The Impact of Single Sales Factor Apportionment on State Tax Revenues: Short- and Long-Run Effects*

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Since 1978, forty U.S. states changed the formulas determining their corporate tax bases. The most common change has been from a definition of taxable corporate income consisting of payroll, property, and sales within the state, to one consisting solely of sales.This paper estimates the effects of these changes on a state's taxable corporate income. Using a two-way fixed-effects regression, I estimate that taxable corporate income increased by nearly 3.4 percent in the first year after the policy change but declined by 4 percent compared to its pre-policy level by the third year.

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1. Introduction

Since 1978, forty states have changed the formulas they use to calculate their taxable share of a corporation's net income. When a corporation operates in multiple U.S. states, states use an apportionment formula to determine the basis on which the corporate income tax is levied. Historically, states apportioned a corporation's net income as a function of a corporation's property, payroll, and sales location relative to the corporations's nationwide totals of those factors. Forty states made some transition from a formula that equally apportions the net income among those three factors to a formula that just apportions net income as a function of a corporation's sales. The names for these formulas and the general transition are commonly referred to as the movement by states from the equally weighted "three-factor" formula to single sales factor apportionment (SSFA).[1] These reforms occur over a staggered timeline and with substantial geographic variation (Figures 2 and 3).

Economic theory indicates that the three-factor formula creates excise taxes on the factors of production in the corporate sector, namely on capital and labor.[2] These reforms towards the single sales formula are important because they structurally alter a corporation's incentives when employing labor or owning capital in a state because SSFA removes these functional excise taxes on payroll and property. These reforms increase the incentives for corporations to locate in a state, hire additional labor, invest more capital, or acquire more land. SSFA benefits corporations with relatively more in-state productive factors and sell relatively little in the state at the expense of out-of-state corporations with relatively less in-state productive factors, but more sales. These reforms do not eliminate the corporate income tax base; rather, they redefine it to only include corporate sales as a determinant of business activity.[3]

The question I answer in this paper is: "What is the effect of switching to SSFA in terms of taxable corporate income and non-corporate tax revenue?" In terms of corporate income tax revenue changes, a state could increase or decrease collections from the switch to SSFA while

[1]More information on the formula is in the Background and Appendix.
[2]McLure (1981)
[3]This consists of sales made by corporations that produce in the state and those that do not.

holding the tax rate constant. If a state is a "market-intensive" state, meaning corporations sell more into the state than produce, the switch will increase taxable corporate income (TCI). Whereas, if a state is a "production-intensive" state, meaning corporations produce more in a state than they sell in it, the switch will decrease TCI. However, if market-intensive states switch, the best response by production-intensive states is to switch to SSFA, or in the long run, corporations may move productive factors to the market-intensive states.[4] This prompts the likelihood that these reforms are a relatively low political cost means of reducing taxation on in-state producers. For this reason, the reforms are sometimes classified within the economic development literature.

In contrast to past studies, this paper does not use a simulation or case-study framework, rather it estimates the effects from the actual implementation of SSFA across states. Using a variety of sources, I compiled the date of introduction, passage, and implementation of these reforms for each state. I used a two-way fixed-effects regression and synthetic difference-in-difference (SDID) approach to estimate the effects of these reforms in the short and long run. Existing studies of state corporate income tax have examined the elasticity of the tax base with respect to tax rate changes, mandatory combined reporting, and sourcing reforms. Previous research on apportionment formula changes largely examined the effect of the switch from an equally weighted three-factor to a double-weighted sales formula.[5]

I estimate a significant 3.48 percent increase in TCI in the first year post-adoption of SSFA and a 4 percent decline by the third year. I obtain these results using the two-way fixed-effects regression and the estimates indicate that while the policy may create an initial increase, that increase is reversed by the third effective year of the policy. I use the SDID approach to provide event-level corroboration of these results. The SDID point estimates are generally insignificant. However, when they are organized into short-run and long-run groups, only two states increase TCI in both periods, underscoring the limited and generally negative long-term impact of SSFA adoption on TCI.

In the long run, states that adopt SSFA lose taxable income and, by extension, tax revenue, as

[4] Background information on these designations is in the Appendix
[5] Background information on this formula is given in section 2.1.2.

corporations adjust behavior to minimize apportioned income. The two-way fixed-effects regression results reveal that TCI increases in the first year post-adoption but declines by the third year, indicating that short-run gains are not sustained. These empirical results are consistent with the theory that the shift to SSFA increases the ability of corporations to generate"nowhere income"- non-taxable income that arises when sales occur in a state where nexus cannot be established. Under Public Law (P. L.) 86-272, states are prohibited from taxing income derived from the sale of tangible goods into the state when a company lacks physical presence.[6] The empirical results coupled with P. L. 86-272 suggest that while states may experience marginal increases in the short run, corporations ultimately increase non-taxable nowhere income under the SSFA regime.

This paper proceeds as follows: Section 2 provides a background on corporate income tax apportionment and the institutional changes that led to the widespread adoption of SSFA. Section 3 reviews the relevant literature on state taxation and apportionment formula changes. Section 4 presents a theoretical model that guides the empirical analysis. Section 5 outlines the data used in the analysis, followed by the empirical approach in Section 6. Section 7 discusses the results, with a particular focus on the distinction between short-run and long-run impacts on TCI. Section 8 concludes with the policy implications of these findings.

2. Background

2.1 General Background

2.1.1 Nexus, Public Law 86-272, and Non-taxable Income

A state only has the standing to levy the corporate income tax (CIT) if a corporation has "nexus" in a state, which is the legal term to designate whether there is "sufficient connection" between that state and the "company's economic activities." In general, if a company has a "physical presence," defined as payroll or property in a state, it will meet the nexus threshold. Beyond the

[6] A detailed discussion of P. L. 86-272 and its implications for nexus can be found in Section 2.1.

physical presence standard, nexus can also be established through licensing of intangibles, engaging in financial transactions, employing telecommuters, or maintaining significant relationships with in-state vendors.[7] Though, in general, if the values for payroll and property are both zero and the corporation only maintains a *de minimis* presence, the corporation will not have nexus.[8] While sales are a significant part of a corporation's economic activity, federal law prohibits using the remote solicitation of sales as the sole criterion for establishing nexus. This nexus requirement, shaped by P. L. 86-272, creates a federal limitation on states' ability to tax multi-state corporations.

Due to P. L. 86-272, sales alone are generally not sufficient to establish nexus in a state. "Public Law 86-272... prohibits states from taxing income arising from the sale of tangible property into the state by a company whose only activity in that state is the (remote) solicitation of sales."[9] In 1959, the Supreme Court held in Northwestern States Portland Cement Co. v. Minnesota that net income from operations of a foreign corporation may be subjected to state taxation Northwestern Cement Co. v. Minnesota (1959). In response to this ruling, the U.S. Congress enacted P.L. 86-272 (the Interstate Income Act of 1959) to facilitate interstate commerce by multi-state corporations.[10] P.L. 86-272 has not been amended.[11] By limiting taxable connections to those involving physical presence or certain substantial activities, the law leaves portions of corporate income effectively untaxed.

In general, if income is generated when a company has no property or payroll in the state or the state does not levy a CIT, then it is deemed "nowhere income." Nowhere income is income that cannot be legally taxed by the state where the income-producing sale occurs (Drenkard, 2016). This framework illustrates how P.L. 86-272 can create nowhere income as indicated by in the following example from the South Carolina Department of Revenue. For example, an Ohio based company maintains a website that is accessible in South Carolina, but is not physically located there. The

[7]As an example, the South Carolina Department of Revenue gives a series of questions to help a corporation determine nexus (see South Carolina Department of Revenue, 2016).

[8]There is a more detailed discussion of the Multistate Tax Commission's recent update to the interpretation of P. L. 86-272 and nexus in the Appendix.

[9](Multistate Tax Commission, 2024a)

[10](DeBruin and Smith, 2023)

[11]The Multistate State Tax Commission has issued updated interpretations of P.L. 86-272, but these interpretations do not have the force of law.

mere accessibility of the website or use of email to solicit sales does not create sufficient connection to meet the nexus threshold.[12] By limiting taxation of income derived from the remote solicitation of sales, P.L. 86-272 directly contributes to the creation of nowhere income.

Consequently, SSFA coupled with P.L. 86-272 increases the ability for corporations to avoid nexus and generate nowhere income—income that no state can legally tax. Under the three-factor formula, the inclusion of property and payroll as factors would create nexus in many cases, and in the process the formula would apportion income to states where corporations operate. The adoption of SSFA shifts the focus of apportionment to sales alone. This change reduces the importance of physical presence (property and payroll) in determining nexus. The shift to SSFA, compounded by the limitations of P.L. 86-272, limits states' ability to tax corporate income.

2.1.2 Apportionment Formulas

If a firm has nexus in more than one state, states use a formula to apportion the firm's TCI among each of the states as a function of where a firm's property, payroll, and sales are located relative to the firm's total of each of those factors.[13] The apportionment system largely arose on the state level due to the relatively homogeneous business environment and a similar starting point for net income created by each multistate corporation filing a federal corporate income tax return before the filing of a state return (Weiner, 1998). The homogeneous business environment created the incentive to initially have the three-factor formula, and there was (and still is) a Multistate Tax Compact, which created a formal cooperative agreement.[14] After the TCI is apportioned to a state, it is then taxed at that state's TCI tax rate. In the calculation of the corporate tax, when the property, payroll, and sales factors are equally weighted, it is generally known as the "three-factor formula."[15] Nearly all states used the three-factor formula at some point between the adoption of their CIT and

[12] State of South Carolina Department of Revenue (2008)

[13] An apportionment formula could still be relevant to firms even if they only have nexus in one state. Under this scenario, all TCI would be apportioned to the nexus state. This might not be the case if a firm has just sales in another state and does not have nexus in that state and/or that state does not levy a corporate income tax.

[14] (Multistate Tax Commission, 2024a)

[15] Uniform Division of Income for Tax Purposes Act (UDITPA) is the name of the law passed by many of the states that formally adopted the three-factor formula. ((Multistate Tax Commission, 2024b)

the 1970s.[16,17]

The three-factor formula determines the share of a corporation's income apportioned to state j, denoted by ϕ_j. This share is calculated as

$$\phi_j = \left(\frac{1}{3} \times \frac{\text{Property in State } j}{\text{Total Property}}\right) + \left(\frac{1}{3} \times \frac{\text{Payroll in State } j}{\text{Total Payroll}}\right) + \left(\frac{1}{3} \times \frac{\text{Sales in State } j}{\text{Total Sales}}\right). \quad (1)$$

Around the 1990s through the 2000s, twenty-five states switched from the equally weighted three-factor formula to a double-weighted sales formula. The share of a corporation's income apportioned to state j, denoted by ϕ_j, under this formula is given by

$$\phi_j = \left(\frac{1}{4} \times \frac{\text{Property in State } j}{\text{Total Property}}\right) + \left(\frac{1}{4} \times \frac{\text{Payroll in State } j}{\text{Total Payroll}}\right) + \left(\frac{1}{2} \times \frac{\text{Sales in State } j}{\text{Total Sales}}\right). \quad (2)$$

Lastly, most states have either transitioned from the equally weighted three-factor formula or the double-weighted sales formula to the single sales factor formula. Under this formula, the share of a corporation's income apportioned to state j, denoted by ϕ_j, is given by

$$\phi_j = \frac{\text{Sales in State } j}{\text{Total Sales}}. \quad (3)$$

Equations (1)-(3) are relevant general formulas that states have used in the apportionment system.

2.2 Brief History and Constitutionality

Some brief history of the adoption and constitutionality of SSFA gives context to these recent apportionment formula reforms. In 1943, Iowa implemented a CIT. The Iowa State Tax Commission allowed the elective use of either the three-factor formula or SSFA (at least between 1948 and 1960). Eventually, the commission required the use of the SSFA formula. This divergence from other states' apportionment formulas led to a legal challenge brought by Moorman Manufacturing Company

[16] The formula was allowed or at least offered as an elective option in each state or required.

[17] Florida adopted a double-weighted sales formula when they adopted CIT in 1971.

(*Moorman*).[18] *Moorman* (an Illinois' based company) sued, contending that "Iowa's single-factor formula results in extraterritorial taxation in violation of the due process clause," (*Moorman Mfg. Co. v. Bair*, 1978). This challenge appeared before the U.S. Supreme Court, which decided that the single sales factor formula was not invalid under either the Due Process Clause or the Commerce Clause. This judgment was rendered in June 1978, and from then onward, states could mandate the use of the single sales factor formula.[19] This institutional change coupled with incentive for some states to increase TCI began the shift to widespread adoption.

