The Role of Taxes in Mitigating Income Inequality Across the U.S. States

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Abstract

Income inequality has risen dramatically in the United States since at least 1980. This paper examines the role that tax policies play in mitigating income inequality. The analysis primarily focuses on state taxes, but also explores federal taxes. Two empirical approaches are employed. First, cross-sectional estimates compare before-tax and after-tax inequality across the 50 states and the District of Columbia. Second, inequality estimates across time are calculated to assess the evolution of the effects of tax policies. The results from the first approach indicate that the tax code reduces income inequality substantially in all states. All of this compression of the income distribution is attributable to federal taxes as state taxes, on average, widen the after-tax income distribution slightly. Nevertheless, there is substantial cross-state variation with some states' tax codes meaningfully reducing income inequality and others significantly increasing inequality. We also document that state EITC programs can significantly mitigate income inequality, that sales tax exemptions for food and clothing moderately reduce income inequality, and that state-levied gasoline taxes work to increase inequality. The results of the second empirical approach indicate that the mitigating influence of taxes on income inequality has increased since the early 1980s, with two-thirds of the increase due to the federal tax code and the remaining one-third due to state taxes. The increase at the state level is due mostly to changes to the tax code. In contrast, at the federal level the majority of the increase is due to the widening of the pre-tax wage distribution interacting with the progressive structure of the tax code.

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1 Introduction

Income inequality has been increasing in the United States since at least 1980 and possibly as far back as 1970 (Gottschalk and Smeeding, 2000). The tax policies of the federal and state governments are a potential compensating factor in the rise in income inequality, particularly as they relate to progressivity or the rate at which taxes rise with income.

This paper quantifies the role of taxes in mitigating income inequality. Our work complements past research on this question by focusing on the extent to which taxes—both federal and state—ameliorate income inequality, and by considering all major elements of state tax systems, including sales tax exemptions, motor fuel taxes, and state earned income tax credit (EITC) programs. The influence of state tax systems on inequality is of considerable interest given their size—state taxes are equal to roughly 5 percent of U.S. GDP—and because of the significant heterogeneity across states in the redistributive capacity of their tax regimes. Our work is also relatively unique in that it isolates the impact of tax policy changes at both the federal and state level on inequality over an unusually long span of time.

Our analysis is based on data from the *Current Population Survey* (CPS) and has two components. The first component is cross-sectional in nature. Averaging over nearly the past 30 years, it compares before-tax and after-tax inequality among each of the 50 states and the District of Columbia. Overall, we find that the combined federal and state tax codes substantially mitigate income inequality. However, state tax systems, on average, tend to *increase* income inequality slightly. This average effect, though, obscures economically meaningful differences across the states. In a few states, such as Minnesota, Oregon, and Wisconsin, state taxes compress the income distribution about one-sixth as much as federal taxes do. In contrast, the tax systems in a handful of states, including Mississippi, Tennessee, and West Virginia, widen the income distribution sufficiently to reverse around one-third of the compression achieved by the federal tax code. In terms of specific tax instruments, we find that the state-levied gasoline tax tends to widen the after tax income distribution by a moderate amount. In a number of states, though, it has a larger effect and reverses about

one-tenth of the compression achieved by the federal tax code. Our analysis also shows that exemptions for food and clothing from some states' sales taxes play a quantitatively important role in narrowing the after-tax income distributions in these states. Finally, we document that state EITC programs meaningfully reduce income inequality in a number of states.

The second component of our analysis assesses the evolution over time of tax-induced income compression. We find that income compression brought about by federal and state taxes has increased significantly over the last 30 years, with a more pronounced increase in compression in the bottom half of the income distribution than in the top half. About two-thirds of this increase is due to the federal tax system and the remaining one-third is due to the state tax systems.

Our analysis concludes by decomposing this increase in tax compression into the portion attributable to legislated changes in the tax code and the portion attributable to changes in the pre-tax distribution of income. We conclude that at the state level the increase in compression is explained mostly by changes to the tax code. In contrast, at the federal level we find a majority of the increase is due to the widening of the before tax income distribution interacting with the progressive nature of the federal personal income tax code.

Given data limitations with the CPS our analysis focuses on inequality in what we term the "broad middle" of the income distribution and does not focus on the widely discussed increase in concentration at the extreme high end of the distribution. The remainder of the paper proceeds as follows. Section 2 discusses the past literature on taxes and inequality and highlights our contributions. Section 3 discusses our methodology. Section 4 presents the data. Section 5 discusses the results and section 6 concludes.

2 Related Literature

This paper is closely related to two distinct literatures—the pre-tax income inequality literature and the literature on post-tax inequality and the redistribution of income through the

tax system. There is a vast body of work in these areas and a comprehensive review is well beyond the scope of this paper. Instead, we provide a selective review which summarizes the general conclusions of related past work and which highlights our contribution.

A large share of the pre-tax inequality literature has focused on wage, or earnings, inequality. This work suggests that there was a broad-based surge in wage inequality from 1979 through 1987 as lower incomes fell and upper incomes rose. Since 1988, the labor market has become "polarized" as upper-income inequality has continued to rise, while the increase in lower-income inequality has eased or even partially reversed. These stylized facts can be largely reconciled with changes in the supply of and demand for skilled workers and the erosion of labor market institutions, such as the minimum wage and labor unions, which had played an important role in supporting middle and low incomes.[1]

Taking a broader focus by examining all income, including government transfers, and by expanding the unit of analysis from the individual to the household or family, past researchers who examined the very broad middle of the income distribution have mostly found that total income inequality grew rapidly in the 1980s and then slowed or even flattened in the 1990s (e.g. Danzinger and Gottschalk, 2005; Burkhauser, Feng, and Jenkins, 2009; Burkhauser et al., 2011). Papers which examine all (or most) of the 2000s have generally concluded that inequality rose more quickly over this period than in the 1990s (see Meyer and Sullivan, 2013; Attanasio, Hurst, and Pistaferri, 2012).

Most directly relevant for this paper is the previous research that explicitly explores the connection between income inequality and taxes. Most such work compares pre-tax inequality to post-tax inequality to infer the effect of the tax system on inequality. Piketty and Saez (2007) and the Congressional Budget Office (2011) conclude that the tendency of the federal tax system to reduce income inequality has waned over time. In contrast, Debacker et al. (2013) find that the ability of the federal system to reduce inequality has increased very slightly with time. The differing conclusions may reflect that Debacker et al. (2013) consider only federal income and payroll taxes, while the other authors consider a

[1]This discussion draws heavily from Autor, Katz, and Kearney (2008)

larger set of federal tax instruments including the corporate income tax. Leigh (2008) adds state taxes to the mix, but only considers personal income taxes.

Similar and contemporaneous work to this paper includes Bargain et al. (2013) who examine the effect of legislated policy changes on the post-tax distribution of income, focusing primarily on the federal tax code. This paper, however, has substantially more focus on state tax systems and state-by-state analysis. In particular, we provide an unusually rich analysis of the influence of state taxes on income inequality. Besides state personal income taxes, we also analyze the role of motor fuel taxes, sales taxes (including exemptions for food and clothing), and state EITC programs. Most previous examinations of after-tax inequality in the U.S. present results for the nation as a whole. To the best of our knowledge, the detailed analysis of multiple facets of state tax systems on a state-by-state basis makes this work by far the most comprehensive analysis of the connection between state taxation and income inequality to date. Finally, we analyze our data over nearly three decades—unusually long time horizon.

3 Methodology

3.1 Measuring Income Inequality

Studies of income inequality vary along three primary dimensions—the inequality metric, the unit of analysis, and the income metric (Karoly, 1994). We use the 90/10 income differential (the difference between incomes at the $90th$ percentile of the income distribution and the $10th$ percentile, measured in natural logs). The 90/10 income split, which has been widely used in the recent literature on both income and wage inequality, can be viewed as capturing inequality over the "broad middle" of the income distribution.

Turning to the unit of analysis, we examine all non-elderly households (i.e. those whose head is between the ages of 16 to 64). We exclude elderly households because we are focusing on tax policy, not on transfers targeted at the elderly such as Social Security. To adjust for differences in family size we scale our income measures by $(A + 0.7C)^{0.7}$ where A is the

number of adults in the household and C is the number of children. This scaling allows for differences in costs between adults and children and displays diminishing marginal costs with each additional adult equivalent (Meyer and Sullivan, 2013). For income, we use money income which is fairly standard in the literature on income inequality. Money income is the sum of wages and salaries, business and farm income, capital income, and private and governmental transfers (e.g. disability payments).

3.2 Interpreting the Income Compression Metric

We quantify the effect of taxes on income inequality by measuring their tendency to compress the income distribution; that is, by comparing before-tax measures of inequality to the corresponding after-tax measures. The primary income compression metric is the difference between the before and after-tax 90/10 income split:

$$comp_{90/10} = [log(Y_{90}) - log(Y_{10})] - [\log(Y_{90} * (1 - t_{90})) - \log(Y_{10} * (1 - t_{10}))] \qquad (1)$$

where Y_g is income at the gth percentile of the before-tax income distribution and t_g is the average tax rate at the gth percentile. The first term in brackets in equation (1) approximates the percentage difference between before-tax incomes at the $90th$ and $10th$ percentiles, while the second term captures this percentage difference for after-tax incomes.

