U.S. Tax Progressivity and Redistribution

Online Appendix

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This online appendix presents the following:

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1. Tax Elasticity as a Measure of Tax Progressivity

The elasticity of tax with respect to pre-tax income, or *tax elasticity*, measures tax progressivity. It is estimated here as the slope of the natural log of federal taxes (i.e., the amount of taxes paid or paid on one's behalf and bottom-coded at $100 for the bottom quintile) relative to the natural log of income before taxes and transfers (i.e., market income plus social insurance benefits). The slope is then subtracted by one so that the tax elasticity parallels common measures of tax progressivity: negative for regressive taxes, zero for proportional taxes, and positive for progressive taxes. Figure B1 presents an example of how the eight income groups presented by the Congressional Budget Office (CBO, 2019) data are used to estimate tax elasticities with an individual-weighted OLS regression.

2. Tax Redistribution Measures (as opposed to tax progressivity measures)

The main paper presents tax progressivity and tax-and-transfer redistribution estimates. But one can also exclude the effect of transfers to estimate *tax redistribution* (or the redistributive effect of taxes).[1] An issue with this measure, and all tax-only measures, is that some policies could be labeled either as "taxes" or "transfers" (e.g., refundable tax credits)—whereas measures of tax-and-transfer redistribution are robust to ad hoc distinctions of what goes into "tax" versus "transfer" categories. Regardless, using the CBO data for market incomes, between 1979 and 2016, Reynolds–Smolensky federal *tax* redistribution increased 73 percent. Since 1986, it increased 186 percent. These are slightly larger than the percentage increases of the Kakwani index of income tax progressivity. About half of the post-1986 increase occurs since 2007, which fits with the analysis of U.S. Treasury (2016) and Gale (2019). Mathews (2016) presents similar comparisons of long-run trends of tax progressivity and tax redistribution. Toder (2018) presents estimates of tax redistribution, measured by differences between shares of pre-tax and after-tax incomes, and forecasts a TCJA-related decline between 2017 and 2018, but that that by 2028, tax redistribution will be higher than in 2017 (pre-TCJA) due to an overall increase in tax rates.

[1] In fact, the Reynolds–Smolensky index of tax redistribution (which excludes transfers) equals the Kakwani index of tax progressivity times the average rate of tax on net income, i.e., scaled by the tax level (Lambert, 1993). For a further discussion, see Kakwani (1977b), and more recently: Peichl and Ochmann (2006); de Sarralde, Garcimartín, and Ruiz-Huerta (2013); and the Commitment to Equity Handbook.

3. Trends in Redistribution Rates

Figure B2 presents estimates of average redistribution rates between 1979 and 2016. Over this period, redistribution rates decreased 1 percentage point for the top quintile (26 to 25 percent) and 17 percentage points for the middle quintile (14 to –3 percent). These resemble the average tax rate decreases of 1 and 5 percentage points. For the bottom quintile, relative to their decline in average tax rates, redistribution rates fell much more, by 163 percentage points (–174 to –337 percent). Meyer et al. (2020) also presented estimates of recent average redistribution rates.

4. Flat Top Average Income Tax Rates vs. Falling Top Statutory Rates

Despite the clear increase in federal tax progressivity, there remains a notion that tax progressivity declined. This is often motivated by the observation that from the early 1960s to 2016 top federal individual income tax rates fell from 91 to 39.6 percent. But top one percent *average* tax rates did not fall with the top rate. This disconnect between top statutory rates and average rates results from two effects: a small share of taxpayers being subject to the top rate and reduced use of corporate tax shelters.

Both the number of taxpayers and the share of income subject to the top federal individual income rate were insubstantial in the early 1960s, meaning the top rate had an irrelevant impact on overall progressivity. Figure B3 shows that in 1962, about 0.001 percent of tax units paid the top tax rate. This represents fewer than 500 tax returns out of more than 70,000,000 tax units. As the top rate fell, (outside of a few years with only two tax rates) this number grew but remained small: 0.06 percent in 1979 (top rate of 70 percent), 0.31 percent in 1985 (top rate of 50 percent), and 0.60 percent in 2016 (top rate of 39.6 percent). Similarly, the share of national income taxed at the top rate was only 0.06 percent in the early 1960s, although it increased to about 10 percent in recent years due to the lowering of real top-rate income thresholds (see online data).

Figure B4 shows that the decline in the top statutory tax rate was mirrored by a decline in the use of the most prevalent high-income tax shelters—corporate retained earnings. This shift emphasizes the importance of using a broad income definition including retained earnings to estimate consistent average tax rates over time.[2] Auten, Splinter, and Nelson (2016), Clarke and Kopczuk (2017), and Auten and Splinter (2019) discussed the shift out of C corporations and into passthrough businesses by high-income owners of closely held businesses following the Tax Reform Act of 1986. Figure B4 shows corporate retained earnings as a share of national income after removing corporate ownership by retirement accounts to focus more on high-income sheltering. This measure of high-income tax sheltering fell from the from more than 4 percent of national income in the 1960s, to about 3 percent in the 1970s, 2 percent in the 1980s, and 1.4 percent since 1990. This decline of about two-thirds in sheltering resembles the fall in the top tax rate.

