The Earth isn't Flat, and Neither is Illinois'—or any other state's—Income Tax

INTRODUCTION:

In her book, *Flat Earth: The history of an infamous idea*,[1] Christine Garwood explains that from medieval times, long predating Christopher Columbus' famous voyages, educated people knew that the earth was not flat. Nevertheless, the flat earth myth persisted for centuries and even has some, possibly (non)ironic, modern adherents (see R. Brazil 2020).[2] Simplistic and wrong-headed ideas often persist despite unassailable evidence to the contrary and a consensus among those who have carefully considered the question.

The exaggerated dichotomy between "flat tax rate" and "graduated tax rate" states is a current manifestation of this phenomenon. Many members of the public, and some people on the fringes of the policymaking world, overstate the differences between these cases and conclude that only graduated rate states can deliver "progressive" tax policy that results in tax liabilities rising with incomes.[3] Tax policy professionals realize that tax

Authors

David F. Merriman, Co-Lead Institute of Government and Public Affairs Fiscal and Economic Policy Working Group; James J. Stukel Presidential Professor of Public Administration at the College of Urban Planning and Public Affairs, University of Illinois Chicago

Michael Disher, PhD Student, Department of Economics, University of Illinois at Chicago

Francis Choi, PhD Student, Department of Public Administration, College of Urban Planning and Public Affairs, University of Illinois Chicago

Xiaoyan Hu, PhD Student, Department of Public Administration, College of Urban Planning and Public Affairs, University of Illinois Chicago

liabilities depend not only on the structure of tax rates but also on many other facets of the tax system including the definition of the tax base and myriad rules about tax credits, exemptions, and interactions between different tax systems (e.g. state and federal tax systems).[4]

In this short paper, we demonstrate that tax rates are just one of many determinants of state personal income tax liability. We also quantify the various ways in which tax liability can vary across states with a consistently defined measure of income.

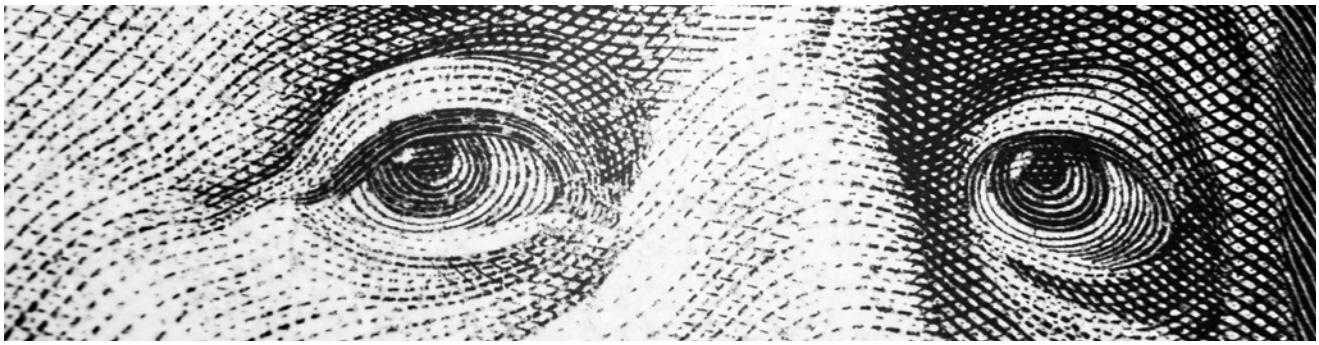
THE FUNDAMENTAL STRUCTURE OF US STATE PERSONAL INCOME TAXES

To set the groundwork, we first briefly discuss the fundamental structure of U.S. state personal income taxes and clarify certain essential terminology. A state individual or personal income tax is a tax levied on individual or household monetary earnings. As of 2021, 41 states and the District of Columbia imposed personal income tax on many forms of income. New Hampshire's personal income tax applies only to income from interest and dividends but excludes income from wages, business activities, and other sources. Eight U.S. states (Alaska, Florida, Nevada, South Dakota, Texas, Washington, and Wyoming) do not tax personal income. In 2018, the 50 state governments collected $390 billion in individual income taxes. This was 19% of their total general revenue.[5]

For any tax, liability fundamentally is determined by the interaction between the tax base (or bases) and the tax rate (or rates). U.S. state personal income tax liabilities can be expressed by the following general formula:

$$\text{Tax liability} = \{(\text{Income} - \text{Exclusions} - \text{Personal exemptions} - \text{Deductions}) \times \text{Tax rates}\} - \text{Credits}$$[6]

Income is, in general, the sum of various income sources including wages, interest income, capital gains, profits from business activities, etc. Different states treat different income sources differently. For example, some states like New Hampshire, tax wages at a different rate (including zero) than capital gains. Note that some sources of income, like that derived from capital gains or business activities, can be negative. Different states may have different rules about the tax treatment of negative income. Another wrinkle is that some states exclude some or all income from certain sources. For example, certain states, including Illinois, wholly or partially exclude retirement income generated by capital gains even though that same income would be taxed if it were derived for non-retirement purposes. Income minus exclusions is called "adjusted gross income" (or AGI). Personal exemptions are certain dollar per person amounts that are exempted from income. States establish their own rules with respect to these exemptions and may include so-called "phase-outs" that reduce the size of exemptions as various types of income change.



Deductions can be divided into two types: standard and itemized. "Standard" deductions are fixed amounts per household. Some states allow "itemized" deductions that are based on the amount that the tax filer spent on certain specific goods and services. AGI minus personal exemptions and deductions is called taxable income. This is the tax base.

A tax rate or tax rates are applied to taxable income. When the state applies a single tax rate to a particular group of tax filers (e.g. married couples) we say that the state has a "flat" tax. In states with graduated rate taxes, different tax rates are applied to different portions of a filer's taxable income. For example, and as shown in Figure 1, in 2021 in Alabama, joint filers pay the following tax rates based on the level of their taxable income:

Figure 1: Alabama joint filers state tax rates paid in 2021

Bottom of taxable income bracket ($)	Top of taxable income bracket ($)	Tax rate (%)
0	1,000	2
1,001	6,000	4
6,001		5

Source: Tax Foundation https://perma.cc/RV9A-6AWD

Alabama's tax system is "graduated" because different tax rates are applied to different portions of tax filers' taxable income. The tax rate that is applied to the last dollar of a tax filer's income is referred to as the marginal tax rate. A joint Alabama tax filer with a taxable income of $999 would face a marginal tax rate of 2%. A tax filer with a taxable income of $1001 would face a marginal tax rate of 4%. We may also be interested in the tax filer's "average" tax rate. The average tax rate can be defined in various ways but for purposes of this document, we define the average tax rate to be the tax filer's tax liability divided by their AGI. Other analysts sometimes use different denominators such as total earned income rather than AGI.