Simplifying the terms in equation (1) reveals that $comp_{90/10}$ is solely a function of the average tax rates at the different points in the before-tax income distribution

$$comp_{90/10} = \log\left(\frac{1 - t_{10}}{1 - t_{90}}\right)$$

A system in which taxes are perfectly proportional to income will have a constant average tax rate: $t_{90} = t_{10}$. Such a system would produce no compression of the income distribution because $t_{90} = t_{10} \iff comp_{90/10} = 0$. A progressive tax system has average tax rates that increase with income (Musgrave and Thin, 1948): $t_{90} > t_{10}$. Such a system therefore

produces compression because $t_{90} > t_{10} \iff comp_{90/10} > 0$. Thus, the $comp_{90/10}$ metric can be viewed as a measure of tax progressivity. A positive value indicates a progressive tax, 0 indicates a proportional tax, and a negative value indicates a regressive tax. See the online appendix for a further discussion of this compression metric.

3.3 Tax Incidence Assumptions

The statutory incidence of a tax – i.e. the legal responsibility for paying the tax – may differ from the economic incidence of the tax. We generally follow the previous literature in our incidence assumptions: As in Musgrave (1951), Gramlich, Kasten, and Sammartino (1993), and numerous others, we assign the incidence of payroll taxes to workers, the incidence of the personal income tax to the individual receiving the income, and incidence of general sales and excise taxes to those who consume the taxed commodities. These assumptions render large scale empirical incidence estimates feasible. Furthermore, they are generally quite consistent with recent empirical research.

Starting with the payroll tax, the assumption that the full incidence falls on workers has been "tested and confirmed repeatedly" (Fullerton and Metcalf, 2005). Although it has been almost universally assumed that the legal and economic incidence of the personal income tax are equal, this assumption has never been tested (see Fullerton and Metcalf, 2005). However, as discussed below in section 3.4, recent research has concluded that individuals in the broad middle of the income distribution – the focus of this study – display little behavioral response to changes in income tax parameters. It is a "fundamental principle" of incidence analysis that the inelastic agent bears the incidence of a tax (Kotlikoff and Summers, 1987). The implication is that the individual being taxed bears the full incidence of the income tax.

There is an important caveat, though, to the above conclusion: It is possible that the incidence of the progressive element of state income taxation may not fall on the workers due to labor mobility. If an increase in the progressivity of a state's income tax causes high wage workers to exit the state and low wage workers to enter, then pre-tax wages will be pushed up for high skilled workers and pushed down for low skilled workers. This shift in

the distribution of pre-tax wages will offset the increased progressivity of taxes and there will be no compression of the after-tax income distribution. Feldstein and Wrobel (1998) find evidence in support of this hypothesis using a cross-sectional research design. More recent work, though, which exploits changes in state taxes over time finds much less support for the hypothesis. In particular, Leigh (2008) concludes that shifts in personal income tax progressivity do not affect the pre-tax wage distribution in a state ((see also Thompson, 2011)). Overall, we interpret the recent empirical evidence as supportive of our assumption that the incidence of the personal income tax falls on wage earners.

The assumption that the general sales tax falls on consumers is supported by results in (Poterba, 1996), although there is also evidence of over-shifting (Besley and Rosen, 1999). Overshifting occurs when prices rise by *more* than the amount of the tax—a phenomenon consistent with models of tax incidence under imperfect competition. We test the robustness of our conclusions to overshifting of the sales tax. Turning to the gasoline tax, recent evidence strongly suggests that the tax is fully born by consumers at the state level (see Marion and Muehlegger, 2011; Alm, Sennoga, and Skidmore, 2009).[2]

The incidence of the corporate income tax depends crucially on the extent of international capital mobility: In a small open economy the tax falls fully on labor, while in a closed economy it falls fully on capital (Fullerton and Metcalf, 2005). Although we do not account for the corporate income tax in our primary results, we provide sensitivity analysis that demonstrates our conclusions are robust to accounting for this tax under varying assumptions about its incidence. Finally, we do not account for the property tax in any of our results because it is primarily a local tax while our focus is on state and federal taxes.

3.4 Limitations

There are two important limitations to the methodology employed in this paper that deserve mention. First, measuring income in the far tails of the distribution is quite challenging.

[2]Federal gas tax receipts are a very small fraction of overall federal tax collections, and have little effect on our conclusions.

Properly measuring very high incomes involves a host of difficulties, including thin data and difficulty measuring capital income. Particularly relevant for this study is the top-coding of income in the CPS micro-data. Although we carefully adjust our data to reflect this top-coding, it remains inappropriate for analysis of the very high end of the income distribution. Such analysis is best left to studies focused on the very top earners and undertaken with income tax-filing data (e.g. Piketty and Saez, 2003; Saez and Veall, 2005) or specialized data such as executive compensation records (Frydman and Saks, 2010). Our inability to measure top incomes is an important limitation because a significant portion of the rise in inequality in recent years is due to rapid gains at the extreme top of the distribution (Piketty and Saez, 2003). Turning to the lower end of the distribution, transfer income from the government is a critical component of total income for the poor. Unfortunately, measuring transfer income has become increasingly difficult. In particular, reporting rates for transfer income in the CPS have deteriorated in recent years for programs such as TANF and food stamps (Meyer, Mok, and Sullivan, 2009).

As a result of the difficulties faced in using the CPS to measure income in the tails of the distribution, we focus on inequality as measured in the broad middle of the distribution using the 90/10 income differential.[3] While our inability to measure inequality across the full breadth of the income distribution is a limitation, inequality in the broad middle of the distribution remains of substantial interest.

The second limitation involves the possibility of behavioral responses to taxation. Taxes may influence the after-tax income distribution both through a direct mechanical effect and through an indirect behavioral response. For instance, if the top marginal rate of the personal income tax is lowered, but other tax brackets are left unchanged, high-earners may increase their supply of labor. This tax change would therefore increase inequality both by increasing before-tax income inequality (a behavioral response operating through labor supply) and by

[3]Use of the 90/10 metric mitigates, but fails to eliminate, the problem of mismeasurement of transfer income: the households at the 10th percentile of the income distribution in our sample typically receive substantial transfers from governmental sources. We note though, that the mismeasurement of transfer income is a limitation of virtually the entire literature which has examined income inequality using the CPS (e.g Danzinger and Gottschalk, 2005; Heathcote, Perri, and Violante, 2010).

lessening the compression of the after-tax distribution achieved by the tax code (a mechanical response). Our approach primarily captures the direct, mechanical response. Any behavioral responses to taxes are captured in before-tax income inequality.[4]

Behavioral responses to taxation, however, are likely of only limited relevance for our examination of broad middle income inequality. Recent research has found evidence of substantial behavioral response to income taxes at the high end of the distribution, but it has generally concluded that there is little evidence of a behavioral response in the broad middle of the distribution.[5] However, there is substantial evidence of a labor supply response to the EITC at the lower end of the income distribution (see the surveys by Eissa and Hoynes, 2006; Hotz and Scholz, 2003). We therefore conduct sensitivity analysis that incorporates a behavioral response to the EITC into our income compression metrics and find that our conclusions are not substantially altered.

Finally, we acknowledge that we rely on annual incidence estimates, which can differ substantially from lifetime tax incidence calculations (see Metcalf, 1994). Certain individuals, such as students and retirees, may have low annual income, but high lifetime income. Thus, "static", point-in-time incidence calculations can differ from "dynamic" incidence calculations based on a person's lifetime tax liabilities and income. An earlier version of this paper (Cooper, Lutz, and Palumbo, 2012) included an exercise that suggested that lifetime tax compression was little different from static tax compression.

4 Data

The main data source for this paper is the March CPS, which we access through IPUMS-USA (King et al., 2010). The March CPS contains detailed information on annual earnings for U.S. households in all 50 states and the District of Columbia, allowing us to evaluate the

[4]See Gramlich, Kasten, and Sammartino (1993) for further details.

[5]For example, Saez (2010) finds no evidence of bunching at kink points in the tax schedule beyond the first income tax bracket, again suggesting no behavioral response to taxes through much of the income distribution.

impact of state tax policies across every state.[6] Percentile and other distributional analysis use the CPS household weights to ensure that the analysis is representative of the overall U.S. population.

In order to address the top-coding of income in the CPS, we use cell means developed by Larrimore et al. (2008). These cell means are based on internal CPS data and provide the mean value of all income values which fall above the top-code amount. By using these cell means it is possible to closely replicate the inequality trends found in the internal CPS data (which are subject to much less severe top-coding than are the public version). However, addressing the top-coding in this manner has almost no effect on our results.