2.3 State Specific Policies that Impact the Data Generating Process

Whether a state has a throwback or throwout rule in place will impact the amount of nowhere income multi-state corporations are able to generate. Throwback and throwout rules are policies designed by states to "capture" sales made into a state that does not have standing to tax that income (i.e., nowhere income) or does not tax corporate income. A throwback rule comes into practice when a corporation has nexus in a state with a throwback rule and generates income from sales into another state, and the corporation does not have nexus in that other state. Under a throwback rule regime, those sales are "thrown back" or added to the sales made in the"nexus" state.[20] In this process, income generated from these sales is still taxable. Over the past several decades, nearly half of states have repealed their throwback or throwout rule (Table 1). Given the role of these policies in increasing or decreasing nowhere income, their presence or absence would need to be accounted for in an empirical analysis.[21]

State tax credits and incentives will impact the amount of tax revenue paid by multi-corporations. In order to estimate TCI apportioned to a state, I use the corporate income tax collections divided by the corporate income tax rate for that state.[22] Given this methodology, the amount of state tax credit and incentives in a state would impact the measure of TCI in that

[18] This is a generalization for a little more context, see Appendix.

[19] See Appendix for court's reasoning upholding the formula.

[20] An example is given in the Appendix for clarity.

[21] The empirical analysis does not currently control for throwback and throwout rules, but this will be addressed in future work.

[22] More detail on imputed corporate income is discussed in Section 5.

state. Since the 1990s, $46 billion of state and local economic developments policies have been implemented via abatements and other tax credits nationwide (**?**). This erosion of the tax base is compounded by state-level policy decisions—like repealing throwback rules and switching to SSFA—that effectively allow corporations to generate non-taxable income. Together, these policies introduce complexities for estimating TCI.

3. Literature Review

This paper contributes primarily to the state and local taxation literature. Drawing on Harberger's general equilibrium framework for corporate income tax incidence (1962), McLure models the incidence of the three-factor apportionment formula for state CIT (1981). He concludes that immobile factors like labor and capital bear the greater burden, depending on their sector's relative mobility. Mieszkowski and Zodrow (1985) confirm McLure's finding, showing that taxing immobile factors reduces the returns to those factors within the taxing state. Gordon and Wilson (1986) indicate that three-factor apportionment incentivizes corporate production in low-tax states and corporate sales into high-tax states, and vice-versa.

Several papers examine the effects apportionment reforms on employment, capital investment, and sales using the three-factor to double-weighted sales reforms or a state level case-study framework. Weiner provides empirical evidence that by increasing the sales factor states can temporarily stimulate capital investment(1998). Goolsbee and Maydew (2000), conclude that reducing payroll weights under double-weighted sales formulas increased manufacturing employment, with limited aggregate effects.[23] Anand and Sensing (2000) find that sales-intensive states have incentives to increase the sales factor, and production-intensive states have incentives to increase the input factors. Edmiston (2002) models the adoption of SSFA as a "prisoners dilemma," where states face the short-term revenue costs but long-term economic development benefits, with nexus thresholds for states playing an important factor in the incentives for states to choose different formulas (Edmiston, 2004). Gupta and Hofmann, (2003) show that apportionment and throwback rules significantly

[23] Replicated by Merriman (2014)

impact capital expenditures and CIT revenues (Gupta et al., 2009). Using firm-level data for five states between 2002-2008, Swenson (2011) estimates that SSFA adoption increases employment among locally-based firms but reduces employment for out-of-state firms. Edmiston (2005), estimates Georgia's transition to double-weighted sales increased property and payroll revenues but reduced Georgia sales tax revenue.

Other papers highlight broader state corporate tax dynamics relevant to SSFA. Wildasin (2010) shows that including sales in apportionment formulas allows states to tax "rents" from intangible assets but effectively imposes implicit tariffs on interstate trade, creating inefficiency. Agrawal (2023) indicates how formula apportionment creates incentives for states to compete on the employment, capital, or sales to incentivize movement of those factors by corporations across jurisdictions. Runkel and Schjelderup (2011) extend this analysis internationally, demonstrating efficiencies from a centralized apportionment regime. Suarez Serrato and Zidar (2018) find that changes to tax base rules, such as SSFA adoption, often explain more of the variation in corporate tax revenues than tax rates, contributing to a more favorable tax environment for corporations. These recent works emphasize the role of apportionment formulas, particularly SSFA, in shaping taxable income, corporate behavior, and interjurisdictional competition.

Several papers explore related state corporate tax dynamics that are indirectly relevant to the impacts of SSFA. Giroud and Rauh (2019) estimate a short-run state corporate income tax elasticity between -0.4 and -0.5, showing significant impacts of tax rate changes on payroll, employment, and capital expenditure.[24] Klassen and Shackelford (1998) show that apportionment formulas influence the location of sales, while (Bruce et al., 2007) and (Cornia et al., 2005) indicate how these reforms impact the efficacy of inter-state tax planning and the relative decline in the state CIT. Deskins and Hill (2023) estimated that a higher CIT rate is positively associated with the speed of moving towards higher sales factor weight. Welsch (2023) estimates employment increases from market-based sourcing for the sales factor in the apportionment formula.

[24]This CIT elasticity is corporate income tax rate with respect to corporate income tax collections.

4. Model

The purpose of this section is to clarify mechanisms underlying the reforms and provide a framework for interpreting the results presented in the empirical analysis. TCI is apportioned to states using weights on sales, payroll, and property. The general form of the apportionment factor of the corporation's taxable net income, denoted by ϕ_j, is expressed as

$$\phi_j = f_j^s \frac{S_j}{S} + f_j^p \frac{P_j}{P} + f_j^R \frac{R_j}{R}. \tag{4}$$

The f_j^s, f_j^p, f_j^R are state j's factor weights for sales, payroll, and property, respectively. The S_j, P_j, R_j are the corporation's sales, payroll, and property in state j, respectively. States modify their apportionment formula by adjusting these weights. I use Edmiston's (2002) decomposition of changes in the corporate income tax base following a change in apportionment as a guide. He expresses the change in TCI apportioned to a state as follows

$$\sum_j \left(\phi_{j,t}\pi_{j,t} - \phi_{j,t-1}\pi_{j,t-1}\right) = \sum_j \left(\phi_{j,t} - \phi_{j,t}^E\right)\pi_{j,t} + \left(\phi_{j,t}^E - \phi_{j,t}\right)\pi_{j,t} + \phi_{j,t-1}^E\left(\pi_{j,t} - \pi_{j,t-1}\right). \tag{5}$$

The $\phi_{j,t}$ is defined in (4) and including the "t" refers to the apportionment factor for a specific year. The $\pi_{j,t}$ refers to firm j's profit. The $\phi_{j,t}\pi_{j,t}$ denotes the apportionment of firm j's profit to the state in the current period, minus the previous period, $\phi_{j,t-1}\pi_{j,t-1}$.

The effect I will be estimating with corporate income tax collections is $\sum_j \left(\phi_{j,t}\pi_{j,t} - \phi_{j,t-1}\pi_{j,t-1}\right)$, and it consists of three different parts that I will not be able to disentangle with aggregate state-level annual tax collections. First is the "technical apportionment effect," $\left(\phi_{j,t} - \phi_{j,t}^E\right)\pi_{j,t}$, which measures the difference in taxable income just from the different formula. This effect is likely the largest, and it is the effect that most directly relates to discussions of the tradeoffs of adoption. Second is the "location-of-factors effect," $\left(\phi_{j,t}^E - \phi_{j,t}\right)\pi_{j,t}$, which denotes the changes in the corporate income tax base because sales are discouraged and production is encouraged in the state. Third, $\phi_{j,t-1}^E\left(\pi_{j,t} - \pi_{j,t-1}\right)$, accounts for the changes in the tax base due to the profitability of firms, which accounts for corporations that are more profitable due to the apportionment formula change.

While I do not estimate these components separately, equation (5) provides a conceptual basis for interpreting those estimations. By using aggregate state-level data, I will estimate the overall effect of SSFA adoption on TCI. Changes in corporate income tax collections reflect a combination of the apportionment change itself, corporations' behavioral responses to minimize taxable income either by redirecting sales or increasing non-taxable nowhere income, and the profitability of those corporations under different tax regimes. This framework clarifies potential sources of variation for the estimates later in the paper.

5. Data

The ideal data to estimate the effects from switching to SSFA would be corporation-level tax liability for each state a corporation has nexus in and, perhaps more importantly, for each state it does not. This data would include state tax credits and incentives, which have been increasing during this period. This data would also include any non-taxable income that does not get attributed to a state. I do not have access to this propriety data, however, I am able to create an imperfect estimate using state level tax collections.

For each state, I started with the state's corporate income tax collections between 1976-2022 from the Annual Survey of State Governments by the Census and exported that information from FRED.[25] I compiled the corporate income tax rate for all states.[26] I used the collections and rate to create an imputed estimate of the TCI that is apportioned to the state.[27] This estimate is calculated as

$$\text{Corporate Income} = \frac{\text{Collections}}{\text{CIT Rate}}. \tag{6}$$

This estimate controls for the impact that the tax rate will have on collections. TCI apportioned

[25]This revenue is adjusted for inflation using the CPI deflator from the Bureau of Labor Statistics; the base year is 1983-1984

[26]The rates from 1976-2002 are from University of Michigan, Office of Tax Policy Research (2024) and from 2003 onwards from Loughead (2024)

[27]There are some states with different rates for different brackets. Though given the types of corporations most likely to be impacted by this policy shift, using the top marginal rate is the most important rate to control

to a state might actually be higher than this because of state tax credits that reduce a corporation's tax liability. An advantage of this approach is that even though states have varying credit regimes, this approach provides a definite lower bound on a state's apportioned corporate income tax base. In order to estimate the effect of the reforms on non-corporate tax revenue, I exported total state tax collections from FRED and subtracted corporate income tax collections. In order to control for scale, I divided the non-corporate collections by the state population. So, those point estimates are real non-corporate revenue per capita. The severance tax collections used in the logistic regression were also collected from FRED.

To compile the list of reforms, I start with a list of all states that levy a CIT. Next, I found each state's current apportionment formula, if it switched to SSFA, the effective date (month and year) of the switch, and the session date.[28] Since the data I am analyzing is annual, at this level of granularity, any revenue effects from the switch will likely not appear in the year prior to the effective year. Therefore, I use the year from the effective date as the treatment year (Table 1). Forty states have switched, but I only examine twenty-six of those states (Table 2). I excluded Iowa because the way it implemented the policy makes it difficult to interpret pre-trends. The rest of the states were excluded because the policy had not been effective long enough.

[28] Among the reforms I examine, the average number of days between the signature date and the effective date is 254. When the five retroactive reforms are removed, the average number of days between the signature and effective date is 349.

Table 1: State Year Effective

State	**Year Effective**
Iowa	1978
Nebraska	1988
Michigan	1991
Illinois	1999
Oregon	2004
Georgia	2006
Wisconsin	2006
Arizona	2007
Indiana	2007
Maine	2007
Minnesota	2007
Pennsylvania	2007
South Carolina	2007
Colorado	2009
California	2011
Utah	2011
New Jersey	2012
New York	2015
Rhode Island	2015
Connecticut	2016
Louisiana	2016
North Carolina	2016
North Dakota	2016
Delaware	2017
Kentucky	2018
Maryland	2018
Missouri	2020
Alabama	2021
Arkansas	2021
Idaho	2022
New Hampshire	2022
West Virginia	2022
Vermont	2023
Tennessee	2024
Massachusetts	2025
Montana	2025

Note: This table lists the states that adopted the Single Sales Factor Apportionment (SSFA) and the corresponding year when the policy became effective. The data is organized by state, starting with Iowa in 1978 as the earliest adopter and continuing through Montana, scheduled to adopt SSFA in 2025.

Table 2: States Organized by Treatment Status

Treated	**Not-yet Treated**	**Never Treated**
Arizona	Vermont	Alaska
California	West Virginia	Florida
Colorado	Idaho	Hawaii
Connecticut	Massachusetts	Kansas
Delaware	Montana	Mississippi
Georgia	New Hampshire	New Mexico
Illinois	Tennessee	Oklahoma
Indiana		Virginia
Kentucky		
Louisiana		
Maine		
Maryland		
Michigan		
Minnesota		
Missouri		
Nebraska		
New Jersey		
New York		
North Carolina		
North Dakota		
Oregon		
Pennsylvania		
Rhode Island		
South Carolina		
Utah		
Wisconsin		

Note: This table presents the treated, not-yet treated, and never-treated states for the empirical approach. The not-yet and never-treated are used in the long-run control group. The short-run control group includes the states for the long-run control group and any states that did not switch within three years of the treated state.

