State Tax Competition in the United States

Jose Casco* Salomon Garcia†

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Abstract

Using a novel panel data set of tax variables for all states in the U.S. we document that the average corporate income tax rate has declined by approximately 40% from 1980 to 2016. At the same time, we observe that most states have gradually shifted towards imposing a sales-only apportionment weight on multi-state firms. We ask whether these patterns are consistent with states competing in setting their corporate tax policy. Empirically, we find evidence of strategic interaction in setting tax policies between neighboring states. Theoretically, we show that moving towards a sales-only apportionment scheme is consistent with the prediction of a dynamic general equilibrium model of tax competition that incorporates the Formula Apportionment rule.

*University of Minnesota, email: casco008@umn.edu
†University of Minnesota, email: garci795@umn.edu

1 Introduction

In the United States, the effective average corporate tax rate at the state level has steadily declined over the last 40 years. The prevailing narrative across the literature is that states engage in corporate tax competition to attract investment, mainly from large firms that operate in multiple states, known as multistate corporations. Such competition has led states to modify their schemes of Formula Apportionment,[1] and to offer a variety of tax credit incentives, effectively reducing the taxable base to multistate corporations. This behavior has raised concerns among policymakers, who see states engaging in a harmful competition that leads to inefficiently low effective corporate tax revenue, and consequently lower provision of public goods, and lower welfare.[2]

We contribute to the discussion by, first, documenting several drivers of the decline of the effective average corporate tax rate, and documenting the evolution of states' tax variables–expanding the analysis to include all sources of tax revenue. Second, we focus our attention on empirical tests of strategic interaction among states' corporate tax variables (including formula apportionment factors). Third, we study the theoretical implications of tax competition among states in a general equilibrium framework.

Using a panel data set of tax variables at the state level from 1980 to 2016, we find that the effective average corporate income tax rate across states has declined by approximately 40% during the period of our analysis; this is robust to several measures. We find that among the main possible drivers of this trend are: i)states have gradually shifted towards imposing a sales-only apportionment scheme which affects multistate firms' incentives to reallocate assets and employment; ii) tax credits and incentives have steadily increased over time since the 1960s, iii) changes in the legal form of taxation to businesses has led to a decline in the number of businesses filing taxes as C-corporations.

Looking at the evolution of other states' taxes, we find that the statutory marginal tax rates for labor and corporate income have remained roughly constant, while statutory sales tax rates have steadily increased across all states during the last 40 years. In terms of share of total revenue, labor income tax revenues have become predominantly important for states' coffers, increasing from 27.2% in 1980 to 34% in 2016. Sales tax revenue share has stabilized at 50%, and corporate income tax revenue shares had steadily decreased from 9.4% in 1980 to 5.9% in 2016. These three sources of tax revenue have consistently represented 90% of state receipts throughout and across the majority of states.

[Joselo] Second, we find empirical evidence of strategic interaction among states when setting their corporate tax policy. By using a econometric model of .....

Third, using a dynamic, neoclassical general equilibrium model of tax competition that incorporates the main features of states tax policy-the Formula Apportionment rule, tax credits, and consumption and labor taxes- we show that the move towards a sales-only apportionment scheme adopted by most states is consistent with the prediction of a non-cooperative Nash game. States' best response is to move towards apportionment only to induce a multistate firm to invest and

[1]The Formula Apportionment rule is a system that all states have adopted to determined the taxable income earned from multistate corporations within each state. Initially, the formula consisted on a weighted average of a multistate corporation's sales, payroll, and assets in every state where it has sufficient economic activity (nexus) for the state to tax its income.

[2]Stark and Wilson (2006) documents several petitions to the Supreme court to legislate "harmful" competitive practice among states to attract multistate corporations. Chirinko and Wilson (2017) report that in recent years, the U.S. Congress has considered several bills that would alter states' capacity to set their capital tax policy independently.

increase employment locally.

Moreover, by shifting towards a sales-only apportionment scheme states the model predicts a reduction in the distortions in the allocation of production inputs, which lead to gains in factors' allocative efficiency for the firm. If states have access to a rich set of tax instruments, they can maintain fiscal solvency and the provision of public goods by increasing less distorting taxes. We argue that this is the case for U.S. states, as the data suggests that states coffers have gradually moved from less reliance on corporate taxes towards higher reliance on consumption and labor income taxes.

The paper is structured as follows: Section 2 documents the empirical findings, Section 3 Section 4 presents the model and tax competition framework, Section 5 presents the theoretical analysis, and Section 66concludes.

1.1 Literature Review

The dynamics of the effective corporate income tax rate at the state level has received significant attention in the state and local public finance literature. Fox and Luna (2002), Steven (2003), and more recently Dubin and Liu (2015) document a consistent decline in the effective corporate tax rate since the 1980s. However, there is less consensus on the main drivers behind such secular decline and on its implications for government revenues and provision of public goods. For instance, Dubin and Liu (2015) mention changes in the apportionment formula, Chirinko and Wilson (2017) emphasize an sustained increased in corporate credits and incentives, while Fox and Luna (2005) point at changes in the choice of businesses' legal form, in particular the explosion of Limited Liability Corporations (LLCs). Our analysis reviews all these options and focuses in studying the implications of corporate tax competition including the apportionment factors as policy instruments.

Most of the literature on state tax competition, typically considers static economies, and focus on evaluating a limited number of the corporate tax components without taking into consideration the complete tax system, for instance, Eichner and Runkel (2011); Runkel and Schjelderup (2011); Chirinko and Wilson (2017). We include this basic ingredients and generalize the model to include a comprehensive set tax policies-sales, labor income and corporate income taxes under formula apportionment-in a dynamic general equilibrium framework.

Our paper also related to the literature on formula apportionment which studies the optimal choice of apportionment weights, and whether such choice should be left to the states in a decentralized manner, or whether it should be centralized. Most of this analysis concludes that if the choice of apportionment weights is left to the states, tax competition leads to inefficiently low tax rates and could be detrimental for welfare (see, Gordon and Wilson 1986; Eggert and Schjelderup 2003; Eichner and Runkel 2011). This body of literature assumes that the tax authority have access only to a restricted set of tax instruments–usually only the tax on corporate income.

Our approach falls within the literature that takes a comprehensive approach to study tax systems and fiscal policy (see Chari and Kehoe 1999; Atkeson et al. 1999; Mendoza and Tesar 2005). We apply the insights of this literature on optimal taxation to jointly study the evolution of all tax variables of US states. Our dynamic, Neoclassical general equilibrium model is a simplified version of the standard two country model used in the trade literature (see Backus et al. 1994; Ljungqvist and Sargent 2012; Chari et al. 2019).

Similar to our approach is Fajgelbaum et al. (2015) which take into account the main sources of tax revenues of U.S. state governments in a spatial general equilibrium model, however, they do not study states tax competition. Similar in spirit to our exercise is Ossa (2015), who uses an

economic geography model to compute the Nash equilibrium of a game where states use lump-sum taxes to finances firm subsidies.

2 Trends in States' Tax Systems

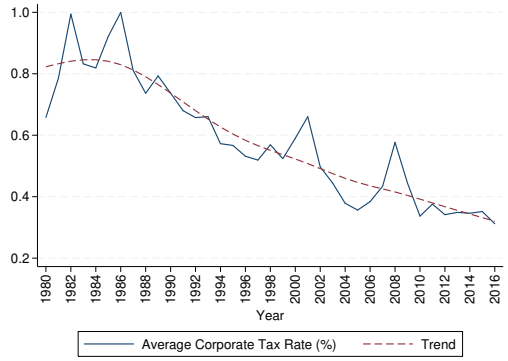
2.1 The Effective Average Corporate Tax Rate

[Brief intro: what's the observation, other papers documenting this, what's the puzzle] We start the analysis by inspecting the behavior over time of the effective average corporate tax rate by constructing two proxy measures: the ratio of state's corporate tax revenues to state's corporate income (measured via state's gross operating surplus) and the ratio of the sum of states corporate tax revenues to U.S. corporate profits.

Figure 1: Average Corporate Tax Rate

(a) Corporate Tax Revenue / Gross Operating Surplus

(b) Corporate Tax Revenue / U.S. Corporate Profits



Note: The weighted average is calculated over the 48 contiguous states for the period 1980 to 2012, using as weights the states GDP (we excluded District of Columbia, Hawaii and Alaska). The average corporate tax rate variable is the ratio of state tax revenues from corporate taxes plus corporation license fees divided by total state business income measured via state's gross operating surplus. The trend was obtained by applying the Hodrick–Prescott high-pass filter.
Source: Bureau of Economic Analysis (Regional Accounts), Annual Survey of state Government Tax Collections (STC)–U.S. Census Bureau.

In Figure 1, we show these two measures over a 32 years period. In Panel (a) the average corporate tax rate is computed using a weighted average over the 48 contiguous states for the period 1980 to 2012. The trend shows a consistent downward slope for the entire period. Similarly, in Panel (b) the other proxy measure of average corporate tax rate, shows a steady descending pattern in the last three decades. Under both measures, the weighted average corporate tax rate declined more than 40 percentage points.

Next, we look into changes in the states' tax policy system for the period 1954 to 2016. First, we document trends on marginal tax rates-which includes corporate, labor, consumption- and apportionment factors. Second, we document the evolution of states revenues. And third, we look into two other major factors affecting the states' corporate tax base: tax concessions and incentives, and trends in the composition of different type of businesses.