Households' federal and state income tax burdens are estimated using the NBER's TAXSIM module, which takes a variety of inputs and returns an estimate of each tax unit's federal and state tax liabilities. The TAXSIM module applies stylized, but reasonably accurate, algorithms to reflect the personal income tax codes at the federal level and for each state. Federal tax estimates include employee and employer contributions to social insurance (Social Security and Medicare). Our sample runs from 1984 through 2011—the last year for which TAXSIM was capable of producing state tax liabilities (as of July 2014).[7]

Sales and gas tax liabilities are inferred based on expenditure data in the *Consumer Expenditure Survey* (CEX) and separate data on state sales tax rates and state and federal gas tax rates. Data on households expenditures on food, clothing, and other taxable goods are merged with the CPS data based on households' age and income group. These data are combined with data on state sales tax rates and exemptions to estimate households' sales tax burden. To estimate a household's gas tax burden we impute the household's gasoline consumption using additional CEX data and state-specific fuel tax data. The CEX sample and the specifics of these matching and imputation procedures are discussed in the appendix.

Overall, we account for the three largest taxes applied to individuals at the state level:

[6]The March CPS also contains information on households' transfer receipts, including disability benefits, veterans benefits, welfare payments, unemployment compensation, social security, and supplemental security income. We include these data in our income measure, but do not analyze the effect of transfers on income inequality given this paper's focus on taxes.

[7]The online appendix includes details of how we implemented TAXSIM for the March CPS.

general sales, personal income, and motor fuels. There are other taxes that we do not account for, such as alcohol excise taxes. These taxes are relatively minor and the taxes that are accounted for in this paper capture much of the variation in tax burdens across states.

5 Results

5.1 Cross-Sectional Approach

Figures 1 and 2 examine the variation in tax-based income compression across states.[8] As already mentioned, the underlying data are annual observations from 1984 to 2011. Percentiles of gross and net income for each state are identified separately by year and then averaged over time. These state averages are then used as inputs to calculate $comp_{90/10}$. Nominal income data are converted to real income using the personal consumption expenditure (PCE) deflator in the National Income and Product Accounts (2000 base year). The figures, tables and text use the terms "gross income" and "before-tax income" interchangeably and "net income" and "after-tax income" interchangeably.

Figure 1 compares gross income (before-tax) inequality to net income (after-tax) inequality across states. The vertical distance between a state and the 45-degree line is equal to the $comp_{90/10}$ metric. All of the states fall beneath the 45-degree line, indicating overall progressive tax systems in every state—that is, their after-tax distributions of income are compressed relative to their before-tax distributions. States with relatively progressive personal income taxes, such as California, Minnesota, New York, and Oregon, have the highest tax compression, while states without a broad-based income tax, such as Florida, New Hampshire, South Dakota and Tennessee, are in the group of states with the least overall tax compression.

The effect of taxes on income inequality can be decomposed into the impact of federal versus state tax policies. This breakdown is shown in Figure 2, which distinguishes federal

[8]We confirmed that the pattern of before-tax income inequality in our data given the 90/10 income split lines up well with the findings of other researchers, particularly Meyer and Sullivan (2013). These results are available upon request.

tax compression (compression excluding state taxes) in Panel A from state tax compression (compression excluding federal taxes) in Panel B.[9]

The results demonstrate that federal taxes are, on average across the states, responsible for all of compression of the net income distribution relative to the gross income distribution. Furthermore, despite significant heterogeneity across states in the extent of before-tax inequality, there is almost no variation across states in terms of the amount of federal compression: The states are very tightly bunched around an almost parallel downward shift in the 45-degree line.

Panel B reveals that about one-half of the states have progressive tax systems that compress income inequality. States such as Oregon, Minnesota, and Wisconsin obtain the greatest degree of compression. In contrast, one-half of the states have tax structures that appear to increase income inequality and effectively offset some of the progressive nature of the federal tax code. The tax systems in Mississippi, Louisiana, Tennessee, and West Virginia are among the most regressive. Notably, the states with the most progressive tax systems tend to have below average pre-tax income inequality (these states are displayed with red hollow squares and appear on the left-hand side of Panel B). Similarly, the states with the most regressive tax systems have above average pre-tax inequality (these states are displayed with blue hollow circles and mostly appear on the right-hand side of Panel B). Finally, the panel shows greater dispersion in the extent to which state taxes influence inequality compared with federal taxes.

Tables 1 and 2 provide more detailed analysis. Table 1 displays gross versus net income at the $90th$ percentile of the distribution and at the $10th$ percentile of distribution averaged across all states with the final column showing compression as quantified by the $comp_{90/10}$ metric. (The $comp_{90/10}$ metric is multiplied by 100 for ease of exposition in this and all subsequent tables.) The results show that, for the U.S. as a whole, taxes reduce income inequality by 32 percentage points. To place this figure into perspective, 90/10 before-tax

[9]The deductibility of state taxes on federal tax returns, which could reasonably be assigned to either the federal or state tax codes, is assigned to the federal tax code.

wage inequality rose roughly 1.1 percentage points per year, on average, over our sample period (not shown). Thus, taxes undo nearly 30 years worth of income inequality growth. The reduction in inequality ranges from almost 40 percentage points in states such as California and Oregon to about 20 percentage points in less progressive states such as Mississippi, South Dakota and Tennessee (see Table A.1 in the online appendix for the state-by-state results).

Table 2 reports the the $comp_{90/10}$ metric measure separately for federal taxes (column 1) and state taxes (column 2). The table also compares the relative magnitude of state versus federal compression (column 3). The table shows results for the U.S. as a whole as well as select states. (The online appendix includes a full set of state-by-state compression results, along with detailed federal and state compression data.) The results show that, on average, the influence of state taxes on inequality is small relative to federal taxes. In particular, state tax systems *widen* the income distribution by 0.9 percentage point as measured by the $comp_{90/10}$ metric (final row). The federal tax system, in contrast, *compresses* the income distribution by about 30 percentage points. Thus, state systems undo about 3 percent of the compression achieved by the federal system.[10]

The average, though, masks extreme variation across the states. Tax policies in Minnesota and Oregon achieve a reduction in income inequality that is nearly one-fifth the size of federal compression within the same state. In contrast, the tax policies of Tennessee and Mississippi reverse around one-third of the compression caused by federal taxes. Illinois and Florida, both top five states in terms of population, undo roughly one-sixth of the compression induced by the federal system. The state compression metric has a range of roughly 15 percentage points—from around -10 percentage points in Tennessee and Mississippi to 5 percentage points in Minnesota and Oregon—equal to nearly $\frac{1}{2}$ of the compression achieved by the federal tax code.

The remainder of the cross-sectional analysis examines three aspects of state tax systems:

[10]The federal and state compression measures are each calculated as if the given set of taxes (federal or state) are the only taxes in place. The federal and state metrics are therefore not additive to the total tax compression metric in Table 1.

motor fuel taxes, sales tax exemptions, and the EITC. Previous studies of overall state tax incidence have for the most part not singled out and analyzed the effect of state gas tax policies. However, as Table 3 shows, there are noticeable differences across states in the impact of gas taxes on income compression.[11] Column (7) repeats the state compression measure from the middle column of Table 2. Column (8) shows the amount of state income compression assuming the counterfactual that state gas taxes equal zero in all states. The difference between column (7) and column (8)—displayed in column (9)—is the estimated effect of the state gas tax on income compression.

Nationwide (bottom row), state tax systems widen the income distribution by 0.9 percentage point with gas taxes included, but compress the income distribution by 0.6 percentage point when gas taxes are excluded. That is, state gas taxes are responsible for making state tax systems slightly regressive, whereas they would be slightly progressive if motor fuel taxes were abolished. A further examination of Table 3 shows that in some states, such as Alaska and New Hampshire, gas taxes have a small percentage effect on inequality. In contrast, gas taxes widen the distribution of after-tax income substantially in states such as Louisiana, Mississippi and West Virginia. Overall, gas taxes play a moderate role in the extent to which states' tax policies influence income inequality.

Turning to sales tax exemptions, many states exempt clothing and/or food from their sales tax on equity grounds.[12] Although these policies have a significant effect on sales tax revenues—the food exemption alone reduces revenue by as much as 20 percent, all else equal (Due and Mikesell, 2005)—there is little evidence on their distributional effect. However, we assess the policy's effectiveness at mitigating income inequality.

Table 4 reveals that these exemptions reduce income inequality.[13] In total (bottom row), the 90/10 difference metric is equal to -0.9 percentage point when the exemptions are included (column 9) and is -1.9 percentage points (more regressive) under the counterfactual of no

[11] A full set of state results can be found in the appendix (Table A.5).

[12] Some states reduce, but do not eliminate, the sales tax on food and clothing. Unfortunately, our analysis does not capture these reductions and we also do not capture exemptions for items other than food and clothing (for example, books are sometimes exempt).