6. Empirical Approach

6.1 Set-up for Two-Way Fixed-Effect Regression

In order to estimate the impact of the policy in the short run, I filtered the corporate income observations from FRED in the following way. First, I ordered states by the effective year of the policy from the earliest (Nebraska in 1988) to the latest examined (Missouri in 2020). Second, I created a treatment state-specific data frame for each state by eliminating the following groups from the control group: any states that previously switched, any states that switched simultaneously (in the same year), and any states that switched within three years of the effective year. Third, I removed all observations that occurred after four years of the switch. I stacked those events on top of each other to create a data frame with twenty-six different events. I use this dataframe to estimate the effects of the policy using a two-way fixed-effects regression that controls for relative year. The relative year variable is created by stacking all the events. This set-up provides an estimate of the dynamic treatment effects by year, which is less granular than the stacked DID and does not account for event-specific fixed-effects.[29]

6.2 Approach for Two-Way Fixed-Effect Regression

I used the two-way fixed-effects (TWFE) approach to estimate the effect of a state switching the corporate income tax apportionment formula to single sales factor. I estimated the impact of the policy using the following regression equation

$$Y_{it} = \alpha_i + \lambda_t + \beta \times D_{it} + \sum_{k \neq -1} \delta_k \times Z_{(it,k)} + \epsilon_{it}. \tag{7}$$

In this equation, Y_{it} is the outcome of interest (logarithm of TCI), α_i is the state fixed effect, λ_t is the year fixed effect, D_{it} is the treatment indicator, $Z_{(it,k)}$ is the relative year dummy variable, β is the coefficient providing a measure of the average difference in logarithm of TCI between treatment and control groups, and δ_k is the coefficient estimated for relative years -4 through 4, excluding the base year of -1. This coefficient provides a measure of the effect of switching to SSFA at different periods.

[29] Ideally I will use this dataframe to estimate the effects of the policy using a stacked difference-in-difference, similar to the methodology used by Agrawal and Tester (2024). Due to current coding limitations, I to not use the stacked DID approach. This will be addressed in future work.

6.3 Set-up for Synthetic Difference-in-Difference

In contrast to the TWFE approach, the primary advantage of using the Synthetic Difference-in-Difference (SDID) to estimate the effects of the policy is that each point estimate is generated from a state-event specific dataframe. Similar to the data filtering process used in the TWFE set-up, the TCI observations from FRED were ordered by the effective year of the policy, and previously treated states, simultaneous adopters, and states that adopted within three years of the policy were filtered out. In contrast to stacking the events into a single dataframe, the events were kept in separate dataframes. For short-run impacts, I retained observations only up to three years post-adoption, as this period aligns with the observed short-term effects in prior studies. Using this filtering process and this approach creates a more accurate control group because in the short-run, the control group will consist of both not-yet-treated and never-treated states.

Another advantage of this approach is that it allows for estimation of long-run effects from the policy. In order to estimate the impact of the policy in the long run, I filtered the corporate data frame by creating a state-specific data frame that just includes the treated state, not-yet treated, and the never-treated states (Table 3). This analysis ends in 2020, therefore, it does not include eleven states that switch to the policy between 2022-2024. I estimated the effect of the policy in the long run, using only the not-yet and never-treated control group. The process used to filter the data for TCI was repeated for non-corporate tax collections.

6.4 Approach for Synthetic Difference-in-Difference

I used a SDID approach to estimate the effect of a state switching the TCI tax apportionment formula to SSFA. I used the `synthdid` R package (Arkhangelsky et al., 2021) for the SDID estimation and plots.[30] The SDID estimator combines parts of the Synthetic Control and Difference-in-Difference estimators. The SDID creates a synthetic control that matches the data-generating process of the treated unit in order to satisfy the assumption of parallel trends necessary for iden-

[30]The package can be accessed at `https://github.com/synth-inference/synthdid`

tification. It also creates a level difference in the outcome, which controls for baseline differences between the treatment and control states.

The objective of the SDID is to create a synthetic control unit that emulates the outcome of the treated unit using a weighted average of other units and time periods. These time weights are created by minimizing the difference between pre-treatment and post-treatment periods for the control (donor) units. The unit weights minimize the difference between the synthetic control and treated units in the pre-period. The minimization process that determines the SDID estimator is expressed as

$$\hat{\tau}^{SDID} = \arg\min_{\mu,\alpha,\beta,\tau} \left\{ \sum_{j=1}^{J} \sum_{t=1}^{T} \left(Y_{it} - (\mu + \alpha_j + \beta_t - \tau D_{it})\right)^2 \hat{w}_i^{sDiD} \hat{\lambda}_i^{sDiD} \right\}. \tag{8}$$

In this equation, τ is the treatment effect, Y_{it} is the outcome of interest (logarithm of TCI), μ is the baseline average outcome, α_j is the state fixed effect, β_t is the year fixed effect, D_{it} is the treatment indicator, $\hat{w}_i^s$ is the unit weight, and $\hat{\lambda}_i^s$ is the time weight.

I used the SDID approach as a supplement to the TWFE approach because the SDID provides state-specific estimates and in contrast to the staggered difference-in-difference (DID) it avoids bias from early adopters. Because there are only twenty-six treated states, the staggered DID approach might be biased by early adopters. Additionally, the refined control group structure created for the SDID mitigates the bias created by estimating differences between the treated and never-treated groups. The refined control group incorporates a substantial number of not-yet-treated states into the control for the earlier and even late adopting states, which enhances the reliability of estimated effects. The state-specific SDID point estimates allows for understanding how SSFA impacts individual states in the short- and long-run, which is not possible using TWFE's pooled approach. The SDID provides a check on the TWFE estimates by using a synthetic control group to address potential biases from treatment timing and challenges from parallel trends.[31]

The minimization process in (8) creates the weights for the synthetic control. The treatment

[31]Given the widespread adopption of state tax credits and incentives, assuming similar adoption of these policies by states in the synthetic control, then this approach also controls for state tax credits and incentives.

effect is estimated using the interactive fixed-effect model given by

$$y_{it} \sim \gamma_t * \upsilon_i^T + \tau(W_{it}) + \epsilon_{ist}. \tag{9}$$

Using (9), I estimate the effect of implementing the single sales factor formula, τ, in the short run (first three years) and in the long run (the life of the policy).

7. Results

7.1 Comparative Yearly Changes in logarithm of Taxable Corporate Income

The purpose of this section is to examine the immediate effects of the switch to SSFA on the logarithm of TCI across various states. By comparing the logarithm of TCI in the year prior to the switch, the year of the switch, and the year following the switch, I show short-run changes from the switch to SSFA. Table 3 presents the logarithm of TCI for each state in the effective year (Year 0), the year prior (Year -1), and the year after the switch (Year +1). The columns,"Y(0) - Y(-1)" and"Y(1) - Y(-1)," denote the differences between these years. This represents the change in the logarithm of TCI from the year before the switch to the effective year and the following year, respectively. After calculating the difference between initial years, I calculate the average of these differences across all states and compute the geometric mean of the original values for the logged differences.[32,33] The geometric means for these differences are 0.03498 and 0.0684, which converts to percentage changes of 3.56% and 7.08%, respectively.[34]

[32] The formula for this computation is in the Appendix.

[33] I used the same formula for the Y(1)-Y(-1) difference.

[34] The formula for this conversion is in the Appendix.

Table 3: Yearly Differences for Ln(TCI) (Year -1, Year 0, and Year +1)

State	Year(-1)	Year(0)	Year(1)	Y(0) - Y(-1)	Y(1) - Y(-1)	Year Effective
Iowa	14.2319	14.3290	14.3986	0.0972	0.1668	1978
Nebraska	13.7018	13.7514	13.7930	0.0496	0.0912	1988
Michigan	17.8949	17.7230	17.7755	-0.1719	-0.1194	1991
Illinois	17.0372	17.0854	17.1245	0.0482	0.0873	1999
Oregon	14.4344	14.7583	14.8573	0.3239	0.4229	2004
Georgia	15.6203	15.8121	15.9168	0.1918	0.2965	2006
Wisconsin	15.4395	15.4398	15.5449	0.0003	0.1054	2006
Arizona	15.6614	15.7359	15.4695	0.0745	-0.1919	2007
Indiana	15.6224	15.5384	15.4189	-0.0840	-0.2036	2007
Maine	13.8589	13.8084	13.7744	-0.0505	-0.0846	2007
Minnesota	15.5066	15.5778	15.4111	0.0712	-0.0955	2007
Pennsylvania	16.1680	16.2169	16.1368	0.0490	-0.0312	2007
South Carolina	14.8953	14.9170	14.8815	0.0217	-0.0137	2007
Colorado	15.4439	15.0148	15.0869	-0.4292	-0.3570	2009
California	17.6717	17.6939	17.4833	0.0222	-0.1884	2011
Utah	14.6292	14.6049	14.6275	-0.0243	-0.0016	2011
New Jersey	16.2087	16.0494	16.2028	-0.1593	-0.0058	2012
New York	17.1802	17.2238	17.1041	0.0436	-0.0761	2015
Rhode Island	13.3778	13.8764	13.6632	0.4987	0.2854	2015
Connecticut	14.9297	15.0807	15.2185	0.1510	0.2887	2016
Louisiana	14.1065	13.7030	14.2113	-0.4034	0.1049	2016
North Carolina	16.2336	16.2233	16.1472	-0.0103	-0.0865	2016
North Dakota	14.3652	13.8119	13.2642	-0.5533	-1.1010	2016
Delaware	14.2366	13.9591	13.9694	-0.2776	-0.2673	2017
Kentucky	14.9529	15.4199	15.6017	0.4670	0.6488	2018
Maryland	15.4158	15.4224	15.6350	0.0066	0.2192	2018
Missouri	14.6525	15.0741	15.6619	0.4216	1.0094	2020
Alabama	15.3159	15.6780	15.8560	0.3621	0.5400	2021
Arkansas	14.8409	15.1188	15.3816	0.2779	0.5407	2021
Ln(Geometric Mean)	-	-	-	0.03498	0.0684	-
Transformed Δ %	-	-	-	3.56%	7.08%	-

Note: This table presents the logarithm of TCI for each state in the effective year (Year 0), the year prior (Year -1), and the year after the switch (Year +1). The columns "Y(0) - Y(-1)" and "Y(1) - Y(-1)" show the differences in the logarithm of TCI between these years. The Ln(Geometric Mean) of the differences across states is exponentiated, $e^{0.03498}$ and $e^{0.0684}$, to obtain geometric means, resulting in values of 1.0624 and 1.1360, representing percentage increases of 3.56% and 7.08%, respectively.

While SSFA adoption reduced TCI collections in several states, broader economic conditions and industry-specific factors offer context for why policymakers may have retained the policy despite an initial fiscal decline.[35] Indiana, Maine, and Colorado adopted SSFA during the Great Recession, and the year-to-year declines during this period can likely be attributed to that broader economic downturn. It is not surprising that North Dakota would experience a decline after adoption because

[35]Contrary to those average increases, Michigan, Indiana, Maine, Colorado, Utah, New Jersey, North Carolina, North Dakota, and Delaware do not increase TCI in the first or second year.

the state's corporate income tax base is largely composed of oil and gas corporations.[36] This is finding aligns with the results from the severance tax logistic regression in Section 7.4. Delaware's outcomes, discussed in Section 7.3, stem from its distinct tax base, while Michigan's volatility in the auto industry during this period likely overshadowed any effects from SSFA adoption.

These observed short-run increases in TCI following SSFA adoption align with the 'nowhere income' story, where the initial apportionment changes increase taxable income for the adopting state before corporations adjust behavior to minimize their tax liabilities. In general, these differences after the implementation of the policy indicate that the reforms did not decrease TCI in a substantial way. This is consistent with the story that in the short-run, state officials and legislators might perceive the switch to SSFA as beneficial, or at least not detrimental. These immediate increases in TCI provide descriptive context for the two-way fixed effect regression and SDID results. Although there is no counterfactual state or formal statistical test, examining these immediate effects contextualizes the longer-term impacts of the SSFA policy.

