R&D credit is fixed. See Section 1 for details on data sources.

by adoption of rules that limit R&D tax credits to incremental expenditures. The data reveal similar patterns for the investment tax credit and loss carryforward provisions, which have on aggregate changed with the result of narrowing the tax base.¹⁴

Panel C of Fig. 3 shows that states have continued to narrow their base by increasing the apportionment weight on sales, and decreasing the weights on property and payroll. In 1980, the majority of states placed less than half of the apportionment weight on sales. This share declined steadily until 2010, leaving only 12 states with sales apportionment shares below 50%. Fig. 4 depicts this shift and the implications for the sales apportioned corporate tax rate, which is the product of the statutory corporate tax rate and the sales weight. Given the secular decline in payroll and property weights, it is not surprising that the range of this distribution is more compressed than the distribution of sales-apportioned corporate rate. However, it is striking that the distribution of the sales-apportioned corporate rate is skewed to the right and has, if anything, become more

dispersed in recent years by increasing the density of states with higher sales-apportioned corporate rates.

In contrast, other dimensions of the tax base have expanded over the past few decades. Panel D of Fig. 3 shows that an increasing number of states have adopted the federal definition of the state tax base for state tax purposes. This policy choice limits the extent to which state lawmakers can tinker with the tax base, but also puts states at risk of changes in federal policy that may have adverse effects on state tax revenues. The panel also shows a slight increase in the number of states adopting throwback rules that limit the ability of companies to have “nowhere income” under state apportionment rules, especially in later years. Similarly, many states adopted combined reporting rules that strengthen the reporting requirements for unitary businesses. This panel also shows that states have moved away from allowing federal income taxes to be deducted from state taxation. The most notable change is the reduction in the number of states adopting bonus depreciation in the early 2000s, which is likely due in part to the substantial fiscal cost of these provisions in a period of reduced tax revenues (Ohrn, 2016).

The structure of the corporate tax system has been an active area for state policymakers. Contrary to conventional wisdom, we do not

¹⁴ Appendix Figs. A5–A19 provide additional detail behind changes in individual tax base measures by state.

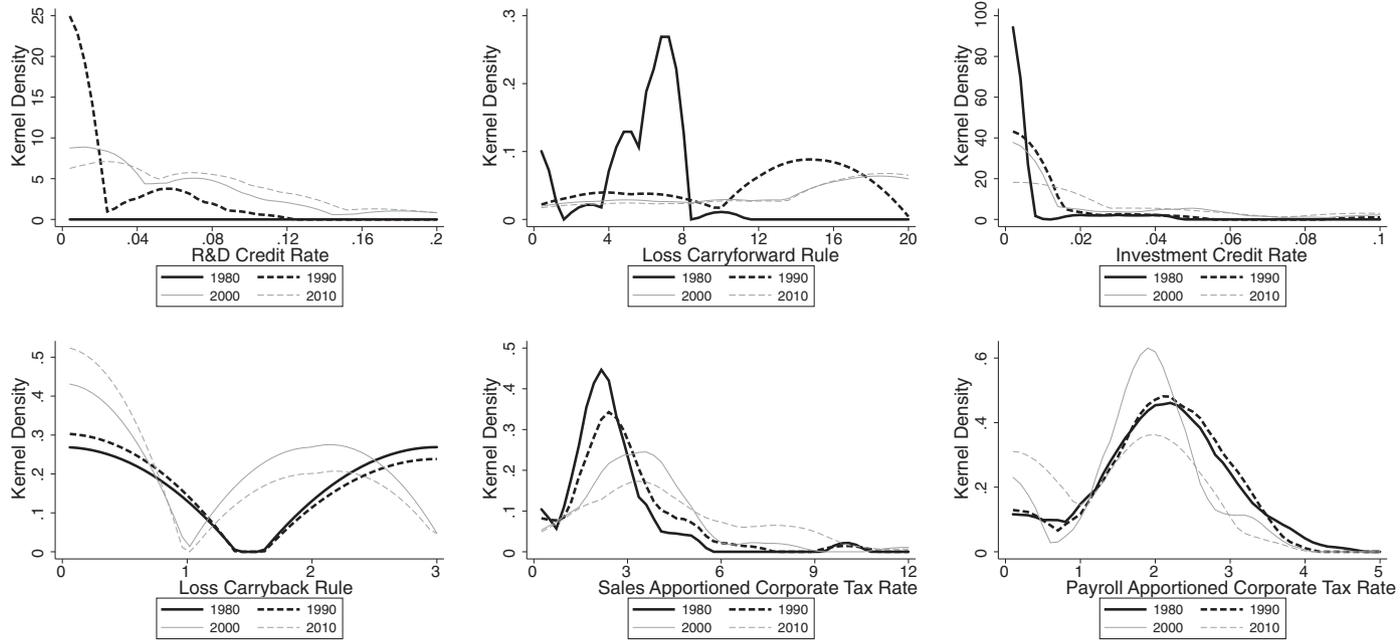


Fig. 4. Corporate tax base and credit densities by decade. Notes: This figure presents kernel density functions for various tax base rules by decade. Loss carryforward and loss carryback are measured in years allotted by the respective rule. See Section 1 for details on each tax base rule and data sources.

find evidence of a temporal concomitance in tax rate and tax base changes.¹⁵ While some aspects of the tax base have become more generous for corporations (e.g., loss carryforward provisions and R&D and investment tax credits), changes in other rules have broadened the tax base (e.g. throwback and combined reporting rules). The following section explores the degree to which these changes to states' corporate tax systems explain changes in tax revenue.

3. Decomposing variation in state corporate tax revenue

The mapping from the state corporate tax structure to state corporate tax revenue is complex. We begin our analysis by taking a first-order approximation of state corporate tax revenue $R(\tau, \mathbf{X}) = \tau \times B(\tau, \mathbf{X})$, which is a function of the state corporate tax rate τ and the tax base $B(\tau, \mathbf{X})$, which depends on a vector of state corporate tax base rules \mathbf{X} . An approximation of the state corporate tax revenue function around (τ^*, X^*) is:

$$R(\tau, \mathbf{X}) \approx R^* \underbrace{\left(1 - \frac{\varepsilon_{R,\tau}}{\tau^*} - \sum_j \frac{\varepsilon_{R,X_j}}{X_j^*} \right)}_{\text{constant}} + \tau \frac{dR^*}{d\tau} + \sum_j X_j^j \frac{dR^*}{dX_j^j}, \quad (1)$$

where X_j^j is an element of the state corporate tax base that is indexed by j .¹⁶

We use Eq. (1) as a point of departure for decomposing state corporate tax revenue into three components: a component related to state corporate tax rates, a component related to the state corporate tax base, and a residual component, i.e.,

$$R_{st} = \alpha + \gamma \tau_{st} + \underbrace{\mathbf{X}'_{st} \Psi_{st}^{BASE}}_{\text{Base Index}_{st}} + u_{st}, \quad (2)$$

where R_{st} is state corporate tax revenue as a share of state GDP and \mathbf{X}_{st} is a vector of tax base controls described in Section 1. The residual component is $\alpha + u_{st}$.

We can then study the variation in state corporate tax revenue shares by decomposing the variation in these components.

$$\text{Var}(R_{st}) = \text{Var} \left(\alpha + \gamma \tau_{st} + \mathbf{X}'_{st} \Psi_{st}^{BASE} + u_{st} \right). \quad (3)$$

We estimate the share of the variance in R_{st} which can be explained by these independent variables overall and then individually.

¹⁵ Appendix Table A5 presents estimates of how the probability of changes in the state corporate tax structure relates to changes in the tax structure of neighboring states in Panel A and of similar states in Panel B. For example, from a baseline probability of 3.1%, states are -0.1, -0.1 and 0.0 percentage points more likely to increase their state corporate tax if, in the prior year, their neighbor increased their corporate tax rate, cut their corporate tax rate or broadened their tax base, respectively. None of these effects were statistically significant. Appendix Table A6 provides analogous results using changes in the past five years. Appendix B describes how we execute the analysis and define similar states.

¹⁶ This expression follows from the following first-order approximation:

$$R(\tau, \mathbf{X}) \approx R^* + (\tau - \tau^*) \frac{dR^*}{d\tau} + \sum_j (X_j - X_j^*) \frac{dR^*}{dX_j} = R^* - \tau^* \frac{dR^*}{d\tau} - \sum_j X_j^* \frac{dR^*}{dX_j} + \tau \frac{dR^*}{d\tau} + \sum_j X_j^j \frac{dR^*}{dX_j^j},$$

where $R(\tau^*, X^*) = R^*$, $\frac{dR^*}{d\tau} = \tau^* \frac{dB(\tau^*, X^*)}{d\tau^*}$, and $\frac{dR^*}{dX_j} = B(\tau^*, X^*) + \tau^* \times \frac{dB(\tau^*, X^*)}{dX_j}$, and from expressing the first group of terms as elasticities. Clausung (2007), Devereux (2007), and Kawano and Slemrod (2015) motivate their analysis with similar derivations.