5. Progressivity vs. Redistribution

Whereas tax progressivity measures the distribution of taxes, redistribution measures effects on the distribution of income, which is sensitive to the tax level and captures different—and arguably more relevant—aspects of public policy (Duclos and Tabi, 1996; Slavov and Viard, 2016). Unfortunately, standard definitions of whether a tax system is progressive do not always provide clarity regarding the progressivity of tax changes. This issue is addressed by the *proportional tax change criterion*: progressivity measures should be unchanged by equal

[2] Wallace, Wasylenko, and Weiner (1991, p. 184) wrote, "Most tax burden studies account for the individual's share of corporate income using dividends and retained earnings of corporations, and corporate income taxes."

proportionate changes in the amount of taxes relative to the amount of income for all individuals. A measure violating this criterion can more clearly be referred to as a measure of redistribution or effective progression.[3] As explained by Lambert (1993, p. 184): "The redistributive effect is determined by disproportionality [i.e., progressivity] and tax *level*. Scaling up the liabilities of an already progressive tax increases the redistributive effect without affecting the departure from proportionality."

Unfortunately, some measures are occasionally referred to as capturing tax progressivity despite violating the proportional tax change criterion. A prominent example is what I refer to as the *elasticity of disposable income* (EDI), which relates pre-tax and after-tax (and in some cases after-transfer) incomes over the income distribution. This measure, originally referred to as the coefficient of residual income progression, was proposed by Musgrave and Thin (1948), popularized by Feldstein (1969), and a version was used in Bénabou (2012) and Heathcote, Storesletten, and Violante (HSV, 2017).[4] This measure is equivalent to the elasticity of the net-of-tax rate (one less the tax rate) with respect to pre-tax income, as shown by Feenberg, Ferriere, and Navarro (2017).

A. Examples Showing Differences Between Measures of Progressivity and Redistribution

This difference between progressivity and redistribution can be seen visually with a hypothetical example based on two individuals. A's income is $10,000 and a policy change doubles his tax from $1,000 to $2,000. B's income is $100,000 and her tax doubles from $30,000 to $60,000. The left panel of Figure B5 shows log of tax relative to log of pre-tax income. The lines connect the two individuals' income-tax combinations and the slopes (less one) are the tax elasticities. Despite a doubling of the tax level, the slope is unchanged because the tax elasticity meets the proportional tax change criterion.[5]

In contrast, the right panel replaces the y-axis with the log of *after-tax income*, such that the slopes are one less the EDIs. When doubling the tax level, the slope changes due to the increase in redistribution—meaning the EDI violates the proportional tax change criterion. An empirical exercise starting with actual CBO data leads to the same conclusion. A proportional increase (decrease) in average tax rates of 10 percent for all income groups has no effect on the Kakwani index or the tax elasticity because both are true measures of progressivity, but the EDI increases (decreases) about 12 percent (see online data). These examples show why the EDI—and equivalently changes in after-tax income—should not be considered measures of progressivity, but instead as measures of redistribution.[6]

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[3] Musgrave and Thin (1948) referred to shifts of income towards equality as effective progression.

[4] Following HSV, define after-tax income ($\tilde{y}$) as a function of pre-tax income (y), where $\tilde{y} = \lambda\, y^{\,1-EDI}$. Moore and Pecoraro (2020) discuss this tax function and shortcomings of imposing smoothness on a tax system with non-convexities. For comparison, in this function, $tax = y - \lambda\, y^{\,1-EDI}$, while for the tax elasticity (ε), $tax = \lambda\, y^{\,1+\varepsilon}$. For both, λ measures the tax level, but while ε measures progressivity, the EDI can be thought of as the degree of redistribution (or "effective progression" or "curvature of the tax schedule") for a given λ.

[5] As explained by Musgrave and Thin: "liability progression will remain the same at all points in the income scale if there is an equal proportionate change in average rates all along the line. In other words, the liability curves plotted on a double logarithmic scale must be shifted in a parallel fashion." (1948, p. 505)

[6] Kakwani (1977a, p. 723) made this point: "Since the average tax rate can be changed without changing the tax elasticity or the progressivity, it follows that by simply comparing the Lorenz curves of pre-tax and post-tax incomes [which do change] one cannot arrive at a suitable measure of progression."

B. Noncomparability with Estimates of Elasticity of Disposable Income

Empirical estimates of EDIs are not comparable to standard tax progressivity estimates—not only because of the progressivity vs. redistribution distinction, but also due to the occasional exclusion of select taxes and inclusion of select transfers. For example, Wu (2020) claims to estimate decreasing U.S. "tax progressivity" between 1979 and 2015 (three-year averages), but his measure (1) estimates trends in the elasticity of disposable income (EDI), which is sensitive to the tax level and therefore measures redistribution—not progressivity—as explained above, (2) excludes "non-labor" taxes,[7] (3) includes select transfers, which means these are tax-and-transfer measures, not strictly tax measures, (4) appears to ignore itemized deductions, which disproportionately benefited higher incomes in earlier decades because of higher marginal tax rates, (5) relies on survey data for which households must be separated into tax units and taxes calculated with incomplete information, rather than tax data where actual tax burdens (after deductions) are observed for separate tax units, and (6) uses a narrow definition of labor income, which ignores significant business losses from tax shelters that were used to offset taxes from labor income in earlier decades.[8] In comparison, Feenberg, Ferriere, and Navarro (2017) find that EDIs *increased* for both federal and federal plus state income taxes since 1979. They include all income taxes, exclude all transfers, rely on tax data that can account for all deductions and business losses, and use an intermediately broad income definition (labor and capital income reported on tax returns), making these EDI estimates closer to actual measures of tax progressivity.