7.2 Two-Way Fixed-Effect Regression Estimates

The TWFE regression estimates that adopting states experience a 3.48 percent increase in TCI in the first year following SSFA implementation but experience a 4 percent decrease by the third year, which suggests an initial rise followed by a decline in TCI (Table 4). The TWFE methodology differs from the SDID by pooling all treatment and control units into a single regression with global state and time fixed effects, rather than isolating the treatment within event-specific treatment-comparison groups. The estimated coefficient, δ_k, on the relative year dummy captures pre-treatment trends relative to the treatment year. These significant estimates indicate that the treated states had a negative baseline relative to the control group states prior to adopting the policy. The significance indicates selection into the policy or pre-existing difference between the adopting vs. non-adopting states. The estimated coefficient, δ_k for year 1 is significant and indicates that the adopting states experienced a 3.48 percent increase in TCI relative to the baseline year

[36]Kroshus (2022)

(-1), demonstrating an initial increase from the policy. The estimated coefficient, δ_k for year 3 is significant and indicates that the adopting states experienced a 4 percent decrease in TCI relative to the baseline year (-1), suggesting a reversal from the initial increase.[37]

Table 4: Point Estimates for Two-Way Fixed-Effect Regression

Variable	**Estimate**	**Std. Error**	**t-value**	**p-value**
Treated, β	0.0189	0.027	0.699	0.4846
Rel Year, δ_k = -4	-0.1703 ***	0.0189	-9.008	$<$ 2e-16
Rel Year, δ_k = -3	-0.1317 ***	0.0189	-6.965	3.66E-12
Rel Year, δ_k = -2	-0.0746 ***	0.0189	-3.945	8.06E-05
Rel Year, δ_k = 0	0.0311	0.0189	1.644	0.1002
Rel Year, δ_k = 1	0.0342 *	0.0189	1.811	0.0702
Rel Year, δ_k = 2	-0.0157	0.0189	-0.830	0.4065
Rel Year, δ_k = 3	-0.0408 **	0.0189	-2.159	0.0309
Rel Year, δ_k = 4	-0.0128	0.0189	-0.676	0.4989

Note: This table presents the point estimates for a two-way fixed-effects regression. "Treated" refers to β, a dummy indicator for whether the state adopts the policy. "Rel Year" refers to the relative year, δ_k, which is a dummy indicator for that year relative to the treatment year. Significance levels are indicated as follows: *p $<$ 0.10, **p $<$ 0.05, ***p $<$ 0.01.

These estimates are consistent with the "nowhere income" story that states are initially able to increase TCI by apportioning "relatively" more out of state corporate sales to that state's corporate income tax base. However, corporations will adjust the sales methodology to avoid nexus by just having sales into a state.[38] The avoidance of nexus increases the amount of non-taxable nowhere income generated by corporations. This increase in year one and decrease in year three relative to the baseline suggests that the initial "accounting switch" apportions more TCI and by extension tax revenue to the state. However, these increases are not sustained in the long-run.

In the long run, this policy leads to a decrease in TCI apportioned to the state. This story and empirical results are exhibited in figure 1. There is a clear initial difference between the

[37] These percentages are transformed log point estimates.

[37] Standard errors are identical across relative year regressors in this table. This outcome may be due to a coding issue in the original implementation and needs to be verified.

[38] Corporations could be increasing use of third party carriers or use other methods to reduce physical presence for existing sales.

adopting vs. non-adopting states, but given that difference, there is still a significant increase in TCI immediately following adoption, which is quickly followed by a decrease relative to baseline. The negative pre-trend evident in figure 1 indicates the potential biases in the TWFE estimates due to pre-existing differences between treated and control states before policy adoption. This observation underscores the importance of using the SDID approach as a supplement to TWFE results.

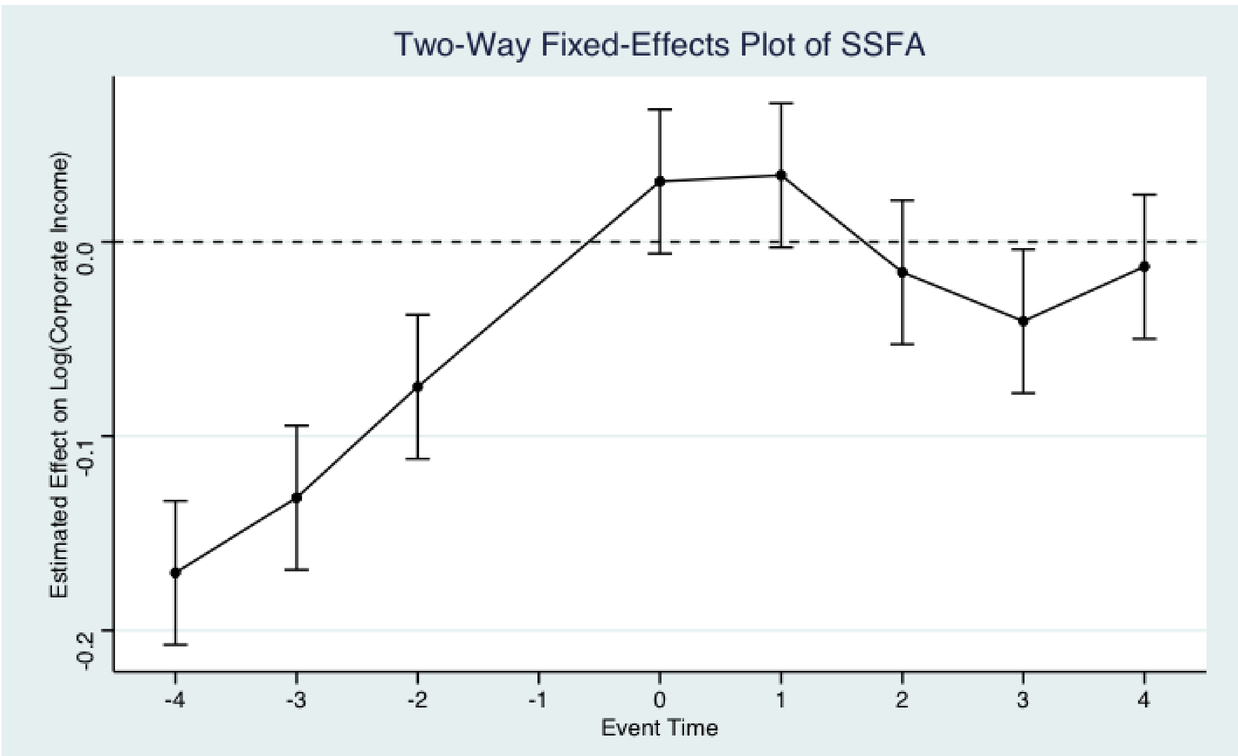

Figure 1: Two-Way Fixed-Effects Estimates of Relative Year Coefficients

Note: This figure presents the estimated coefficients from a Two-Way Fixed-Effects regression model for relative years around the policy adoption event. The solid points indicate statistically significant estimates at the 0.10, 0.05, and 0.01 levels. The dashed horizontal line represents zero, the reference year is ($k = -1$), against which all other relative year coefficients are compared.

7.3 Synthetic Difference-in Difference Point Estimates

7.3.1 Short Run and Long Run Point Estimates

The point estimates are generally insignificant across most states, with a few exceptions. Table 5 shows the SDID point estimates of the logarithm of TCI by state in the short run, reflecting the first three years after each state's adoption of SSFA. Indiana shows a significant negative effect, with a point estimate of -0.64005, indicating a substantial decline in TCI. Missouri has a positive effect nearing significance, with a point estimate of 0.52804. I convert the geometric mean across all states of -0.04523 into an average decrease in TCI of approximately 4.42% over the first three years post-adoption (Table 10).[39]

As in the short run, the point estimates in the long run are mostly insignificant across the majority of states. Table 6 presents SDID point estimates of the logarithm of TCI by state in the long run, which indicates the effects over the life of SSFA adoption. Michigan shows a significant negative effect, with a point estimate of -1.23669, and Delaware demonstrates a significant negative effect, with a point estimate of -0.43166.[40] The geometric mean across all states is -0.09350, which converts to a long-run decrease of approximately 8.92% (Table 10).

Delaware's significant decline in TCI under SSFA can be understood through the way Delaware historically positioned itself in the state corporate tax landscape. Before these apportionment formula changes, part of Delaware's "sales pitch" to why a corporation might locate in Delaware involved access to Delaware's Court of Chancery. Under the equally weighted three-factor apportionment regime, if a corporation locates its property and payroll in a state, then it would be increasing the amount of TCI allocated to that state. This legal and court system were, at least historically, business friendly, which led to the incorporation of capital and payroll in Delaware (Agrawal, 2023). The move to SSFA would likely have a substantial effect given that history and the relative size of Delaware.[41]

[39] The same conversion formula is used as in 7.1.
[40] Michigan's tax base dependence on the auto industry is discussed in 7.1
[41] Quillen and Hanrahan (1993)

Table 5: Point Estimates for Ln(TCI) in Short Run

State	Year	Estimate	95% CI (Low, High)	t-statistic	p-value
Nebraska	1988	-0.02006	(-0.4192, 0.3790)	-0.099	0.9216
Michigan	1991	0.00235	(-0.4164, 0.4211)	0.011	0.9912
Illinois	1999	0.11044	(-0.1461, 0.3670)	0.844	0.3991
Oregon	2004	0.13269	(-0.4409, 0.7062)	0.453	0.6503
Georgia	2006	-0.19895	(-0.5988, 0.2009)	-0.975	0.3297
Wisconsin	2006	-0.23157	(-0.6808, 0.2176)	-1.010	0.3125
Arizona	2007	0.01839	(-0.2778, 0.3146)	0.122	0.9032
Indiana	2007	-0.64005	(-0.9516, -0.3285)	-4.027	0.0001***
Maine	2007	-0.12706	(-0.4743, 0.2202)	-0.717	0.4734
Minnesota	2007	-0.11005	(-0.4296, 0.2095)	-0.675	0.4999
Pennsylvania	2007	-0.13771	(-0.4767, 0.2012)	-0.796	0.4260
South Carolina	2007	-0.16959	(-0.4777, 0.1385)	-1.079	0.2809
Colorado	2009	0.01649	(-0.4389, 0.4718)	0.071	0.9434
California	2011	-0.27212	(-1.0857, 0.5414)	-0.656	0.5122
Utah	2011	-0.02009	(-0.6853, 0.6451)	-0.059	0.9528
New Jersey	2012	-0.07816	(-0.5314, 0.3750)	-0.338	0.7354
New York	2015	-0.00107	(-0.8253, 0.8231)	-0.003	0.9980
Rhode Island	2015	0.15385	(-0.6831, 0.9908)	0.360	0.7187
Connecticut	2016	0.25011	(-0.7566, 1.2568)	0.487	0.6264
Louisiana	2016	0.01134	(-0.9896, 1.0123)	0.022	0.9823
North Carolina	2016	0.04613	(-1.0003, 1.0926)	0.086	0.9312
North Dakota	2016	-0.34899	(-1.4198, 0.7218)	-0.639	0.5231
Delaware	2017	-0.32311	(-0.8156, 0.1694)	-1.286	0.1989
Kentucky	2018	0.23977	(-0.2983, 0.7778)	0.873	0.3827
Maryland	2018	-0.01078	(-0.5473, 0.5257)	-0.039	0.9686
Missouri	2020	0.52804	(0.0204, 1.0357)	2.039	0.0419**

Note: This table presents the Synthetic Difference-in-Differences (SDID) point estimates for the logarithm of TCI by state in the short run (first three years). The point estimate is calculated as $\hat{\tau}$. The 95% confidence interval is computed as $(\hat{\tau} - 1.96 \cdot \text{se}, \hat{\tau} + 1.96 \cdot \text{se})$. Significance levels are indicated as follows: *p<0.10, **p<0.05, ***p < 0.01.

Table 6: Point Estimates for Ln(TCI) in Long Run

State	**Year**	**Estimate**	**95% CI (Low, High)**	**t-statistic**	**p-value**
Nebraska	1988	0.20545	(-0.4570, 0.8679)	0.608	0.5434
Michigan	1991	-1.23669	(-2.0502, -0.4231)	-2.979	0.0030**
Illinois	1999	-0.42876	(-1.0843, 0.2267)	-1.282	0.2002
Oregon	2004	-0.03523	(-0.5374, 0.4670)	-0.137	0.8907
Georgia	2006	-0.11582	(-0.5776, 0.3459)	-0.492	0.6231
Wisconsin	2006	-0.25653	(-0.7646, 0.2516)	-0.990	0.3227
Arizona	2007	0.22247	(-0.3216, 0.7665)	0.801	0.4231
Indiana	2007	-0.89009	(-1.4176, -0.3626)	-3.307	0.0010***
Maine	2007	-0.15517	(-0.6464, 0.3361)	-0.619	0.5360
Minnesota	2007	0.00603	(-0.4793, 0.4914)	0.024	0.9806
Pennsylvania	2007	-0.35021	(-0.8639, 0.1635)	-1.336	0.1819
South Carolina	2007	-0.22706	(-0.7685, 0.3144)	-0.822	0.4114
Colorado	2009	0.33616	(-0.2529, 0.9252)	1.119	0.2637
California	2011	-0.22460	(-0.9146, 0.4654)	-0.638	0.5237
Utah	2011	0.51401	(-0.2236, 1.2516)	1.366	0.1724
New Jersey	2012	-0.47215	(-1.3982, 0.4540)	-0.999	0.3180
New York	2015	-0.17026	(-1.0755, 0.7350)	-0.369	0.7125
Rhode Island	2015	0.01007	(-0.7362, 0.7563)	0.026	0.9789
Connecticut	2016	0.69759	(-0.1199, 1.5151)	1.672	0.0948*
Louisiana	2016	0.23426	(-0.5798, 1.0483)	0.564	0.5729
North Carolina	2016	0.07774	(-0.7465, 0.9019)	0.185	0.8534
North Dakota	2016	-0.36645	(-1.2318, 0.4989)	-0.830	0.4068
Delaware	2017	-0.43166	(-0.8086, -0.0547)	-2.245	0.0251**
Kentucky	2018	0.16644	(-0.2478, 0.5807)	0.788	0.4312
Maryland	2018	-0.03685	(-0.4534, 0.3797)	-0.173	0.8624
Missouri	2020	0.49325	(-0.0775, 1.0640)	1.694	0.0907*

Note: This table presents the Synthetic Difference-in-Differences (SDID) point estimates for the logarithm of TCI by state in the long run (life of the policy). The point estimate is calculated as $\hat{\tau}$. The 95% confidence interval is computed as $(\hat{\tau} - 1.96 \cdot \text{se}, \hat{\tau} + 1.96 \cdot \text{se})$. Significance levels are indicated as: *p<0.10, **p<0.05, ***p $<$ 0.01.