Fig. 5 presents the results.¹⁷ Panel A shows that roughly half the variation in corporate tax revenue as a share of GDP across states and over time can be explained by the state corporate tax structure. Of this explained variation, state corporate tax base and credits explain more of the variation than state corporate tax rates. Panels B and C examine this result further by showing the importance of variation from specific tax base and credit rules. The contribution to the variance from a given base provision j is $\text{Var} \left(X_{st}^j \Psi_{st}^j \right)$, which depends on the variance of the rule X_{st}^j and the magnitude of its relationship with corporate tax revenue as a share of GDP Ψ_{st}^j . Panel B shows the overall contribution from each rule, i.e., $\frac{\text{Var}(X_{st}^j \Psi_{st}^j)}{\sum_j \text{Var}(X_{st}^j \Psi_{st}^j)}$. The five most important rule provisions are having a franchise tax (21%), sales apportionment weights (20%), using the federal income tax as state base (17%), the deductibility of the federal income tax (16%), and throwback rules (8%).¹⁸ To isolate the importance of variation in the effects of base rules Ψ_{st}^j , we standardize the rules $\tilde{X}_{st}^j = \frac{X_{st}^j - X_{st}^j}{\sigma_{X_j}}$ and then regress each standardized rule on revenue as a share of GDP. Panel C shows the results. Each row shows the point estimate of $\tilde{\Psi}_{st}^j$, which is the effect of a one standard deviation increase in standardized tax base measure \tilde{X}_{st}^j . Two aspects of this figure are interesting: the direction and magnitude of each effect. First, Panel C shows, for example, that a one standard deviation increase in standardized sales apportionment is associated with a 30 basis point decrease in state corporate tax revenue as a share of GDP. This impact is positive and relatively large compared with the overall contribution to the variance shown in Panel B. The largest negative correlate is an indicator for having a franchise tax, which is more common among southern states and sometimes substitutes for having any corporate tax system at all (e.g., Texas).¹⁹ Most of the base and credit provisions listed are positively related to revenue as a share of GDP, except for federal income tax deductibility, loss provisions, and depreciation provisions, which are associated with less corporate tax revenue as a share of GDP. Overall, tax base and credit rules account for the majority of the explained variation in corporate tax revenues as a share of GDP.

Fig. 6 shows that the explanatory power of base and credit rules has evolved over time. Specifically, it shows the share of variation for each five-year interval from 1980 to 2010 that can be explained by the state corporate tax structure in Panel A, rates versus base and credit rules in Panel B, and for each base rule in Panel C. The upper left panel shows that the state tax policy parameters explain roughly half of the variation in state corporate tax revenues as a share of state GDP. The upper right panel shows that a larger share of the explained variance is accounted for by state corporate tax base rules. Sales apportionment weights and loss provisions were quite important in the first half of the sample period. More recently, however, federal provisions (such as adopting the federal tax base and federal bonus depreciation or allowing for the deductibility of federal taxes) have grown in importance. Additionally, franchise taxes and loss carryforward provisions have also increased their share of explained variance.

¹⁷ Each decomposition is weighted by mean state GDP across the full period (1980–2010). Appendix Figs. A2 and A3 show a version of Eq. (2) and Eq. (3) that uses $\ln R_{st}$ as the outcome. Appendix Table A7 shows the results for different specifications. Appendix Table A8 shows how the base rules and their changes are correlated. See Appendix Table A2 for variance decomposition results that take Bartik (2017) controls into account for the subset of states and years for which these controls are available.

¹⁸ We present further results of this variance decomposition in Table A7. For example, when we control for an interaction of throwback rules and apportionment weights, the explanatory power of the throwback rule increases.

¹⁹ See Appendix Fig. A6 for a map of which states have franchise taxes.

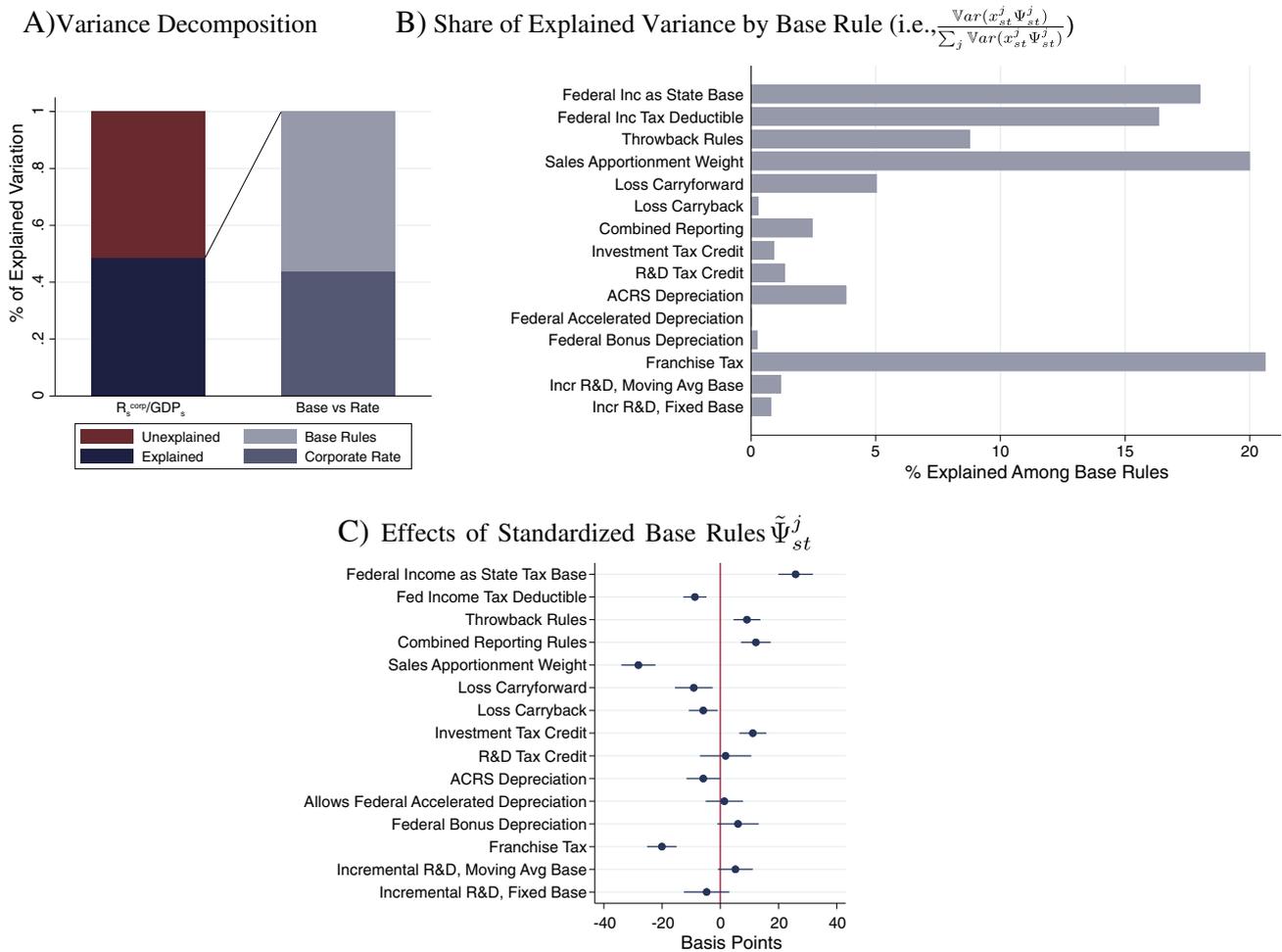


Fig. 5. Variance of state corporate tax revenue as a share of GDP. Notes: This figure decomposes the variation in the corporate revenue-to-GDP ratio into corporate tax rate and tax base components. Panel A decomposes the variation in state corporate tax revenue as a share of state GDP from 1980 to 2010 using Eq. (2). Panel B displays the contribution to base variation from each base rule. Panel C plots the effect of each base rule on state corporate tax revenue as a share of state GDP from 1980 to 2010. We standardize each base rule prior to determining the coefficients to facilitate comparisons across base rules with different variances. Revenue-to-GDP ratio is measured in basis points. See Section 3 for details. The decomposition is weighted by mean state GDP across our sample period. See Section 1 for details on data sources.

4. Impacts on state tax revenue and economic activity

We now analyze how taxes impact state tax revenue and economic activity. Eq. (1) shows that tax base controls should be included when estimating the effects of state taxes on state outcomes. In this section we focus on the extent to which omitting state corporate tax base affects these estimates. We first explore an event study approach that flexibly captures the dynamic effects of tax changes. We then summarize these results with a more parsimonious regression specification.

4.1. Event study estimates

We begin with an analysis of the typical path of state outcomes preceding and following a change in the state corporate tax structure. We use an event study specification of the form:

$$Y_{st} = \alpha_s + \gamma_t + \sum_{k \in \{-4, -3, -2, 0, 1, 2, 3, 4, 5\}} \beta_k D_{st}^k + \beta \sum_{k < -4} D_{st}^k + \bar{\beta} \sum_{k > 5} D_{st}^k + \varepsilon_{st} \tag{4}$$

where D_{st}^k is an indicator for state s having changed the state tax rate k periods in the past, α_s is a state fixed effect, and γ_t is a time fixed effect. The coefficients β_k provide the impact on the time path of mean outcomes relative to the period before the tax rate change (which has been normalized to zero). Additionally, we address imbalance issues by “binning” periods greater than 5 or less than -4 , which is reflected in the $\bar{\beta}$ and β coefficients that are assumed to be stable within end point bins. To address serial correlation in ε_{it} , all standard errors are clustered by state. We consider three main outcomes: state corporate tax revenue as a share of state GDP, log state corporate tax revenue, and log state GDP.

We fit specifications of this type on our state panel data using data from 1980 to 2010. We also consider specifications that control for the leads and lags of key components of the tax base. Specifically, we control for leads and lags of the six most important tax base controls in terms of variance shares of corporate tax revenue: federal income tax treated as state base, sales apportionment weight, throwback rules, federal income tax deductibility, loss carryforward, and franchise tax.