The use of the term "tax progressivity" to measure something very different from the normal meaning of tax progressivity can cause unnecessary confusion. Much of this confusion could be avoided if the EDI literature used alternative terms. For example, Guner et al. (2014, p. 572) refer to the EDI as controlling the "curvature or degree progressivity in the tax schedule."

6. Reconciliation of Saez-Zucman & Congressional Budget Office Estimates

This section presents a step-by-step reconciliation of average tax rate estimates by Saez and Zucman (SZ, 2019) with CBO estimates. This reconciliation is based on 2010, the most recent year for which both SZ and CBO estimates are available.[9] Additional details are available in the online

[7] "Labor income taxes" are not well defined. It's not clear how to isolate labor taxes from a base that combines labor and capital income and then applies deductions and progressive rates to this mixed-income base, or where labor income is reclassified as business income to avoid taxes (Auten and Splinter, 2019; Smith et al., 2019).

[8] Wu (2020) was careful to include the employer's portion of payroll taxes in his labor income definition and population-weight his EDI estimates. Without this weighting, the EDI can merely capture the overall curvature of the tax schedule, regardless of how few people actually pay the top rates and possibly exaggerate EDIs in earlier decades when there were few taxpayers paying the top rates (see Figure B3). In comparison to his emphasized EDI results, Wu (2020) also shows a log-log figure that suggests little change in elasticities.

[9] SZ also presented estimates for 2018, but these have a number of issues: (1) the tax return data used for analysis in other years was not yet available, hence these estimates rely on many forecasted values, (2) 2018 corporate tax levels are not representative of subsequent years, during which top average tax rates should be higher due to the end of temporary downward pressure on corporate tax receipts from the phasing out of bonus depreciation and one-time accounting changes in the TCJA, and (3) a multi-year (or even lifetime) perspective is more appropriate than annual tax burden measures for the top of the distribution due to estate taxes only paid upon death and the extreme income volatility of high-income individuals (Splinter, 2012; Auten, Gee, and Turner, 2013). For example, the IRS found more than 4,500 different taxpayers in the annual top 400 tax returns between 1992 and 2014 (www.irs.gov/pub/irs-soi/14intop400.pdf). Moreover, in 2014, the IRS found that the top 400 tax returns had $14.5 billion in charitable deductions, or 14 percent of their taxable income. Deducting a portion of charitable contributions from income, as an ability-to-pay perspective could imply, would result in higher top average tax rates. Splinter (2018) documented the long-run increase in high-income charitable contribution rates.

data. To summarize, SZ average tax rates are flatter over the income distribution than CBO estimates for two reasons: (1) the imputation of excess non-taxable business and retirement income to the top of the distribution, which pushes high-income tax rates down; and (2) the removal of some refundable tax credits and pre-tax income from the bottom of the distribution, which pushes low-income tax rates up.

Before the four-step reconciliation, CBO tax rates must first be made more comparable to those of SZ in one fundamental way. The CBO tax rates are only for federal taxes, whereas the SZ tax rates include federal, state, and local taxes and the federal portion cannot be easily disentangled. Following an approach used by Jason Furman,[10] I add the state and local tax rates estimated by the Institute for Taxation and Economic Policy (ITEP) to the federal tax rates of CBO to get CBO+SL (state and local) tax rates, as seen in Figure B6.[11] The ITEP income definition, however, is likely narrower than that of CBO. Accounting for this difference could slightly lower the CBO+SL rates.

The first step of the SZ–CBO reconciliation adds missing payroll taxes and social insurance benefits to the SZ pre-tax income definition, which excludes both the employer and employee sides of Social Security payroll taxes (these need to be included to be a pre-tax measure) as well as Medicare benefits. These amounts are included in the CBO definition of income used to estimate average tax rates: income before transfers and taxes (that is, market income plus social insurance benefits). Figure B7, panel 1, shows that adding these excluded items to income reduces the SZ tax rates about 5 percentage points for the bottom-half of the distribution. The smaller effect for high incomes results from the Social Security (OASDI) payroll tax only applying to wages below a taxable maximum ($106,800 in 2010 and indexed for other years) and Medicare benefits representing a smaller share of top incomes.[12]

The second step removes imputed retirement and underreported income from SZ income because these are not included in the CBO income definition. The adjustment for retirement income results from the estimated SZ retirement income less taxable retirement income and other retirement income included in the CBO income definition. Figure B7, panel 2, shows that deducting these items from income increases the SZ tax rates by less than one percentage point in the bottom-half of the distribution and 6 percentage points for the top five percent. For the top five percent, about half of the increase is from retirement income and half from underreported income. For the top one percent, underreported income effects are larger.