Marginal tax rates are of interest because they help determine tax filers' *incentive* to earn additional taxable income. The higher the marginal tax rate the smaller the amount of additional taxable income the tax filer gets to keep for his/her own use. A large literature in economics has examined the relationship between marginal tax rates and economic incentives.[7] These studies show that marginal tax rates may affect behavior at the "intensive" margin. That is, marginal tax rates may affect the intensity of a behavior. For example, marginal tax rates may affect the number of hours a person is willing to work or the amount of capital an investor is willing to invest in entrepreneurial activity.

Marginal tax rates are of interest because they help determine tax filers' *incentive* to earn additional taxable income. The higher the marginal tax rate, the smaller the amount of additional taxable income the tax filer gets to keep.

Average tax rates are of interest both because they help us assess the fairness of the tax system and because they may affect behavior at the "extensive" margin. That is, average tax rates may affect whether an activity is undertaken at all. For example, average tax rates may determine whether a parent decides to enter the labor market or chooses to stay at home with his or her child.

We can also use average tax rates to help assess whether we should regard a tax system as "fair" For example, some might regard the tax system as more fair if average tax rates rise substantially as taxable income rises. Many analysts use the term "progressive" to refer to tax systems in which the average tax rate rises with tax liability and the term "regressive" to refer to tax systems in which the average tax rate falls as tax liability rises.

The terms *vertical* and *horizontal* equity are sometimes used to assess tax systems. A tax system is generally assessed to be more vertically equitable if tax liabilities rise with ability to pay. However, there is little consensus about either how to measure ability to pay or by the degree to which tax liabilities should rise with ability to pay. Horizontal equity is said to be achieved when tax filers with the same ability to pay have the same tax liability.

State income tax liabilities depend on many variables that interact with state (and federal) tax systems in complex ways. As a result, tax filers may face a variety of marginal tax rates even in flat tax states. Average tax liability depends on a large variety of variables and so average tax rates rarely rise (or fall) uniformly with AGI and, as a result, tax filers with identical AGI may face different tax liabilities and different average tax rates. Our analysis demonstrates that a clean division of states into flat or graduated rate systems is difficult and similarly tax systems do not clearly divide into progressive or regressive groups.

We show that state tax liabilities depend on many variables besides the tax rates in a state and thus tax liabilities typically vary within *and* across a standardized measure of AGI. Thus, state tax systems achieve less than perfect horizontal equity. If states are not horizontally equitable —i.e. tax filers with the same AGI have different income tax liabilities — it may be difficult or impossible to rank the vertical equity of alternative states' income tax systems since it is not possible to make a general statement about how tax liabilities change as taxable income increases.

State income tax liabilities depend on many variables that interact with state (and federal) tax systems in complex ways. As a result, tax filers may face a variety of marginal tax rates even in flat tax states.

METHODOLOGY

We employ methodologies that are standard and will be familiar to the tax research community but may be unfamiliar to a general audience. The basic steps can be concisely summarized as follows:

1. We gather data that are representative of all U.S. tax filers 2011 SOI Synthetic PUF (synpuf 2011 files);
2. we use a tax calculator provided by the National Bureau of Economic Research (TAXSIM) to estimate federal and state tax liabilities for each of the tax filers in our data; and
3. we aggregate those results and provide graphical descriptions of our findings.

Because our data are nationally representative, the individual and aggregate federal tax liabilities will be representative (i.e. accurate estimates) of national tax liabilities. This procedure will also be representative of the hypothetical state tax liability of each tax filer in our data. However, because U.S. states differ in population characteristics, income distributions, sources of income, etc. aggregations of the synpuf data (explained below) will not necessarily be representative of aggregate tax payments in any particular state.

Data: Synthetic Public Use File (2011)

The Statistics of Income (SOI) Division of the Internal Revenue Service (IRS) annually compiles an administrative dataset (Public Use File or PUF) detailing U.S. tax filers' income and tax return information.[8] The SOI PUF uses a large sample of individual federal tax returns — i.e., Form 1040s, Form 1040EZs, Schedule D, etc. — to tabulate numerous variables of interest representing millions of U.S. tax filers, such as tax filers' marriage status, number of dependents, adjusted gross income, taxes, credits, exemptions, and deductions. This sample is representative along many dimensions. The SOI omits personally identifiable information such as social security numbers and names, and keeps the identity of all filers confidential. The SOI PUFs are publicly available for use in research and analysis by academic researchers, policy analysts, and governmental agencies. The SOI has established that the major use of the PUF has been to "simulate the administrative and revenue impact of tax law changes, as well as to provide general statistical tabulations relating to sources of income and taxes paid by individuals."[9]

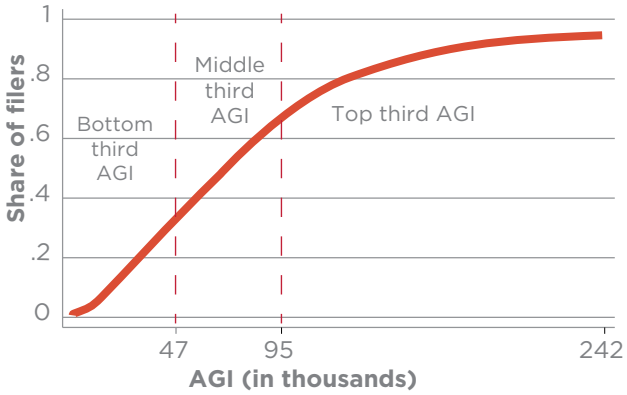
The dataset we use for this paper is the 2011 SOI Synthetic PUF (synpuf data) which is a synthesized file representing tax return data from the 2011 SOI PUF.[10] The SOI PUFs are publicly available but restricted in usage to those who obtain a license for a fee of approximately $10,000 and purchasers of these data must sign a legal agreement.[11]

To overcome these restrictions, Don Boyd, Max Ghenis and Daniel Feenberg, constructed a public and freely available synthetic dataset modeling the tax return data in the 2011 SOI PUF. As a synthetic file, the dataset does not contain any real tax return records. Instead, the file models the 2011 tax return data using predicted observations, optimizing, and maintaining the statistical characteristics of the true data — i.e., mean, variance, correlations, and missing patterns of missing variables.[12] The resulting file of synthesized tax return records is a close representation of the actual 2011 PUF data and suitable, for the purposes of this paper, in obtaining accurate estimates of state tax liabilities and tax rates across varying levels of AGI.