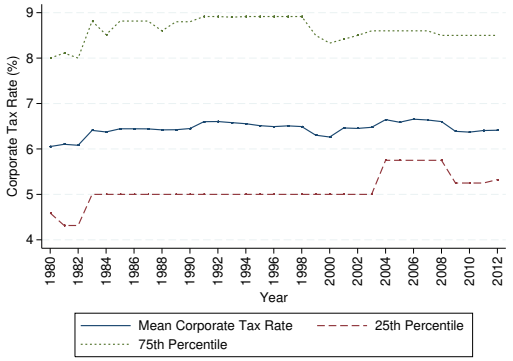
2.2 Corporate Tax Rates and Apportionment Factors

Marginal corporate tax rates and apportionment factors are the main determinants of a business' tax payments. Under the formula apportionment structure, the tax bases of a multistate corporation's subsidiaries (or is considered to have nexus) are first consolidated and then apportioned to the states according to a formula that takes into consideration the capital, sales and payroll share.

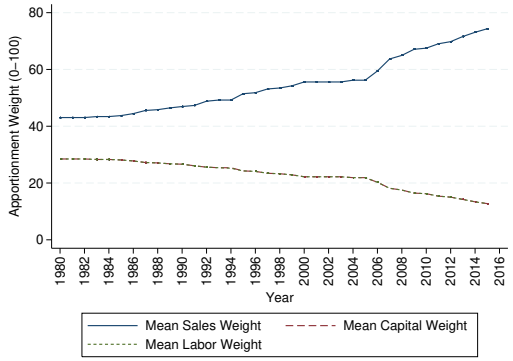
Panel (a) of Figure 2 shows that the average maximum statutory corporate tax rates have remained relatively flat over the last decades around 6%, the interquartile range shows that the majority of states have marginal corporate tax rates between 5% and 8.5%. On the other hand, the apportionment factors have moved towards higher apportionment weight on sales, and lower weights on property and payroll over time, as shown in Panel (b). These observations suggest that apportionment factors have been constantly changing over time and are actively used as tax policy instruments.

Figure 2: Statutory Corporate Tax Rates and Apportionment Factors

(a) Corporate Tax Revenue / Gross Operating Surplus



(b) Corporate Tax Revenue / U.S. Corporate Profits



Note: Panel (a) presents the evolution over time of the state corporate tax rate as well as the 25th and 75th percentiles. Source: The University of Michigan Tax Database. The Tax Foundation. National Bureau of Economic Research (TAXSIM). Panel(b) presents the evolution over time of the states sales, capital and payroll apportionment weights. We excluded District of Columbia, Hawaii and Alaska in the computation. Source: Commerce Clearing House's State Tax Handbooks.

Table 2 summarizes the evolution of states in setting the apportionment weights over time. The common factor is that a large number of states have moved from an equally weighted structure to a configuration that relies more heavily on the sales apportionment factor. In 1980, the majority of states placed less than 50% of the apportionment weight on sales. [3] By 2010 only 10 states were using three factors equally weighted structure, 16 states were employing three-factor double-weighted sales and 17 states were using sales a single factor structure. Also, Table 3 in the appendix shows that means across states and the weighted means have similar patterns for the three apportionment factors. And Figures 6 and 7 show that the above observations remain when disaggregating by regions.

[3] 38 states had three factors equally weighted structure, 4 states had three-factor double-weighted sales and 6 states had sales single factor structure.

2.3 Tax Credits and Businesses' Legal Form

Corporate tax credits and incentives have a direct effect on state corporate tax collections. Although there has been research documenting the pervasiveness of this factor across states little is known about its relative importance in accounting for the decline in the average corporate tax rate. We borrow from Chirinko and Wilson (2017) who document a growing trend in tax incentives since the late 1960s. Figure 9 (in the appendix) shows the number of states with an investment tax credit (vertical axis) and the average credit rate (vertical axis).

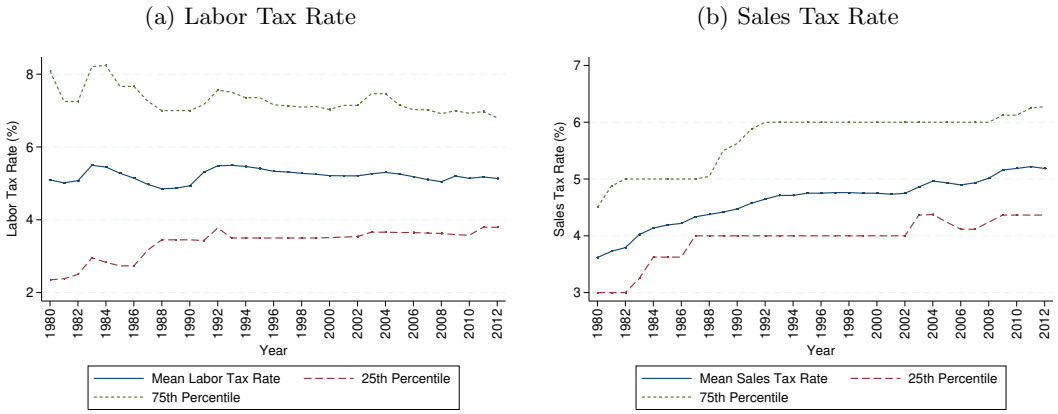
Another potential factor linked to the declining behavior of average corporate tax rate is the increase of Limited Liability Companies (LLCs) and pass-through businesses during the last three decades. This business structures are not subject to corporate income tax and instead, the shareholders are taxed upon their allocated share of the income. Although we do not address this factor in this study, we acknowledge its importance and document how it can impact states' coffers. Figure 10 compares C-corporations and S-corporations share of returns and share of receipts. By looking at Panel (a), the share of tax returns of S-corporations show a pronounced upward drift since 1984, surpassing C-corporation share of returns by 1996 and then experiencing a diminishing pattern after 2008. Currently, from each 100 returns received from corporations, S-corporations are responsible of 72 returns while C-corporations are responsible of 27 returns. Panel (b), shows that despite the increase in the share of receipt from S-corporations over time, C-corporations remain as the most important corporate contributors. Currently, from each dollar received from corporations, S-corporations are responsible of 23 cents while C-corporations are responsible of 75 cents. This suggest that even though pass-through businesses have increased in number, C-corporations are still the main tax contributors.

2.4 Consumption and Labor Income Taxes

We also examine labor income and consumption (sales) tax rates to get a complete picture of the behavior of other available tax instruments and sources of revenue for states. Figure 3 shows that the average statutory labor income tax exhibits a nearly constant behavior fluctuating around 5.2%, while the average statutory consumption rate have increased substantially from 3.5% to more than 5%. Table 5 (in the appendix) provides a clearer picture of the mean, weighted mean and dispersion of these statutory rates[4]. Corporate and labor income taxes display the highest dispersion among states, both tax rates features a standard deviation around 2.9%.

[4]We weight tax rates using states' GDP provided by the Bureau of Economic Analysis (BEA) regional accounts.

Figure 3: Tax Rates Across U.S. States



Note: These figures present the evolution over time of the state corporate, labor and sales tax rates as well as the 25th and 75th percentiles. We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: The University of Michigan Tax Database. The Tax Foundation. National Bureau of Economic Research (TAXSIM).

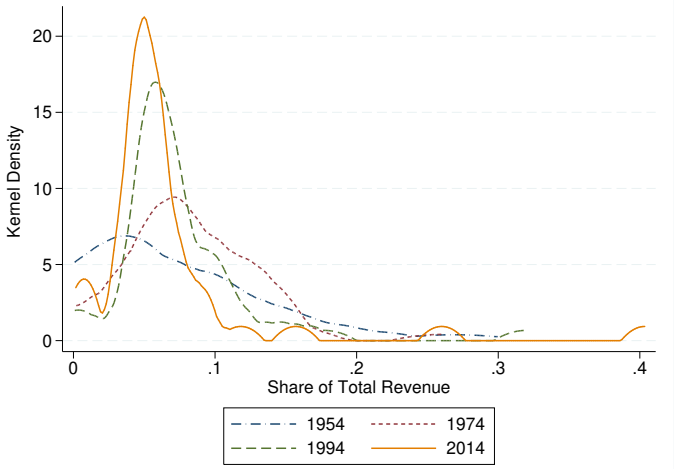
Regional patterns of states' statutory tax rates present observable differences[5]. Panel (a) in Figure 5 (See the appendix) shows that states in the Northeast region have consistently set a higher corporate tax rate than other regions in the U.S., oscillating between 8% and 9%. States in the West region has gradually decrease the corporate tax rate and in the last years, which has wavered around 5.5%. Panel (b) display the statutory labor tax rates, a salient feature, is that states in the South region have steadily set lower labor tax rates averaging just below 5%. Panel (c) shows that states in all four regions have consistently increased consumption marginal tax rates.

2.5 Tax Revenue shares

Here we document the dynamics of the tax revenue shares from corporate, labor and consumption taxes. The first observation is that the corporate tax revenue share–measured as corporate tax revenues share of total state tax revenues–has gradually decline over the past thirty years as shown in Figure 4.

[5]For our analysis we cluster several states in four different regions: West={Arizona, Colorado, California, Idaho, Oregon, Montana, New Mexico, Utah, Washington, Nevada, Wyoming,}, Midwest={North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Michigan, Ohio}, Northeast{Pennsylvania, New York, New Jersey, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, Maine} and South{Oklahoma, Texas, Arkansas, Louisiana, Alabama, Mississippi, Tennessee, Kentucky, West Virginia, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia,Florida}.