Auten and Splinter (2019) showed that the Piketty, Saez, and Zucman (2018) income imputations, which were used by SZ, allocated too much retirement and underreported income to the top of the distribution. For retirement account ownership estimates, their computer code shows a confounding of retirement income flows and asset levels due to the combining of retirement account distributions and rollover amounts. These rollover-biased estimates are then used to distribute income accrued in retirement accounts. For underreported income, SZ allocated amounts

[10] https://twitter.com/jasonfurman/status/1181276490047975425

[11] For ITEP estimates, see page 128 of https://itep.org/wp-content/uploads/whopaysreport4th.pdf

[12] The standard goal of average tax rates is to understand the amount of taxes borne by individuals relative to a broad measure of their annual pre-tax economic flows, regardless of specific national income levels. This ability-to-pay perspective means the average tax rate income denominator should have no taxes deducted and government transfers should be included. This logic applies to both expanded income definitions, such as that used by CBO and other government agencies, as well as national income definitions—even if the average tax rate income denominator exceeds national income. This is because pre-tax flows of broad economic resources include transfers and are therefore appropriately larger than national income, which excludes transfers. For average tax rate income denominators, transfers mean the same dollar can both be in a rich person's tax base and a poor person's wallet.

by positive reported income, rather than according to special IRS stratified random audits that are used to estimate the aggregate underreporting amounts included in national accounts.[13] Auten and Splinter (2020) provided further discussion and Splinter (2019b) showed how this misallocation of income can affect average tax rates.

The third step accounts for refundable tax credits. For the SZ average tax rate numerator, the refundable portion of tax credits are excluded, even though increased consumption resulting from those amounts can result in sales taxes that are included. The SZ exclusion of these credits resulted from a labelling issue: national accounts categorize the refundable portion of tax credits not as decreases in taxes but as increases in transfers, and hence, SZ included them as relatively small increases in the income denominator rather than relatively large decreases in the tax numerator. This deviation from conventional estimates, however, results in a biased interpretation of policy changes because much of the increase in progressivity resulted from the expansion of tax credits. Moreover, the exclusion of these credits results in very large tax rates at the bottom of the distribution, where these credits are especially important (Levy, 2019). Rather than including refundable tax credits in the tax numerator—as done by all government agencies and think tanks—the SZ response to these exaggerated tax rates was to truncate their sample by removing the bottom of the income distribution, as discussed below.

Figure B7, panel 3, shows that accounting for refundable income tax credits decreases the SZ tax rates by at least 17 percentage points in the bottom quintile and 4 percentage points in the second quintile. This adjustment, however, underestimates the actual effect of the refundable portion of tax credits because it is based only on the negative amount of income taxes reported for each income group by CBO, and some refundable credit effects are offset by positive income taxes within each group.

The final step shows remaining differences. These are due to: (a) adding back the bottom decile of adults dropped by SZ—those with incomes below half the annualized minimum wage, or 11 percent of the 2010 Census estimate of the number of adults; (b) removing remaining imputed income not in the CBO definition;[14] (c) changing from ranking by adult-level tax unit incomes (equally split for married filers) to size-adjusted household incomes that accounts for sharing of resources;[15] (d) changing from setting income quintiles to have an equal number of adults, as in SZ, to having an equal number of individuals; and (e) accounting for differences in tax incidence assumptions besides those for refundable tax credits. Figure B7, panel 4, suggests that these remaining differences would increase the bottom-quintile tax rate by about 8 percentage points. This should mostly result from removing some additional income sources included by SZ and adding back the low-income adults excluded by SZ.

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[13] Allocating by positive reported income has the odd implication that if a taxpayer increases their compliance rate then they will be allocated more underreported income, rather than correctly being allocated less. It also disregards underreporting on returns with losses. For more details on the stratified random audits see DeBacker et al. (2020) and Auten and Langetieg (forthcoming). For BEA background on how national accounts incorporate income estimated in these audits, see page 16 of www.bea.gov/system/files/2019-05/Chapter-11.pdf

[14] Note that imputed retirement and underreported income were removed in a prior step. Relative to CBO income, these additional national income components create a more comprehensive income measure. For example, including imputed rental income, which is untaxed and disproportionately accrues to upper-income households, arguably provides an improved measure of tax progressivity. When allocating income sources missing from tax data, however, the imputation approach matters (Auten and Splinter, 2019). For example, SZ allocated imputed rent amounts with a fixed ratio between itemizers and non-itemizers, resulting in bias over time.

[15] Cronin, DeFilippes, and Lin (2012) and Kallen and Mathur (2018) showed that using no equivalence scale appears to overstate average tax rates at low income levels.

7. The TCJA is Forecasted to Have a Small Effect on Federal Tax Progressivity

The 2017 Tax Cuts and Jobs Act (TCJA) is expected to have little effect on federal tax progressivity levels. While there are currently no estimates using actual microdata from 2018, the first year the TCJA was effective, the Urban-Brookings Tax Policy Center (TPC, 2017) estimated the effects of TCJA and forecasted average tax rates.[16] These suggest that the TCJA had little effect on federal tax progressivity but caused a decrease in tax redistribution. This implies that progressivity decreases from changes in corporate and estate taxes offset progressivity increases from changes in individual income taxes (Kallen and Mathur, 2019; Splinter, 2019a).