The 2011 synthetic PUF contains 750,347 observations which, when adjusted for weighting, represents about 145 million tax return records.[13] We account for weights in our analyses.[14] The file contains a total of 67 variables detailing tax filers by income and tax information. Out of the 67 variables, we selected the variables corresponding to the inputs for the TAXSIM program (discussed further below; also see the Appendix for a list of variables). In our analyses of the synpuf data we always adjust for weights (unless otherwise stated) but we drop the records of very high income tax filers—specifically the top 5% in AGI—from our analyses. Many of these very high AGI observations had very low weights and unusual income patterns, making it difficult to interpret our results. In addition, we dropped records with negative AGI and records with average tax rates above 100% in magnitude (following inputting into TAXSIM). We used 211,390 observations with the TAXSIM program to calculate levels of adjusted gross income and state tax liabilities.

Our results should be seen as illustrative of patterns of AGI and state tax liabilities. These patterns are not strictly representative of tax payments in the population due to our sample restrictions. Figure 2 shows the cumulative distribution of joint filers by AGI.[15] One third of filers have an AGI of less than $47,000 and two thirds of filers have an AGI of less than $95,000. The top filers in our sample (which excludes the top 5% of filers) have an AGI of about $242,000.

Figure 2: Cumulative distribution national adjusted gross income (AGI) Joint filers 2011, excludes the top 5% of tax filers



Source: Synthetic public use data file courtsey of Don Boyd and the Open Source Policy Center (https://www.ospc.org/portfolio/) synthetic household data project.

Tax calculator: TAXSIM

"TAXSIM" is a collection of programs and datasets implementing a microsimulation model for tax analysis under U.S. federal and state income tax laws. Although TAXSIM has several components, our research only uses the tax calculator. The calculator allows users to submit data through an internet interface and feeds back estimates of tax filers' federal and state tax liabilities. Similar to most tax preparation tools, once a tax filer's income and deductions are provided, the calculator will return an estimate of their tax liabilities. Readers can think of TAXSIM as a simplified version of commercial tax preparation software such as TurboTax.[16] However, TAXSIM allows many fewer variables than commercially available software. Thus, its results should be thought of as an estimate, rather than a calculation, of tax liability. In most research applications (including the present one) the full set of variables required by commercial software is unavailable and TAXSIM's estimates are a good alternative. TAXSIM's ability to process thousands (or hundreds of thousands) of records in a few seconds makes it a very useful research tool.

TAXSIM was originally written by Amy Taylor and later was given its present form by Daniel Frisch. Subsequent studies by Martin Feldstein and others proved the usefulness of the model. The model has been updated every year by incorporating changes in federal and state laws. The calculator is housed at the National Bureau of Economic Research which provides a web page for each version of TAXSIM (internet TAXSIM). The web page is free to the public. The current version is called TAXSIM (v32). It incorporates state income tax laws through 2019 including the Tax Cuts and Jobs Act. Internet TAXSIM uses user supplied data to calculate tax liabilities. Up to 32 tax related input variables, such as year, state, marital status, and various income variables, are specified in the web page and recognized by the calculator. Not all 32 variables are required. The more variables provided, the more accurate we would expect the results to be.

We use a Stata interface to TAXSIM. We developed a correspondence between the variables available in the synpuf data and the variables TAXSIM accepts. The correspondence between available data and the variables required by TAXSIM is explained in an appendix table (found at the end of this paper). We capture the most important income and deduction variables used by TAXSIM. TAXSIM's output includes estimated federal and state tax liabilities and the marginal state and federal tax liabilities of the tax filer. Because we observe both tax liabilities and federal AGI we can calculate average (state) tax rate as the ratio of state tax liability to federal AGI.

Because synpuf data is not necessarily representative of tax filers in any separate state, we investigated the possibility of obtaining additional data that would be able to indicate tax filers in particular states. Unfortunately, the most recent publicly available PUF data with state identifiers are from 1991[17] and so we do not discuss them here.

Simulated Tax Liabilities

Though the synpuf data alone are not representative of tax filers in any separate state, we are able to input synpuf into TAXSIM to estimate tax liabilities for filers under different state tax codes and years. By combining our synpuf data with TAXSIM as our tax calculator, we estimated Illinois state tax liabilities for each tax filer in our data set in 2011. This exercise illustrates the impact that Illinois' 2011 tax system—a flat rate tax system with a single tax rate of 5%—would have had were it applied to a nationally representative group of tax filers. The tax payments that we simulate accurately portray the tax payments of individual higher and lower AGI tax filers. However, the relative size of these groups may be somewhat different in simulations with nationally representative tax filers than it would be with only Illinois' tax filers. The reason is that the distribution of AGI in Illinois may not precisely mirror the national distribution of AGI.

HORIZONTAL VARIATION IN TAX LIABILITIES

We were interested in using our data and analysis tools to better understand the sources of horizontal and vertical variation in tax payments, marginal tax rates, and average tax rates.

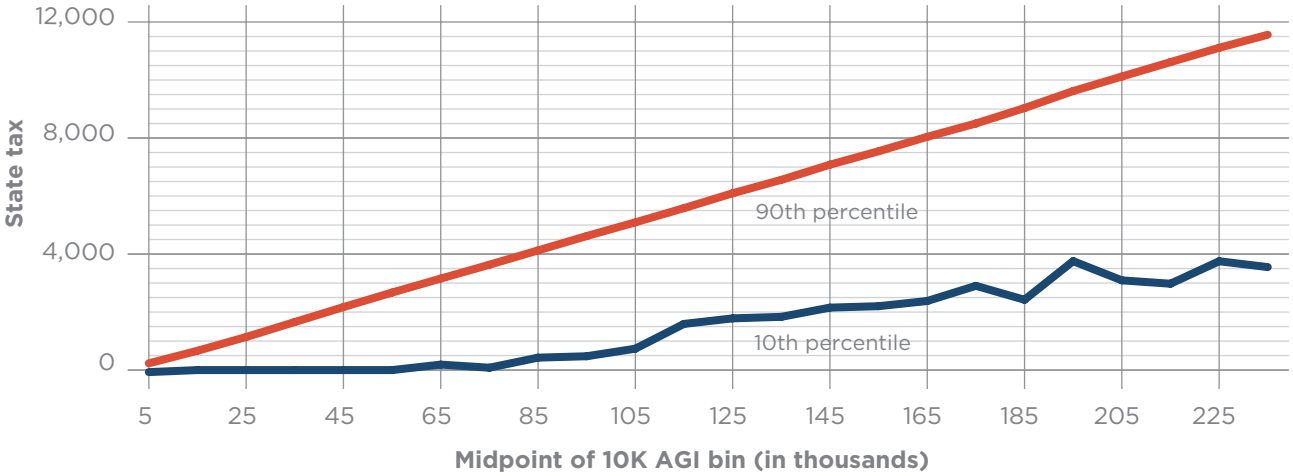
We focused on Illinois' tax code and found substantial variation in tax liabilities for tax filers with similar federal AGIs.