Figure 4: Corporate Tax Revenue as a Share of Total Revenue



Note: These are kernel density function for the states corporate revenue as a share of total state tax revenue, analyzed by two decades time spams. We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: Annual Survey of state Government Tax Collections (STC)–U.S. Census Bureau.

The average corporate tax share declined from 8.1% in 1974 to 6.6% in 2014. This situation has generated concern among academic and policymakers because it might affect the provision of public goods[6]. Table 4, provides a clearer picture, the corporate tax revenue share has not only experienced a reduction but also has become more volatile. In turn, the labor income tax share has consistently increased its participation in total revenues going from 27% in 1982 to 34% by 2012, this was accompanied with a slight increase in volatility. The consumption tax revenue share has remain stable accounting for about 50% of all states revenue.

Figure 8 shows the composition of tax revenues by region. Although there are important differences in levels, all regions have experienced a decline in their corporate tax revenue share, and an increased reliance on their labor tax revenue. It is also interesting that states within the South region have steadily relied in consumption taxes as their main source of state revenue while the opposite occurs for the Northeast region.

This changes in shares are consistent with our theoretical model, developed in section 4, where changes in corporate tax rate or corporate apportionment factor could lead to reduction in tax collections from this source of revenue; however when policymakers have access to other—less distortive—taxes they can balance its budget and maintain the provision of public goods.

3 Strategic Interaction in States Tax Policy

3.1 Formula Apportionment

The adoption of Formula Apportionment to allocate a corporation's income among states was established by the multistate Tax Compact in 1967. It aimed at increasing uniformity across

[6]Several studies have look into how a tax competition environment could drive states to charge inefficiently low tax rates, see for instance Egger, Pfaffermayr, and Winner (2005), Devereux, Lockwood, and Redoano (2007), and Chirinko and Wilson (2017).

estates by apportioning among the states the business income from multistates companies on the basis of an equally weighted, three-factor formula, of the company's sales, payroll, and property in each state. This scheme prevailed from 1965 until 1978, year in which the Supreme Court[7] clarified that state have the right to deviate from the equally weighted three-factor formula to any scheme as long as when one or more factors are dropped, weight is reallocated to the remaining factors. Since then, X% of the states that levy a corporate tax income have deviated from the equally weighted formula to a double-weighted sales scheme, or to a only-sales weighting scheme. Interestingly, no state have moved in the opposite direction, i.e towards weighting more labor and property and less sales.

4 The model

This section presents a simplified version, with only one tradable commodity, of a standard two country model used in the trade literature, see Backus et al. (1994), Ljungqvist and Sargent (2012), and Chari et al. (2017). In section 5 we use this model in Nash game context to study tax policy competition and to derive the implications for tax policy, firm's inputs allocations and government revenue.

4.1 Environment

Time is discrete and infinite. There is no uncertainty and decision makers have perfect foresight. The economy is comprised of two countries, indexed by $i = a, b$. In each country there is a representative household, a government authority, and a subsidiary firm that is part of a parent firm who owns the two subsidiaries.

The representative household in each country has the same preferences over consumption c_{it}, and leisure $1 - n_{it}$,

$$U^i = \sum_{t=0}^{\infty} \beta^t u^i(c_{it}, 1 - n_{it}), \qquad \beta \in (0, 1) \tag{1}$$

where $u^i(\cdot)$ is strictly increasing in c_{it} and $1 - n_t$, twice continuously differentiable, and strictly concave.[8]

The technology of each subsidiary firm is the same in both countries, $i = a, b$, given by

$$y_{it} = F(k_{it}, n_{it}) \tag{2}$$

where y_{it} denotes the quantity of the commodity good produced by country i, and $F(\cdot)$ is a constant returns to scale function with positive and decreasing marginal products of capital and labor.

The total production of the commodity good across countries can be used for private consumption c_{it}, public consumption g_{it}, and investment, x_{it}. The resource constraint of the economy is

$$c_{at} + c_{bt} + x_{at} + x_{bt} + g_{at} + g_{bt} \leq y_{at} + y_{bt} \tag{3}$$

[7]The Supreme Court upheld the right of state to deviate in *Moorman Manufacturing Company v. Bair,* 437 U.S. 267 (1978), known as the 1978 Moorman decision.

[8]We also require that $c_{it} \geq 0$, and $n_{it} \in [0, 1]$. These are the standard assumptions on preferences, see Ljungqvist and Sargent (2012).

the law of motion of capital is

$$x_{it} = k_{it+1} - (1-\delta)k_{it} \qquad \forall i = a, b \tag{4}$$

where $\delta \in (0,1)$ represents the depreciation rate.

Parent-Firm

The parent firm owns the aggregate capital in the economy, and centrally decides on investment and labor for each subsidiary. Let V_0 denote the value of the firm in period zero after the dividend payout in that period, d_0. Then the parent firm maximizes the value of its after tax dividends,

$$V_0 + d_0 = \sum_{t=0}^{\infty} Q_t d_t \tag{5}$$

where Q_t is the intertemporal price of the common numeraire at time t in units of the numeraire at zero ($Q_0 = 1$), and dividends are defined as

$$\begin{aligned} d_t &= \Pi_t(1-\bar{\tau}_t) - (1-\rho_a)x_{at} - (1-\rho_b)x_{bt} \\ \Pi_t &= [y_{at} - w_{at}n_{at} - \delta k_{at}] + [y_{bt} - w_{bt}n_{bt} - \delta k_{bt}] \end{aligned} \tag{6}$$

where $\rho_i \in [0,1]$ represents the fraction of investment expenditures allowed to be deducted in country i.[9]

The parent firm first consolidates its taxable base across countries, Π_t. Consolidated profits are taxed at rate $\bar{\tau}_t$, which is a weighted averaged of each individual country corporate income tax rate, $\{\tau_a, \tau_b\}$, that we assume time-invariant.

We assume that the weighting scheme is determined according to the Formula Apportionment rule. This rule specifies a vector of weights $\overrightarrow{\alpha}_i$ on the firm's shares of production inputs and sales in each country according to the formula in (7). Notice that under Formula Apportionment the tax bases of the firm's subsidiaries are first consolidated and then apportioned to countries. We consider a formula based on three factors: capital, labor and sales with respective weights given by the vector $\overrightarrow{\alpha}_i = (\alpha_i^K, \alpha_i^L, \alpha_i^S)$, which is the formula used across US states.

$$\begin{aligned} \bar{\tau}_t &= \tau_a \left(\alpha_a^K \frac{k_{at}}{k_{at}+k_{bt}} + \alpha_a^L \frac{n_{at}}{n_{at}+n_{bt}} + \alpha_a^S \frac{s_{at}}{s_{at}+s_{bt}} \right) \\ &+ \tau_b \left(\alpha_b^K \frac{k_{bt}}{k_{at}+k_{bt}} + \alpha_b^L \frac{n_{bt}}{n_{at}+n_{bt}} + \alpha_b^S \frac{s_{bt}}{s_{at}+s_{bt}} \right) \end{aligned} \tag{7}$$

$$\alpha_i^K + \alpha_i^L + \alpha_i^S = 1 \qquad \alpha_i \in [0,1],\ i = a, b \tag{8}$$

$$\begin{aligned} s_{at} + s_{bt} &= y_{at} + y_{bt} \qquad \forall t \\ k_0 &= k_{a0} + k_{b0} > 0 \end{aligned} \tag{9}$$

where 8 states that aggregate firm's sales in both countries must equate aggregate firm's output. Although we don't allow for exports out of the two countries, however, this could be easily relaxed by including an external sector to the economy.

The problem of the parent firm is to choose allocations $\{x_{it}, n_{it}\}$ to maximize (5) subject to (2), (4), (7) given initial conditions (9).

[9] This framework encompasses the standard practice where only depreciation is allowed to be deducted, which can be obtained by setting $\rho x_{it} = \delta k_{it}$.

Households

Households in each country i, save or borrow using two type of assets: equity shares, e_{it}, from the parent firm that we assume is internationally traded, and a domestic government bond, b_{it}, traded locally. The flow of funds constraint in period t for the household in country i in units of the numeraire is

$$(1+\tau_i^c)c_{it} + V_t e_{it+1} + b_{it+1} \quad = \quad (1-\tau_i^n)w_{it}n_{it} + (V_t + d_t)e_{it} + \frac{q_{it-1}}{q_{it}}b_{it} \tag{10}$$

Household face country specific consumption taxes, τ_i^c, and labor income taxes, τ_i^n.[10] Notice that returns on domestic debt, $\frac{q_{it-1}}{q_{it}}$, are country specific because countries can have different tax systems.[11]

The problem of the representative household in each country i is to choose allocations $\{c_{it}, n_{it}, b_{it+1}, e_{it+1}\}$ to maximize (1) subject to (10), and a non-Ponzi scheme condition on domestic debt $\lim_{T\to\infty} Q_T b_{iT} \geq 0$, given initial conditions e_{i0} for each $i = a, b$.