Fig. 7 shows the results for corporate tax cuts and corporate tax increases that exceed a 0.5 percentage point change in the rate in

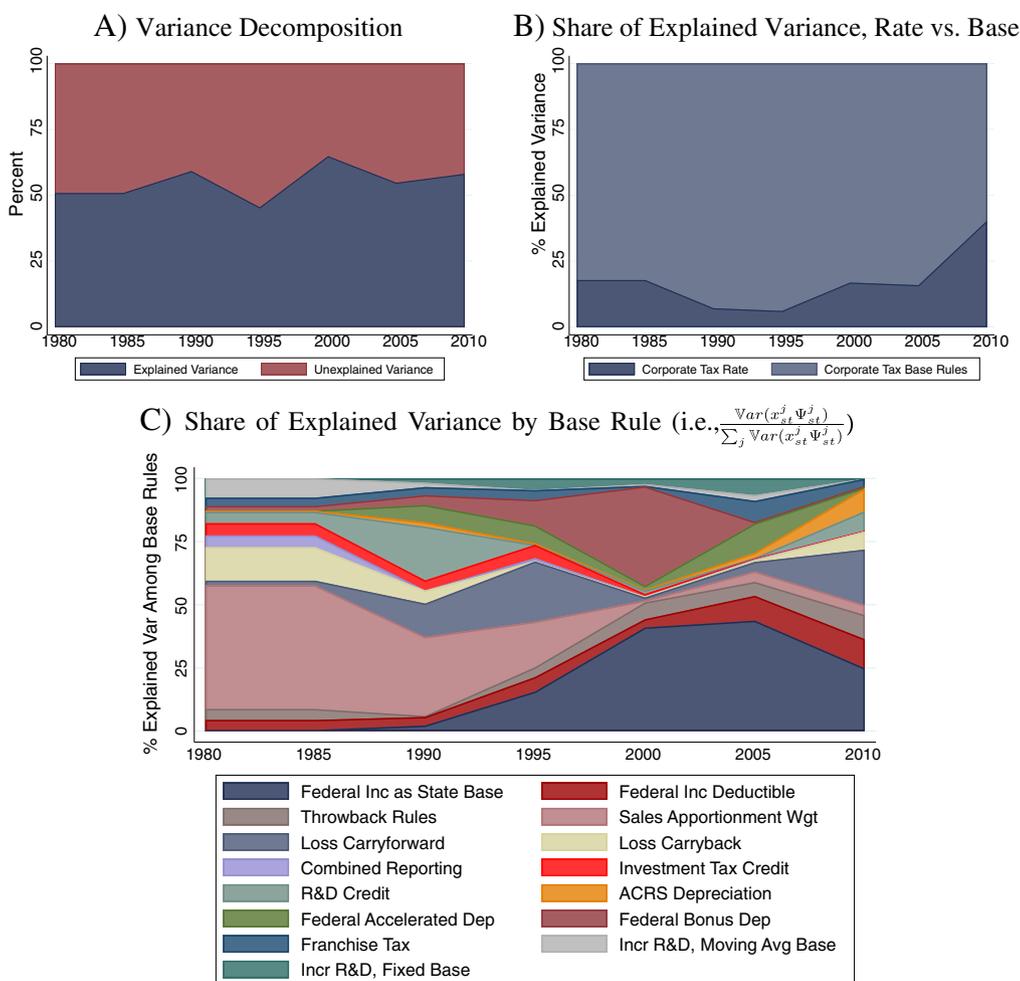


Fig. 6. Corporate tax revenue share of GDP - Variance decomposition by five-year period. Notes: This figure replicates Fig. 5 over five-year periods between 1980 and 2010. Panel A decomposes the variation in state corporate tax revenue as a share of state GDP from 1980 to 2010 using Eq. (3). Panel B displays the contribution to base variation from each base rule. Panel C plots the effect of each base rule on state corporate tax revenue as a share of state GDP from 1980 to 2010. See Section 3 for details. The decomposition is weighted by mean state GDP across our sample period. See Section 1 for details on data sources.

absolute value on state outcomes.²⁰ Panel A shows that corporate tax decreases that exceed 0.5 percentage point cuts in the rate tend to reduce state corporate tax revenue as a share of state GDP by roughly 6 percentage points cumulatively over a 5-year period. Panels B and C show the importance of the numerator and denominator separately. Despite modestly higher economic activity, corporate tax cuts decrease state tax revenue by roughly 10%. The increases in state GDP are imprecise and not statistically different than zero, though the point estimate is roughly 2%. Controlling for the tax base does not alter these general patterns. Panels D, E, and F show that tax increases have symmetric impacts, though pre-trends are a bit more noticeable prior to state corporate tax increases. Specifically, the event studies in D and E show that tax revenues were also higher preceding the tax increase events by roughly a similar magnitude, so it is not clear

that corporate tax revenues actually increase following tax increases. We view these event studies as describing the typical evolution of outcomes before and after tax changes. Since these tax changes potentially include some endogenous changes that are intended to address current (or expected) economic conditions, these impacts are descriptive and not causal.²¹ Overall, these point estimates of the effect of state corporate tax changes are imprecise, but the key finding for our purposes is that they do not depend strongly on base controls on average.

4.2. Regression estimates

We summarize these relationships by estimating Eq. (2) with state and year fixed effects, i.e.,

$$R_{st} = \alpha_s + \phi_t + \gamma \tau_{st} + \mathbf{X}'_{st} \Psi_{st}^{BASE} + u_{st},$$

This specification increases statistical precision relative to the event study Eq. (4) by combining the periods before and after tax changes

²⁰ We focus on the impacts of non-trivial changes in state corporate tax rates and present analogous results for all state changes in Appendix Fig. A23. The threshold of 0.5 percentage points includes roughly half the state corporate tax changes (see Appendix Fig. A24 for a histogram). A corporate tax cut that exceeds 0.5 percentage points amounts to roughly a one percentage point cut in state corporate tax rate on average. On average, a corporate tax increase that exceeds 0.5 percentage points corresponds to a 1.5 percentage point increase in the state corporate tax rate. Controlling for leads and lags of the other tax base controls (in addition to the ones in our baseline specification) results in similar but slightly noisier estimates as shown in Appendix Fig. A26.

²¹ For example, macroeconomic shocks might induce changes in state corporate tax systems. Appendix Fig. A25 shows analogous results to Fig. 7 for the subset of state corporate tax changes that Giroud and Rauh (2015) classify as exogenous.