7.3.2 Summary Statistics and Control Group Composition

The summary statistics and control group composition provide further context for interpreting the SDID estimates. Tables 11 and 12 provide the summary statistics for both the treatment and control groups in the short run across all states. For the treated group, the observations consist of the logarithm of TCI before the policy switch and for the first three years following SSFA adoption.

The control group includes states that had not yet switched or never switched to SSFA during this same period. I exclude states that adopted SSFA within three years after the policy was enacted from the control group. The number of observations in the control group increases steadily until 2011, then it begins to decrease as more states adopt the SSFA, which reduces the size of the control group. Tables 13 and 14 provide the summary statistics for both the treatment and control groups in the long run. The observations for treated states include the logarithm of TCI over an extended time frame, while the control group consists of states that either had not yet switched or never switched to SSFA. States that adopted SSFA after 2022 were included in the control group.

7.3.3 Discussion of Short Run and Long Run SDID Estimates

The SDID point estimates indicate that the effects of the policy are barely identified and nearly non-identified. Given that insignificance, I group the point estimates for each state into the following groups (Table 7): (1) positive point estimates in the short- and long-run, (2) positive estimates in the short-run and negative in the long-run, (3) negative short-run and positive long-run, (4) negative short- and long-run, (5) positive short-run, and (6) negative short-run. This grouping shows a positive, insignificant point estimate in the short and long run for only two states, Arizona and Colorado. The groupings indicate that SSFA had limited or mixed effects in the short run, with any long-term impacts tending to be negative. This is consistent with the story that in the short-run, there may be no substantial decreases in TCI, in the long run, corporations increase the amount of non-taxable income. In the process, the SSFA regime generally tends to decrease the amount of TCI in a state in the long run. Supplemental plots provided in the separate appendix further illustrate this result of no effect, and if an effect, generally a negative one in the long run.

Table 7: Point Estimates for TCI with Short-Run (SR) and Long-Run (LR) Changes

State	SR-Estimate	SR-Δ %	LR-Estimate	LR-Δ %
Positive Short-Run, Long-Run				
Arizona	0.01839	1.85136	0.22247	24.93023
Colorado	0.01649	1.65885	0.33616	40.00621
Ln(Geometric Mean)	0.01743		0.27480	
Transformed Δ %		1.75%		31.60%
Positive Short-Run, Negative Long-Run				
Michigan	0.00235	0.23527	-1.23669	-71.36002
Illinois	0.11044	11.67553	-0.42876	-34.79002
Oregon	0.13269	14.16973	-0.03523	-3.46390
Ln(Geometric Mean)	0.08199		-0.56694	
Transformed Δ %		8.55%		-43.27%
Negative Short-Run, Positive Long-Run				
Nebraska	-0.02006	-1.98600	0.20545	22.82335
Minnesota	-0.11005	-10.42970	0.00603	0.60426
Utah	-0.02009	-2.00184	0.51401	67.10751
Ln(Geometric Mean)	-0.05007		0.23718	
Transformed Δ %		-4.88%		26.74%
Negative Short-Run, Negative Long-Run				
Georgia	-0.19895	-18.03052	-0.11582	-10.96326
Wisconsin	-0.23157	-20.68685	-0.25653	-22.62306
Indiana	-0.64005	-47.29962	-0.89009	-59.03582
Maine	-0.12706	-11.93463	-0.15517	-14.37008
Pennsylvania	-0.13771	-12.85684	-0.35021	-29.57493
South Carolina	-0.16959	-15.57252	-0.22706	-20.31198
California	-0.27212	-23.78794	-0.22460	-20.08194
New Jersey	-0.07816	-7.51693	-0.47215	-37.64281
New York	-0.00107	-0.10692	-0.17026	-15.65047
Ln(Geometric Mean)	-0.20573		-0.31836	
Transformed Δ %		-18.65%		-27.31%
Positive Short-Run, $<$ 6 yr LR				
Rhode Island	0.15385	16.63952	-	-
Connecticut	0.25011	28.42323	-	-
Louisiana	0.01134	1.13647	-	-
North Carolina	0.04613	4.71783	-	-
Kentucky	0.23977	27.13079	-	-
Missouri	0.52804	69.48171	-	-
Ln(Geometric Mean)	0.20501		-	
Transformed Δ %		22.70%		
Negative Short-Run, $<$ 6 yr LR				
North Dakota	-0.34899	-29.47462	-	-
Delaware	-0.32311	-27.64086	-	-
Maryland	-0.01078	-1.07395	-	-
Ln(Geometric Mean)	-0.22793		-	
Transformed Δ %		-20.39%		

Note: Organizes point estimates from Tables 5 and 6 into six different groups: (1) positive SR & LR, (2) positive SR & negative SR, (3) negative SR & positive LR, (4) negative SR & LR, (5) positive SR, and (6) negative SR.

7.4 Fixed Factors and When States Switch

A state's decision to adopt SSFA is closely tied to the nature of its fixed factors, particularly whether they are mobile or geographically constrained. The advantages and disadvantages of each formula depend on how fixed capital and labor change over time. If a state does not adopt SSFA, and its neighboring states do, then investment in its fixed factors will likely deteriorate over time. However, there is a distinction in mobility between types of "fixed factors." Some factors are, by nature, fixed in the short and long run, such as geographically fixed resources (oil or minerals in the ground), which are immobile in the short- and long-run. Whereas, there is investment that becomes immobile after it has been expended (capital to build a factory), but it can be competed over ex ante. If this is true, then states with a corporate income tax base comprised of corporations that have immobile fixed factors seem more likely to be never adopters or possibly even late adopters. In that context, I used a logistic regression to estimate the likelihood of adopting SSFA with respect to severance tax revenue in a state.[42]

Table 8: Logistic Regression Results for Switch on Severance Tax Revenue

Variable	**Estimate**	**Std. Error**	**z Value**	**p-Value**
Intercept	1.5065	0.0906	16.62	$< 2 \times 10^{-16}$***
Sev_log	-0.1299	0.0096	-13.46	$< 2 \times 10^{-16}$***
		Odds Ratio		
Intercept		4.5108		
Sev_log		0.8782		

Interpretation:
The intercept (1.5065) has an odds ratio of 4.5108, indicating that the baseline odds of switch = 1 are quite high when Severance Tax Revenue = 0.
The odds ratio for Severance Tax is 0.8782, suggesting that higher values of Severance Tax are associated with slightly lower odds of switch = 1.

The results of the logistic regression support the hypothesis that states with a higher reliance on severance tax revenue are less likely to adopt SSFA (Table 8). The odds ratio of 4.5108 for the

[42]Severance tax is a tax on the extraction of non-renewable natural resources.

intercept indicates that when severance tax collections are 0, the odds of a state switching to SSFA are 4.51 times the odds of them not switching. The ratio of .8782 for Severance tax collections indicates that for each 1-unit increase in log severance tax collections, the odds of a state switching to SSFA are 0.8782. Since this value is less than 1, it indicates that more severance tax collections have a negative effect on the likelihood of a state adopting SSFA. This is consistent with the theory that states whose tax bases are composed of corporations that generally have immobile factors are more resistant to changing their corporate tax apportionment formula. By continuing to choose the three-factor apportionment formula, these states do not face as much of a factor depreciation risk. Meanwhile, states facing declining investment in fixed factors—where corporate operations are more mobile—are more likely to adopt SSFA to attract or retain corporate activity.

7.5 Non-Corporate Tax Revenue

Proponents of SSFA contend that adopting the policy increases economic development. That is likely true given the way a corporation's incentives change from the policy change. If this is occurring, corporate investment in capital and labor will spill over into other tax bases. This section estimates if there are any effects of these reforms on non-corporate tax revenue per capita. Tables 15-17 show I generally do not find evidence that these reforms create spillovers into other tax bases. The point estimates are insignificant for almost all states in the short and long run. Delaware and North Dakota are the exceptions, which is not surprising given the unique structure of the respective tax bases (discussed in sections 7.1-7.2). Nonetheless, the aggregate nature of the data used may obscure any local tax base effects. The results suggest the economic development benefits may be too small to be detected at this level.

8. Conclusion

The question of how corporate tax reforms, like the adoption of SSFA, impact state economies remains relevant to academic research and current public policy. Due to P. L. 86-272 and the repealing of throwback and throwout rules, corporations are likely able to increase non-taxable income to a greater extent under SSFA than under the three-factor formula. This background, combined with the short-run descriptive statistics, indicates that the decreases in TCI from the reforms are subtle. The two-way fixed-effects regression results show that in the first year after adopting SSFA, states experienced a 3.48 percent increase in TCI relative to the baseline year. However, by the third year, this initial increase was reversed, with TCI declining by 4 percent relative to the baseline year. This suggests the short-term gains in TCI are not sustained and provides circumstantial evidence that corporations increase nowhere income at the expense of apportioned TCI. In that context, the SDID point estimates on TCI indicated that there are minimal significant short or long-run effects of switching to SSFA. In contrast to the minimally positive short-run descriptive statistics and two-way fixed-effects regression results, the SDID results suggest that the reforms have no effect, though if there is any effect, it is generally negative. Lastly, I do not estimate any significant impacts of the reforms on non-corporate tax revenue.

These results answer one dimension of the impact of these reforms, highlighting the trade-offs inherent in apportionment formula choices by states. While the switch to SSFA may yield immediate TCI gains, it creates long-term reductions in the amount of TCI apportioned to states. Five states have still not switched to SSFA, and given the fixed factors present in those states, it is likely most will not do so. However, the impact and timing of these reforms are still relevant for policymakers, particularly as states continue to weigh the long-term consequences of tax policy on economic development and corporate behavior. Addressing these challenges may involve reforms to nexus rules, revisiting P. L. 86-272 at the federal level, or alternative apportionment formulas that balance economic development with corporate income tax revenue.

9. Appendix

Introduction Information

This section provides additional background information on the three-factor formula. The use of the factors (Property, Payroll, and Sales) used in an equal-weight fashion to apportion TCI came to be known as the equally weighted “three-factor formula”. Nearly all states used the three-factor formula at some point between the adoption of their CIT and the 1970s.

The Multistate Tax Commission defines property to include“The property factor includes all real and tangible personal property owned or used during the tax period to produce business income. The term “real and tangible personal property” includes land, buildings, machinery, stocks of goods (inventory), equipment, and other real and tangible personal property used in connection with the production of business income but does not include coin or currency.”

This provides clarification on what constitutes a market or production intensive state. The general form of the apportionment factor of the corporations’s taxable profits, ϕ_j is expressed as

$$\phi_j = f_j^s \frac{S_j}{S} + f_j^p \frac{P_j}{P} + f_j^R \frac{R_j}{R}. \tag{10}$$

The f_j^s, f_j^p, f_j^R are state j’s factor weights for sales, payroll, and property, respectively. The S_j, P_j, R_j are the corporation’s sales, payroll, and property in the state j, respectively. States modify their apportionment formula by adjusting these weights.

States with a larger share of in-state sales relative to productive factors, such as payroll or property, may see short-term increases in apportioned TCI from adopting SSFA. The state is a “Market-intensive” state if

$$\frac{S_j}{S} > \frac{(R_j/R) + (P_j/P)}{2}. \tag{11}$$

In contrast, states with significant production but fewer in-state sales may not benefit from this transition. The states can either choose ϕ_j^S, which weights the sales factor more, or ϕ_j^P, which weights the productive factors more. The state is a “Production-intensive” state if:

$$\frac{S_j}{S} < \frac{(R_j/R) + (P_j/P)}{2}. \tag{12}$$

This distinction between sales-intensive and production-intensive states is central to understanding how apportionment changes affect taxable corporate income.

Background Information

Multistate Tax Commission 2021 Update, Nexus for Online Sales, and South Dakota v. Wayfair, Inc.