[13] Again, a full set of state results can be found in the online appendix (Table A.6).

exemptions in any state (column 10). Thus, sales tax exemptions reduce the extent to which state tax systems widen the distribution of after-tax income by 1 percentage point (column 12)—a relatively large effect given that 16 states had no exemptions (or no sales tax) over the period of our study and therefore contribute zeros to the average amount of compression caused by the exemptions.

A similar conclusion is reached by comparing the actual 90/10 differential (column 9) to the counterfactual of all states having full tax exemptions for food and clothing (column 11): full exemptions would narrow the post-tax income differential by about 1 percentage point (column 13). As with the gas tax, there is significant variation across the states in the effect of the exemptions. In states such as Rhode Island and Kentucky, which exempted food for the entire sample period, the exemptions reduce inequality by around 3 percentage points (column 11) – equal to about 10 percent of the compression achieved by the federal tax code (see Table 2).

Finally, we examine the effect of state EITC programs on income inequality.[14] To do so, we limit the period of analysis to 2003-to-2007. Seventeen states offered the credit continuously over this period—a much larger set of states than did so earlier in the sample. The state credits are typically equal to a percent of the federal EITC credit received by the individual, with the percentage ranging from 3.5 percent to 50 percent (IRS, 2014). (We end the analysis as of 2007 so as to mostly avoid the Great Recession.)

Table 5 displays the results of the analysis for these 17 states. Column (7) contains the compression caused by the state tax code over the 2003-2007 period and column (8) displays the same compression metric under the counterfactual of no state EITC programs. State-level EITC programs, on average across these 17 states, increase compression by 1 percentage point, equal to over one-third of total state tax compression in this period for this sub-set of states (bottom row). In a few states with relatively generous credits, such as Maryland and New York (see column 10 for a measure of generosity), the credit accounts for

[14]The EITC is a refundable tax credit targeted at low income working individuals—especially those with children.

well over half of total state compression. On the other hand, the credit has little influence in less generous states such as Illinois and Oklahoma. Overall, the analysis suggests that state EITC programs have the potential to significantly increase the extent to which state tax systems reduce income inequality.

5.2 Time-Series Approach

In this subsection we explore how the influence of taxes on income inequality has evolved over time. Panel A of Figure 3, displays pre and post-tax upper tail income inequality. Upper tail tax compression, $comp_{90/50}$, is the difference between gross income inequality (green line with solid circles) and net income inequality (orange line with solid squares). This difference widens a bit over time, rising from 0.13 log points in 1984 to 0.17 in 2011. That is, upper tail tax compression rose 0.04 log points, an increase of nearly 25 percent.[15]

The changes over time at the bottom of the income distribution are more dramatic as shown by the $comp_{50/10}$ metric (Panel B). In particular, the difference between gross income inequality and net income inequality in the lower tail widens substantially over time, growing from around 0.15 log points in the mid-1980s to 0.22 log points in 2011—an extremely large increase of 50 percent. Finally, Panel C displays total tax compression, $comp_{90/10}$. Tax compression of the broad middle of the income distribution increased a great deal over the sample period as it rose from 0.28 in 1984 to 0.39 in 2011—an increase of 0.11 log points or 37 percent. Of this change, 0.07 can be attributed to the federal tax code and 0.04 can be attributed to the state tax code. Thus, the state tax code was responsible for a little more than one-third of the increase in tax compression for the broad middle of the income distribution. The importance of state taxes in the change in compression is interesting in light of the relative small role that they play for the average level of compression (see Table 2).

Overall, the results Figure 3 suggest that tax compression of the income distribution

[15]Figure A.1 in the online appendix discusses and displays the evolution of the $90th$, $50th$ and $10th$ percentiles of the gross and net income distributions—including the role played in the bottom tail of the income distribution by the Federal EITC.

increased substantially over the nearly 30 years of our sample, with a more sizable increase in the bottom half of the distribution than in the upper half. Figure A.2 in the online appendix explores the evolution over time of tax compression on a state-by-state basis, and further confirms the increase in tax compression over our period of study.

The time-series analysis presented so far confounds two factors. First, as before-tax income inequality increases, the impact of the tax system on inequality may change even in the absence of any adjustments to the tax code. More specifically, under a progressive tax system in which the function relating income to taxes is stable, an increase in before-tax inequality would be expected to increase compression as quantified by the $comp_{90/10}$ metric (see Section 3.2). Second, the tax code is often adjusted over time, and may even be adjusted in response to changes in pre-tax income inequality (e.g. Piketty, 1995).[16]

Figure 4 displays counterfactual exercises which isolate the contribution of these two factors. Panel A displays after tax income inequality (the red line with hollow squares) and before tax income inequality (the blue line with solid diamonds) assuming that the income distribution in all years equals the 1988 real income distribution. By holding the income distribution fixed, the effect of legislated tax changes is isolated. The counterfactual tax compression measure is calculated as the difference between the counterfactual gross income inequality and counterfactual net income inequality. As the counterfactual gross income inequality is fixed (i.e. a horizontal line on the graph), movements in counterfactual net income inequality map one-for-one into the counterfactual tax compression measure.

In Panel A, the counterfactual net income inequality moves down, on net, by about 0.06 log points over the sample period – a 6 percentage point *increase* in tax compression. As actual tax compression increased by around 0.11 log points over this period (see Panel C of Figure 3), this counterfactual exercise suggests that changes to the tax code accounted for roughly one-half of the change in tax compression over this period. Changes in the income distribution (and the interaction of shifts in the income distribution and the changes to the tax code) explain the remaining one-half.

[16]The increase in overall tax compression is also a function of the interaction of these two factors.

Panels C and E repeat the counterfactual exercise for state and federal tax compression, respectively. (Note that the scale of the vertical axis differs across the panels of Figure 4.) State tax compression holds relatively constant from the mid-1980s through the end of the 1990s and then begins to increase thereafter. Over the entire period it increases by 0.03 log points. As actual state compression increased by 0.04 log points (see Panel C of Figure 3), changes to the tax code account for most of the change in state compression. This conclusion is very consistent with the finding that state taxes on average, over the entire sample period, have only a limited effect on income inequality (e.g. Table 2). With a nearly neutral tax structure—i.e. neither progressive nor regressive—there is little scope for a change in pre-tax inequality to alter the amount of tax compression.

In Panel E, after-tax income inequality drifts down over time, implying a gradual increase in federal tax compression. There is a notable increase in compression in the mid 1990s, possibly reflecting the effects of the Omnibus Budget Reconciliation Act of 1993 (which began affecting tax liabilities in 1994). There is also a noticeable increase in tax compression in 2009 which is subsequently reversed in 2011, potentially reflecting the effects of temporary stimulus measures enacted through the federal tax code. Overall, counterfactual federal tax compression increased by 0.03 log points over the period. Given that actual federal compression increased by 0.07 log points, legislated changes to the tax code therefore account for around 40 percent of the change in actual federal compression. Perhaps surprisingly, changes to federal taxes and changes to state taxes contribute equally to the increase in tax compression.

Figures B, D and E repeat the counterfactual exercise, but assume that the 2006 real income distribution was present in all years. The conclusions reached are extremely similar to those based on the 1988 real income distribution.

Overall, we conclude that around two-thirds of the increase in tax compression from 1984 through 2011 is due to the federal tax system and the remaining one-third is attributable to state tax systems. Most of the increase due to state taxes arises from changes to the tax codes. At the federal level, in contrast, a majority of the increase is due to the increase in

pre-tax inequality interacting with a progressive tax structure. Legislated tax changes did, however, play some role.

Finally, Figure 5 focuses on state taxes and presents two net income inequality counterfactuals. The first counterfactual assumes that the entire sample is subject to the state tax code of Minnesota in all years (orange line with x's), while the second assumes that the entire sample is subject to the state tax code of Tennessee in all years (brown line with solid triangles). The choice of Minnesota and Tennessee reflect the analysis in Table 2 that indicates Minnesota is a high compression state whereas Tennessee is a state that substantially widens the income distribution through taxation. Actual net income inequality (blue line with solid squares) is calculated using households' true state of residence.

Net income inequality based on assigning everyone the Minnesota state tax system is well below actual net income inequality across the U.S., suggesting that if all states switched to Minnesota's tax code, after-tax wage inequality would fall. In contrast, a switch by all states to the Tennessee tax code would serve to increase after-tax inequality substantially. The average gap between the two state net income counterfactuals, 0.13 log points, is quite large, equal to roughly 40 percent of the compression achieved by the federal tax code (0.33 log points). This exercise further highlights the substantial dispersion in state-based tax compression across the United States.

5.3 Sensitivity Analysis

Table 6 assesses the robustness of our conclusions to differing assumptions about tax incidence and to the possibility of a labor supply response to receipt of the EITC. The analysis is presented for total U.S. outcomes. The first row replicates the bottom row of Table 2 in order to provide a baseline.