Progressivity changes are based on the pattern of percentage changes in average tax rates over the income distribution. TPC (2017) estimates show that these were nearly equal over the income distribution, which implies that the TCJA had little impact on federal tax progressivity. For 2018, average tax rates for the bottom and middle quintiles decreased by 10 percent, while for the top quintile they decreased by 9 percent. Within the top quintile, average tax rates for the P90–95, P95–99, and top 1 percent decreased by 8, 12, and 7 percent. Estimates by the Joint Committee on Taxation suggest similar impacts.[17]

Kakwani indexes also suggest that the TCJA had little impact on federal tax progressivity. First, I confirm that the pre-TCJA tax progressivity levels were similar when estimated with CBO or TPC data (otherwise using identical methods). Between 2012 and 2016, the average CBO-based Kakwani index was 0.213 and the average TPC-based estimate was 0.203. Second, the trend in the TPC-based Kakwani index suggests little progressivity effect from the TCJA. Between 2017 and 2018, the first year the TCJA became effective, the TPC-based Kakwani index increases from 0.194 to 0.195. In 2019, it increases further to 0.198 (see the online data for details).

While the TCJA had little impact on tax *progressivity* (which is insensitive to changes in the overall tax level), it reduced tax *redistribution* (which is sensitive to changes in the tax level). This is because tax progressivity is based on percentage changes in average tax rates while redistribution is based on changes in after-tax income. The TCJA is expected to have similar effects on percentage changes in average tax rates across the distribution, but larger percentage decreases in after-tax incomes for the top of the distribution. Unchanged tax progressivity means each income group pays a similar share of taxes before and after the policy change (ignoring any pre-tax income changes), but because the TCJA decreased overall federal taxes by about a tenth, the redistributive effect of taxes declined. As discussed in section 5 above, when a policy change holds tax progressivity constant, redistribution will decrease when tax levels fall and increase when tax levels rise. For example, Toder (2018) forecasts a TCJA-related redistribution decrease in 2018 due to tax levels falling, but that that by 2028 tax redistribution will be higher than 2017 (pre-TCJA) due to tax levels rising.

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[16] TPC's estimates of average federal tax include individual and corporate income, payroll, estate, and excise taxes and were downloaded on August 27, 2020 from www.taxpolicycenter.org/model-estimates/baseline-distribution-income-and-federal-taxes-feburary-2020/t20-0009-baseline

[17] See JCX-68-17 at www.jct.gov/publications.html?func=startdown&id=5054. For 2019, average tax rates for the $20–30K, $40–50K, $100–200K, $500K–1M, and >$1M income groups were estimated to decrease by 10, 9, 7, 10, and 8 percent, respectively.

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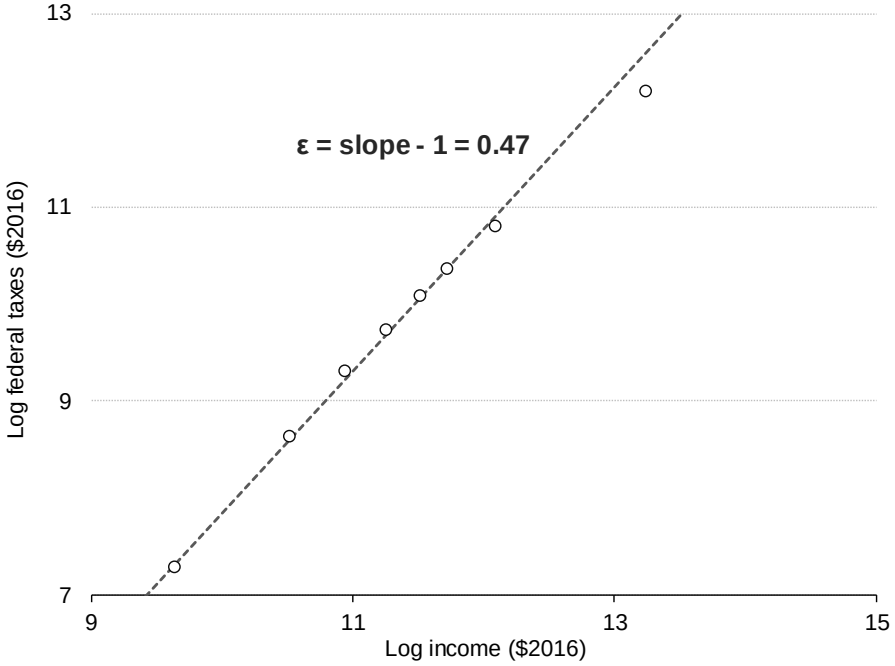
Online Appendix Figures