Government

The fiscal policy in each country i consist of an exogenous sequence of public consumption g_{it}, that government finances by raising revenues through its time-invariant tax policy sequence $\pi_i = \{\tau_i, \tau_i^c, \tau_i^n, \overrightarrow{\alpha}_i, \rho_i\}$, and by choosing a sequence of public bonds b_{it}. The flow of funds of the government in each country i is given by

$$\tau_i^c c_{it} + \tau_i^n w_{it} n_{it} + \hat{\tau}_{it}\Pi_t - \rho_i x_{it} - g_{it} = b_{it} \qquad \forall t,\ \forall i = a, b \tag{11}$$

where $\hat{\tau}_{it}$ is the effective tax rate of state i over the parent firm's consolidated taxable income according to the Formula Apportionment Rule:

$$\hat{\tau}_{it} = \tau_i \left(\alpha_i^K \frac{k_{it}}{k_{at} + k_{bt}} + \alpha_i^L \frac{n_{it}}{n_{at} + n_{bt}} + \alpha_i^S \frac{s_{it}}{y_{at} + y_{bt}} \right)$$

where time dependence of the allocation of production inputs and sales induces a effective time varying corporate income tax rate.

The flow of funds (11) expressed in present value, together with the No-Ponzi condition for government debt $\lim_{T\to\infty} Q_T b_{iT} \geq 0$ yields the government budget constraint,

$$\sum_{t=0}^{\infty} Q_t \left[\tau_i^c c_{it} + \tau_i^n w_{it} n_{it} + \hat{\tau}_{it}\Pi_t - g_{it}\right] = Q_{-1} b_{i0} \tag{12}$$

4.2 Optimality Conditions

Taking F.O.Cs with respect $\{c_{it}, n_{it}, e_{it+1}, b_{it+1}\}$ for the household's problem rearranging we obtain the intra-temporal and inter-temporal conditions, and the non-arbitrage condition for assets:

[10] Taxes on dividends and capital gains are ignored in this version. However, it is straightforward to add them.

[11] Government from each country might adjust debt differently, according to its tax revenues and public consumption expenditures.

$$\begin{aligned}
\frac{u^i_{ct}(1-\tau^n_i)}{u^i_{nt}(1+\tau^c_i)} &= \frac{1}{w_{it}} \\
\frac{u^i_{ct}}{(1+\tau^c_{it})} &= \frac{V_{t+1}+d_{t+1}}{V_t}\frac{\beta u^i_{ct+1}}{(1+\tau^c_{it+1})} \\
\frac{q_{it-1}}{q_{it}} &= \frac{V_{t+1}+d_{t+1}}{V_t}
\end{aligned}$$

We define the change in equity value in units of the numeraire between period t and period $t+1$ to be:

$$\frac{Q_t}{Q_{t+1}} = \frac{V_{t+1}+d_{t+1}}{V_t} \tag{13}$$

The parent firm's problem can be re-written as choosing allocations $\{k_{it+1}, n_{it}\}_{i=a,b}$ subject to the structure of the average tax rate (7)

$$\begin{aligned}
\max_{\{k_{it+1},n_{it}\}_{i=a,b}} \quad & \sum_{t=0}^{\infty} Q_t(\ [F(k_{at},n_{at}) - w_{at}n_{at} - \delta k_{at}](1-\bar{\tau}_t) - [k_{at+1}-k_{at}] \\
& +[F(k_{bt},n_{bt}) - w_{bt}n_{bt} - \delta k_{bt}](1-\bar{\tau}_t) - [k_{bt+1}-k_{bt}] \ )
\end{aligned}$$

The F.O.C for the parent firm are:

$$F^i_{nt} = w_{it} + \frac{\Pi_t}{1-\bar{\tau}_t}\frac{\partial \bar{\tau}_t}{\partial n_{it}} \qquad i=a,b \tag{14}$$

$$\frac{Q_t}{Q_{t+1}} = 1 + (1-\bar{\tau}_{t+1})(F^i_{kt+1}-\delta) - \Pi_{t+1}\frac{\partial \bar{\tau}_{t+1}}{\partial k_{it+1}} \ i=a,b \tag{15}$$

If we ignore the the terms containing the derivative respect to $\bar{\tau}_t$ in equations (14) and (15), we obtain the standard expressions of the problem of a firm, that equates marginal product of inputs to its net prices. The average tax rate doesn't distort the firm's labor decision, whereas the capital decision is distorted because the firm cannot fully deduce its capital investment cost. Hence, the net return of capital is affected by the weighted tax rate. The terms containing the derivative respect to $\bar{\tau}_t$ show how the firm's choice of inputs affects the average tax rate it faces, the firm internalizes the fact that its choice of production inputs affects the weighting scheme of the formula apportionment.

Note that (15) indicates that the net marginal return of capital in each country must equate the ratio of inter-temporal prices of the numeraire, from this equation we can obtain the capital allocation Production Efficiency:

$$(1-\bar{\tau}_{t+1})(F^a_{kt+1}-\delta) - \Pi_{t+1}\frac{\partial \bar{\tau}_{t+1}}{\partial k_{at+1}} = (1-\bar{\tau}_{t+1})(F^b_{kt+1}-\delta) - \Pi_{t+1}\frac{\partial \bar{\tau}_{t+1}}{\partial k_{bt+1}} \tag{16}$$

this equation indicates that the parent firm will allocation capital in each country so that the marginal return of the last unit of capital in across countries is equated.

Combining the FOCs from the firm and households we obtain, the Intra-temporal Euler equation:

$$\frac{u^i_{ct}(1-\tau^n_i)}{u^i_{nt}(1+\tau^c_i)} = \frac{1}{F^i_{nt} - \frac{\Pi_t}{1-\bar{\tau}_t}\frac{\partial \bar{\tau}_t}{\partial n_{it}}} \qquad \forall i=a,b \tag{17}$$

and the Inter-temporal Euler equation:

$$\frac{u^i_{ct}}{\beta u^i_{ct+1}}\frac{(1+\tau^c_i)}{(1+\tau^c_i)} = 1+(1-\bar{\tau}_{t+1})(F^i_{kt+1}-\delta)-\Pi_t\frac{\partial\bar{\tau}_{t+1}}{\partial k_{it+1}} \qquad \forall i=a,b \tag{18}$$

4.3 Equilibrium

A competitive equilibrium for this two-country economy consist of a set of allocations $\{c_{it}, n_{it}, e_{it}, k_{it+1}, x_{it}, b_{it}\}$, prices $\{Q_t, w_{it}, V_0, q_{it}\}$, and policies $\{\tau^c_i, \tau^n_i, \tau_i, \overrightarrow{\alpha_i}, \rho_i\}$, given $\{k_0, e_{i0}, Q_{-1}b_{i0}\}$such that households solve their problem, firms maximize value, government budget constraint holds (11), and markets clear-meaning (3), (4) hold, together with the condition for the parent firm's equity $e_{at}+e_{bt}=1$.

The system of equations that characterizes the equilibrium in this economy are given by (17), (18), (16) , (13), (12), (10), (4), and (3).

4.4 Tax Competition Framework

We follow the approach of Mendoza and Tesar (2005) in modeling tax competition as governments from each country meeting once to play a game in which they choose a particular scheme for the Formula Apportionment (FA) weights in (7) that define the average corporate income tax rate. The payoffs of the game are the welfare gains or losses that each country incurs at the competitive equilibrium supported by their choice of FA factors and consumption taxes needed to satisfy the intertemporal government budget constraints. Specifically, payoffs are computed as the percentage change between the present value of lifetime utility under the initial conditions and the lifetime utility under the competitive equilibrium under the new tax system.

Our strategy to keep labor and corporate income tax rates fixed is motivated by the observations in Section 2. There, we documented that the statutory tax rates on capital and labor income have remained roughly constant, whereas the sales statutory tax rates have significantly increased since the 1980, these are common patterns across all states in the US. Consequently, we allow the tax authority in each country to adjust the consumption tax rate in order to maintain fiscal solvency through out time.

In a competitive equilibrium the restriction that endogenous tax adjustments in response to the other country's tax policy- must respect the government budget constraint to preserve fiscal solvency can be expressed as:

$$\begin{aligned} Q_{-1}b_{i0} = & \sum_{t=0}^{\infty} Q_t(\pi_i,\pi_j)[\tau^c_i c_{it}(\pi_i,\pi_j) \\ & +\tau^n_i w_{it}(\pi_i,\pi_j)n_{it}(\pi_i,\pi_j)+\hat{\tau}_{it}\Pi_t(\pi_i,\pi_j)-\rho_i x_{it}-g_{it}] \end{aligned} \tag{19}$$

Here, we have made explicit the dependence of the intertemporal price $Q_t(\pi_i,\pi_j)$ of the numeraire on the vector of tax policy (π_i,π_j). The left-hand side of (19) is the present value of government deficits- surpluses which must equate its initial asset position, $Q_{-1}b_{i0}$. Also, equilibrium factor prices w_{it}, and allocations $(c_{it}, n_{it}, x_{it}, k_{it})$ depend on the vector tax policy since those determine government's tax revenues.

A strategic decision rule for each country's choice of FA weights given the other country's choice of factors consist of each government in each country choosing its FA weights in order to maximize the payoff to the residents on its country subject to:

1. The implied allocations and prices for a global tax structure $\pi_a = (\tau_a, \tau_a^c, \tau_a^n, \overrightarrow{\alpha}_a, \rho_a)$, and $\pi_b = (\tau_b, \tau_b^c, \tau_b^n, \overrightarrow{\alpha}_b, \rho_b)$ constitute a competitive equilibrium.

2. Governments in each country adjust consumption taxes in order to keep their intertemporal budget constraints balanced.