Panel A presents results which assume that the sales tax is subject to 100 percent overshifting – i.e. the price paid by consumers rises by twice the amount of the tax. One-hundred percent overshifting is consistent with the evidence in Besley and Rosen (1999). The sales tax is a relatively regressive component of state tax systems. Correspondingly, increasing

its magnitude pushes state tax systems toward being more regressive. The magnitude of this effect is large, as the state tax compression metric changes from -0.9 in the baseline estimate to -4.3 in the overshifting estimate. Although this result is an important caveat to our conclusions, we are hesitant to place too much weight on it for two reasons. First, studies suggest the sales tax is not overshifted (see Poterba, 1996). Second, overshifting is a theoretic possibility only when firms have pricing power. We assume in our sensitivity analysis that all retail goods are subject to 100 percent overshifting, but many goods are subject to competitive pressures which limit the ability of firms to set prices. Thus, even if overshifting is prevalent for some goods, the results in Panel A almost certainly overstate its importance.

Panel B presents results which account for the federal corporate income tax.[17] Consistent with previous studies (e.g. Gramlich, Kasten, and Sammartino, 1993), we assign the incidence of the tax based on a tax unit's share of either aggregate labor income or aggregate capital income. Capital income is measured as the sum of interest income, dividend income, and realized capital gains. The first row assigns the full incidence of the corporate income tax to capital, consistent with a closed economy, while the second row assigns the full incidence to labor, consistent with a small open economy. The third row assigns the incidence 40 percent to capital and 60 percent to labor, consistent with the beliefs of public finance economists at top-40 U.S. academic institutions (Fuchs, Krueger, and Poterba, 1998). Accounting for the corporate income tax has a moderate effect on the results, increasing the amount of federal compression by roughly 15 percent with the full incidence on capital, by 12 percent with the 60/40 incidence assumption, and by about 9 percent with the full incidence on labor.

Panel C presents results which allow for a labor supply response to the EITC. Indeed, the existing literature finds that there is a a strong positive relationship between the EITC and employment with nearly all the response being on the extensive margin rather than intensive margin. Focusing on the labor force participation decisions of single women with

[17]We do not consider state corporate income taxes as they usually account for 5 percent or less of annual state tax collections.

children we find that failure to account for a labor supply response to the EITC may cause us to understate tax compression by 13 percent.[18] Thus, by drawing low-income individuals into the labor force and thereby boosting their income, the EITC may be increasing the tax compression by more than what we observe in our baseline estimate.

6 Conclusion

This paper documents the role of the federal and state tax codes in compressing the after-tax distribution of income relative to the before-tax distribution—that is, to mitigate income inequality—over the broad middle of the income distribution. The overall progressive structure of federal taxes tends to mitigate income inequality across households to a substantial extent in all U.S. states. However, we find that state-levied taxes, on average, work to exacerbate income inequality. Looking at average state tax compression, however, masks significant heterogeneity across states. A few states' income compression is equal to one-fifth of the compression caused by the federal code in the same state. On the other hand, the tax systems in several states reverse about one-third of the compression of the income distribution caused by the federal tax code. We find that state levied gas taxes increased income inequality moderately, while and sales tax exemptions decrease inequality moderately. We also demonstrate that generous state-based EITC credits can substantially increase the compression caused by state tax systems.

Between 1984 and 2011 the mitigating effect of taxes on income inequality appears to have strengthened as the rapid rise in income inequality in the before-tax distribution was passed less than one-for-one into the after-tax distribution. Federal taxes explain two-third of this strengthening with state taxes explaining the remainder. The strengthening at the state level is mostly explained by changes to the tax code. At the federal level, though, a majority of the strengthening is attributable to the increase in pre-tax earnings interacting with the progressive tax schedule.

[18] Our estimation approach is explained in detail in the online appendix.

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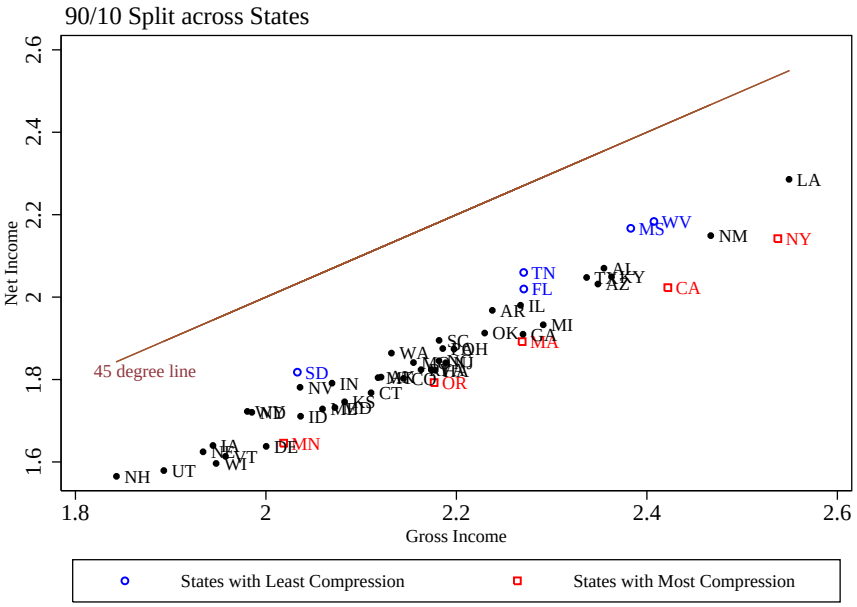
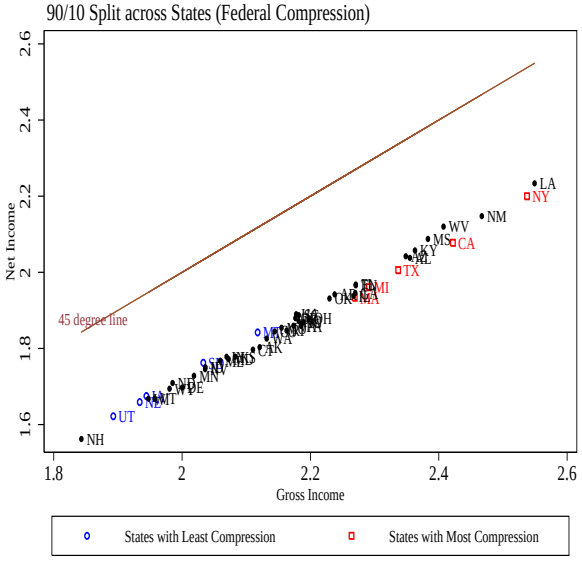
Figure 1: Differences Among U.S. States



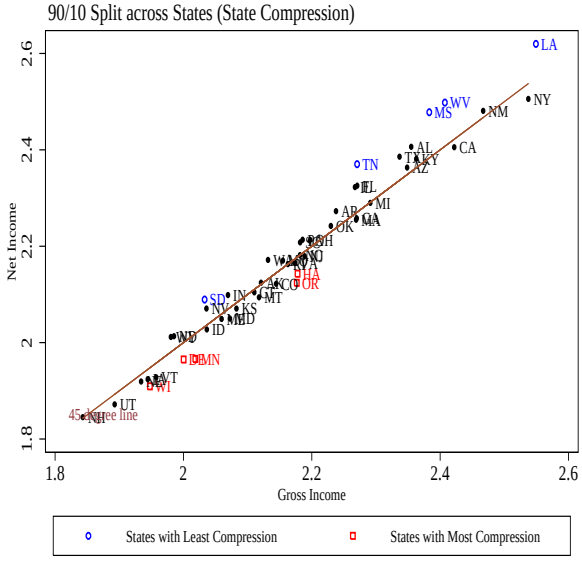
Source: Authors' calculations using CPS data.

Figure 2: Compression from Federal and State Tax Systems Among States

Panel A



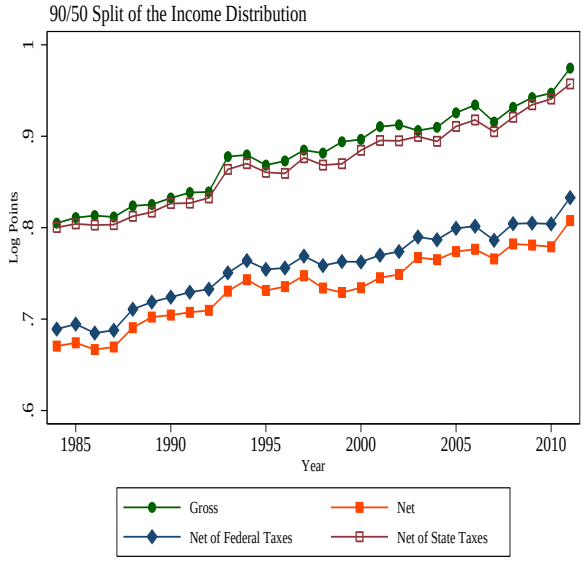
Panel B



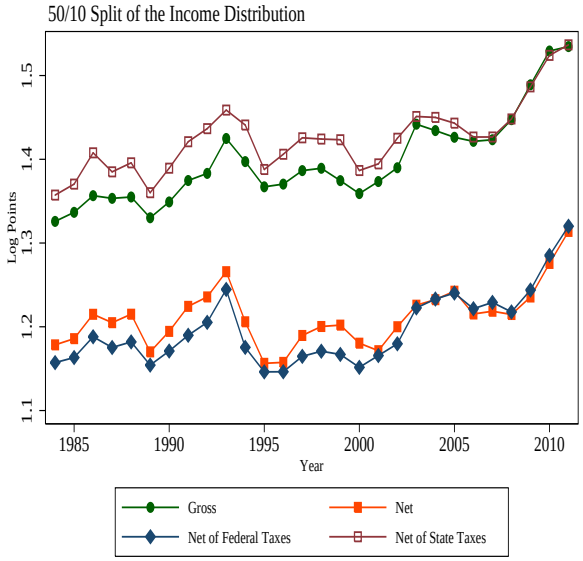
Source: Authors' calculations using CPS data.