FIGURE B1

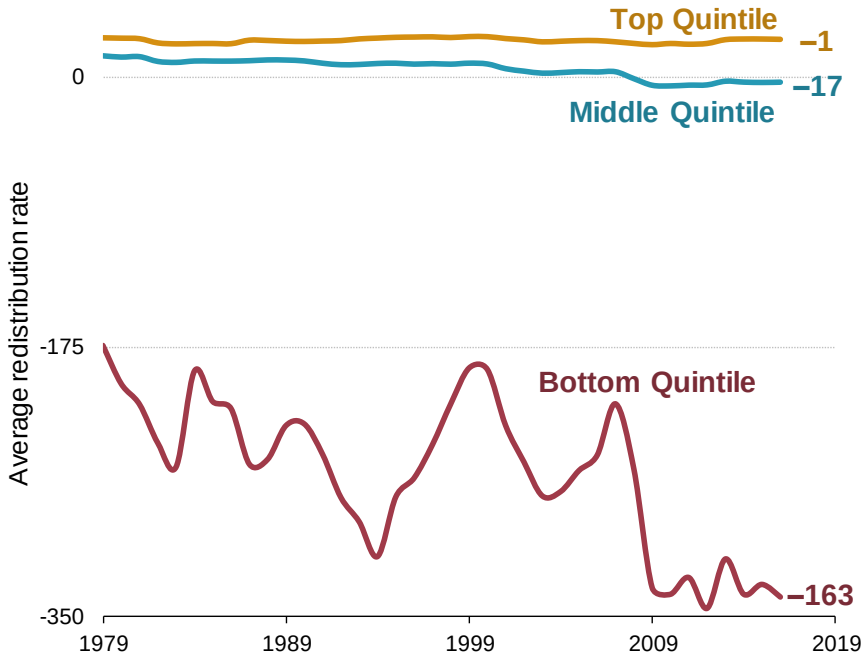
Federal tax elasticity in 1979



Notes: Income is market income plus social insurance benefits. *Source*: Author's calculations using CBO data.

FIGURE B2

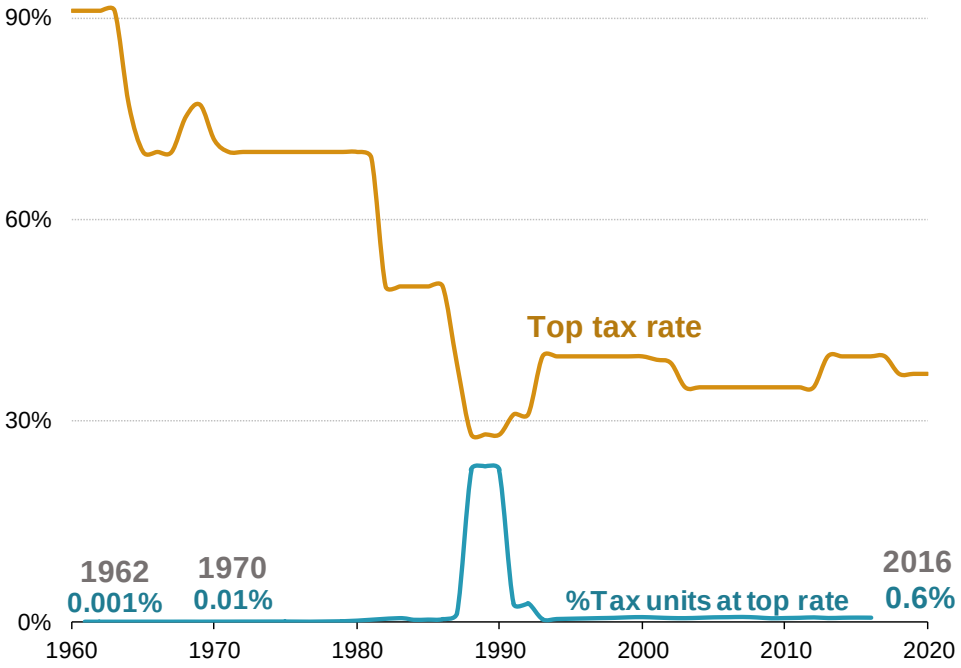
Average redistribution rates (federal taxes less transfers) by income group, 1979–2016



Notes: Individuals are ranked by size-adjusted household market income.
Source: Author's calculations using CBO data.