Let $V(\overrightarrow{\alpha}_i|\overrightarrow{\alpha}_j)$ be *the payoff function* for country i strategic choice of FA weights given country's j scheme of FA weights, for $i \neq j$. Then, country i reaction curve $\overrightarrow{\boldsymbol{\alpha}}_{\boldsymbol{i}}(\overrightarrow{\alpha}_j)$ is given by

$$\overrightarrow{\boldsymbol{\alpha}}_{\boldsymbol{i}} = \arg\max_{\overrightarrow{\alpha}_i \in \mathcal{A}_i} V(\overrightarrow{\alpha}_i|\overrightarrow{\alpha}_j) \qquad i = a, b,\ i \neq j$$

where $\mathcal{A}_i$ is the space of admissible schemes for FA weights.

A *Nash Equilibrium* for the Formula Apportionment competition game is defined by a pair of FA weight vectors $(\overrightarrow{\alpha}_a, \overrightarrow{\alpha}_b)$ and the associated payoffs $V(\overrightarrow{\alpha}_a|\overrightarrow{\alpha}_b)$, and $V(\overrightarrow{\alpha}_b|\overrightarrow{\alpha}_a)$ such that:

1. $\overrightarrow{\alpha}_a$ maximizes $V(\overrightarrow{\alpha}_a|\overrightarrow{\alpha}_b)$ given $\overrightarrow{\alpha}_b$,

2. $\overrightarrow{\alpha}_b$ maximizes $V(\overrightarrow{\alpha}_b|\overrightarrow{\alpha}_a)$ given $\overrightarrow{\alpha}_a$,

3. the payoff functions are consistent with the competitive equilibrium prices and allocations corresponding to $(\overrightarrow{\alpha}_a, \overrightarrow{\alpha}_b)$,

4. the fiscal solvency rules of both $i = a, b$ countries are satisfied.

Then the Nash equilibrium satisfies:

$$\overrightarrow{\alpha}_a^N = \overrightarrow{\boldsymbol{\alpha}}_{\boldsymbol{a}}(\overrightarrow{\alpha}_b^N) \tag{20}$$

$$\overrightarrow{\alpha}_b^N = \overrightarrow{\boldsymbol{\alpha}}_{\boldsymbol{b}}(\overrightarrow{\alpha}_a^N) \tag{21}$$

meaning that the Nash equilibrium is at intersection of the reaction curves, (20) and (21).

5 Theoretical Analysis

5.1 Formula Apportionment Analysis

The Formula Apportionment method for defining the taxable base in each country makes the tax rate faced by the parent firm a weighted average of individual state tax rates. These weights are a function of the states' apportionment factors ($\alpha_i's$), and of the fraction of a firm's capital, labor, and sales in each country.

We assume that sales are not under the control of the parent firm, or either of the subsidiaries, but sales get determined according to the demand for consumption in both countries. Thus our approach treat sales and output as different objects motivated by the empirical observation that corporations operating in different states distribute their production operations and sales differently across such states. This implies that firm's output and firm's sales are different objects and can have different distributions across the states the firm operates.[12].

[12]For a different analysis in which sales and output are the same object see Eichner and Runkel (2011)

We repeat (7) here

$$\begin{aligned}\bar{\tau}_t &= \tau_a\left(\alpha_a^K\frac{k_{at}}{k_{at}+k_{bt}}+\alpha_a^L\frac{n_{at}}{n_{at}+n_{bt}}+\alpha_a^S\frac{s_{at}}{s_{at}+s_{bt}}\right)\\ &\quad+\tau_b\left(\alpha_b^K\frac{k_{bt}}{k_{at}+k_{bt}}+\alpha_b^L\frac{n_{bt}}{n_{at}+n_{bt}}+\alpha_b^S\frac{s_{bt}}{s_{at}+s_{bt}}\right)\end{aligned}$$

The formula apportionment structure has an impact on the firm's average tax rate as long as the firm operate in countries that impose different corporate income tax rates $\tau_a \neq \tau_b$. If a firm has only subsidiaries in countries with the same tax rate, then formula apportionment is irrelevant as the average tax rate for a firm will be exactly the same as the countries' tax rate on capital, $\bar{\tau} = \tau_a = \tau_b$. This can be easily seen in the equation above as weights across countries add up to one.

The interesting case for analysis is when corporate income tax rates differ across countries. In this case, a parent firm has incentives to reallocate production input in order to modify the weights on its favor. Equations (23) and (22) show how the choice of capital and labor allocations in the firm's problem (5) affects the average tax rate the firm faces,

$$\frac{\partial\bar{\tau}_t}{\partial n_{it}} = \frac{n_{jt}(\tau_i\alpha_i^L-\tau_j\alpha_j^L)}{(n_{at}+n_{bt})^2}-F_{nt}^i\frac{\sum\tau_{it}\alpha_{it}^S s_{it}}{(y_{at}+y_{bt})^2} \qquad i=a,b \tag{22}$$

$$\frac{\partial\bar{\tau}_{t+1}}{\partial k_{it+1}} = \frac{k_{jt+1}(\tau_i\alpha_i^K-\tau_j\alpha_j^K)}{(k_{at+1}+k_{bt+1})^2}-F_{kt+1}^i\frac{\sum\tau_{it+1}\alpha_{it+1}^S s_{it+1}}{(y_{at+1}+y_{bt+1})^2} \qquad i=a,b \tag{23}$$

For exposition purposes, suppose $\forall t:\ \tau_a > \tau_b$, $\alpha_a^L > \alpha_b^L$, and $\alpha_a^K > \alpha_b^K$. Then, the effective tax burden of country a is greater than country b**,** $\tau_b\alpha_b^K < \tau_a\alpha_a^K$, and

$$\frac{\partial\bar{\tau}_{t+1}}{\partial k_{bt+1}} < 0 < \frac{\partial\bar{\tau}_{t+1}}{\partial k_{at+1}}$$

which implies that allocating one unit of capital to the subsidiary in country b will reduce the average tax rate the firm faces. From the production efficiency condition from a planning problem, equation (30), we see that the return of investing in country b would be higher than investing in country a. Hence, the parent firm will invest more on country b in order to reduce its average tax rate $\bar{\tau}$, which will increase its production activity in country b.

Because capital and labor are complements in the firm's production function, allocating more capital to country b is associated with hiring higher labor. This reallocation of production inputs towards country b can generate higher tax corporate and tax revenues for the government in country b due to an increase in production at the expense of lower tax revenue for country a. In a context of tax competition where government play a Nash game as the one presented in Section 4.4, the government in country a has incentives to retaliate in the same fashion by lowering its apportionment factors such that $\alpha_a^L < \alpha_b^L$ and $\alpha_a^K < \alpha_b^K$. Notice that lowering apportionment factors to the same level as country b will leave a firm indifferent between moving capital across countries, thus country a needs lower labor and capital weights more than country's b to create enough incentives for reallocating production inputs. A repeated game like this will converge to a an equilibrium in which

$$\begin{aligned}(\alpha_a^K,\alpha_a^L,\alpha_a^S) &= (0,0,1)\\ (\alpha_b^K,\alpha_b^L,\alpha_b^S) &= (0,0,1)\end{aligned}$$

In this simple example we have assumed that sales are distributed equally among countries. In practice, the distribution of sales is uneven among the states a firm choose to operate, however, the dispersion in sales taxes across states together with the fact that a significant fraction of output is exported generate settings that replicate this outcome.

5.2 Efficiency

As documented in Section 2 we see that in practice most states in the US have move towards setting weights on capital and labor equal or close to zero. We argue that this behavior can be explained by strategic competition between states that compete to attract capital investments from multistate corporations. Although the idea that competition among states will direct state's choice of apportionment factors towards lower weights on capital has some support by researchers in the field, see B. and Sansing (2000); Eggert and Schjelderup (2003), there is no consensus on the whether this is an efficient outcome or not. Furthermore, the leading theoretical work in this field see this outcome as an inefficient result of tax competition, see Gordon and Wilson (1986); Eggert and Schjelderup (2003); Runkel and Schjelderup (2011) to name a few.

We argue that setting production inputs weights to zero in the formula apportionment is an efficient outcome from the perspective of the primal approach to taxation, also known as the Ramsey approach. To see why, consider the case in which $\alpha_i^K = \alpha_i^L = 0$ for both $i = a, b$, in this case the formula apportionment structure depends only on firm's distribution of sales across countries as $\alpha_i^S = 1$ for both $i = a, b$. Then, equation (7) becomes:

$$\bar{\tau}_t = \tau_a \left(\frac{s_{at}}{s_{at} + s_{bt}} \right) + \tau_b \left(\frac{s_{bt}}{s_{at} + s_{bt}} \right) \tag{24}$$

which is independent of firm's allocation of inputs but still induces time dependence on the average corporate income tax rate faced by the firm according to the demand of the composite good in each country. In this case the derivatives with respect to $\bar{\tau}_t$ in the firm's F.O.C. will disappear obtaining,

$$F_{nt}^i = w_{it} + \frac{\Pi_t}{1 - \bar{\tau}_t} \frac{\partial \bar{\tau}_t}{\partial n_{it}} \qquad i = a, b \tag{25}$$

$$\frac{Q_t}{Q_{t+1}} = 1 + (1 - \bar{\tau}_{t+1})(F_{kt+1}^i - \delta) - \Pi_{t+1} \frac{\partial \bar{\tau}_{t+1}}{\partial k_{it+1}} \; i = a, b \tag{26}$$

$$F_{kt+1}^a = F_{kt+1}^b \tag{27}$$

which means that there are no distortions to the intra-temporal conditions, and the only distortion in the inter-temporal conditions is the wedge introduced by the average tax rate. Consequently, there are no distortions in the production efficiency condition across countries, equation (27). Thus, the parent firm allocates capital and labor between subsidiaries according to their marginal returns, and there are no additional wedges derived from the effect of the allocation choice in the average tax rates.