Figure 3: Pre and Post-Tax Income Inequality Over Time

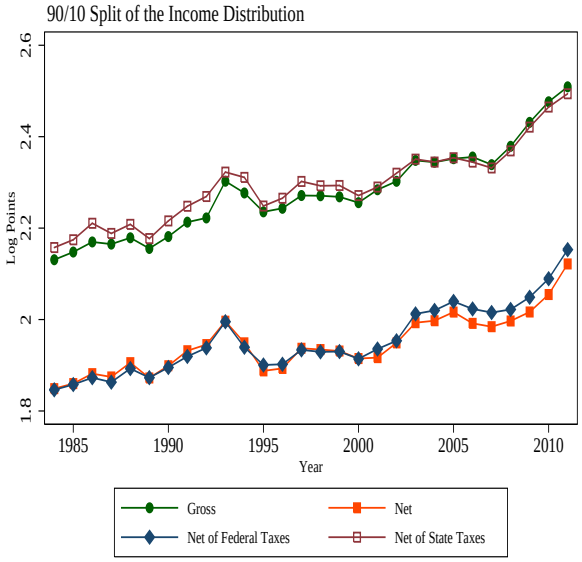
Panel A



Panel B

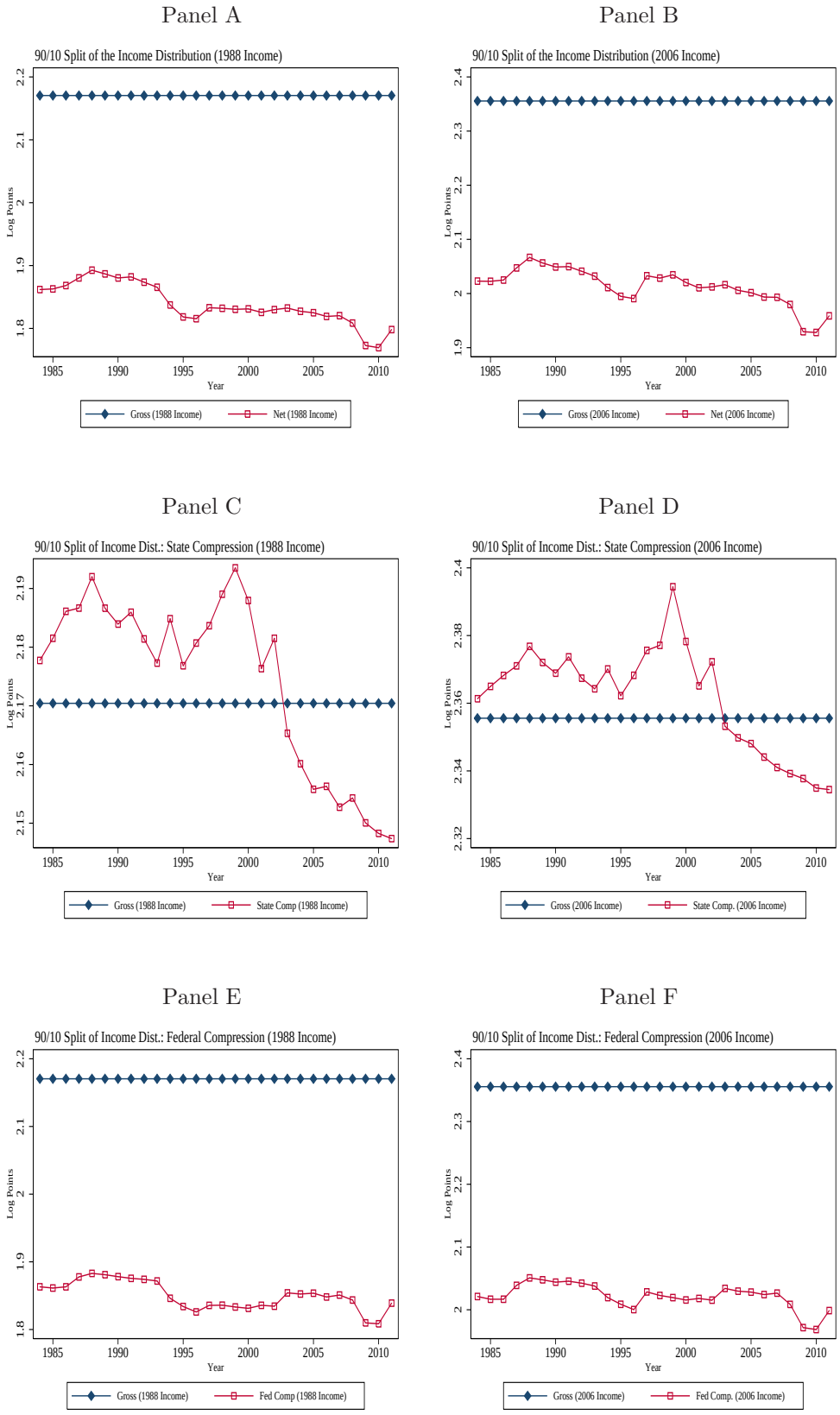


Panel C



Source: Authors' calculations using CPS data.

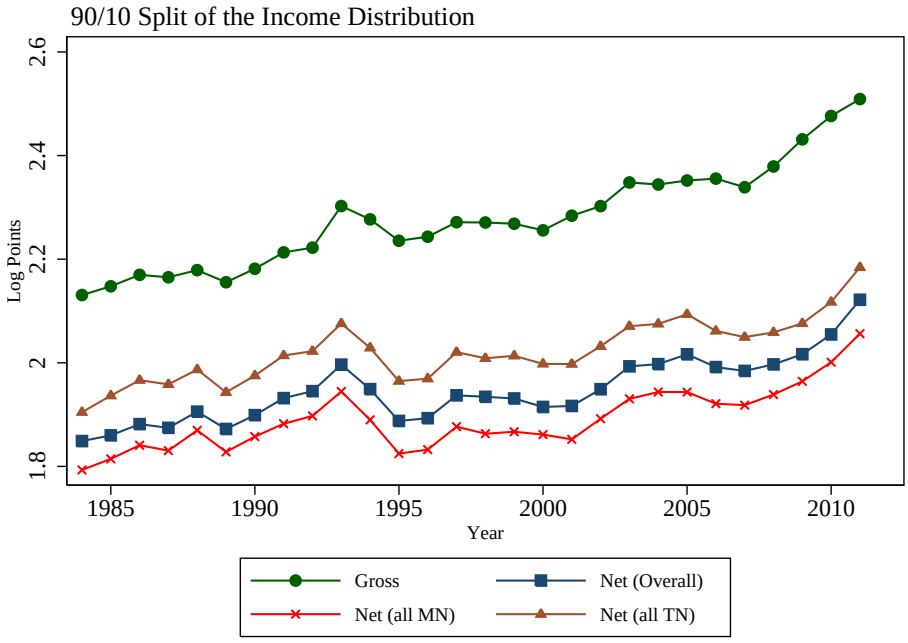
Figure 4: Tax Compression Under Counterfactual Income Distributions



Source: Authors' calculations using CPS data.

Note: Panels on the right use the 2006 income distribution; panels on the left use the 1988 income distribution.

Figure 5: Counterfactual State Tax Schemes



Source: Authors' calculations using CPS data.

Table 1: Total Compression (Select States)

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
CA	70.3	43.0	6.2	5.7	39.9
MS	45.9	30.9	4.2	3.5	21.6
OR	57.2	36.4	6.5	6.1	38.4
SD	48.1	34.0	6.3	5.5	21.5
TN	50.3	34.8	5.2	4.4	21.1
Total	58.0	37.7	6.6	5.9	31.5

Source: Authors' calculations using CPS data. Notes: [1] Percentage points. A full set of state results can be found in the online appendix.