We grouped observations into $10,000 AGI bins from 0 to $10,000 through $230,000 to $240,000 and then calculated the cumulative distribution of tax payments within each bin. Figure 3 graphs the 10th and 90th percentile tax liability at the midpoint of each bin. For example, the bottom 10% of tax payments from tax filers in the $10,000 to $20,000AGI bin (midpoint $15,000) had near zero tax liabilities. The top 10% of tax filers in this bin had state tax liabilities of more than $665 in state taxes. As AGI increases, the difference in tax liabilities between the 10th and 90th percentile also tends to increase — although not uniformly. The bottom 10% of tax liability from tax filers in the $230,000 to $240,000 AGI bin (midpoint $165,000 paid $3600 or less in state taxes. The top 10% of tax payments from tax filers in this bin had tax liabilities of more than $11,500.

Figure 3 demonstrates that tax filers with essentially identical federal AGIs can have very different state tax liabilities. Near the upper end of the AGI scale (around $200,000) tax filers with similar federal AGIs may have state tax liabilities that differ by as much as $8,000. To the extent that federal AGI is a measure of ability to pay, this suggests significant horizontal variation in the tax paid by filers with similar ability to pay.

Analyses of the precise reasons for the wide variation in state tax liabilities among Illinois tax filers with similar federal AGIs shown in Figure 3 is beyond the scope of this paper. We speculate that an important factor explaining these discrepancies is likely to be that Illinois does not tax retirement income, but income from those sources is included in federal AGI. High AGI tax filers often have significant income from 401Ks and other (untaxed in Illinois) retirement sources while others do not. This would result in significant horizontal variation in state tax liability among tax filers with similar federal AGIs.

Figure 3: State tax payment at the 90th and 10th percentile of the distribution as a function of AGI Illinois Joint filers 2011



Source: Synthetic public use data file courtsey of Don Boyd and the Open Source Policy Center (https://www.ospc.org/portfolio/) synthetic household data project. The state tax liabilities of each tax filer in our data set were simulated using TAXSIM. Figure 2 was constructed by clustering tax filers into 10K bins based on their federal AGIs. The distribution of state tax liabilities within each bin was then calculated and the tax liabilities at the 10th and 90th percentile were extracted. The bottom ("10th" percentile) line represents the tax liability of a tax filer at the 10th percentile of tax liabilities in the appropriate AGI bin. Analogously, the top ("90th" percentile) line represents the tax liability of a tax filer at the 90th percentile of tax liabilities in the appropriate AGI bin.

EXAMPLES OF VARYING MARGINAL TAX RATES

The previous section discussed horizontal variation in tax liability and illustrated the specific case of Illinois in 2011. In this section, we discuss horizontal variation in marginal tax rates and illustrate using information about Illinois in 2011.

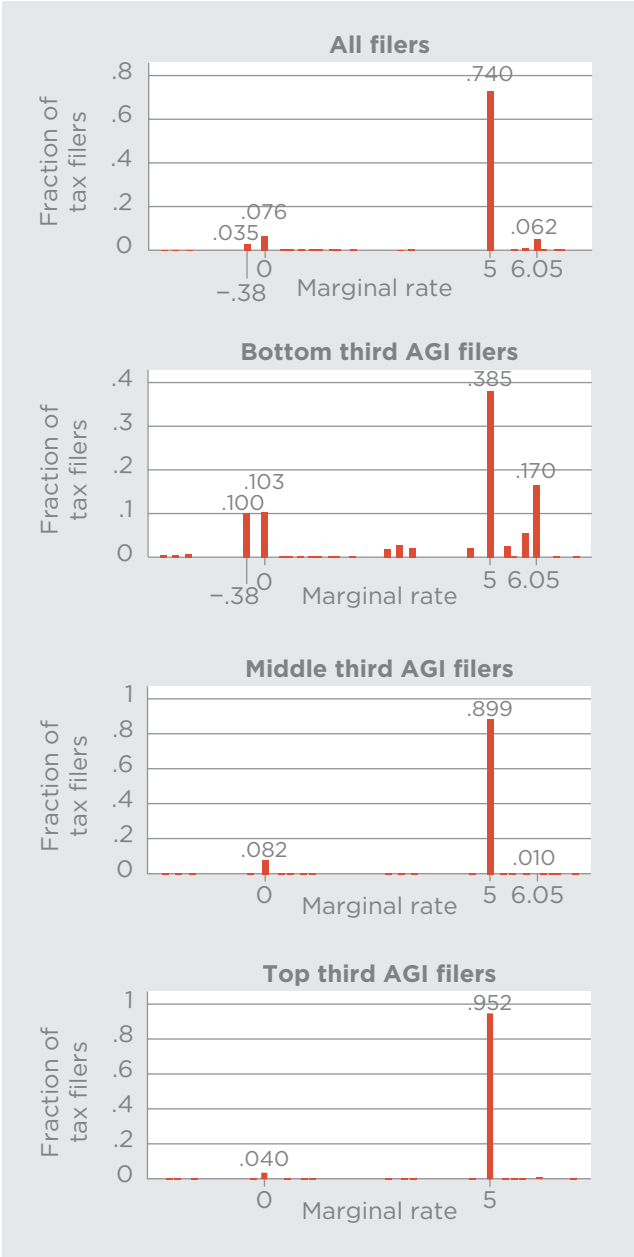
There are many reasons why marginal tax rates may vary even when statutory rates do not. Among the most important reasons is that states often include earned income tax credits (EITCs) which supplement the earnings of low wage workers. Such credits generally are expressed as a percentage of the federal EITC and are taken into account when TAXSIM estimates state tax liabilities.[18] The federal EITC's subsidy varies with a number of variables, including family size and earned income, and includes segments where the subsidy rises with earned income, stays constant with earned income, and eventually declines as earned income increases. Because the subsidy is positive for workers with low earnings, their marginal tax rate can be negative — i.e. a dollar of additional earned income reduces their net taxes because the subsidy more than compensates for any increase in tax liability. Similarly, marginal state tax rates for some filers can be negative because their state EITC is calculated as a fraction of their federal EITC. Of course, as the EITC is phased out, marginal tax rates will be higher than the statutory marginal tax rates because the EITC subsidy is reduced with each dollar earned.

2011 tax filers in Illinois faced one of more than 25 potential marginal tax rates despite the fact that Illinois was a flat tax state.

Marginal tax rates may also vary for many other reasons including the fact that states often cap the value of certain tax exemptions and tax credits. Tax filers may face abrupt shifts in their marginal tax rates when their income rises to such an extent that they have hit the cap on a credit or an exemption.