Notice that this result pertains completely to the efficient allocation of inputs across countries and does not imply that the average tax rate faced by the firm will change in any particular direction.If the tax authority has access to a rich set of tax instruments, as it is in practice, it can then balance the government budget by raising revenue using other available tax instruments on labor and consumption, which is consistent with the empirical evolution of government revenues we documented in Section 2.

6 Conclusion

In this paper we have documented that the average corporate income tax rate has declined by approximately 40% from 1980 to 2016. During the same period, we observe that states have gradually shifted towards imposing a sales-only apportionment weight on multistate firms. We ask whether these patterns are consistent with states' competing in setting corporate tax policy. Empirically, we find evidence of strategic interaction in setting tax policies between neighboring states. Theoretically, we have shown that moving towards a sales-only apportionment scheme, adopted by most states, is consistent with the prediction of a dynamic general equilibrium model of tax competition that incorporates the Formula Apportionment rule.

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A Data Sources

Effective corporate tax rates

- The average corporate tax rate variable is the ratio of state tax revenues from corporate taxes plus corporation license fees divided by total state business income measured via state's gross operating surplus. The trend was obtained by applying the Hodrick-Prescott high-pass filter.
- Source: Bureau of Economic Analysis (Regional Accounts), Annual Survey of state Government Tax Collections (STC)U.S. Census Bureau.

Statutory tax rates

- We use the maximum statutory tax rates for corporate income, labor income and sales.
- Source: The University of Michigan Tax Database. The Tax Foundation. National Bureau of Economic Research (TAXSIM).

Apportionment factors

- Apportionment factors for all the states are taken directly from official records. We excluded District of Columbia, Hawaii and Alaska in the computation.
- Source: Commerce Clearing House's state Tax Handbooks.

Tax Revenue variables

- We compute the state share of total state tax revenue (expressed in percentages) by its components. We weight states by their GDP. District of Columbia, Hawaii and Alaska are excluded from the computation.
- Source: Annual Survey of State Government Tax Collections (STC)-U.S. Census Bureau.

Tax returns adn receipts

- Tax returns refer to the number of filed forms IRS received from each type of corporation.
- Tax receipts refer to the amount of income IRS received from each type of corporation.
- Source: Statistics of Income (SOI)-IRS.

B Benchmark Planner's Problem

If lump sum taxes and transfers across countries are available to a planner[13], the problem it solves is the following:

$$\max_{\{c_{it},k_{it+1},n_{it}\}} \quad \theta_a U^a + \theta_b U^b$$

subject to the aggregate resource constraint (3) and the law of motion of capital (4).
The F.O.C. are

$$\begin{aligned} c_{it}: \quad \theta_i \beta^t u^i_{ct} &= \lambda_t \quad \forall i = a, b \\ n_{it}: \quad -\theta_i \beta^t u^i_{nt} &= \lambda_t F^i_{nt} \quad \forall i = a, b \\ \lambda_{t+1}[F^i_{kt+1} + 1 - \delta] &= \lambda_t \quad \forall i = a, b \end{aligned}$$

re-ordering we obtain the intratemporal condition:

$$-\frac{u^i_{ct}}{u^i_{nt}} = \frac{1}{F^i_{nt}} \quad \forall i = a, b \tag{28}$$

the inter-temporal condition

$$\frac{u^i_{ct}}{\beta u^i_{ct+1}} = F^i_{kt+1} + 1 - \delta \quad i = a, b \tag{29}$$

and the production efficiency condition

$$F^a_{kt+1} = F^b_{kt+1} \tag{30}$$

Every allocation $\{c_{it}, n_{it,} k_{it+1}\}_{i=a,b}$that satisfies equations (3), (4), (28), (29), and (30) is on the Pareto efficient frontier of this economy. Notice that when a planner is unconstrained on the set of instrument it can choose, then there are not intra-temporal wedges and there are not inter-temporal wedges. This allocation can also be achieved in a decentralized economy where governments can use lump-sum taxes and transfers across countries.

The following section analyses the case in which a government cannot use lump-sum taxes and must raise revenue using distorting taxes on consumption and labor. This setting is also isomorphic to using distorting taxes on consumption and capital, or distorting taxes on labor and capital. The main point of this section is that the most efficient tax system in an environment in which government must use distorting taxes, is one in which there are production efficiency wedges. It is preferable to distort the intra-temporal condition in order to keep the inter-temporal condition undistorted.

The above result is key for as our analysis of choice of apportionment factor driven by competition among states points towards a reduction of the wedges in the intertemporal condition, and the production efficiency condition, which brings the economy closer to more efficient tax system in general.

[13]This is the case in which the planner is unconstrained in the set of tax instruments it can use.

C Additional Figures and Tables

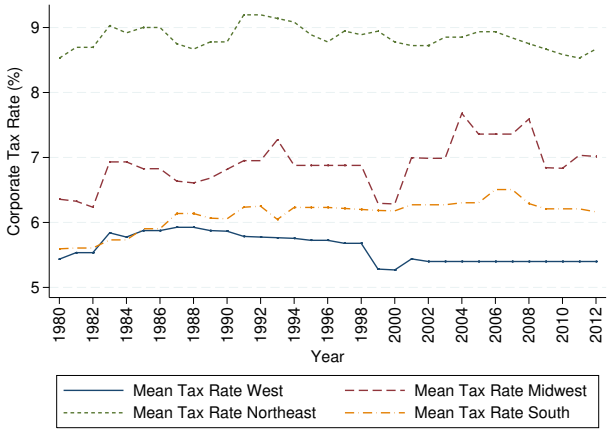
Table 1: Tax Rates

Year	Corporate Tax			Labor Tax			Sales Tax		
	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.
1980	6.51	6.05	2.95	5.21	5.10	3.83	4.07	3.62	1.47
1990	6.67	6.45	2.90	5.06	4.93	2.90	4.93	4.47	1.69
2000	6.28	6.26	2.90	5.23	5.21	2.88	5.22	4.75	1.72
2010	6.28	6.37	2.87	5.42	5.14	2.87	5.83	5.19	1.89

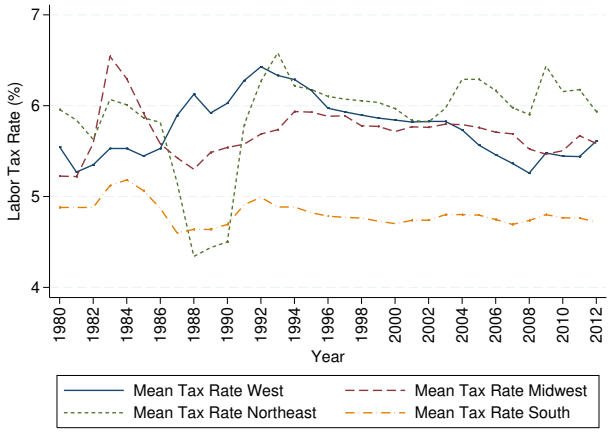
Note: The table report weighted mean, mean and standard deviation of the different state tax rates, analyzed by decade and using as weights the states GDP . We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: The University of Michigan Tax Database. The Tax Foundation. National Bureau of Economic Research (TAXSIM).

Figure 5: Tax Rates by Region

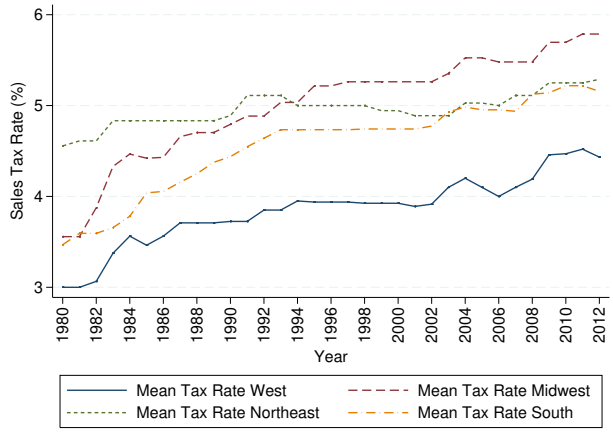
(a) Corporate Tax Rate



(b) Labor Tax Rate



(c) Sales Tax Rate



Note: These figures present the evolution over time of the state corporate, labor and sales tax rates by region. We excluded District of Columbia, Hawaii, Alaska because these are not-continental states. Washington, Wyoming, Nevada and South Dakota in the computation because they do not have a corporate income tax rate.
Source: The University of Michigan Tax Database. The Tax Foundation. National Bureau of Economic Research (TAXSIM).