Table 2: Federal and State Compression (Select States)

	Gross 90/10 -Net 90/10 Federal[1]	Gross 90/10 -Net 90/10 State[1]	State as % Federal
MN	29.0	5.2	18.1%
MS	29.5	-9.5	-32.2%
OR	29.7	5.3	17.7%
TN	30.5	-10.0	-32.7%
Total	30.4	-0.9	-2.9%

Source: Authors' calculations using CPS data. Notes: [1] Percentage points. A full set of state results can be found in the online appendix.

Table 3: State Compression: Gas Tax Analysis (Selected States)

	90th Percentile			10th Percentile			90/10	90/10	(7) - (8)[2]
	Gross Inc.	Net Inc.	Net Inc. x Gas[1]	Gross Inc.	Net Inc.	Net Inc. x Gas[1]	Compression[2]	Compression x Gas[1,2]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AK	68.2	68.2	68.3	8.2	8.1	8.2	-0.3	-0.0	-0.3
AL	50.8	48.5	48.6	4.8	4.4	4.5	-5.1	-2.7	-2.5
AR	46.1	43.4	43.6	4.9	4.5	4.6	-3.5	-1.0	-2.5
GA	57.5	54.1	54.2	5.9	5.7	5.7	1.2	2.0	-0.8
HA	65.1	60.0	60.1	7.4	7.0	7.1	3.5	4.3	-0.8
LA	52.0	49.9	50.1	4.1	3.6	3.8	-7.1	-4.0	-3.1
MS	45.9	43.5	43.6	4.2	3.6	3.8	-9.5	-6.6	-2.9
NH	63.3	63.1	63.3	10.0	10.0	10.1	-0.2	0.3	-0.6
WV	46.2	43.3	43.5	4.2	3.6	3.7	-9.1	-5.8	-3.3
Total	58.0	55.1	55.3	6.6	6.2	6.4	-0.9	0.6	-1.5

Source: Authors' calculations using CPS data. Notes: [1] Post-tax income excludes state gas taxes. [2] Percentage points. All income data values are in $1000s of 2000 dollars. A full set of state results can be found in the online appendix.

Table 4: State Compression: Sales Tax Exemption Analysis (Selected States)

	90th Percentile				10th Percentile				90/10	90/10	90/10	(9)-(10)[3]	(9)-(11)[3]
	Gross Inc.	Net Inc.	Net Inc. no Ex.[1]	Net Inc. Full Ex.[2]	Gross Inc.	Net Inc.	Net Inc. no Ex.[1]	Net Inc. Full Ex.[2]	Comp-ression[3]	Compression No Ex.[1,3]	Compression Full Ex.[1,3]		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
AK	68.2	68.2	68.2	68.2	8.2	8.1	8.1	8.1	-0.3	-0.3	-0.3	0.0	0.0
AL	50.8	48.5	48.5	48.7	4.8	4.4	4.4	4.5	-5.1	-5.1	-2.2	0.0	-2.9
AR	46.1	43.4	43.4	43.6	4.9	4.5	4.5	4.6	-3.5	-3.5	-0.4	0.0	-3.1
CA	70.3	65.4	65.1	65.5	6.2	5.9	5.8	5.9	1.6	-0.4	2.1	2.0	-0.5
CO	65.6	62.3	62.2	62.4	7.7	7.5	7.4	7.5	2.2	1.5	2.4	0.7	-0.2
FL	57.8	57.2	56.9	57.2	6.0	5.6	5.4	5.6	-5.5	-7.7	-4.9	2.2	-0.6
KY	50.8	47.8	47.5	47.8	4.8	4.4	4.3	4.4	-1.9	-4.6	-1.2	2.8	-0.6
MN	61.7	57.2	56.8	57.2	8.2	8.0	7.8	8.0	5.2	3.4	5.2	1.8	0.0
MS	45.9	43.5	43.5	43.8	4.2	3.6	3.6	3.9	-9.5	-9.5	-4.3	0.0	-5.2
RI	61.5	57.8	57.5	57.8	7.1	6.7	6.4	6.7	0.0	-2.9	0.0	2.9	0.0
WV	46.2	43.3	43.2	43.5	4.2	3.6	3.5	3.7	-9.1	-9.8	-5.4	0.7	-3.7
Total	58.0	55.1	54.9	55.2	6.6	6.2	6.2	6.3	-0.9	-1.9	0.2	1.0	-1.1

Source: Authors' calculations using CPS data. Notes: [1] Post-tax income excludes state sales tax exemptions. [2] Post-tax income assume food and clothing are exempt from sales taxes in all states. [3] Percentage points. All income data values are in $1000s of 2000 dollars. A full set of state results can be found in the online appendix.

Table 5: State Compression: EITC TAX Analysis

	90th Percentile			10th Percentile			90/10	90/10	(7) - (8)[2]	Percent of
	Gross Inc.	Net Inc.	Net Inc. x EITC[1]	Gross Inc.	Net Inc.	Net Inc. x EITC[1]	Compression[2]	Compression x EITC[1,2]		Federal EITC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DC	99.4	90.3	90.3	5.3	5.0	4.9	3.8	1.7	2.1	31%
IA	59.8	56.2	56.2	7.5	7.1	7.1	1.7	1.7	0.1	7%
IL	67.6	64.5	64.5	6.9	6.3	6.3	-3.7	-4.2	0.4	5%
IN	59.2	56.4	56.4	6.6	6.1	6.0	-3.2	-3.8	0.6	6%
KS	60.3	56.4	56.4	6.7	6.4	6.4	1.8	0.9	0.9	15%
MA	83.0	77.9	77.9	7.2	6.9	6.8	2.5	1.2	1.3	15%
MD	82.1	77.6	77.6	8.6	8.4	8.2	2.8	0.6	2.2	20%
ME	57.7	53.6	53.6	6.5	6.2	6.2	3.1	2.6	0.6	5%
MN	69.3	64.6	64.6	9.6	9.6	9.4	6.6	4.6	1.9	33%
NE	60.4	56.5	56.5	7.8	7.5	7.5	3.0	2.6	0.4	8%
NJ	86.7	82.0	82.0	9.0	8.8	8.7	3.0	2.2	0.8	20%
NY	73.8	69.1	69.1	5.5	5.4	5.3	5.6	2.3	3.3	30%
OK	58.8	54.8	54.8	6.4	6.0	6.0	0.2	-0.1	0.3	5%
OR	60.8	56.6	56.6	6.5	6.4	6.3	5.0	4.4	0.6	5%
RI	68.3	63.8	63.8	7.1	6.8	6.7	1.8	1.7	0.1	25%
VT	61.2	57.6	57.6	8.2	8.1	8.0	5.1	4.3	0.7	32%
WI	60.5	56.3	56.3	8.0	7.8	7.8	4.3	4.3	0.0	14%
Average	68.8	64.4	64.4	7.3	7.0	6.9	2.6	1.6	1.0	NA

Source: Authors' calculations using CPS data. Notes: [1] Post-tax income excludes state EITC. [2] Percentage points. Calculated over 2003 - 2007. The percentage of the federal credit in column 10 is an average across the years 2003-2007. For MN column 10 is averaged across recipient categories within year and for WI is for families with two children. All income data values are in $1000s of 2000 dollars.

Table 6: Sensitivity Analysis: Tax Incidence

	U.S. Total		
	Gross 90/10 -Net 90/10 Federal[1]	Gross 90/10 -Net 90/10 State[1]	State as % Federal
Baseline (Table 2)	30.4	-0.9	-2.9%
Panel A:			
100% Sales Tax Over Shift	30.4	-4.3	-14.3%
Panel B:			
Corporate Taxes			
Accrues 100% to Capital[1]	35.3	-0.9	-2.9%
Accrues 100% to Labor[2]	33.0	-0.9	-2.6%
Accrues 40% Capital 60% Labor	34.0	-0.9	-2.8%
Panel C:			
EITC Adjustment	34.3	-1.0	-2.0%

Source: Authors' calculations using CPS data. Notes: [1] Corporate tax allocated based on a household's share of aggregate capital income. [2] Corporate tax allocated based on a household's share of aggregate labor income.

A Online Appendix

A.1 Implementing TAXSIM

The NBER's TAXSIM module calculates federal and state income tax liabilities at the *tax unit* level. A major task in preparing the CPS data for processing by TAXSIM is to combine the individual-level CPS data into tax units. In particular, we define individuals over the age of 18 as their own tax unit even if they are living in the same household as their parents and/or other relatives. Children over the age of 15 who are members of a household in the CPS, but who have positive wages and/or other earnings, are also classified as their own tax unit. In addition, we identify tax units as "joint" filers if the primary tax payer (household head) is married, "single" if the primary tax payer is unmarried, and "head of household" if he/she is unmarried but has dependents. When available, a spouse's income data are combined with the primary taxpayer's income data for all relevant income categories.