How important are these potential variations in marginal tax rates in practice? Figure 4 shows marginal tax rates facing 2011 Illinois tax filers overall and, in the top, middle, and bottom third of our AGI distribution.[19] The vertical axis shows the share of tax filers facing each marginal rate and the horizontal axis shows each marginal rate. The numbers at the top of each bar show the share of tax filers that face that particular marginal rate. Figure 4 reveals that 2011 tax filers in Illinois faced one of more than 25 potential marginal tax rates despite the fact that Illinois was a flat tax state.

Figure 4: Marginal tax rate across the AGI distribution Illinois 2011



Source: Synthetic public use data file and taxsim32. See text for data restrictions.

However, as shown in the "all filers" panel in Figure 4, almost three quarters of all filers faced a marginal tax rate of 5%. An additional 7.6% of

filers faced a marginal tax rate of 0%. About 3.5% of filers faced a negative marginal tax rate of -0.38%, and more than 9% had marginal tax rates of over 5%. Tiny fractions of tax filers faced various other rates.

The typical marginal rate and the variation in rates varied quite substantially with the AGI group considered. The bottom third of AGI filers panel of Figure 4 shows that a little less than two-fifths (38.5%) of tax filers in this group faced a marginal tax rate of 5%. Roughly 23% of filers in this group faced a zero or negative marginal rate and more than 26% of these filers faced marginal rates above 5%. On the other hand, 95% of tax filers in the top third of AGI filers panel of Figure 4 faced a marginal tax rate of 5% and most of the rest (3.95%) faced a zero marginal rate. Most tax filers in the middle third of AGI filers panel also faced a tax rate of 0% or 5%.

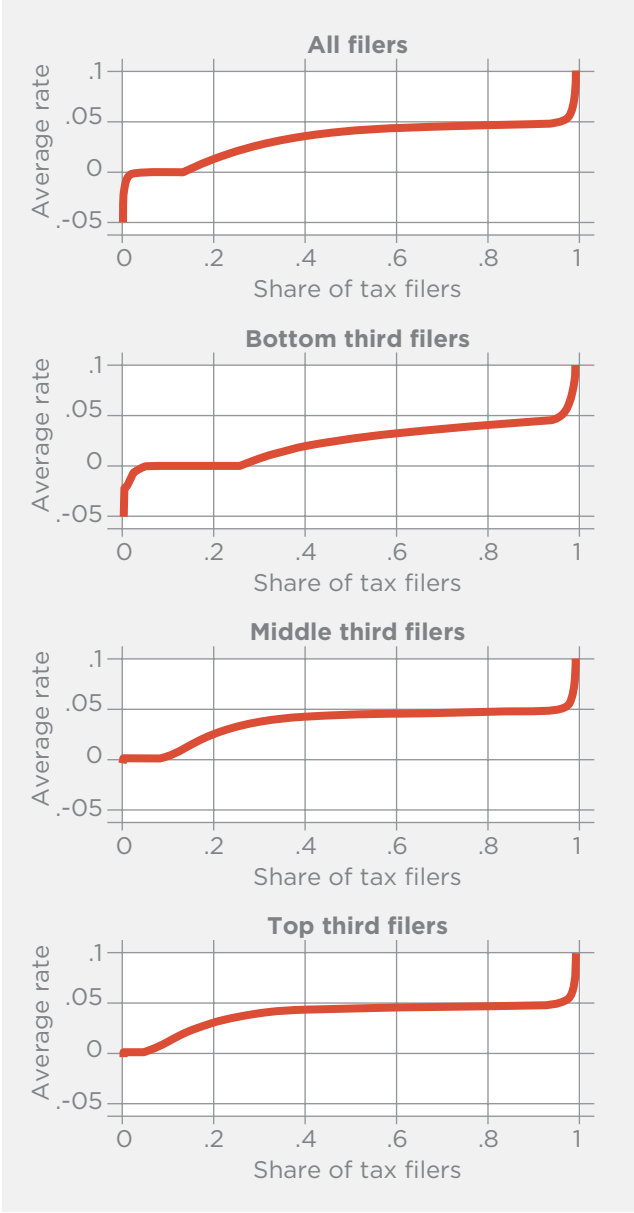
As we have shown above, these varying marginal rates come about because of facets of the tax system other than the rate structure. Negative marginal rates and rates above 5% are most likely the result of EITC phase-ins and phase-outs but other facets of Illinois' tax system, including exemptions and limits on property tax credits, may also cause marginal tax rates to differ from the single statutory rate. Based on other analyses not reported here, we know that other flat rate states and the same states in other years would have similar patterns of variation in marginal rates. States with graduated rate systems will generally have even more variation in the marginal tax rates facing tax filers.

As discussed earlier, horizontal variation in marginal tax rates suggests that tax filers with similar federal AGIs will face somewhat different incentives to earn additional income. However, in order to assess the fairness of the tax systems in Section VI of this paper, we investigate the degree to which average state tax rates vary among tax filers with similar federal AGIs.

EXAMPLES OF AVERAGE TAX RATES

Since we have seen in prior sections that, even in a flat tax state, marginal tax rates differ across filers, it is not surprising that average tax rates also will differ. We illustrate the across-tax-filer distribution of average tax rates for Illinois in 2011 in Figure 5. As shown in the "all filers" panel, average tax rates vary from well below zero to well above 5%. The vast majority of tax filers have tax rates that are between zero and the statutory rate of 5%, with most having average tax rates well below

Figure 5: Average tax rate across the AGI distribution Illinois 2011



Source: Synthetic public use data file and taxsim32. See text for data restrictions.

5%. The panel, showing the bottom third of filers, reveals that about 25% of these filers have a negative or zero average tax rate. A small percentage have average tax rates approaching 5% (about 4% have rates greater than 4.5% but not greater than 5%. However, a surprisingly substantial share (about 4.3%) actually have tax rates exceeding the statutory rate of 5%.

The panels showing the middle and top third of tax filers also show variation in average tax rates.

A relatively small portion of the middle third of tax filers have a zero average tax rate while about 60% of tax filers in this group have an average tax rate greater than 4% but not greater than 5%. About 3.9% have average tax rates above 5%. Tax filers in the top third of the AGI distribution are similar, though slightly more have an average rate near or above 5%.

VERTICAL VARIATION IN AVERAGE TAX RATES IN ILLINOIS AND OTHER STATES

One of the implications of the tax system's numerous deductions, exemptions, credits, and other variations is that an individual taxpayer's marginal tax rate could differ substantially from his or her statutory tax rate. The tax tables do not tell the whole story. On an aggregate level, this implies that comparing states' statutory rates could provide an imperfect description of tax progressivity. Given sufficient credits and deductions, a state with a steeper pattern of statutory tax rates could theoretically have a less progressive tax system than one with a flatter pattern.