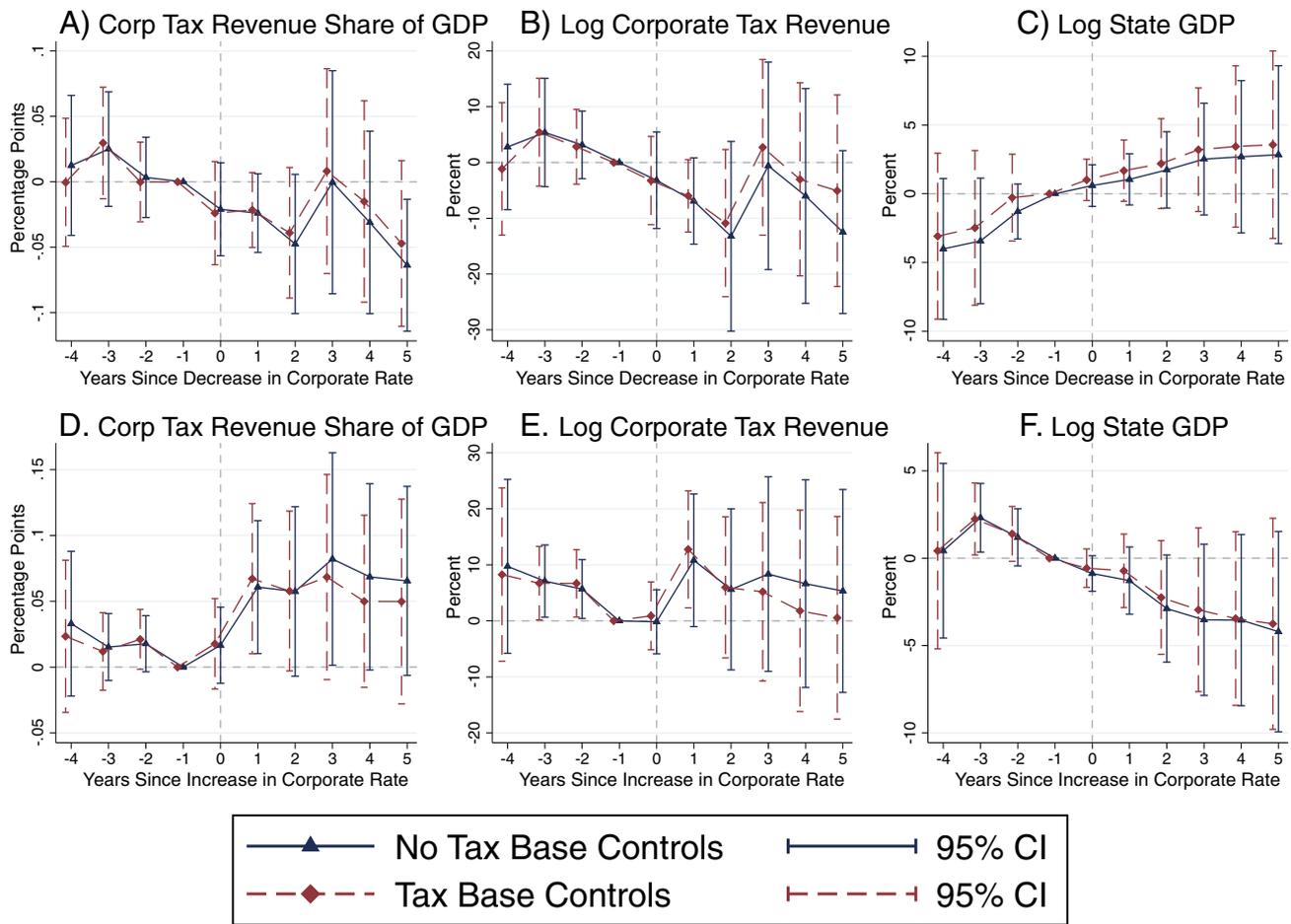


Fig. 7. Event analysis: Impacts on state corporate tax revenue and GDP. Notes: This figure shows the effect of changes in the state corporate rate of at least 0.5pp on state corporate tax revenue as a share of state GDP, log corporate tax revenue, and log state GDP, respectively. The full navy line indicates a specification without additional controls. The dashed red line plots the coefficients from a specification that additionally controls for the following tax base rules: federal income tax treated as state base, sales apportionment weight, throwback rules, federal income tax deductibility, loss carryforward, and franchise tax. Standard errors are clustered by state. The estimating equation is Eq. (4). Appendix Fig. A23 replicates this figure for changes in the state corporate rate of any magnitude. Appendix Fig. A25 shows analogous results for the subset of state corporate tax changes that Giroud and Rauh (2015) classify as exogenous. Appendix Fig. A26 compares the estimated impacts when all tax base controls are included, relative to the aforementioned rules. See Section 1 for details on data sources.

and by imposing symmetry in the effects of tax increases and decreases.²² Column (1) of Table 5 shows results when we omit tax base controls. This estimate implies that increasing the state corporate tax rate by 1 percentage point leads to an increase in corporate tax revenues relative to GDP of 1.8 basis points. Relative to the average value of R_{st} of 35 basis points, a 1 percentage point increase in τ represents a $(1.8/35=)$ 5% increase in R_{st} .

Column (2) of Table 5 shows that including controls for the tax base does not affect this estimate, which reinforces the results from the event studies in Fig. 7. However, including these controls increases the precision of the estimate. As we discussed in Section 3, these controls have large explanatory power on the revenue-to-GDP ratio. The coefficients on the tax base controls have a similar interpretation as those in Fig. 5. For instance, some controls that narrow the base — including the R&D tax credit, the investment tax credit, and an indicator for allowing the deductibility of federal income

taxes — have negative effects on R_{st} . Conversely, controls that correspond to broader bases, such as throwback rules or incremental tax bases for R&D tax credits, have positive effects on R_{st} . Having a franchise tax also negatively impacts R_{st} , as states with a franchise tax often use it as an alternative to a tax on corporate income.

4.2.1. Base index

We can use these estimates to construct a composite measure of the tax base. We define an index of the breadth of the tax base: $\text{Base Index}_{st} = \frac{\sum_{j \in \mathcal{J}} \psi_{st}^j}{\sigma^B}$, where \mathcal{J} is the set of all 15 base and credit controls, and where we normalize this index to have unit standard deviation. A regression that replaces the base controls with the Base Index recovers σ^B as a regression coefficient. We report this estimate in the bottom of Column (2), which is statistically significant at the 1-percent level, and implies that increasing the Base Index by 1 standard deviation leads to an increase in R_{st} of 2.7 basis points.

4.2.2. Separating effects on revenue and GDP

Taxes may affect the revenue-to-GDP ratio by increasing revenues or by decreasing GDP. We estimate the effects on the numerator and denominator separately. To facilitate comparisons across states and across time, we present estimates of the effects on log state corporate

²² In these estimations we weight observations by the mean GDP in the state over our sample, and the standard errors allow for arbitrary correlation between observations from a given state. We scale the revenue-to-GDP variable so that coefficients can be interpreted in terms of basis points.

Table 5
Effects of corporate tax rates and tax base controls on tax revenues and economic activity.

	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue to GDP ratio		Log(Revenue)		Log(GDP)	
τ	1.776*	1.608**				
	(1.054)	(0.763)				
$\ln(1 - \tau)$			-2.318	-2.585	1.077	0.818
			(2.699)	(1.898)	(1.363)	(0.988)
R&D tax credit		-31.171		0.173		-0.078
		(31.453)		(0.969)		(0.274)
Sales apportionment Wgt		-0.073		-0.001		-0.001*
		(0.069)		(0.002)		(0.001)
Loss carryback		-0.357		0.005		0.014
		(0.637)		(0.022)		(0.012)
Loss carryforward		0.034		0.001		0.001
		(0.165)		(0.004)		(0.002)
Franchise tax		-9.615		-0.406**		-0.126***
		(6.834)		(0.164)		(0.043)
Fed income tax deductible		-7.649*		-0.336***		-0.182***
		(3.847)		(0.115)		(0.061)
Fed income as tax base		-2.675		-0.028		-0.036
		(2.536)		(0.095)		(0.051)
Allow fed Acc Dep		6.242		0.055		-0.007
		(5.339)		(0.132)		(0.026)
ACRS depreciation		-0.698		-0.033		-0.018
		(1.312)		(0.032)		(0.021)
Federal bonus depreciation		1.185		-0.006		0.031
		(1.575)		(0.052)		(0.021)
Throwback rules		1.431*		0.008		-0.022
		(0.749)		(0.045)		(0.014)
Combined reporting		-0.699		-0.016		0.004
		(1.965)		(0.114)		(0.033)
Investment tax credit		-76.918***		-1.382		0.276
		(25.973)		(0.837)		(0.523)
R&D incremental Mov Avg		2.614		-0.013		0.004
		(2.560)		(0.085)		(0.023)
R&D incremental fixed		1.875		0.009		0.052
		(3.288)		(0.113)		(0.032)
Observations	1550	1550	1426	1426	1550	1550
Base index		2.663				
(se)		0.788				

Notes: This table reports the results of regressions that estimate the effects of changes in tax rates on tax revenue and economic activity. Each specification weights observations by the mean state GDP in our sample and includes state and year fixed effects. The 15 base controls included in Columns (2)–(3) are described in Section 1. Details of the specification and the definition of the joint interaction can be found in Section 5. The revenue-to-GDP ratio is measured in basis points. Standard errors are clustered by state (* $p < .1$, ** $p < .05$, *** $p < .01$). Overall, this table shows that including tax base controls does not have significant effects on the effect of taxes on revenues and economic activity.

tax revenue and on log state GDP. For these specifications we report the effect of the log keep rate, *i.e.*, $\ln(1 - \tau)$.²³ Columns (3) and (5) of Table 5 show that an increase in the log keep rate reduces revenue and increases GDP. Columns (4) and (6) further show that controlling for the tax base does not have large effects on these estimates. However, some tax base controls affect these outcomes even when the effect on R_{st} is not statistically significant. For instance, states with a franchise tax and states that allow for the deductibility of federal income taxes have both lower revenues and lower GDP.²⁴

5. Heterogeneous effects of tax rate changes

This section relaxes the assumption of homogeneous treatment effects of τ . We show that tax base interactions with the tax rate

can lead to heterogeneous effects across time and states, and that omitting these interactions leads to biased estimates of the average treatment effect of state corporate tax rate changes.

Changes in state corporate tax rates may have differential effects on tax revenue and economic activity depending on the breadth of the tax base. Intuitively, a tax increase should raise less revenue whenever the tax base is relatively narrow. This intuition holds (1) for mechanical effects, since narrow bases by definition tax a smaller share of profits; (2) for reporting responses, since firms in states with narrow bases may respond by adopting new deduction strategies; and (3) for behavioral responses, since firms are likely to respond less to a tax increase whenever the tax affects a smaller share of their profits.²⁵ As a hypothetical example, suppose that California and New York both increase their state corporate tax rates, but suppose further that California has a much more lenient treatment of loss carryforward provisions. Firms in California with past losses will face a smaller increase in their effective tax liability as firms in New York, since the tax base in California is narrower. Any behavioral

²³ We use $\ln(1 - \tau)$ because these expressions are in log form and the keep rate formulation avoids taking logs of zeros for states that have no state corporate tax.

²⁴ It may also be the case that tax base controls have dynamic effects on these outcomes. A full discussion of the effects of each base control is beyond the scope of this paper. Nonetheless, Appendix Figs. A30–A44 present results of event studies around changes in the tax base controls. From these graphs, the most interesting case is the adoption of incremental tax base for R&D tax credits, which led to tax increases in future years by limiting the value of R&D tax credits.

²⁵ Indeed, our derivation above implies that the marginal effect of taxes will depend on the base through both mechanical and behavioral effects of taxes: $\frac{dR}{d\tau} = B(\tau, \mathbf{X}) + \tau \times \frac{dB(\tau, \mathbf{X})}{d\tau}$.

Table 6
Effects of corporate tax rate changes on tax revenues and economic activity.