In the South Dakota v. Wayfair, Inc.(2018), the Supreme Court held that remote retailers that meet an economic nexus threshold (determined by the dollar amount or number of sales into a state), then they would meet the sales tax nexus threshold. This overturned the previous physical presence standard established in Quill Corp. v. North Dakota (1992). This case did not overrule the standards laid forth in P. L. 86-272 for corporate income tax nexus. Though, the Multistate Tax Commission did issue an updated interpretation of P. L. 86-272 in the wake of this ruling in 2021.

This interpretation stated, ”As a general rule, when a business interacts with a customer via the business's website or app, the business engages in a business activity within the customer's state.” Multistate Tax Commission (2024a) It should be noted that this interpretation does not have the force of law and though it has been adopted by some states, the issue has not been taken up by the courts on whether it conflicts with P. L. 86-272 (DeBruin and Smith (2023)).[43]

Moorman Vs Bair Info

Between 1949-1960, the State Tax Commission “allowed” Moorman to apportion its Iowa income using the three-factor formula. Between 1961-1964, Moorman complied with the State Tax Commission and used SSFA for apportionment. In 1965, Moorman used the three-factor formula “without the consent of the commission.”

Moorman Vs Bair- SC's judgment on why SSFA does not violate Due Process Clause

“The Due Process Clause places two restrictions on a State's power to tax income generated by the activities of an interstate Page 437 U. S. 273 business.

First, no tax may be imposed unless there is some minimal connection between those activities and the taxing State. National Bellas Hess, Inc. v. Department of Revenue,386 U. S. 753, 386 U. S. 756. This requirement was plainly satisfied here. Second, the income attributed to the State for tax purposes must be rationally related to“values connected with the taxing State.” Norfolk & Western R. Co. v. State Tax Comm'n, 390 U. S. 317, 390 U. S. 325.

Since 1934, Iowa has used the formula method of computing taxable income. This method, unlike separate accounting, does not purport to identify the precise geographical source of a corporation's profits; rather, it is employed as a rough approximation of a corporation's income that is reasonably related to the activities conducted within the taxing State. The single factor formula used by Iowa, therefore, generally will not produce a figure that represents the actual profits earned within the State. But the same is true of the Illinois three factor formula. Both will occasionally over-reflect or under-reflect income attributable to the taxing State. Yet despite this imprecision, the Court has refused to impose strict constitutional restraints on a State's selection of a particular formula.”

Moorman Vs Bair- SC's judgment on why SSFA does not violate Commerce Clause

“Nor is Iowa's single factor formula invalid under the Commerce Clause. Pp. 437 U. S. 276-281. Page 437 U. S. 268 (a) On this record, the existence of duplicative taxation as between Iowa and Illinois (which uses the so-called three factor – property, payroll, and sales – formula) is speculative, but even then assuming some overlap, appellant's argument that Iowa, rather than Illinois, was necessarily at fault in a constitutional sense cannot be accepted. Where the record does not reveal the sources of appellant's profits, its Commerce Clause claim cannot rest on the premise that profits earned in Illinois were included in its Iowa taxable income, and therefore the Iowa formula was at fault for whatever overlap may have existed. Pp. 437 U. S. 276-277. (b) The Commerce Clause itself, without implementing legislation by Congress, does not require, as appellant urges, that Iowa compute corporate net income under the Illinois three factor formula. If the Constitution were read to mandate a prohibition against any overlap in the computation of taxable income by the States, the consequences would extend far beyond this particular case and would require extensive judicial lawmaking. Pp. 437 U. S. 277-281.”

Throwback Rule Example

A company headquartered in North Dakota (which has throwback rule) earns $100,000 in net

[43]Thank you to Theodore Soto at Loyola Marymount University Law School for bringing this to my attention.

income and has operations and sales in South Dakota (No CIT) and Nebraska; 80% of their property is in ND, 80% of their payroll is in ND, and 33% of their sales are in ND. Further, 10% of their property is in SD and NE, 10% of their payroll is in SD and NE, and 33% of their sales are in each state as well. Given CIT rates of 4.31% for ND, and 7.25% for NE, their state CIT apportionment under the three-factor formula would be as follows: In ND: (1/3*(.8+.1))+(1/3*(.8+.1))+(1/3*(.333+.333))= .8225. In SD: There is no CIT, but because of the throwback rule, the factor income that would have been apportioned to SD (.1 and .333 added above) is thrown back in the numerator to ND. In NE: (1/3*.1)+(1/3*.1)+(1/3*.333)= .1775.

ND CIT Base $82,250 taxed at 4.31%, yields a ND tax liability of $3,545. NE CIT Base $17,750 taxed at 7.25%, yields a NE tax liability of $1,286. This leaves a total state CIT liability under three-factor apportionment of $4,831.

If one expands the above situation to a scenario where all of the sales are purchased online, packaged, and then just delivered in all fifty states, it is straightforward to understand the revenue and total tax liability implications of a state having a throwback rule. Twenty-two states have a throwback rule, one states has a throwout rule, and the rest of states do not have either (Table 1). In throwout rule states any "nowhere income" is thrown out or subtracted from the denominator, or total sales, if SSFA. Since the only state remaining with this policy is Maine, I will not go through an example scenario.

Results Information

The following formulas were used for transformations of the logarithm of TCI results.

In section 7.1, this formula was used to calculate the average of the log difference across all states and compute the geometric of the original values for the logarithm of differences. It is as follows

$$\text{Average Log Difference} = \frac{1}{n}\sum_{i=1}^{n}\left(\log(\text{Year}(0)_i) - \log(\text{Year}(-1)_i)\right). \tag{13}$$

In order to convert the logarithm of geometric mean into a percentage change, I exponentiate the average log difference and subtract 1. This is expressed as

$$\text{Percentage Change} = \left(e^{\text{Average Log Difference}} - 1\right) \times 100. \tag{14}$$

This gives the geometric mean percentage change in non-logged TCI.

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Tables

Table 9: Throwback/Throwout Rules by State

State	Throwback/Throwout Rule	State	Throwback/Throwout Rule
Alabama	No Throwback Rule	Montana	Throwback Rule
Alaska	Throwback Rule	Nebraska	Throwback Rule
Arizona	Throwback Rule	Nevada	
Arkansas	Throwback Rule	New Hampshire	Throwback Rule
California	Throwback Rule	New Jersey	No throwback rule
Colorado	Throwback Rule	New Mexico	Throwback Rule
Connecticut	No Throwback Rule	New York	No throwback rule
Delaware	No Throwback Rule	North Carolina	No throwback rule
Florida	No Throwback Rule	North Dakota	Throwback Rule
Georgia	No Throwback Rule	Ohio	
Hawaii	Throwback Rule	Oklahoma	Throwback Rule
Idaho	Throwback Rule	Oregon	Throwback Rule
Illinois	Throwback Rule	Pennsylvania	No Throwback rule
Indiana	No Throwback Rule	Rhode Island	Throwback Rule
Iowa	No Throwback Rule	South Carolina	No Throwback rule
Kansas	Throwback Rule	South Dakota	
Kentucky	No Throwback Rule	Tennessee	No Throwback rule
Louisiana	No Throwback Rule	Texas	
Maine	Throwout Rule	Utah	No Throwback rule
Maryland	No Throwback Rule	Vermont	No Throwback rule
Massachusetts	Throwback Rule	Virginia	No Throwback rule
Michigan	No Throwback Rule	Washington	
Minnesota	No Throwback Rule	West Virginia	No Throwback Rule
Mississippi	Throwback Rule	Wisconsin	Throwback rule
Missouri	No Throwback Rule	Wyoming	

Note: This table lists the throwback and throwout rules for each state. In general, states have been repealing these rules over the past twenty years. Any state without a throwback or throwout rule likely increases the amount of non-taxable income that increases under SSFA.

Table 10: Point Estimates and Percentage Changes for Ln(TCI) in Short and Long Run

State	SR-Estimate	SR-Δ %	LR-Estimate	LR-Δ %
Nebraska	-0.02006	-1.98600	0.20545	22.82335
Michigan	0.00235	0.23527	-1.23669	-71.36002
Illinois	0.11044	11.67553	-0.42876	-34.79002
Oregon	0.13269	14.16973	-0.03523	-3.46390
Georgia	-0.19895	-18.03052	-0.11582	-10.96326
Wisconsin	-0.23157	-20.68685	-0.25653	-22.62306
Arizona	0.01839	1.85136	0.22247	24.93023
Indiana	-0.64005	-47.29962	-0.89009	-59.03582
Maine	-0.12706	-11.93463	-0.15517	-14.37008
Minnesota	-0.11005	-10.42970	0.00603	0.60426
Pennsylvania	-0.13771	-12.85684	-0.35021	-29.57493
South Carolina	-0.16959	-15.57252	-0.22706	-20.31198
Colorado	0.01649	1.65885	0.33616	40.00621
California	-0.27212	-23.78794	-0.22460	-20.08194
Utah	-0.02009	-2.00184	0.51401	67.10751
New Jersey	-0.07816	-7.51693	-0.47215	-37.64281
New York	-0.00107	-0.10692	-0.17026	-15.65047
Rhode Island	0.15385	16.63952	0.01007	1.00958
Connecticut	0.25011	28.42323	0.69759	100.85756
Louisiana	0.01134	1.13647	0.23426	26.41792
North Carolina	0.04613	4.71783	0.07774	8.08868
North Dakota	-0.34899	-29.47462	-0.36645	-30.70235
Delaware	-0.32311	-27.64086	-0.43166	-35.05177
Kentucky	0.23977	27.13079	0.16644	18.11745
Maryland	-0.01078	-1.07395	-0.03685	-3.61524
Missouri	0.52804	69.48171	0.49325	63.64099
Ln(Geometric Mean)	-0.04523		-0.09350	
Transformed Δ %		-4.42		-8.92

Note: This table presents the Synthetic Difference-in-Differences (SDID) point estimates and percentage changes for logarithm of TCI in both the short and long run. The columns "SR-Estimate" and "LR-Estimate" represent the point estimates for the short-run and long run, respectively. The "SR-Δ%" and "LR-Δ%" columns show the corresponding percentage changes in TCI, derived from the point estimates. The geometric means of the short-run and long-run estimates are provided at the bottom of the table. The transformed Δ% rows represent the exponentiated log geometric means, converted to percentage changes, indicating an overall decrease of 4.42% in the short-run and 8.92% in the long run.

Table 11: Summary Statistics for Treatment and Control Groups - Ln(CI) Short-Run

Group	Observations	Mean	SD	Median	Min	Max	IQR (25th, 75th)
Treated (Nebraska)	15	13.8938	0.3127	13.7930	13.4360	14.3319	(13.6642, 14.1989)
Control (for Nebraska)	645	14.8420	1.1560	14.8911	12.4355	18.0167	(13.9200, 15.5260)
Treated (Michigan)	18	17.7525	0.2208	17.8167	17.0350	18.0167	(17.6805, 17.8736)
Control (for Michigan)	756	14.7617	1.0793	14.8507	12.4038	17.5975	(13.9182, 15.4458)
Treated (Illinois)	26	16.7252	0.2444	16.7204	16.2410	17.1245	(16.5354, 16.9333)
Control (for Illinois)	1066	14.7709	1.0554	14.8437	12.4038	17.6013	(14.0114, 15.4164)
Treated (Oregon)	31	14.6447	0.2532	14.5809	14.3122	15.1036	(14.4219, 14.8638)
Control (for Oregon)	1178	14.7452	1.0903	14.7998	12.0704	17.8740	(13.9534, 15.4164)
Treated (Georgia)	33	15.5771	0.2172	15.6203	15.1734	15.9168	(15.3942, 15.7695)
Control (for Georgia)	1056	14.7334	1.1117	14.7821	12.0704	17.9468	(13.9313, 15.3709)
Treated (Wisconsin)	33	15.3455	0.1469	15.3805	14.9569	15.5575	(15.2592, 15.4398)
Control (for Wisconsin)	1056	14.7334	1.1117	14.7821	12.0704	17.9468	(13.9313, 15.3709)
Treated (Arizona)	34	14.6290	0.5869	14.4520	13.6137	15.7359	(14.1877, 15.1042)
Control (for Arizona)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (Indiana)	34	15.8858	0.5105	15.7011	15.2057	16.6761	(15.4511, 16.4266)
Control (for Indiana)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (Maine)	34	13.4224	0.2534	13.4235	12.8253	13.8589	(13.2310, 13.6036)
Control (for Maine)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (Minnesota)	34	15.1341	0.2296	15.1429	14.5692	15.5778	(14.9571, 15.3095)
Control (for Minnesota)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (Pennsylvania)	34	16.0455	0.1669	16.0824	15.6181	16.2638	(15.9406, 16.1655)
Control (for Pennsylvania)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (South Carolina)	34	14.7865	0.1744	14.8440	14.3904	15.0837	(14.6540, 14.9148)
Control (for South Carolina)	1020	14.7117	1.1350	14.7461	12.0704	17.9468	(13.8840, 15.3235)
Treated (Colorado)	36	14.7731	0.3568	14.7576	13.9361	15.4440	(14.4841, 15.0297)
Control (for Colorado)	1008	14.6380	1.0411	14.7434	12.0704	17.3660	(13.8478, 15.2716)
Treated (California)	38	17.4786	0.2088	17.4783	17.0374	17.9468	(17.3633, 17.5913)
Control (for California)	1026	14.5989	1.0211	14.7154	12.0704	17.3660	(13.8271, 15.2159)

Note: Summary statistics for the treatment and control groups in the short run. The statistics include the logarithm of TCI observations from the year prior to SSFA adoption and the first three years post-adoption. Control group observations span the same period but exclude states that switched within the first three years of SSFA implementation. The table shows the number of observations, mean, standard deviation, median, minimum, maximum, and interquartile range (25th and 75th percentiles) for each group. Discussed in Section 7.3.