Table 2: Apportionment Weights Structure Across States

Apportionment Structure	1980	1985	1990	1995	2000	2005	2010	2015
33.33	38	36	30	18	13	13	10	7
50	4	6	10	22	23	22	16	13
¿50	6	6	8	8	12	13	22	24
Number of States	48	48	48	48	48	48	48	44

(a) Sales Apportionment Weights Structure

Apportionment Structure	1980	1985	1990	1995	2000	2005	2010	2015
¡25	6	6	8	8	12	13	22	24
25	4	6	10	22	23	22	16	13
33.33	38	36	30	18	13	13	10	7
Number of States	48	48	48	48	48	48	48	44

(b) Payroll Apportionment Weights Structure

Apportionment Structure	1980	1985	1990	1995	2000	2005	2010	2015
¡25	6	6	8	8	12	13	22	24
25	4	6	10	22	23	22	16	13
33.33	38	36	30	18	13	13	10	7
Number of States	48	48	48	48	48	48	48	44

(c) Capital Apportionment Weights Structure

Note: The table report the number of states that used property, payroll and sales apportionment factors, analyzed by five year spams . We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: Commerce Clearing House's State Tax Handbooks.

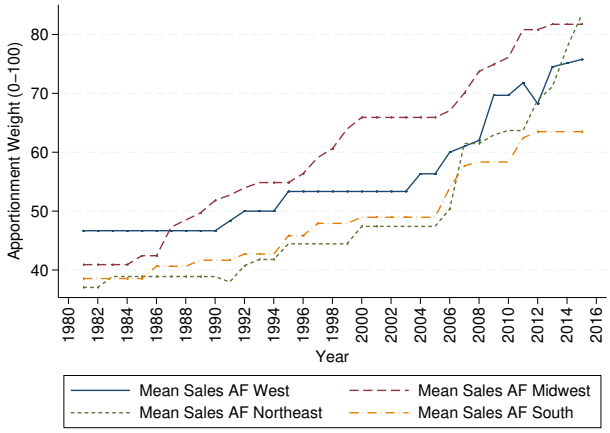
Table 3: Apportionment Weights

Year	Property Apportionment Factor			Payroll Apportionment Factor			Sales Apportionment Factor		
	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.
1980	27.91	28.47	11.12	27.91	28.47	11.12	44.17	43.06	22.23
1990	26.43	26.63	11.24	26.43	26.63	11.24	47.19	46.94	22.78
2000	20.15	22.20	11.42	20.15	22.20	11.42	59.70	55.59	22.85
2010	13.67	16.15	13.86	13.67	16.25	13.86	72.66	67.51	27.73

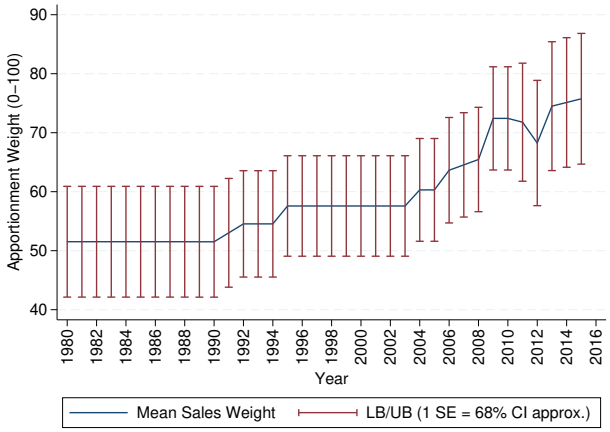
Note: The table report weighted mean, mean and standard deviation of the states property, payroll and sales apportionment factors, analyzed by decade and using as weights the states GDP . We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: Commerce Clearing House's State Tax Handbooks.

Figure 6: Sales Apportionment Weight by Region

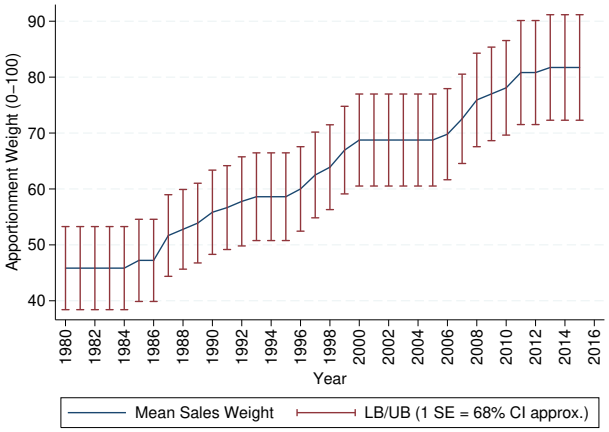
(a) Sales Apportionment



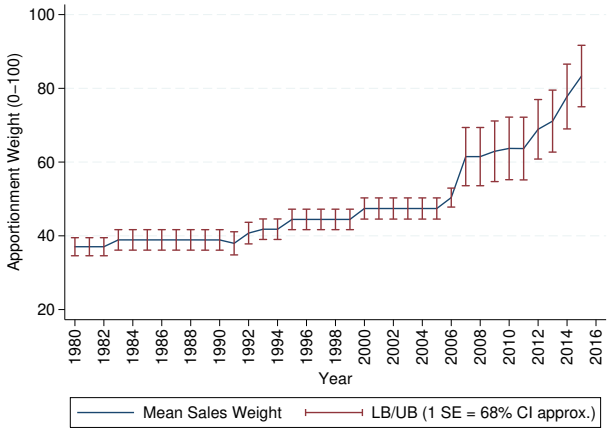
(b) West



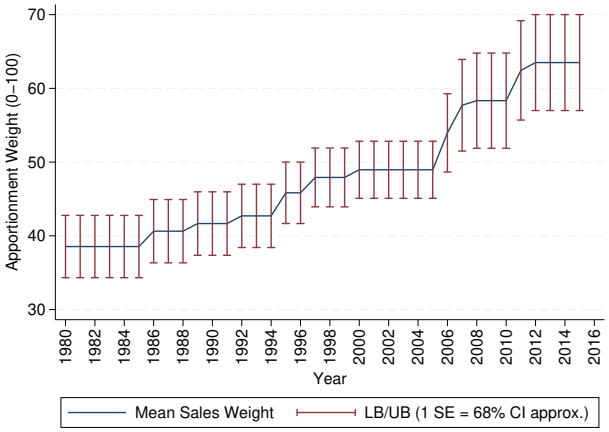
(c) Midwest



(d) Northeast



(e) South

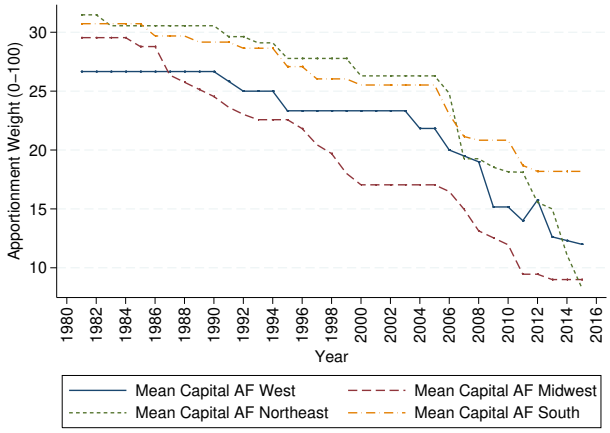


Note: These figures present the evolution over time of the state sales apportionment factor by region. We excluded District of Columbia, Hawaii, Alaska, Nevada and South Dakota in the computation to make the regions more regionally homogeneous.

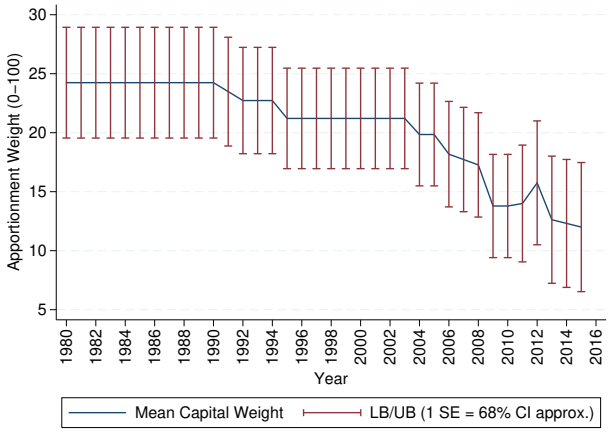
Source: Commerce Clearing House's State Tax Handbooks.