	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue to GDP ratio		Log(Revenue)		Log(GDP)	
τ	1.608** (0.763)	2.423*** (0.517)				
$\log(1 - \tau)$			-2.585 (1.898)	-4.661*** (1.233)	0.818 (0.988)	0.889 (0.816)
Joint interaction		1.244*** (0.215)		4.582*** (0.795)		1.710*** (0.338)
<i>Individual interactions</i>						
R&D credit		0.016 (0.481)		-2.618** (1.198)		1.798*** (0.390)
Sales apportionment Wgt		0.194 (0.120)		-0.557* (0.291)		-0.266*** (0.098)
Loss carryback		-0.038 (0.119)		0.545* (0.289)		0.171* (0.097)
Loss carryforward		-0.160 (0.127)		0.744** (0.346)		0.408*** (0.104)
Franchise tax		0.695*** (0.150)		-2.294*** (0.378)		-0.551*** (0.121)
Federal Inc deductible		-0.185 (0.185)		0.611 (0.432)		0.758*** (0.149)
Federal Inc as state base		0.326** (0.155)		-1.786*** (0.358)		-0.411*** (0.125)
Federal accelerated dep		-0.750*** (0.150)		0.889** (0.413)		0.206* (0.123)
ACRS depreciation		0.357*** (0.106)		-0.784** (0.349)		0.200** (0.087)
Federal bonus dep		0.143 (0.117)		0.597* (0.325)		0.065 (0.096)
Throwback rules		0.063 (0.079)		-0.241 (0.278)		-0.160** (0.065)
Combined reporting		0.255*** (0.083)		0.377 (0.350)		-0.244*** (0.069)
Investment tax credit		-0.041 (0.128)		-0.245 (0.308)		-0.345*** (0.103)
R&D incremental Mov Avg		-0.174 (0.260)		1.265* (0.657)		-0.688*** (0.211)
R&D incremental fixed		-0.730** (0.291)		5.454*** (0.909)		-0.493** (0.237)
N	1550	1550	1426	1426	1550	1550
Base controls	Y	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y

Notes: This table reports the results of regressions that estimate the effects of changes in tax rates on tax revenue and economic activity. Each specification weights observations by the mean state GDP in our sample and includes state and year fixed effects. Standard errors are clustered by state (* $p < .1$, ** $p < .05$, *** $p < .01$). The 15 base controls included in Columns (1)–(6) are described in Section 1. Details of the specification and the definition of the joint interaction can be found in Section 5. The revenue-to-GDP ratio is measured in basis points. The number of observations is lower in Columns (3) and (4) because some states do not collect corporate income taxes. Overall this table shows that, while including tax base controls does not have significant effects on the average effect of taxes on revenues and economic activity, estimators that do not allow for heterogeneous effects of taxes that depend on the structure of the state corporate tax system result in inconsistent estimates of the average partial effect of taxes on revenues and economic activity.

response by firms that depends on current rates, such as investment, employment, or relocation, will therefore be more muted in California than in New York. While this example only mentions loss carryforward provisions, the treatment of other aspects of the tax base, such as depreciation allowances or investment tax credits, may also modulate the degree to which tax changes affect tax revenue.

5.1. Econometric intuition

When the effect of a state corporate tax rate change depends on the tax base, estimates that do not account for tax-base-driven heterogeneity can lead to bias in average treatment effects. The intuition for this bias follows directly from the Omitted Variable Bias (OVB) formula. For simplicity, consider the case in which there are two types of states with narrow and broad bases, and that the effects of tax changes depend on the tax base. The long regression is:

$$R_{st} = \alpha + \beta_1 \tau_{st} + \beta_2 \tau_{st} \times \mathbb{I}\{\text{Narrow base}\}_{st} + \delta \mathbb{I}\{\text{Narrow base}\}_{st} + u_{st}.$$

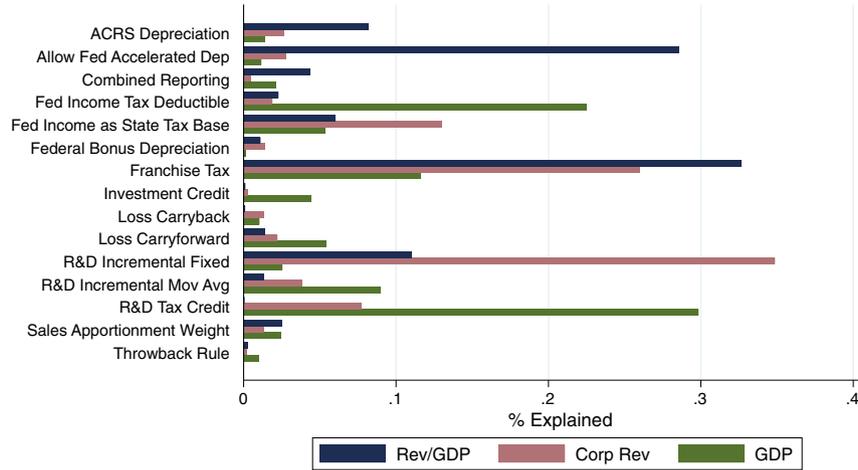
If we assume that the effect of a tax rate change in broad-base states (β_1) is greater than in narrow-base states ($\beta_1 + \beta_2$), we might worry that a short regression that omits the interaction term $\tau_{st} \times \mathbb{I}\{\text{Narrow base}\}_{st}$ will yield a biased estimate of the average effect across states, i.e., $\beta_1 + \beta_2 \Pr(\text{Narrow base})$. The OVB formula shows that the short regression estimate will be biased:²⁶

$$\begin{aligned} \mathbb{E}[b_1] &= \beta_1 + \beta_2 \times \frac{\text{Cov}(\tau_{st}, \tau_{st} \times \mathbb{I}\{\text{Narrow base}\}_{st})}{\text{Var}(\tau_{st})} \\ &= \beta_1 + \beta_2 \Pr(\text{Narrow base}) \times \frac{\text{Var}(\tau_{st} | \text{Narrow base})}{\text{Var}(\tau_{st})}. \end{aligned}$$

The sign and magnitude of the bias is governed by two forces: (1) heterogeneous effects due to the tax base interactions (i.e., $\beta_2 \geq 0$) and (2) the covariance between the interaction term and τ . First, the sign

²⁶ Where the short regression is given by: $R_{st} = a + b_1 \tau_{st} + d \mathbb{I}\{\text{Narrow base}\}_{st} + u_{st}$.

A) Full Decomposition of Total Effects



B) Decomposition of Total Effect on Revenue-to-GDP over Time

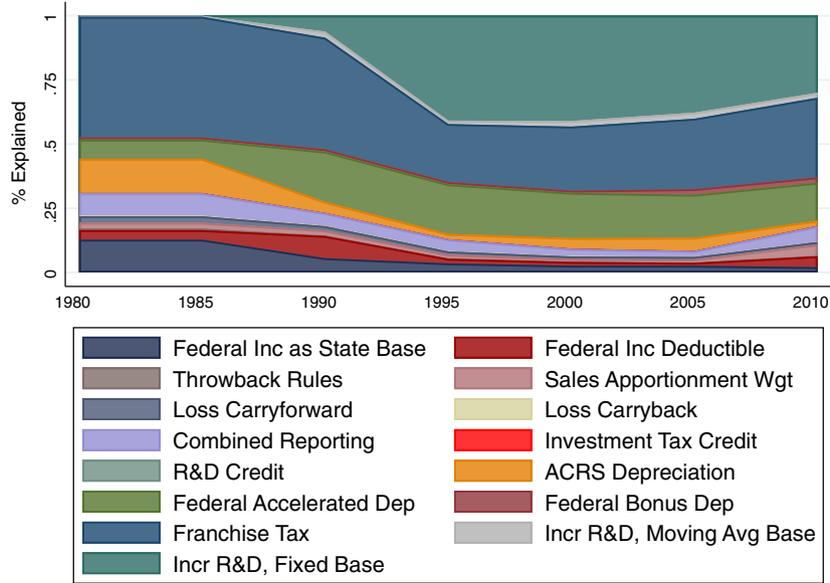


Fig. 8. Decomposing the total effects of the corporate tax rate. Notes: This figure decomposes the variance in the estimated total effects of τ on the revenue-to-GDP ratio, and of $\ln(1 - \tau)$ on log-GDP and log-revenue. The total effect varies across states and years since it accounts for interactions between the state corporate tax rate and base controls. This figure describes the relative importance of different tax base controls in explaining the heterogeneity in the total effect that is driven by interactions with tax base controls. By construction, the variance in the model is equal to the total variance. The bars in Panel A report the fraction of the variance that is due to changes in each of the tax base parameters for each of the three estimated total effects. Panel B focuses on the revenue-to-GDP ratio and describes how the importance of different tax base controls has evolved over time. The total effect is defined in Eq. (6) and estimates of the coefficients for the total effect are reported in Column (3) of Table 6; see Section 5 for more details.

and magnitude of the effect of tax base provision β_2 depend on the base rule. For base-narrowing provisions, we expect $\beta_2 < 0$. Second, the term β_2 is scaled by the covariance between the tax rate and the interaction. In contrast to the average treatment effect, which scales β_2 by the fraction of the population with a narrow base, the short regression scales β_2 by a different term.²⁷ In the case of indicator

variables, this scaling term is the conditional variance of the state corporate tax rate in narrow-base states.

If $\beta_2 < 0$ and narrow-base states change taxes more frequently (i.e., $\text{Var}(\tau_{st}|\text{Narrow Base}) > \text{Var}(\tau_{st})$), then omitting the interaction term will result in a downwardly-biased estimate of the average effect of taxes on revenues. The general case with 15 interactions is slightly more complex, but the potential biases from not including interactions have a similar intuition. This type of bias is well known in the econometrics literature (e.g., Wooldridge, 2005), and has been shown to be empirically important across several fields of applied economics (Gibbons et al., 2014).