Table 12: Summary Statistics for Treatment and Control Groups - Ln(CI) Short-Run (Continued)

Group	Observations	Mean	SD	Median	Min	Max	IQR (25th, 75th)
Treated (Utah)	38	14.2403	0.4693	14.2283	13.4330	15.1630	(13.9073, 14.6219)
Control (for Utah)	1026	14.5989	1.0211	14.7154	12.0704	17.3660	(13.8271, 15.2159)
Treated (New Jersey)	39	16.0461	0.2407	15.9990	15.4955	16.5545	(15.8997, 16.2156)
Control (for New Jersey)	1053	14.6051	1.0203	14.7181	12.0704	17.3660	(13.8484, 15.2226)
Treated (New York)	42	16.8430	0.2471	16.8282	16.4140	17.3660	(16.6462, 17.0406)
Control (for New York)	840	14.5839	0.9170	14.7185	12.2676	16.8927	(13.9246, 15.1493)
Treated (Rhode Island)	42	13.3567	0.3373	13.3888	12.0704	13.8764	(13.2052, 13.6004)
Control (for Rhode Island)	840	14.5839	0.9170	14.7185	12.2676	16.8927	(13.9246, 15.1493)
Treated (Connecticut)	43	15.0959	0.3018	15.0931	13.9178	15.6798	(14.9263, 15.2543)
Control (for Connecticut)	774	14.5385	0.9516	14.6262	12.2676	16.8927	(13.8399, 15.1299)
Treated (Louisiana)	43	14.7133	0.4068	14.7480	13.7030	15.3281	(14.4269, 15.0899)
Control (for Louisiana)	774	14.5385	0.9516	14.6262	12.2676	16.8927	(13.8399, 15.1299)
Treated (North Carolina)	43	15.7942	0.2463	15.8429	15.3391	16.2336	(15.5926, 15.9592)
Control (for North Carolina)	774	14.5385	0.9516	14.6262	12.2676	16.8927	(13.8399, 15.1299)
Treated (North Dakota)	43	13.2447	0.5700	13.1831	12.4337	14.6636	(12.7842, 13.5894)
Control (for North Dakota)	774	14.5385	0.9516	14.6262	12.2676	16.8927	(13.8399, 15.1299)
Treated (Delaware)	44	13.8839	0.4241	13.9847	12.7478	14.4800	(13.6800, 14.1950)
Control (for Delaware)	792	14.5463	0.9528	14.6310	12.2676	16.9134	(13.8549, 15.1390)
Treated (Kentucky)	45	14.9972	0.3185	14.9081	14.5263	15.7753	(14.7243, 15.2226)
Control (for Kentucky)	765	14.5337	0.9813	14.5668	12.2676	16.9134	(13.7797, 15.1660)
Treated (Maryland)	45	15.1076	0.3023	15.0477	14.5711	15.6413	(14.8679, 15.4157)
Control (for Maryland)	765	14.5337	0.9813	14.5668	12.2676	16.9134	(13.7797, 15.1660)
Treated (Missouri)	47	14.8508	0.3016	14.8179	14.2332	15.6755	(14.6508, 15.0575)
Control (for Missouri)	564	14.6597	1.1047	14.7623	12.2676	17.4399	(13.7311, 15.4771)

Note: Summary statistics for the treatment and control groups in the short run. The statistics include the logarithm of TCI observations from the year prior to SSFA adoption and the first three years post-adoption. Control group observations span the same period but exclude states that switched within the first three years of SSFA implementation. The table shows the number of observations, mean, standard deviation, median, minimum, maximum, and interquartile range (25th and 75th percentiles) for each group. Discussed in Section 7.3.

Table 13: Summary Statistics for Treatment and Control Groups - Ln(CI) Long-Run

Group	Observations	Mean	SD	Median	Min	Max	IQR (25th, 75th)
Treated (Nebraska)	47	14.0007	0.3462	13.9420	13.4360	14.9967	(13.7417, 14.2470)
Control (for Nebraska)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Michigan)	47	17.1701	0.9600	17.7531	15.4708	18.0167	(15.9857, 17.8966)
Control (for Michigan)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Illinois)	47	16.6674	0.2662	16.6130	16.0425	17.3604	(16.4918, 16.8317)
Control (for Illinois)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Oregon)	47	14.7699	0.3495	14.7698	14.1789	15.7168	(14.4664, 14.9775)
Control (for Oregon)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Georgia)	47	15.6238	0.2615	15.6653	15.1734	16.5178	(15.4414, 15.7680)
Control (for Georgia)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Wisconsin)	47	15.4189	0.2484	15.4135	14.9569	16.3540	(15.2774, 15.4730)
Control (for Wisconsin)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Arizona)	47	14.7964	0.5890	14.9286	13.6137	15.9090	(14.2929, 15.2243)
Control (for Arizona)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Indiana)	47	15.7779	0.5013	15.6224	14.9858	16.6760	(15.4098, 16.2277)
Control (for Indiana)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Maine)	47	13.5163	0.2890	13.5658	12.8253	14.2799	(13.2956, 13.6933)
Control (for Maine)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Minnesota)	47	15.2702	0.3536	15.2365	14.5692	16.6184	(15.0503, 15.4287)
Control (for Minnesota)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Pennsylvania)	47	16.0737	0.1884	16.0909	15.6181	16.6561	(15.9670, 16.1684)
Control (for Pennsylvania)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (South Carolina)	47	14.8361	0.2828	14.8710	14.1245	15.9232	(14.6555, 14.9544)
Control (for South Carolina)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Colorado)	47	14.9881	0.5184	14.8432	13.9361	16.2428	(14.6058, 15.3797)
Control (for Colorado)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (California)	47	17.5637	0.3316	17.5268	17.0374	18.9963	(17.3789, 17.6586)
Control (for California)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)

Note: Summary statistics for the treatment and control groups in the long run. The statistics include the logarithm of TCI observations between 1976-2022. The control group consists of states that either had not yet switched or never switched to SSFA. The table shows the number of observations, mean, standard deviation, median, minimum, maximum, and interquartile range (25th and 75th percentiles) for each group. Discussed in Section 7.3.

Table 14: Summary Statistics for Treatment and Control Groups - Ln(CI) Long-Run (Continued)

Group	Observations	Mean	SD	Median	Min	Max	IQR (25th, 75th)
Treated (Utah)	47	14.4025	0.5573	14.4751	13.4330	15.7012	(13.9862, 14.7836)
Control (for Utah)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (New Jersey)	47	16.1076	0.2914	16.0718	15.4955	17.0632	(15.9122, 16.2529)
Control (for New Jersey)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (New York)	47	16.8717	0.2578	16.8369	16.4140	17.4175	(16.6673, 17.0818)
Control (for New York)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Rhode Island)	47	13.4142	0.3712	13.4304	12.0704	14.1658	(13.2593, 13.6369)
Control (for Rhode Island)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Connecticut)	47	15.2009	0.4545	15.1296	13.9178	16.5811	(14.9320, 15.3547)
Control (for Connecticut)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Louisiana)	47	14.7265	0.4011	14.7480	13.7030	15.3711	(14.4860, 15.0899)
Control (for Louisiana)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (North Carolina)	47	15.8621	0.3409	15.8529	15.3391	16.9234	(15.5941, 16.0585)
Control (for North Carolina)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (North Dakota)	47	13.3114	0.5959	13.1901	12.4337	14.6636	(12.8433, 13.7477)
Control (for North Dakota)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Delaware)	47	13.9031	0.4213	14.0001	12.7478	14.4882	(13.7022, 14.1957)
Control (for Delaware)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Kentucky)	47	15.0320	0.3538	14.9231	14.5263	15.8930	(14.7681, 15.2393)
Control (for Kentucky)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Maryland)	47	15.1439	0.3432	15.0604	14.5711	15.9984	(14.8698, 15.4159)
Control (for Maryland)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)
Treated (Missouri)	47	14.8508	0.3016	14.8179	14.2332	15.6755	(14.6508, 15.0575)
Control (for Missouri)	705	14.5383	1.0491	14.4708	12.2676	17.4399	(13.6790, 15.2676)

Note: Summary statistics for the treatment and control groups in the long run. The statistics include the logarithm of TCI observations between 1976-2022. The control group consists of states that either had not yet switched or never switched to SSFA. The table shows the number of observations, mean, standard deviation, median, minimum, maximum, and interquartile range (25th and 75th percentiles) for each group. Discussed in Section 7.3.

Table 15: Short-Run Point Estimates for Non-Corporate Tax Revenue per Capita (First 3 Years)

State	Year	Estimate	95% CI (Low, High)	t-statistic	p-value
Nebraska	1988	16.56	(-88.05, 121.17)	0.310	0.7565
Michigan	1991	-64.01	(-184.78, 56.76)	-1.039	0.2992
Illinois	1999	6.73	(-164.94, 178.40)	0.077	0.9387
Oregon	2004	-23.42	(-172.76, 125.92)	-0.307	0.7586
Georgia	2006	-93.33	(-785.19, 598.52)	-0.264	0.7915
Wisconsin	2006	-61.06	(-715.68, 593.56)	-0.183	0.8550
Indiana	2007	23.02	(-626.72, 672.75)	0.069	0.9447
Arizona	2007	-128.96	(-936.76, 678.85)	-0.313	0.7544
Maine	2007	-9.35	(-452.98, 434.27)	-0.041	0.9670
Minnesota	2007	-50.73	(-808.45, 706.99)	-0.131	0.8956
Pennsylvania	2007	7.17	(-845.01, 859.34)	0.016	0.9868
South Carolina	2007	-101.15	(-863.94, 661.65)	-0.260	0.7950
Colorado	2009	-2.99	(-739.47, 733.49)	-0.008	0.9937
California	2011	46.27	(-221.49, 314.03)	0.339	0.7349
Utah	2011	-26.87	(-281.84, 228.11)	-0.207	0.8364
New Jersey	2012	-92.53	(-702.93, 517.87)	-0.297	0.7664
New York	2015	282.99	(-710.58, 1276.56)	0.338	0.7354
Rhode Island	2015	-48.75	(-958.21, 860.71)	-0.105	0.9163
Louisiana	2016	37.94	(-542.70, 618.58)	0.128	0.8981
North Carolina	2016	27.53	(-550.09, 605.15)	0.093	0.9256
Connecticut	2016	-10.08	(-606.07, 585.91)	-0.033	0.9736
North Dakota	2016	-1073.03	(-1664.65, -481.41)	-3.555	0.0004***
Delaware	2017	143.83	(44.98, 242.67)	2.852	0.0045**
Kentucky	2018	-55.19	(-195.86, 85.48)	-0.769	0.4421
Maryland	2018	-29.99	(-166.84, 106.86)	-0.429	0.6677
Missouri	2020	-79.01	(-294.50, 136.47)	-0.719	0.4726

Note: This table presents the short-run (first 3 years) point estimates for non-corporate tax revenue per capita. The estimates reflect the impact on non-corporate tax bases. Discussed in 7.5.