FIGURE B3

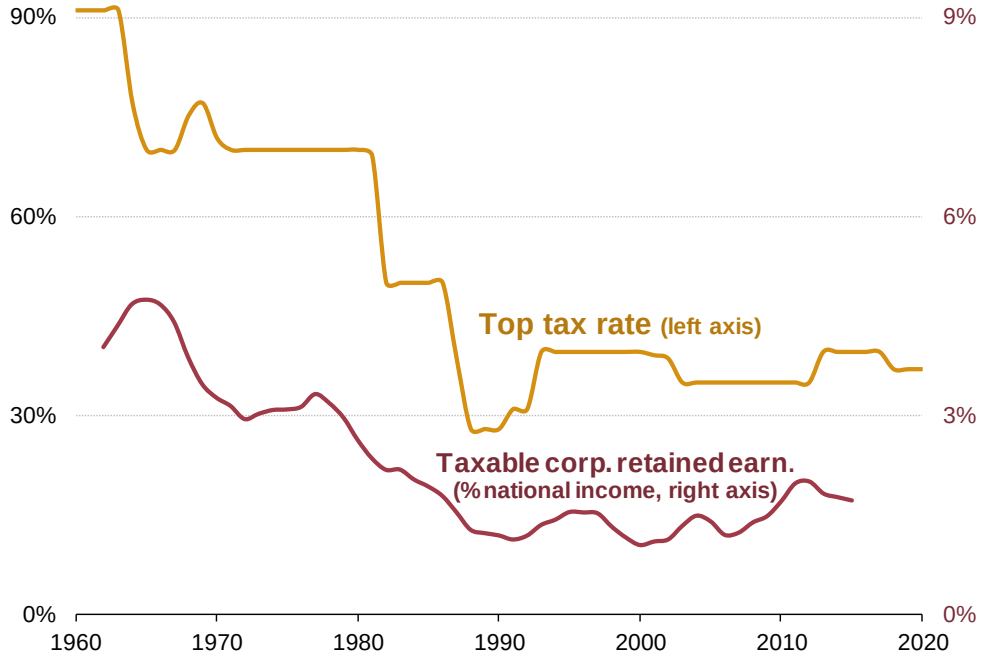
Share of tax units taxed at top federal individual income tax rate and top rate, 1960–2016



Source: Tax Policy Center and author's calculations using IRS Statistics of Income data.

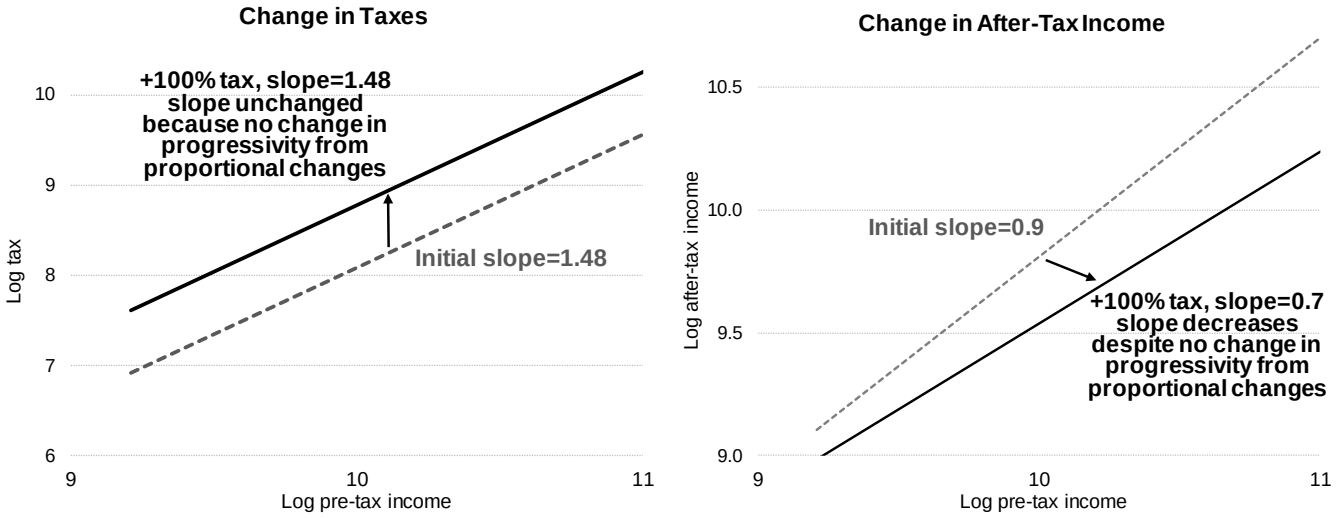
FIGURE B4

Top federal individual income tax rate and degree of high-income tax sheltering, as measured by taxable corporate retained earnings as a share of national income, 1960–2015



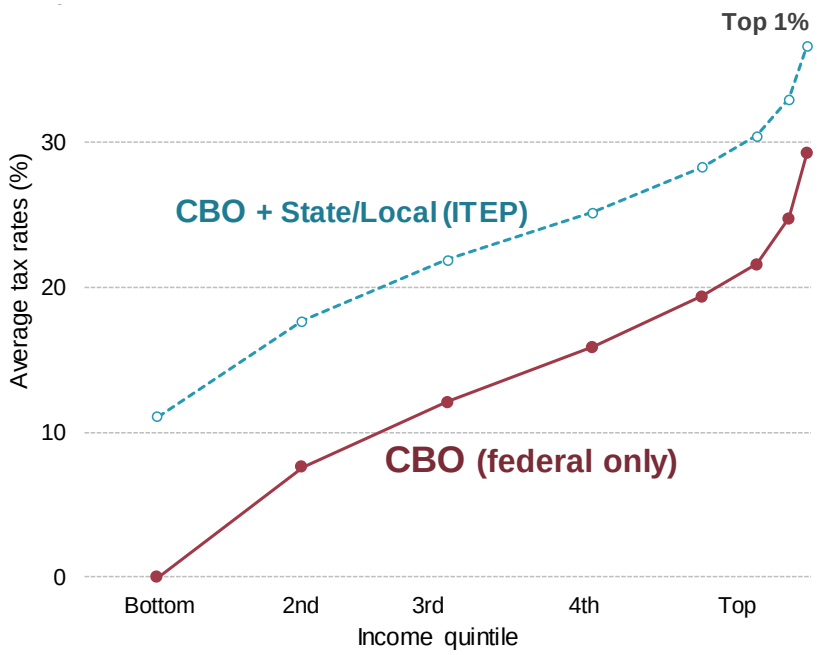
Source: Tax Policy Center and author's calculations using online data from Auten and Splinter (2019).