²⁷ Except in knife-edge cases, these weights do not coincide with sample frequencies and the resulting weighted average is not representative of the average effect across states.

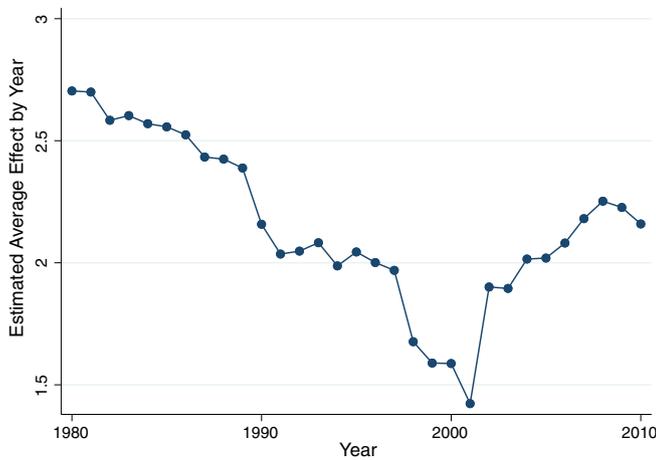


Fig. 9. Average estimated total effect of τ on the revenue-to-GDP ratio by year. Notes: This figure plots the average total effect of τ on the revenue-to-GDP ratio by year. The total effect is presented in terms of basis points of the revenue-to-GDP ratio. The effect varies across states and years since it accounts for interactions between the state corporate tax rate and base controls. In general, the effect is smaller when states adopt policies that narrow the tax base. This figure shows that, on average, the total effect declined in magnitude as the tax base narrowed between 1980 and 2000, and that it increased during the last decade as the tax base broadened. The total effect is defined in Eq. (6) and estimates of the coefficients for the total effect are reported in Column (3) of Table 6; see Section 5 for more details.

5.2. Estimates of heterogeneous effects of tax rate changes

To explore tax-base-driven heterogeneity, we expand the model of Eq. (2) to include interaction terms between the tax rate and the tax base controls:

$$R_{st} = \alpha_s + \gamma_t + \beta_0 \tau_{st} + \sum_{j=1}^{15} \beta_j \tau_{st} \times \tilde{x}_{st}^j + \tilde{x}'_{st} \tilde{\Psi}_{st}^{BASE} + u_{st}, \tag{5}$$

where \tilde{x}^j 's are the standardized base rules, which facilitate the interpretation of β_0 as the mean effect of τ . Column (1) of Table 6 presents the results from a model that controls for the tax base but that omits interactions (as in Column (2) of Table 5), and Column (2) includes the interactions. In contrast to the results of Table 5, we find that including interaction terms leads to a larger average effect of the corporate tax rate on the revenue-to-GDP ratio, with the estimate increasing from 1.6 to 2.4 basis points. This effect is 50% larger, which is strong evidence that tax-base interactions matter and that the OLS estimator is not a consistent estimator for the average effect across states. Relative to the mean value of $R_{st} = 35$ basis points, a 1 percentage point increase in τ leads to a $(2.4/35 =)$ 7% increase in the revenue-to-GDP ratio.

For a given state with a tax base \tilde{x}_{st} , the total effect of τ on R_{st} is given by:

$$\beta_R(\tilde{x}_{st}) = \beta_0 + \sigma^J \underbrace{\sum_{k=1}^{15} \frac{\beta_k}{\sigma^J} \tilde{x}_{st}^k}_{\text{Joint interactions}}, \tag{6}$$

where σ^J equals the standard deviation of the linear combination $(\sum_{k=1}^{15} \beta_k \tilde{x}_{st}^k)$. The joint interaction term has mean zero, since the \tilde{x}_{st}^k 's are normalized, and a unit standard deviation since we divide

by σ^J .²⁸ The specification in Eq. (6) has two main advantages. First, the joint interaction term is a useful data-reduction measure that captures the variation across 15 bases in a single index. Second, the statistical significance of the total effect $\beta_R(\mathbf{X}_{st})$ for a given state depends on the covariance matrix of the individual β_k terms. While it is hard to evaluate the joint statistical importance of these interactions from individual coefficients, the joint interaction term collapses the covariance structure and allows for a simple univariate statistical analysis.

Column (2) in Table 6 reports the coefficient on the joint interactions. The joint interaction term is statistically significant and shows that interactions between the tax rate and the tax base are economically important. For instance, a 1 percentage point tax increase in a state with a joint interaction term that is two standard deviations above the mean would increase R_{st} by $(2.4 + 2 \times 1.25 \approx)$ 5 basis points. Conversely, a state with a joint interaction term that is two standard deviations below the mean would not see an increase in revenue.²⁹

Columns (3)–(6) in Table 6 report the effects of $\ln(1 - \tau)$ on log-GDP and log-revenue. As before, controlling for the tax base does not have large effects on our estimates of β_0 . While an increase in $\ln(1 - \tau)$ both reduces revenue and increases GDP, we find that the effects on revenue are a larger driver of the net effect on the revenue-to-GDP ratio. In addition, these columns also show that both state GDP and state tax revenue are subject to statistically significant joint interactions between $\ln(1 - \tau)$ and the tax base. For the case of log-revenue, we find that the mean effect is much larger in Column (4) than in Column (3), while the mean effect β_0 on log-GDP is less affected by introducing interactions.

These joint interaction terms can be decomposed into the individual interactions, which are presented in the remaining rows of Table 6.³⁰ Fig. 8 further describes how each of the interaction terms contributes to the joint interaction term for each outcome. Panel A plots the fraction of the variation in the total effect $\beta_Y(\tilde{x}_{st})$ for each outcome that is driven by each of the base controls. Each contribution in this graph is driven by the coefficient of each interaction term, as well as by the number of tax base changes for each control. This figure shows that the heterogeneous effects for the revenue-to-GDP ratio are driven mostly by the R&D tax credit, the presence of a franchise tax, the allowance for federal accelerated depreciation, and the deduction of federal taxes. Of these four policies, the franchise tax and the allowance for federal depreciation drive variation through heterogeneous effects on corporate revenue, while the allowance for the deductibility of federal taxes has a larger effect on GDP. For example, a 1 percentage point tax increase in a state with a franchise tax would increase R_{st} by $(2.4 + 0.7 \times 1 \approx)$ 3.1 basis points, while an equal increase in a state without a franchise tax would only increase R_{st} by $(2.4 + 0.7 \times 0 =)$ 2.4 basis points. Panel B splits this decomposition by five-year intervals, and shows that the importance of the franchise tax and the deductibility of federal taxes has waned over time, while the importance of the allowance for federal accelerated depreciation and the R&D tax credit has grown in importance over time.

²⁸ We first estimate Eq. (5) to recover β_k 's. By construction, the estimate of β_0 is not affected by this procedure. Note also that, without the standardization of the joint interaction term, we would obtain a coefficient of one on this variable.

²⁹ These results are robust to including lagged values of the tax rate, the tax base, and the joint interactions. Table A10 shows that controlling for 1–5 lags of any of these variables does not affect the total cumulative mean effect of tax rates on revenues. See the note to Table A10 for more detail.

³⁰ We expect interaction terms to have a positive coefficient whenever the rules broaden the base. Conversely, we expect negative coefficients for rules that narrow the base. In Appendix A.2, we list these predictions for each interaction term.

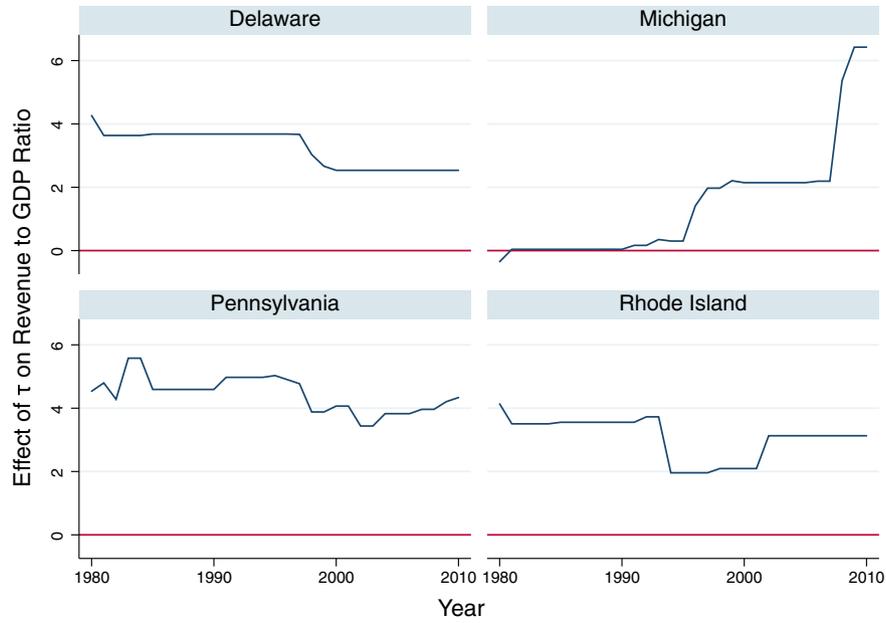


Fig. 10. Estimated total effect of τ on the revenue-to-GDP ratio by year for selected states. Notes: This figure plots the estimated total effect of τ on the revenue-to-GDP ratio for selected states. The total effect is presented in terms of basis points of the revenue-to-GDP ratio. The effect varies across states and years since it accounts for interactions between the state corporate tax rate and base controls. These plots show that the aggregate pattern described in Fig. 9 is a result of states that have a mirror experience to the national average (such as Pennsylvania and Rhode Island), as well as of states that have contracting (Delaware) and expanding (Michigan) bases. Appendix Fig. A47 presents similar plots for the rest of the states. The total effect is defined in Eq. (6) and estimates of the coefficients for the total effect are reported in Column (3) of Table 6; see Section 5 for more details.