Figure 7: Capital Apportionment Weight by Region

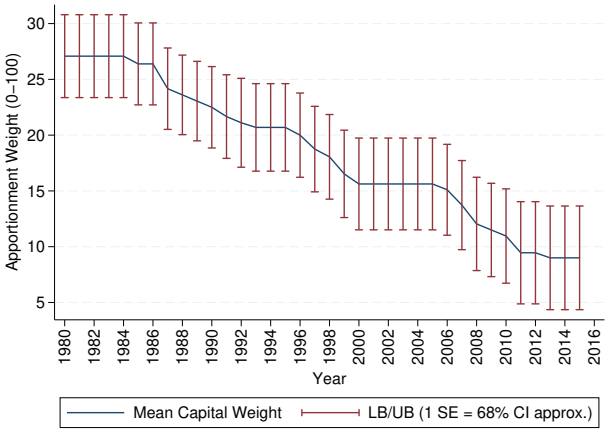
(a) Capital Apportionment



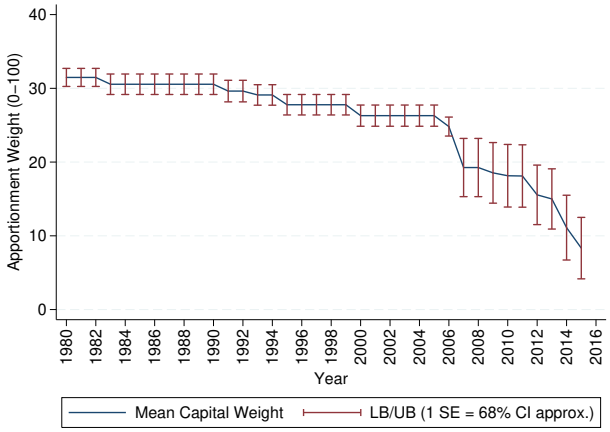
(b) West



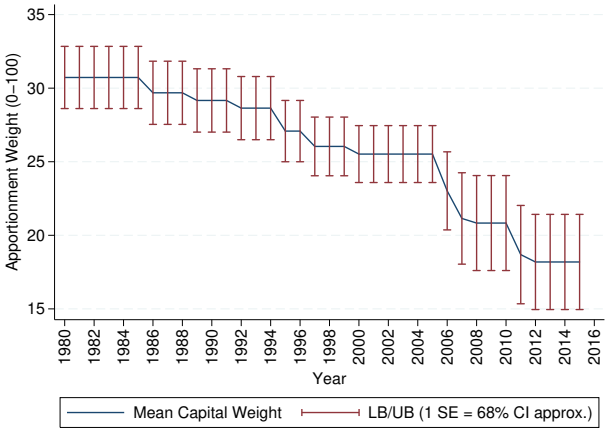
(c) Midwest



(d) Northeast



(e) South



Note: These figures present the evolution over time of the state capital apportionment factor by region. We excluded District of Columbia, Hawaii, Alaska, Nevada and South Dakota in the computation to make the regions more regionally homogeneous.

Source: Commerce Clearing House's State Tax Handbooks.

Table 4: Tax Revenue Share

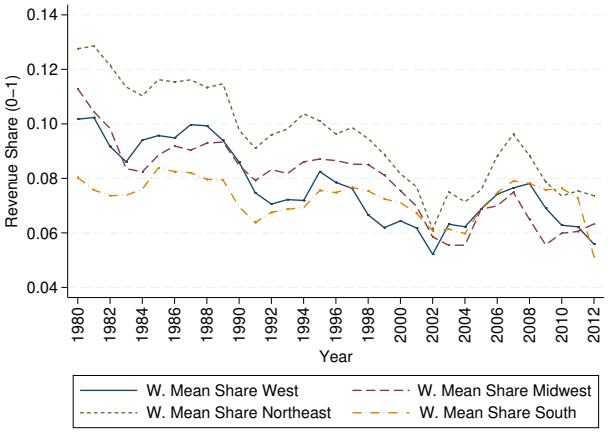
Year	Corporate Tax (%)			Labor Tax (%)			Sales Tax (%)		
	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.
1982	9.35	8.27	4.78	27.17	25.26	16.11	49.95	50.67	15.69
1992	7.79	6.96	4.84	31.09	29.64	15.75	50.57	50.48	15.30
2002	5.80	5.58	5.50	34.00	31.72	16.91	49.90	49.69	15.37
2012	5.91	6.40	5.41	34.03	31.62	17.15	49.93	48.25	15.50

Year	Property Tax (%)			Other Tax (%)		
	W. Mean	Mean	S.D.	W. Mean	Mean	S.D.
1982	1.76	1.76	2.99	11.76	14.04	11.93
1992	2.07	2.02	3.98	8.48	10.91	7.38
2002	1.65	2.92	5.96	8.64	10.09	6.04
2012	1.48	2.95	6.16	8.65	10.78	9.16

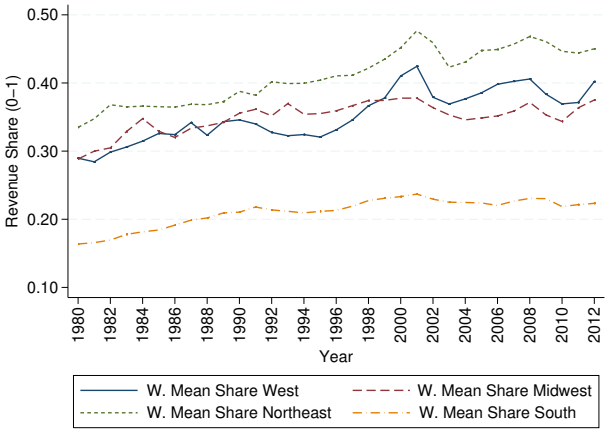
Note: The table report weighted mean, mean and standard deviation of the state share of total state tax revenue (expressed in percentages) by its components, analyzed by decade and using as weights the states GDP. We excluded District of Columbia, Hawaii and Alaska in the computation.
Source: Annual Survey of State Government Tax Collections (STC)–U.S. Census Bureau.

Figure 8: Weighted Tax Revenue Share by Region

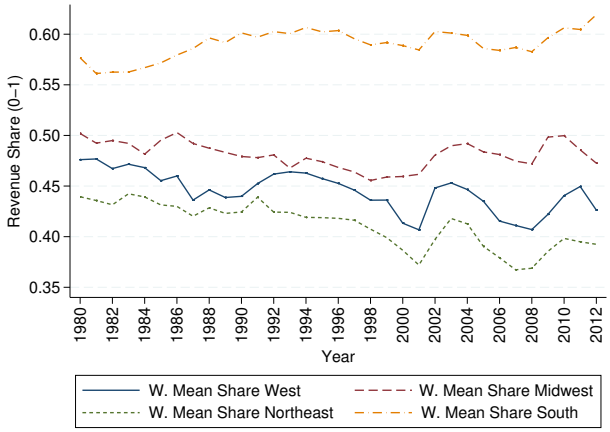
(a) Corporate Tax Revenue Share



(b) Labor Tax Revenue Share

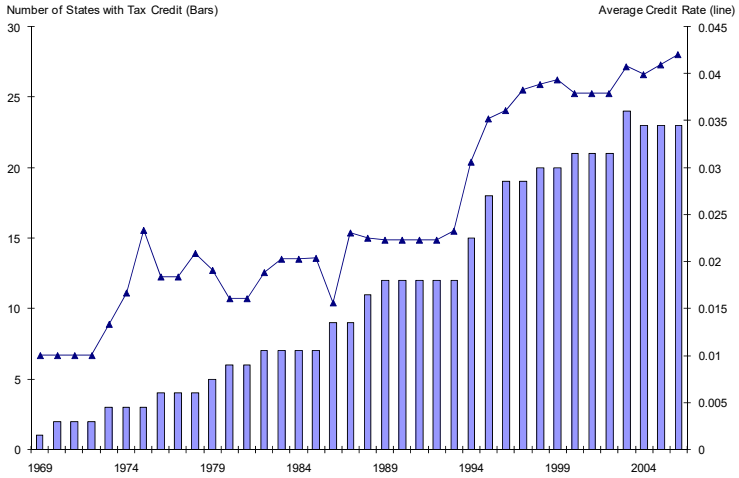


(c) Sales Tax Revenue Share



Note: These figures present the evolution over time of the share of total state tax revenue of each tax component by region. We excluded District of Columbia, Hawaii, Alaska, Nevada and South Dakota in the computation to make the regions more regionally homogeneous. We have used GDP as weights.
Source: Annual Survey of State Government Tax Collections (STC)–U.S. Census Bureau.

Figure 9: Corporate Tax Credits and Incentives

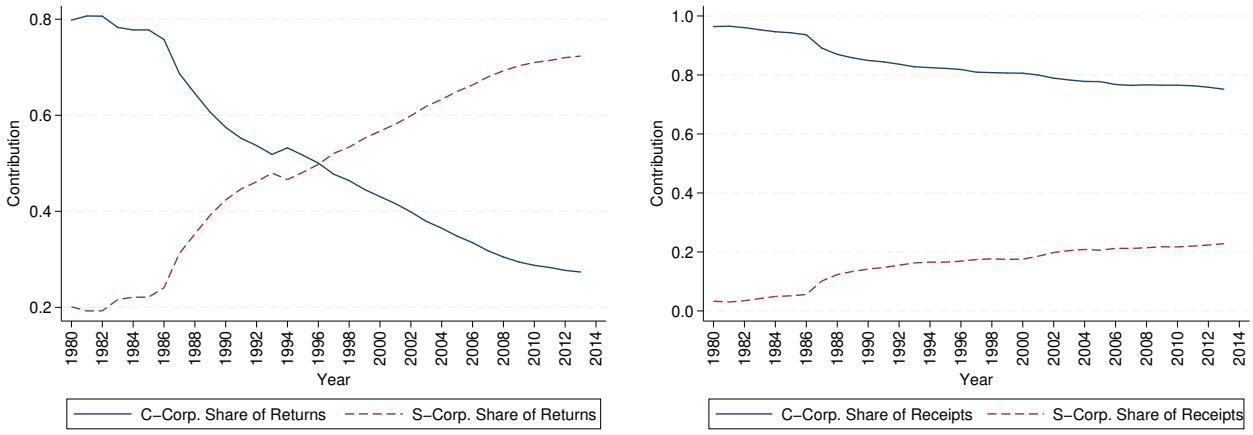


Note: The average credit rate is an unweighted average across only those states with a credit.
Source: Chirinko and Wilson (2017).

Figure 10: Evolution of C-Corporations and S-Corporations

(a) Filed Corporate Tax Returns

(b) Tax Receipts



Note: Tax returns refer to the number of filed forms IRS received from each type of corporation and tax receipts refer to the amount of income IRS received from each type of corporation.
Source: Statistics of Income (SOI)–IRS.