FIGURE B5
Progressivity versus Redistribution Measures



Notes: Hypothetical example: A has initial income of $10K and tax of $1K, B has income of $100K and tax of $30K; after 100 percent tax increase, A pays tax of $2K and B of $60K.

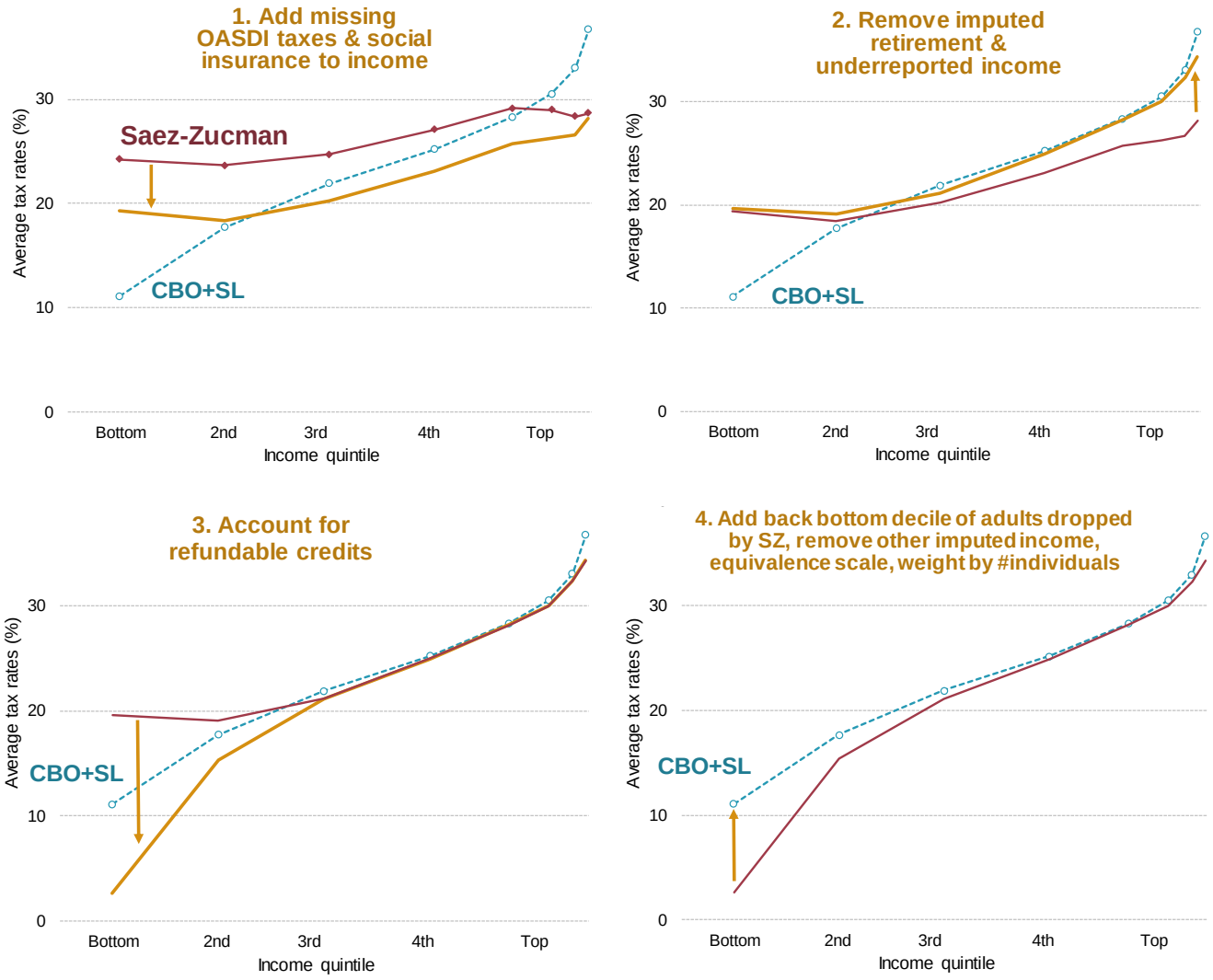
FIGURE B6
Average tax rates in 2010: Effect of adding state/local taxes to federal taxes



Source: Author's calculations using CBO and Institute on Taxation and Economic Policy data.

FIGURE B7

Step-by-step reconciliation of Saez-Zucman and CBO + state/local average tax rates, 2010



Notes: See online data for details. *Source*: Author's calculations using data from CBO, IRS Statistics of Income, the Institute on Taxation and Economic Policy, Piketty, Saez, and Zucman (2018), and Saez and Zucman (2019).