5.3. Tax base trends and implications for the revenue responses to rate changes

We now evaluate how $\beta_Y(\bar{x}_{st})$ varies across states and over time due to changes in the state corporate tax base \bar{x}_{st} . Fig. 9 plots the average value of $\beta_Y(\bar{x}_{st})$ in a given year t , and shows that changes in tax bases between 1980 and 2000 diminished the effect of taxes on revenue. Consistent with the descriptive evidence in favor of narrowing tax bases in Section 2, this figure shows that tax cuts lead to smaller reductions in 2000 than 1980. This figure also shows that this pattern is slightly reversed during the 2000's. Two trends that we observe during this time are the adoption of combined reporting, which tightens the reporting requirements for unitary businesses, and of throwback rules, which limit the extent to which firms can have “nowhere income” under the apportionment system.

Fig. 9 shows how the state average has evolved, but masks considerable heterogeneity across states. Fig. 10 plots the estimated total effect $\beta_Y(\bar{x}_{st})$ for four selected states during our sample period. Delaware, for example, narrowed its tax base, which is reflected by a decrease in the effect of a tax change on revenue over time. This pattern is due to changes to the Delaware corporate tax base in the late 1990's that led to an increase in the number of years allowed for loss carryforward, and by the adoption of a generous R&D tax credit. In contrast, Michigan broadened its tax base by disallowing both the MACRS depreciation rule and federal accelerated and bonus depreciation rules. In addition, the adoption of throwback and combined reporting rules in the late 2000's further broadened the tax base. As a result, the second panel in Fig. 10 shows that revenue became more responsive to changes in tax rates in the later years of our sample for Michigan. Pennsylvania and Rhode Island are examples of states whose experience mirrors the reversal pattern observed on average across states. Pennsylvania narrowed its tax base in the 1990's by increasing the number of years allowed for loss carryforward, as well as introducing R&D and investment tax credits. In the 2000's, it reversed this trend by reducing the investment tax credit and introducing throwback and combined reporting rules. In Rhode Island,

the narrowing of the base was due to the introduction of R&D and investment tax credits, and the reversal was due to the disallowance of federal bonus depreciation.³¹

6. Revenue-maximizing-tax rate

This section evaluates how the structure of the state corporate tax system determines the revenue-maximizing-tax rate.

We extend the framework in Eq. (1) by introducing a quadratic term that can capture the degree to which tax rate increases raise progressively less revenue, or even result in revenue losses:³²

$$R_{st} = \beta_0 \tau_{st} + \delta_0 (\tau_{st})^2 + \alpha_s + \gamma_t + u_{st}. \tag{7}$$

A positive value of β_0 indicates that introducing a small tax will increase revenue. A negative coefficient for δ_0 means that the marginal effect of taxes on revenue is decreasing in τ .³³ If $\delta_0 < 0$, the revenue-maximizing-tax rate is given by:

$$\tau^* = \frac{\beta_0}{-2\delta_0}.$$

³¹ Appendix Fig. A47 shows the total effect for each state year, which can be compared to the base changes by state in Appendix Figs. A7–A19. Appendix Fig. A48 compares the estimated effect across all states in 1985 and 2005. These maps are consistent with the trends in Fig. 9, as the map in 2005 has more states with effects closer to zero. However, this average effect masks considerable heterogeneity in experiences across states. In addition to Michigan, other mid-western states including Wisconsin, Ohio, and Illinois saw a broadening of the tax base between 1985 and 2000. In contrast, several other states including California, Oregon, Florida, and Massachusetts saw a narrowing of the tax base, as evidenced by the diminished effects of taxes on corporate tax revenue.

³² Clausing (2007), Devereux (2007), and Kawano and Slemrod (2015) discuss results of similar specifications using data on OECD countries.

³³ The marginal effect of τ on revenue is $\frac{dR_{st}}{d\tau} = \beta_0 + 2\delta_0 \times \tau$. For small taxes we have $\left. \frac{dR_{st}}{d\tau} \right|_{\tau=0} = \beta_0 > 0$.

Table 7
Linear and quadratic effects of corporate tax rate changes on tax revenues.

	(1)	(2)	(3)	(4)	(5)
<i>Panel A. State corporate tax revenue-to-GDP ratio</i>					
State corporate tax rate τ	3.95** (1.87)	0.49 (4.88)	2.74 (2.16)	3.10 (3.94)	3.46 (3.69)
State corporate tax rate ² (τ) ²	2.53 (23.00)	14.12 (31.91)	9.99 (24.56)	-5.06 (25.00)	-6.65 (24.23)
Base index \times 100			5.33 (3.21)	5.32*** (1.87)	11.69 (8.00)
State corporate tax rate $\tau \times$ Base index					-1.78 (1.72)
State corporate tax rate ² (τ) ² \times Base index					11.27 (10.28)
Observations	1550	1550	1550	1550	1550
Year fixed effects	Yes	Yes	Yes	Yes	Yes
State fixed effects		Yes		Yes	Yes
Revenue-maximizing rate				0.307	0.260
<i>Panel B. Total state tax revenue-to-GDP ratio</i>					
State corporate tax rate τ	6.4 (13.3)	26.0 (18.5)	6.2 (13.0)	20.2 (18.8)	29.9* (15.8)
State corporate tax rate ² (τ) ²	53.1 (112.3)	-113.1 (130.3)	56.9 (109.1)	-98.8 (129.4)	-156.2 (106.6)
Base index \times 100			10.1 (12.2)	22.9** (9.2)	-15.5 (25.2)
State corporate tax rate $\tau \times$ Base index					8.3 (7.7)
State corporate tax rate ² (τ) ² \times Base index					-38.6 (53.1)
Observations	1550	1550	1550	1550	1550
Year fixed effects	Yes	Yes	Yes	Yes	Yes
State fixed effects		Yes		Yes	Yes
Revenue-maximizing rate				0.102	0.096

Notes: This table reports the results of regressions that estimate the effects of changes in tax rates and tax bases on tax revenue. Each specification weights observations by the mean state GDP in our sample and includes state and year fixed effects. See Appendix Table A12 for a version of that controls for state sales and top personal income tax rates. The revenue-to-GDP ratio is measured in basis points. Standard errors are clustered by state ($p < .1$, $**p < .05$, $***p < .01$). The 15 base controls included in the base index are described in Section 1.

Panel A of Table 7 presents estimates of this regression. Columns (1) and (2) present specifications with and without state fixed effects. These columns show positive estimates for β_0 , but the inclusion of state fixed effects reduces the precision of the estimate for β_0 . The interpretation of a positive value for δ_0 is that these regressions do not detect decreasing returns of increasing taxes, which may be due to the relatively low tax rates observed in the data. Since the implied relationship between tax rates and corporate tax revenues is convex, we cannot identify a revenue-maximizing-tax rate using these estimates of β_0 and δ_0 .

As in the previous section, we are interested in the possibility that the responsiveness to taxes, and the implied revenue-maximizing-tax rate, depend on the breadth of the tax base. We explore this possibility by allowing the linear and quadratic effects of taxes to depend on the Base Index_{st} defined in Section 4.2.1. This measure is mean-zero by construction. A higher value of the Base Index_{st} means that the tax base is broader in the sense that the tax base controls are associated with a higher revenue-to-GDP ratio.

Armed with this measure, we estimate the regression:

$$R_{st} = \beta_1 \tau_{st} + \beta_2 \tau_{st} \times \text{Base Index}_{st} + \delta_1 (\tau_{st})^2 + \delta_2 (\tau_{st})^2 \times \text{Base Index}_{st} + \alpha_s + \gamma_t + \theta \text{Base Index}_{st} + u_{st}. \quad (8)$$

The revenue-maximizing-tax rate now depends on the base index:

$$\tau^*(\text{Base Index}_{st}) = \frac{\beta_1 + \beta_2 \times \text{Base Index}_{st}}{-2(\delta_1 + \delta_2 \times \text{Base Index}_{st})}.$$

Column (3), which includes the Base Index_{st} as a control, still yields a positive estimate of δ_0 . Column (4), however, which includes state fixed effects, results in a negative value of δ_0 , and implies a value of τ^* of 31%. Column (5), which is our preferred specification, further interacts the Base Index_{st} and the tax rate. This specification also detects a negative but statistically insignificant coefficient for τ^2 . Evaluating the revenue-maximizing rate at the mean value of the base index yields a value of $\tau^*(\text{Base Index}_{st} = 0)$ of 26%. Panel A of Fig. 11 plots the estimated relation between the state corporate tax rate and R_{st} at the value Base Index_{st} = 0. We also explore the heterogeneity in $\tau^*(\text{Base Index}_{st})$ that is implied by variation in Base Index_{st}. Panel B of Fig. 11 plots the cumulative distribution function of the estimated $\tau^*(\text{Base Index}_{st})$ for every state-year in our data. The average revenue-maximizing rate is greater than 45% and the minimum value is greater than any corporate tax rate we observe in the data.³⁴

Changes in corporate tax rates affect local economic activity and other forms of tax revenue. Indeed, in Suárez Serrato and Zidar (2016) we show that changes to state corporate tax rates affect the location decisions of firms and workers. These decisions affect the demand and supply of labor, which influences local population and income. As a result, state tax revenue from personal income taxes and sales taxes may also be affected by changes in state corporate

³⁴ For many observations we do not find any evidence of decreasing returns, i.e., $\delta_1 + \delta_2 \times \text{Base Index}_{st} > 0$, which results in a value of $\tau^*(\text{Base Index}_{st})$ of 100%. This result should not be interpreted as literally suggesting that revenue will be maximized with a tax rate of 100%. Rather, this result suggests that the low values of τ in the data fail to identify a value of δ_0 that implies strong decreasing returns to increasing taxes.