Table 16: Long-Run Point Estimates for Non-Corporate Tax Revenue per Capita

State	Year	Estimate	95% CI (Low, High)	t-statistic	p-value
Nebraska	1988	56.50	(-221.67, 334.67)	0.398	0.6907
Michigan	1991	5.84	(-325.28, 336.96)	0.035	0.9724
Illinois	1999	36.99	(-459.37, 533.35)	0.146	0.8839
Oregon	2004	14.57	(-592.01, 621.15)	0.047	0.9625
Georgia	2006	-121.77	(-570.95, 327.41)	-0.531	0.5953
Wisconsin	2006	-30.54	(-537.68, 476.60)	-0.118	0.9061
Indiana	2007	110.78	(-393.59, 615.16)	0.431	0.6670
Minnesota	2007	95.42	(-441.59, 632.43)	0.348	0.7277
Pennsylvania	2007	43.79	(-484.27, 571.84)	0.163	0.8709
Arizona	2007	-154.89	(-595.56, 285.78)	-0.689	0.4911
Maine	2007	-36.35	(-496.61, 423.92)	-0.155	0.8770
South Carolina	2007	-79.89	(-572.52, 412.74)	-0.318	0.7507
Colorado	2009	69.46	(-1671.53, 1810.44)	0.078	0.9377
California	2011	234.38	(-1054.78, 1523.55)	0.356	0.7217
Utah	2011	-5.24	(-1106.35, 1116.82)	-0.009	0.9926
New Jersey	2012	-12.10	(-1074.40, 1050.21)	-0.022	0.9822
New York	2015	232.59	(-559.92, 1025.09)	0.575	0.5653
Rhode Island	2015	-67.01	(-964.82, 830.80)	-0.146	0.8837
Louisiana	2016	12.25	(-158.62, 183.13)	0.141	0.8883
North Carolina	2016	6.42	(-171.80, 184.65)	0.071	0.9437
Connecticut	2016	-77.29	(-250.12, 95.53)	-0.877	0.3810
North Dakota	2016	-1102.40	(-1270.94, -933.87)	-12.820	0.0000***
Delaware	2017	206.89	(65.20, 348.58)	2.862	0.0043**
Kentucky	2018	-72.04	(-227.43, 83.36)	-0.909	0.3639
Maryland	2018	-73.87	(-217.47, 69.74)	-1.008	0.3137
Missouri	2020	-51.52	(-220.99, 117.95)	-0.596	0.5515

Note: This table presents the long-run point estimates for non-corporate tax revenue per capita.The estimates reflect the impact on non-corporate tax bases. Discussed in 7.5.

Table 17: Summary Statistics for Non-Corporate Tax Revenue per Capita by State

State	Mean	Median	IQR	Min	Max
Alabama	742.0	765.0	145.0	544.0	1001.0
Alaska	1836.0	1571.0	1706.0	465.0	5023.0
Arizona	838.0	844.0	73.6	625.0	1076.0
Arkansas	928.0	991.0	487.0	530.0	1354.0
California	1181.0	1154.0	423.0	759.0	2134.0
Colorado	781.0	783.0	213.0	496.0	1182.0
Connecticut	1349.0	1501.0	733.0	621.0	2012.0
Delaware	1306.0	1330.0	286.0	956.0	1948.0
Florida	744.0	746.0	133.0	512.0	1030.0
Georgia	756.0	776.0	170.0	528.0	984.0
Hawaii	1593.0	1588.0	340.0	1067.0	2366.0
Idaho	864.0	900.0	283.0	555.0	1186.0
Illinois	918.0	905.0	282.0	600.0	1448.0
Indiana	883.0	857.0	275.0	533.0	1386.0
Iowa	938.0	961.0	219.0	643.0	1287.0
Kansas	909.0	975.0	347.0	552.0	1368.0
Kentucky	926.0	997.0	261.0	632.0	1165.0
Louisiana	799.0	813.0	203.0	617.0	1127.0
Maine	1026.0	1094.0	304.0	617.0	1481.0
Maryland	1070.0	1054.0	293.0	723.0	1509.0
Massachusetts	1206.0	1232.0	342.0	717.0	1903.0
Michigan	958.0	1039.0	332.0	610.0	1211.0
Minnesota	1344.0	1405.0	453.0	814.0	1896.0
Mississippi	828.0	891.0	342.0	574.0	1101.0
Missouri	725.0	759.0	166.0	449.0	910.0
Montana	859.0	861.0	353.0	570.0	1318.0
Nebraska	861.0	920.0	371.0	522.0	1201.0
New Hampshire	476.0	552.0	269.0	248.0	666.0
New Jersey	1100.0	1108.0	382.0	494.0	1628.0
New Mexico	1038.0	1032.0	201.0	771.0	1346.0
New York	1232.0	1138.0	378.0	776.0	1914.0
North Carolina	901.0	965.0	230.0	582.0	1176.0
North Dakota	1286.0	958.0	987.0	622.0	3356.0
Ohio	799.0	834.0	232.0	477.0	1050.0
Oklahoma	870.0	871.0	134.0	589.0	1052.0
Oregon	844.0	841.0	278.0	555.0	1436.0
Pennsylvania	929.0	966.0	303.0	629.0	1293.0
Rhode Island	999.0	1084.0	293.0	636.0	1407.0
South Carolina	769.0	788.0	115.0	575.0	960.0
Tennessee	672.0	694.0	142.0	419.0	953.0
Utah	852.0	860.0	244.0	587.0	1314.0
Vermont	1304.0	1334.0	991.0	578.0	2245.0
Virginia	879.0	912.0	235.0	575.0	1369.0
West Virginia	974.0	1004.0	277.0	697.0	1290.0
Wisconsin	1071.0	1129.0	202.0	785.0	1296.0

Note: This table presents summary statistics for non-corporate tax revenue per capita across various states, including the mean, median, interquartile range (IQR), minimum, and maximum values.

Figures

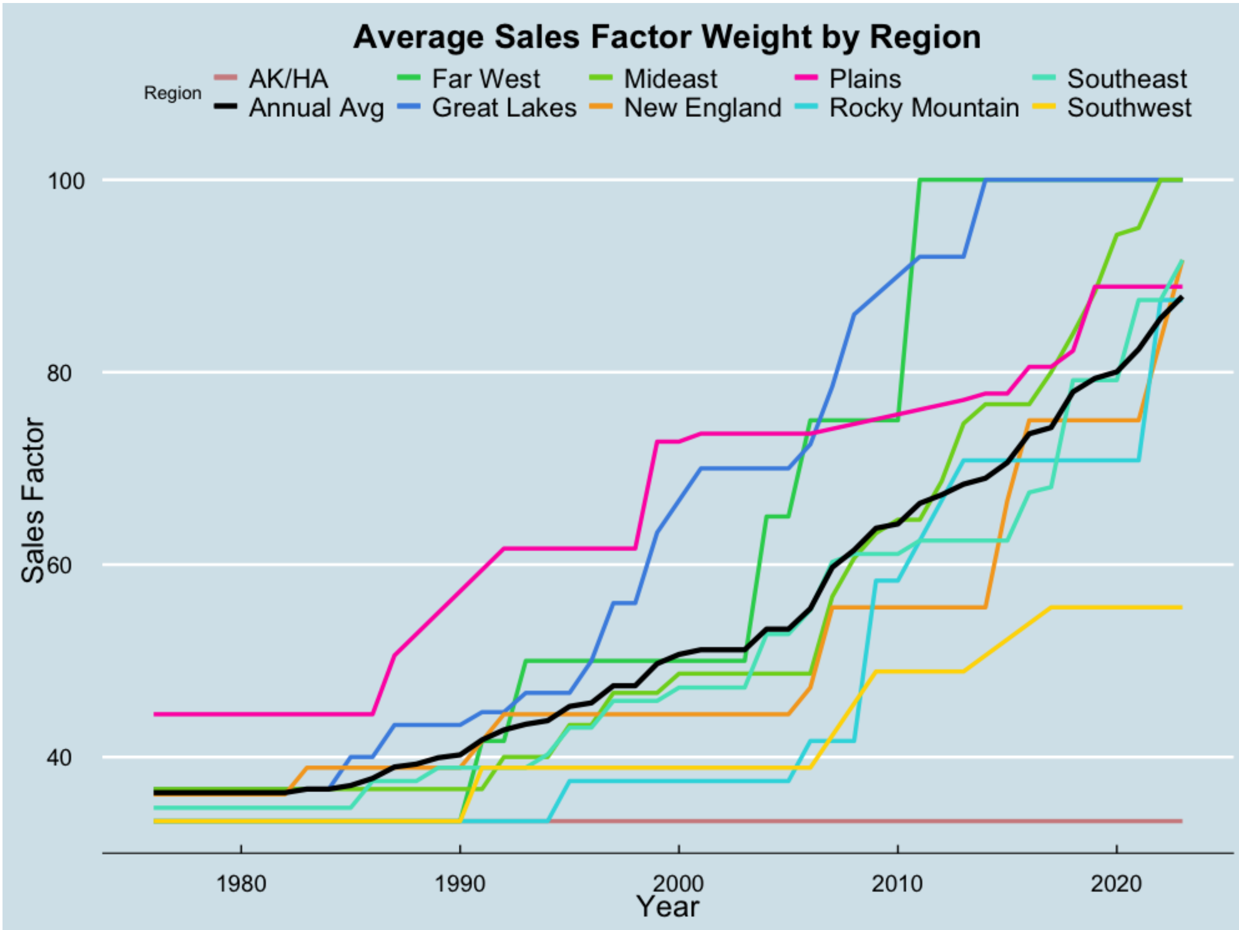

Figure 2: Regional Trends in Sales Factor Weight and National Average Over Time

Note: This figure depicts the overall trend of states increasing the sales factor weight in corporate income tax apportionment formulas, broken down by region. The figure highlights that, beginning in the late 1980s, several regions started shifting toward a heavier reliance on sales as a key factor for apportioning corporate income. This figure captures the cumulative effect of states gradually transitioning from the traditional three-factor formula (property, payroll, sales) to formulas that place more weight on sales.

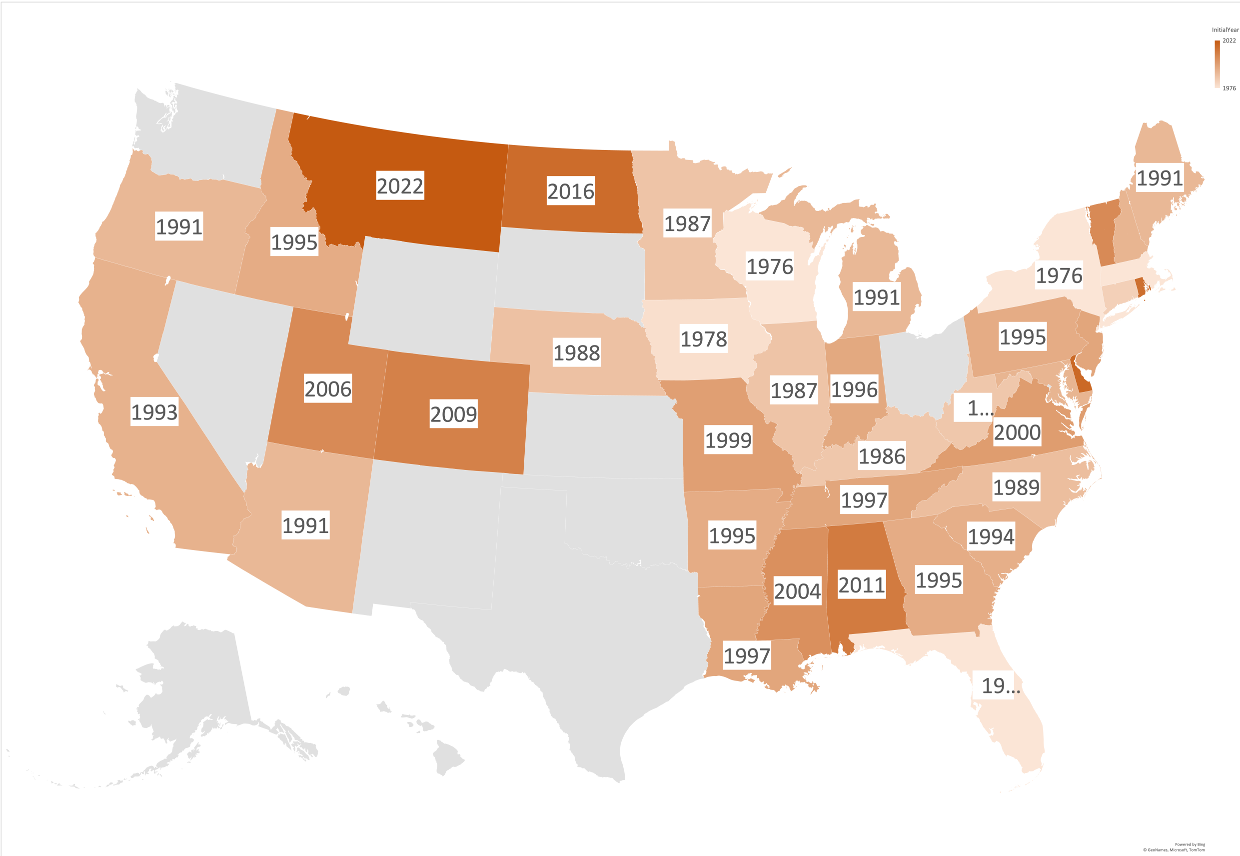

Figure 3: Map Showing First Year State Increased Sales Factor Weight

Note: This figure provides a map illustrating the staggered adoption of the Single Sales Factor Apportionment (SSFA) across the United States. Each state is color-coded according to the year it first increased the weight of the sales factor in its apportionment formula. The map emphasizes the geographical variation in policy changes.