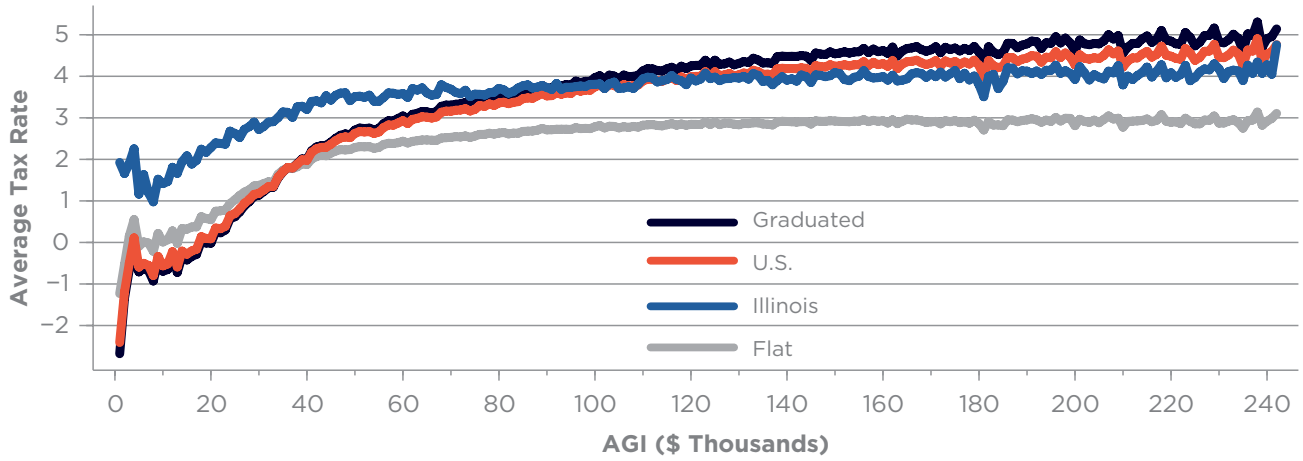
Furthermore, either state could have substantial horizontal variation in tax burdens. One specific implication of this idea is that we should not exaggerate the distinction between graduated rate tax systems and flat tax systems. Looking at the actual tax burdens of people in graduated and flat tax states reveals that these types of systems are not so different after all. While graduated rate tax systems are progressive on average (in the sense that average tax rates increase with AGI), the same is often true for flat tax systems.

Figure 5 shows that, in Illinois, average tax rates vary both within, and across, the AGI distribution, and that average tax rates are generally lower for low AGI tax filers but do not differ as much between moderate and high AGI tax filers. Is Illinois typical? Are flat and graduated tax rate states different? We attempt to shed some light on the answers to these questions in Figure 6.

Figure 6 uses the same sample restrictions used in earlier figures and breaks tax filers into $1,000 AGI bins. Because average tax rates vary within a bin, we calculate the average of the average tax rates and plot it against the midpoint of the AGI of the relevant group. The resulting graph allows us to see how average tax rates vary with AGI in various groups of states.

As can be seen in Figure 6, despite the fact that it is a flat tax state, Illinois' average tax rate rises with AGI until AGI hits about $50,000. Afterwards, it is relatively flat. Compared to other flat tax states, Illinois' average tax rate is higher throughout the AGI distribution. However, average tax rates in Illinois and other flat tax states change in a similar manner — increasing quickly at first, and then more slowly at higher AGIs. Compared to graduated states, Illinois has higher average tax rates for AGIs below approximately $100,000, but lower average tax rates above that, and average tax rates grow with AGI more slowly.

Figure 6: Average State Tax Rate by AGI in 2011 Illinois Relative to Rest of U.S., Graduated and Flat Tax States



Source: Synthetic public use data file and taxsim32. See text for data restrictions. Graduated line includes all states with graduated rates. Flat line includes all states with flat taxes except Illinois. U.S. line includes all states with income taxes except Illinois. States without income taxes are not included. AGI values are binned together at the nearest thousand dollar value. Average Tax Rate is calculated by calculating each individual's state tax liability as a proportion of their AGI, and then averaging those across tax payers within their AGI bin. Data excludes negative AGIs and the top 5% of AGI distribution. AGIs less than $500 and tax rates above 100% in magnitude are dropped due to a high frequency of outliers (i.e abnormally large tax rates).

Fitting with the standard narrative, graduated tax states have lower average tax rates at low AGIs and higher average tax rates at high AGIs. The difference in average tax rates between high and low AGIs is greater in graduated states compared to flat tax states. However, it is noteworthy that the general pattern of average tax rates increasing at a decreasing rate with AGI is seen within both systems. The curves in Figure 6 are qualitatively similar. On average, both systems are progressive (where progressive means people at higher AGIs on average pay higher average tax rates). The main distinction is the degree to which they are progressive.

On average, both systems are progressive (where progressive means people at higher AGIs on average pay higher average tax rates). The main distinction is the degree to which they are progressive.

There are numerous reasons why both systems mainly vary in the degree to which they are progressive, rather than whether they are progressive. One of the simpler reasons is that states often have standard deductions or personal exemptions. These can mechanically cause average tax rates to rise with AGI, since a larger share of AGI becomes taxable as AGI increases. A second reason for why these systems are not that different is because credits, like the EITC, can make a flat tax state more progressive. For instance, a joint filer with one dependent in Illinois in 2011, earning solely wage income will see the marginal tax rate increase with wage income from -1.7% to 3.3% to 5% and then peak at 5.8% at an earnings level just under $22,000. Although Illinois' income tax is flat, the EITC causes them to have more marginal tax rates.

Beyond the above two factors, many graduated states have tax rates that often increase little with AGI or flatten out early. An example of tax rates flattening early would be Alabama, where joint filers reach their maximum statutory marginal tax rate at an AGI of $6,000. Missouri had 10 different tax brackets in 2011, but the highest tax rate is reached at $9,000. It's not difficult to imagine how a flat tax state with a sizable EITC program could effectively be more progressive than a state with a graduated tax system that reaches its peak early.

Moreover, many graduated tax states do not increase taxes much with AGI, at least compared to the federal tax system. For instance, joint filers in Kentucky in 2011 making $8,000 to $75,000 faced a marginal tax rate of 5.8%. Above $75,000, they are taxed at a marginal rate of 6.0%. This increase is arguably quite small. Moreover, because it is an increase in the marginal rate, this tax increase is only affecting any additional money earned above $75,000. Consequently, while the marginal rate immediately increases, the average tax rate for Kentucky will increase much more slowly. Given all the other factors affecting tax rates beyond the statutory rates, increases as small as 0.2% help explain why graduated systems are often not more distinguishable in their tax rates.