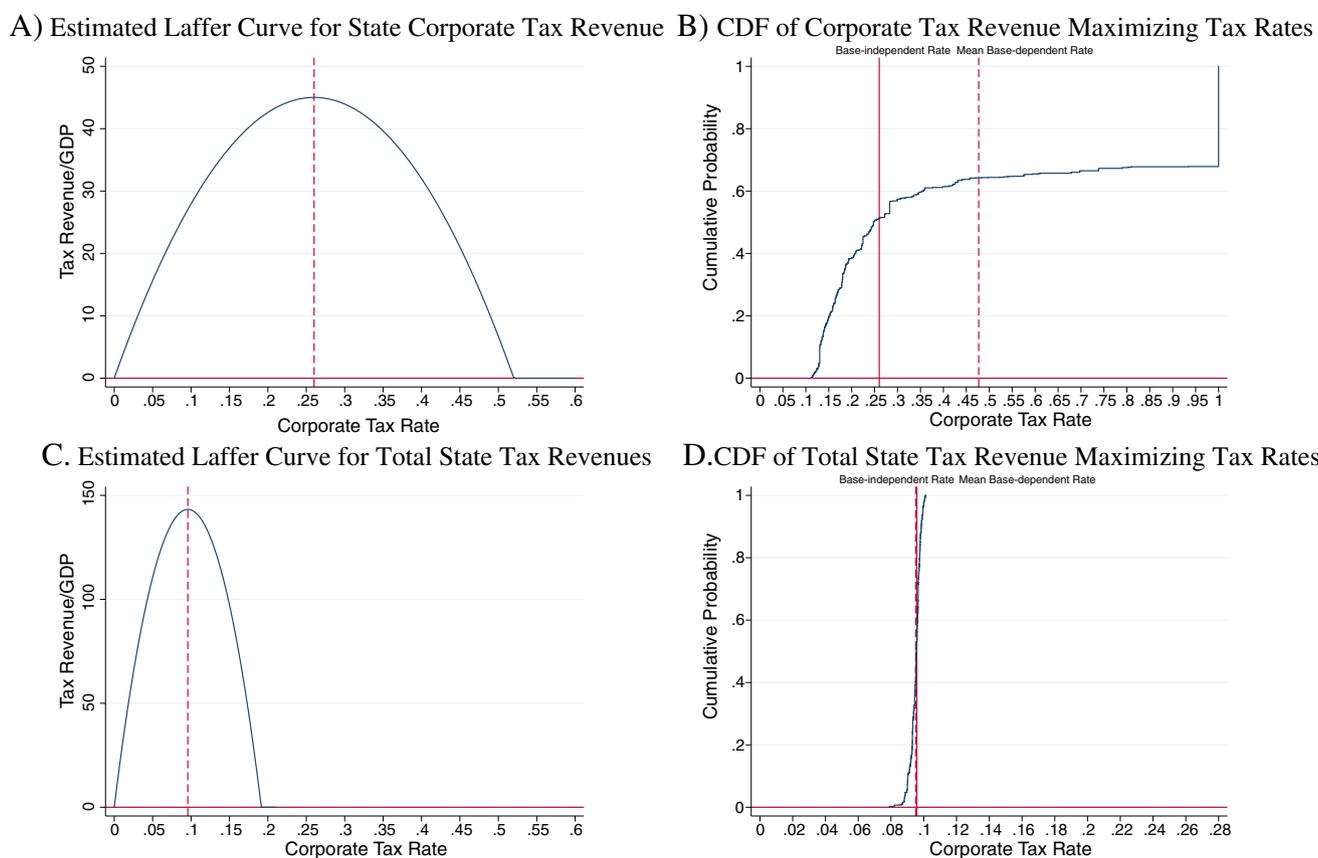


Fig. 11. Estimated revenue-maximizing-tax rates. Notes: This figure plots the implied revenue-maximizing-state-corporate-tax rates. Panel A plots the estimated relation between state corporate tax revenues and the state corporate tax rate at the mean value of the base index. Panel B plots the distribution of the estimated revenue-maximizing-tax rates as a function of the base index. These estimates are based on estimates coefficients from Eq. (6) in Table 7. Panels C and D replicate Panel A and B for total state tax revenue. See Appendix Fig. A49 for a version that controls for state sales and top personal income tax rates. See Section 6 for details. Note that the mass of observations in Panel B at 100% corporate tax rate are cases where we do not find decreasing returns to taxation. We interpret these estimates as suggesting that current levels of tax rates are below revenue maximizing corporate tax rates and therefore the variation in the data do not identify decreasing returns to taxation. See Section 1 for details on data sources.

tax rates. We quantify the importance of these fiscal externalities by estimating Eqs. (7) and (8) on total tax revenue as a share of state GDP. Panel B of Table 7 presents estimates for these regressions. These results are qualitatively similar to those in Panel A, in that we do not find statistically significant decreasing returns to taxation on total tax revenue. Panel C of Fig. 11 plots the estimated relation between the corporate tax rate and the total tax revenue-to-GDP ratio at the mean value of $\text{Base Index}_{st} = 0$, and shows that a tax rate of 9.6% maximizes total state tax revenue. Panel D of Fig. 11 plots the CDF of the estimated revenue-maximizing-tax rates and shows a much more compressed distribution that centers around 10%. As shown in Fig. 1, only a few states have ever had tax rates above 10%, and this fraction has been declining over time.³⁵

Given the lack of precision in these estimates, we interpret these results as suggesting that the data do not show strong patterns of decreasing returns from increasing taxes. At the current levels of corporate tax rates, we can rule out the hypothesis that, for states with corporate tax rates below 10%, cutting corporate tax rates has tended to raise corporate tax revenue.

7. Discussion of policy implications

This paper has established several facts detailing how state tax rates, base rules, and credits determine the structure of the state

corporate tax system. We find that changes to tax base rules and credits are more common than changes in tax rates, and that changes in tax base rules are not enacted to temporally offset changes to tax rates. Further, we show that changes in tax base rules and credits play a more important role in explaining patterns in the revenue-to-GDP ratio across states than do changes in tax rates. We document trends in individual tax base rules over time and provide evidence that, while some states have broadened their tax bases by adopting combined reporting and throwback rules in recent years, most other measures of the tax base point toward a narrowing of the tax base. We analyze the role that tax base rules play in the estimation of the effects of tax rates on tax revenues and economic activity, and find that controlling for these rules does not affect the estimated effects. Instead, we show that accounting for heterogeneous effects of tax changes that depend on the structure of the corporate tax system is important both to obtain consistent estimates of the average effect of changing taxes, and to more precisely forecast the revenue response of individual states with different corporate tax systems.

These findings have important implications for policy. First, while changes in tax rates receive public and media attention, changes in state tax bases may have larger effects on revenue and may also modulate the effects of state corporate tax rates on revenue and economic activity. For this reason, the public debate should place relatively more attention to policy changes that affect the structure of state corporate taxation, and not only the statutory tax rate.

Second, given the large effects of the structure of the tax base on corporate tax revenue, state policymakers should be careful to

³⁵ These results are robust to controlling for state personal income taxes and sales taxes, as shown in Appendix Table A12 and Appendix Fig. A49.

use these policies to accomplish particular goals. States that are able to attract businesses for non-tax reasons may prefer to have a lower tax rate and a broader base by, for instance, adopting the federal income tax base as their own. States wishing to increase investment may depart from this strategy by using tax credits or generous depreciation allowances to encourage investment, but they may see substantial declines in revenue. Finally, states wishing to attract or retain innovative businesses may craft a treatment of loss carryforward provisions that is very favorable to new businesses. Policymakers would likely benefit from further research outlining the relative success of these strategies.

Third, as states structure the taxation of corporate income for their particular needs and objectives, state policymakers should bear in mind that changes to the structure of state corporate taxation will influence the distortionary costs of increasing the state corporate tax rate. In particular, we find that when states narrow the tax base, they also diminish the relation between tax rates and corporate tax revenue. By making it harder to raise tax revenue from corporations, it is also likely that state policymakers will be forced to raise revenue from other sources including sales taxes, property taxes, or personal income taxes, or to reduce spending on public goods.

Future work can explore the degree to which tax base determinants affect the incidence of the state corporate income tax by extending the framework in Suárez Serrato and Zidar (2016) to allow for deductions that may affect the response of firms to tax rate changes. Intuitively, a narrower tax base lowers the benefits of a tax cut to business owners as they only pay taxes on a smaller fraction of profits. As there is a smaller benefit from the tax cut, firms are less likely to enter a particular location, which will also mute the effect of the tax cut on employment, wages, and costs of living. Whether the decrease in firm entry is larger than the decrease in the real wage and employment will determine the extent to which the incidence of a state income tax cut is borne by workers, landowners, or firm owners. Overall, many exciting questions on the incidence and efficiency consequences of reforms to the state corporate tax structure remain open.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpubeco.2018.09.006>.

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