TENTATIVE CONCLUSIONS

Policy discussions about state personal income taxes often simplify important complexities regarding design and focus solely on statutory tax rates. Most discussions of tax policy focus on vertical equity while ignoring variation in tax liabilities across tax filers with similar AGI and perhaps similar abilities to pay. We have shown that there is substantial horizontal variation as well as vertical variation in tax liabilities. Both marginal and average tax rates can differ from statutory tax rates and filers' tax liability may depend on many factors in addition to their AGI.

We further show that even flat tax states may introduce significant variation in average tax rates as AGI increases. Both Illinois and other flat tax states manifest significant average progressivity toward the bottom of the AGI distribution but are relatively flat at higher levels of AGI.

Vertical equity cannot be achieved without horizontal equity because inequitable variation in the tax liability of tax filers with similar abilities to pay will make it impossible to achieve an equitable distribution of tax liabilities among higher and lower ability to pay tax filers. Because of this, those concerned with vertical inequity necessarily must also consider horizontal inequity. In our view, a fuller accounting of factors that influence horizontal variation is deserving of increased attention.

In addition, our work suggests that the dichotomy between flat and graduated rate tax systems has been exaggerated. Those wishing to introduce more progressivity into Illinois' (or other flat tax states') tax system could likely design features to raise the AGI level at which average tax rates flatten out without the necessity of adopting a graduated rate tax system.

APPENDIX

Marginal variation in 1991 PUF data

The symput data that we use for analysis in this paper are representative of national tax filers but are not necessarily representative of tax filers in any state. For a number of years, the IRS PUF files did contain state identifiers so that analysts could study state specific patterns of tax filers. However, the IRS discontinued the practice of attaching state identifiers to tax filers in 2008. Filers from 2008 and earlier years are not available to researchers through the IRS. However, we discovered that the National Archives did have some much older PUF data with state identifiers and did some simple analyses with the 1991 data which are the most recent publicly available PUF data with state identifiers.

We began our analysis by selecting only Illinois taxpayers from the 1991 PUF file that we obtained from the National Archives. Illinois then had, and still has, a flat tax rate system with a single statutory marginal tax rate. Despite this, Illinois tax filers may face different marginal rates even with the same level of AGI. Varying marginal tax rates may come about because Illinois' tax code allows for deductions, credits and exemptions. We used the Illinois tax filers from the 1991 PUF data together with taxsim to calculate tax liabilities and marginal tax rates in 1991 and reran the same data through taxsim but calculated tax liabilities and marginal tax rates in 1990. Since there were no major changes in Illinois' tax system between 1990 and 1991, we expected that tax filers would face the same tax liability and marginal tax rates in the two years; that is what we found for the vast majority of tax filers. However, when we investigated in more detail, we found just a few cases for which tax liabilities and marginal tax rates were different in 1990 and 1991. In particular, these tax filers faced a zero marginal tax rate in 1990 but a 3% marginal tax rate in 1991. Upon further investigation, we discovered that in 1990 Illinois' tax filers could deduct twice the amount paid in property taxes from their AGI when calculating state taxable income.[21] However, in 1991, Illinois' double deduction was replaced by a property tax credit equal to 5% of the tax filer's property tax payment. As

a hypothetical, an Illinoisan could have the same AGI in 1990 and 1991 but pay a different marginal rate in both years depending on how much property tax they paid e.g. 0% marginal rate in 1990 and 3% marginal rate in 1991. In fact, we found seven cases in which tax filers would not have owed state income taxes in 1990 but did owe taxes in 1991. All seven cases could be explained by the policy change from the property tax deduction to the property tax credit in the subsequent year. In 1990, tax filers' state income tax liability would be 0 and the state marginal rate would be 0, as long as their state taxable income after deduction was negative or 0. In 1991, a tax filer with exactly the same data could face a positive tax liability and a marginal tax rate of 3%.

Table 1: Tax liability variables

Var #	Taxsim variable name	Taxsim variable description	Equivalent synpuf variable if available	Notes
1	taxsimid	Case ID (arbitrary, but must be a non-negative numeric)	N/A	Synthetic variable supplied by taxsim
2	year	Tax year	2011	
3	state	State	N/A	We assigned this variable
4	mstat	Marital Status	e00100	
5	page	Age of primary taxpayer December 31st of the tax year (or zero).	N/A	We assigned all individuals age 40
6	sage	Age of spouse (or zero).	N/A	
7	depx	Number of dependents (part of personal exemption calculation).	XTOT	XTOT is total number of dependents. We compute depx
8	dep13	Number of children under 13 with eligible child care expenses (Dependent Care Credit).	N/A	We compute probabilistically based on depx
9	dep17	Number of children under 17 for the entire tax year (Child Credit). This includes children under 13.	N/A	We compute probabilistically based on depx
10	dep18	Number of qualifying children for EITC. (Typically younger than 19 or younger than 24 and a full-time student). Note that a young child is counted in all three depNN variables.	N/A	Computed based on XTOT, equal to depx
11	pwages	Wage and salary income of Primary Taxpayer (include self-employment but no QBI).	e00200	

(Table 1 coninued on next page)

Table 1: Tax liability variables (continued)

Var #	Taxsim variable name	Taxsim variable description	Equivalent synpuf variable if available	Notes
12	swages	Wage and salary income of Spouse (include self-employment but no QBI).	N/A	
13	dividends	Qualified dividends	e00650	e00600 (dividends included in AGI) was used for 1991 analysis
14	intrec	Interest Received (+/-)	e00300	
15	stcg	Short Term Capital Gains or losses. (+/-)	p22250	
16	ltcg	Long Term Capital Gains or losses. (+/-)	p23250	
17	otherprop	Other property income subject to NIIT, including	e01100	Variable was unavailable for 1991 analysis
18	nonprop	Other non-property income not subject to Medicare NIIT	e00800 +e00700	
19	pensions	Taxable Pensions and IRA distributions	e01700 +e01400	
20	gssi	Gross Social Security Benefits	e02400	
21	ui	Unemployment compensation received.	e02300	
22	transfers	Other non-taxable transfer Income such as	N/A	
23	rentpaid	Rent Paid	N/A	
24	proptax	Real Estate taxes paid	e18500	
25	otheritem	Other Itemized deductions	N/A	
26	childcare	Child care expenses.	N/A	
27	mortgage	Deductions not included in item 25 and not a preference for the AMT, including (on Schedule A for 2009)	e17500 +e19200	
28	scorp	Active S-Corp income (is SSTB).	e00900	Proxied for with Business or profession (Schedule C) net profit/loss
29	pbusinc	Primary Taxpayer's Qualified Business Income (QBI) subject to a preferential rate	N/A	
30	pprofinc	Primary Taxpayer's Specialized Service Trade or Business service (SSTB)	N/A	
31	sbusinc	Spouse's QBI. Must be zero for non-joint returns.	N/A	
32	sprofinc	Spouse's SSTB. Must be zero for non-joint returns.	N/A	
Note: N/A= not available. Taxsim variables with no corresponding Synpuf variable and no notes were automatically assigned a value of zero by taxsim.				

ENDNOTES

[1] Christine Garwood, *Flat Earth: The history of an infamous idea* (Pan Macmillan, 2008), https://perma.cc/9UUN-G9NU.

[2] Rachel Brazil, "Fighting flat-Earth theory," *Physics World* 33, no. 7 (2020): 35.

[3] "Illinois needs fair tax reform," Council 31 AFSME, April 25, 2019, https://perma.cc/3LHG-3JB4.

[4] See Joseph Cordes, "Horizontal Equity" in *Encyclopedia of Taxation and Tax Policy*, eds. Joseph Cordes, Robert D. Ebel, Jane G. Gravelle (Urban Institute Press, 2d ed., 2005), 195-96. https://perma.cc/WP5R-MMQR.

[5] Urban Institute, https://perma.cc/UZV2-4F2M.

[6] Ronald Fisher, *State and Local Public Finance* (Routledge, 4th ed., 2018).

[7] See Emmanuel Saez, Joel Slemrod, and Seth H. Giertz, "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review," *Journal of Economic Literature* 50, no. 1 (2012): 3–50.

[8] For more on the information contained in SOI PUF and SOI's methodology to compile the dataset, see General Description Booklets for annual PUF files available in PDF on the webpage: https://users.nber.org/~taxsim/gdb/.

[9] See General Description Booklet for the 2011 Public Use File, p. 2: https://perma.cc/2FB2-P8RM.

[10] The 2011 Synthetic PUF was constructed by Don Boyd (University of Albany-State University of New York), Max Ghenis (UBI Center) and Daniel Feenberg (National Bureau of Economic Research) and was made available to the authors. For more information on the methodology used to construct the synthetic file, see: Don Boyd, "A new synthetic data set for tax policy analysis.," *OpenRG Quantitative Notes*. 2020, no. 2 (May, 7, 2020), https://perma.cc/8R75-D46G.

[11] Ibid.

[12] *Id*.

[13] The weight variable in the synthetic PUF file, S006, was constructed after synthesizing all the tax return records to ensure the synthetic file matched as closely as possible the weighted true PUF.

[14] The weight variable varies for each observation in the synthetic file and represents several tax returns such that each observation in the synthetic file may represent thousands of tax filers.

[15] The graph excludes the top 5% of filers since including this group in the graph obscures the distribution of the bottom 95% of filers.

[16] See https://turbotax.intuit.com/.

[17] The IRS produced PUF files with state identifiers through 2008. However, the most recent PUF files offered for sale by the IRS are currently from 2010, see: https://perma.cc/7L5X-NBYP. The National Archives houses several much older PUF files and we obtain the 1990 data from https://catalog.archives.gov/id/646643.

[18] See https://perma.cc/F2MV-UA5H.

[19] Recall the AGI distribution was modified by dropping tax filers in the top five% of the AGI distribution and tax filers with negative AGIs. The AGI distribution is split into thirds *after* making these adjustments.

[20] With only the exemptions (excluding EITC), a joint filer earning solely wage income in Illinois in 2011 would face a marginal tax rate of 0 until the wage income was large enough to be taxable at 5%. The EITC phase-in adds two marginal rates (one where they purely gain credits (-1.7) and another where they gain credits but income is taxed (3.3 = 5 + -1.7), and the phase out adds one marginal tax rate (5.8). The plateau within the EITC system does not add a new marginal tax rate.

[21] Annual Report of Collections and Distributions: Fiscal Year 2000. Illinois Department of Revenue, https://perma.cc/2WH5-PRL4.

[22] With the Taxsim program, we were able to calculate how much 1991 tax filers' state tax liabilities and tax rates would be in 1990 if all filers' income had remained the same in both years. As an example from one case: A tax filer with an AGI of $4,131 who paid $1,723 in property taxes had a 0% marginal rate and $0 in state tax liability in 1990 because of the double deduction and personal exemption of $1,000 ($4,131 - $1,000 - 2 * $1732 = $0 taxable income and 0% marginal rate). The same tax filer had a 3% marginal rate and $7.78 in state tax liability in 1991 because of the property tax credit of 5% ($4,131 - $1,000 = $3,131 taxable income; $3,131 * 0.03 - 0.05 * $1,732 = $7.78 in state tax liability).

The authors thank Donald Boyd for providing data and Daniel Feenberg for help with TAXSIM. Remaining errors or omissions are our own. Funding from the University of Illinois Chicago, Government Finance Research Center is gratefully acknowledged.

JEL Codes: H11, H71

Keywords: State income tax, horizontal equity, vertical equity, TAXSIM, standard deductions, itemized deductions, graduated rate tax system, flat tax rates system

Publisher's Notes

Any opinions expressed herein are those of the authors and not necessarily those of the Institute of Government and Public Affairs, the authors' employers, including the University of Illinois Urbana-Champaign, or the University of Illinois System.

ABOUT GFRC

The Government Finance Research Center (GFRC) at the University of Illinois Chicago shapes and informs public policy and scholarly discourse on government and public finance by identifying, planning and executing research, providing periodic reports and informed analyses, and offering venues at which to convene national and local discussion on fiscal and governmental issues. Contact GFRC Director Deborah A. Carroll at (312) 996-8587 or *deborahc@uic.edu*.

ABOUT IGPA

Since 1947, the Institute of Government and Public Affairs (IGPA) has connected scholars across the University of Illinois System with legislators, civil servants, and key decision-makers in Springfield, throughout the Land of Lincoln, and beyond. As the only U of I System-level institute dedicated to policy engagement, we connect world-class research with the needs of the state and the nation—and we support policymakers in pursuing research-driven solutions. Contact IGPA Director Robin Fretwell Wilson at (217) 244-1227 or *wils@uillinois.edu*.

Photography from istockphoto.com

Pg. 1 - Chart collage, #175256323 by Jacob Hart
Pg. 1 - Planet Earth, #824379206 by XtockImages
Pg. 2 - Notebook and taxes, #1335050708 by Khanchit Khirisutchalual
Pg. 2 - Detail of currency, #1125114784 by bigtunaonline
Pg. 3 - Couple doing paperwork, #1296487184 by Skynesher
Pg. 4 - USA financial graphic, #952063590 by chombosan
Pg. 5 - Blue chart collage, #1250581414 by Dilok Klaisataporn
Pg. 6 - Calculator and tax forms, #866275422 by LIgorko
Pg. 7 - Calculator tape, #117547644 by AdShooter
Pg. 11 - Cityscape and chart, #1343547174 by Igor Kutyaev
Pg 12 - New Tax Laws and currency, #1342296394 by DNY59
Pg. 13 - Shredded forms, #1299661464 by SK Howard