The other major task with implementing TAXSIM is to match the CPS earnings data categories with the appropriate income categories utilized by TAXSIM as inputs for calculating taxpayers tax liabilities. Total earnings are defined as the sum of business, farm, and wage income, and there is a fairly direct match between the remaining data needed to run TAXSIM and the data available in the CPS, with a few exceptions. In particular, dividend income data are only available as a separate category in the CPS from 1988 onward (TAXSIM #9). Prior to 1988 these data were included in capital income, which falls under the "other income" category in (TAXSIM #10). As a result, the stand-alone dividend income category is set to zero prior to 1988. In addition, the CPS does not have data on a tax unit's rent paid, child care expenditures, or unemployment compensation.[19] (TAXSIM #s 14, 17, 18). These fields are also set to zero. We impute capital gains based on tax return data collected by the Statistics of Income (SOI) section of the IRS. This imputation procedure is based on a tax unit's inflation-adjusted wages and marital status. Finally, we use the same procedure with SOI data to impute whether or not a tax unit itemizes its deductions and the dollar amount of its itemized deductions (if applicable).[20]

After executing TAXSIM, we aggregate tax unit income tax liability data up to the household level (our unit of analysis for the CPS). These liabilities are then added to a household's estimated sales tax and gas tax burdens to get a measure of its total tax burden.

A.2 Using CEX Data to Calculate Sales and Gas Tax Burdens in the CPS

The CEX is a nationally representative survey, but it contains a smaller sample than the CPS and the state identifiers for households living in a number of the less populated states in the U.S. are suppressed for confidentiality reasons. As a result, we calculate consumers' average expenditures on food, clothing, and other taxable goods by age and income groups

[19]Unemployment compensation is only unavailable prior to 1988. Before this year it was combined with workers compensation and veterans payments. We include unemployment compensation in the "other income" category (TAXSIM #10) in all years.

[20]For the itemization imputation, each tax unit's taxes are calculated twice by TAXSIM—once assuming the unit itemizes and once assuming it does not. The final personal income tax burden for the tax unit is the weighted average of these two calculations with the weight equal to the tax unit's implied probability of itemization.

for the U.S. as a whole.[21,22] Consumers are divided into 10-year age groups, and average expenditures are calculated within these age groups by income decile. Our selection criteria for the CEX sample are discussed below. The CEX expenditure data are then translated into the CPS based on the equivalent age and income groupings. The sales tax burden for each CPS household is then obtained by applying the sales tax rate in the tax unit's state of residence to the relevant expenditure data. Our sales tax liability estimates take into account whether food and/or clothing are exempt from sales taxes in a household's given state of residence.[23,24]

Our approach to calculate a household's gas tax burden is slightly different. We estimate a reduced-form demand equation for gallons of gasoline consumed in the CEX, making use of our data on the total (tax inclusive) price of gasoline to capture the price elasticity of demand. In particular, we estimate

$$g_{it} = \beta_1 p_t^s + \beta_2 Y_{it} * A_{it} + \beta_3 D_t + \epsilon_{it}, \tag{A.1}$$

where g_{it} is gallons of gas consumed by household i in year t, p_t^s is the state-specific price of gas, $Y_t * A_t$ are a set of income (Y) and age group (A) interaction terms (to capture life-cycle influences on gas consumption), and D_t are year and census region dummy variables to capture region and time-specific trends in gasoline consumption.[25] The β parameters from equation (A.1) are used to impute each household's gallons of gasoline consumed in the CPS. The household's gas tax burden is then calculated based on state-specific fuel taxes and the household's imputed gasoline consumption.[26]

A.3 CEX Sample Selection

There are two distinct surveys that constitute the CEX: a "Diary" component that surveys consumers' daily spending habits over the course of two weeks, and an "Interview" survey that asks respondents to report their spending habits for the past three months. In the inter-

[21]Other taxable items include tobacco, alcohol, personal care items (including grooming services), toys, flowers, paper goods, home furnishings, home appliances, vehicles, vehicle parts, medical supplies, books, recreation (including equipment), and jewelry.

[22]A few states have sales tax bases which are broader than the food, clothing and other taxable item categories. Due to the difficulty in quantifying state-by-state differences in sales tax bases over nearly 30 years, our analysis is unable to account for these differences. However, the states that have the broadest bases currently—HI, NM, SD, and WY—are all quite small, and adjusting their bases would have little effect on the results for the U.S. as a whole.

[23]Data on state sales tax rates and sales tax exemptions were collected from the yearly *State Tax Handbook*, published by Commerce Clearing House, Inc. and the yearly *Guide to Sales and Use Taxes*, published by the Research Institute of America.

[24]The CEX expenditure data *include* sales taxes. As a result, the state sales tax rates are applied to the average expenditure data to back out before-tax expenditures. The sales tax burden is the difference between total expenditures and before-tax expenditures.

[25]Consumers in the CEX are divided into five 10-year age groups (A) and 10 income groups (Y). Regional effects are included because consumers in Wyoming may have different driving needs than those in Rhode Island or Massachusetts.

[26]Erich Muehlegger kindly provided yearly data on federal and state gas tax rates per gallon as well as state-level data on before-tax fuel costs (per gallon).

view survey, consumer units (households) are followed for up to four consecutive quarters.[27] Since the interview survey collects spending data for a longer horizon than the diary survey, the interview part of CEX is used in this paper.

The sample selection for the CEX data follows the standard approach in the literature. The primary criteria are that consumer units must be in the sample for all four interviews, and they must have complete income responses.[28] It is necessary for households to be in the survey for all four quarters in order to get an accurate picture of their annual expenditures. The income data are necessary in order to match the CEX expenditures with the CPS data. The CEX tracks the income of husbands and wives separately. These data are combined, where applicable, to get a measure of total income for each household. The earnings categories are chosen to most closely match the earnings data available in the CPS.

In addition, households may begin their quarterly interviews at any month during the year, so it is important to take this timing into account when calculating annual expenditures. If a consumer unit is interviewed for at least two quarters in a given year t, then the reference year for their consumption is t, otherwise the reference year for their spending is $t-1$. This timing convention is consistent with the existing literature

A.4 Changes in Tax Compression Explained

Recall that $comp_{90/10}$ is solely a function of the average tax rates at the different points in the before-tax income distribution

$$comp_{90/10} = \log\left(\frac{1-t_{10}}{1-t_{90}}\right)$$

Changes in tax compression occur in two ways. First, holding the before-tax distribution of income fixed, legislated tax changes that alter average tax rates may change tax compression (for example, $\frac{\partial comp_{90/10}}{\partial t_{90}} > 0$). Second, holding the legislated parameters of the tax system fixed, changes in the distribution of before-tax income may cause a change in compression if the tax system is progressive or regressive, but not if the system is proportional. For instance, under a progressive personal income tax an increase in income for the $90th$ percentile taxpayer will either bump him to a higher marginal tax bracket or will lead him to pay his existing marginal tax rate on a larger fraction of his income: $\frac{\partial t_{90}}{\partial Y_{90}} > 0$. Thus, an increase in $90th$ percentile income will increase compression:

$$\frac{\partial comp_{90/10}}{\partial Y_{90}} = \frac{\partial comp_{90/10}}{\partial t_{90}} * \frac{\partial t_{90}}{\partial Y_{90}} > 0$$

Incomes will often change simultaneously at different points in the before-tax income distribution. Under a progressive tax structure, as long as the dollar increase at the $90th$ percentile is equal to or larger than the dollar increase at the $10th$ percentile, compression will increase. In particular, assume that the tax system is "equally" progressive at both the

[27] Data collection starts in the 2^{nd} interview and runs though the 5^{th} interview. The 1^{st} interview is used only to gather background information on the consumer unit.

[28] Income data are collected only in the 2^{nd} and 5^{th} interviews.

$90th$ and $10th$ percentile of before-tax income such that

$$\frac{\partial t_{90}}{\partial Y_{90}} = \frac{\partial t_{10}}{\partial Y_{10}} = \alpha$$

The change in compression with an increase in $90th$ percentile income is:

$$\frac{\partial comp_{90/10}}{\partial Y_{90}} = \frac{\partial comp_{90/10}}{\partial t_{90}} * \frac{\partial t_{90}}{\partial Y_{90}} = \frac{1}{1 - t_{90}} * \alpha$$

The corresponding compression change at the $10th$ percentile is:

$$\frac{\partial comp_{90/10}}{\partial Y_{10}} = \frac{\partial comp_{90/10}}{\partial t_{10}} * \frac{\partial t_{10}}{\partial Y_{10}} = \frac{-1}{1 - t_{10}} * \alpha$$

Increasing average tax rates, $t_{90} > t_{10}$, imply that

$$\frac{\partial comp_{90/10}}{\partial Y_{90}} > \left| \frac{\partial comp_{90/10}}{\partial Y_{10}} \right|$$

Under the same progressivity assumption, equal *percentage* increases in income at the $90th$ and $10th$ percentiles—which would hold the before-tax 90/10 income differential constant—result in an increase in compression, as such a change implies a larger dollar increase in Y_{90} than in Y_{10}. Similarly, an increase in incomes that widens the before-tax 90/10 differential will yield an increase in compression under a progressive tax system.

A.5 Evolution of Income Percentiles

Figure A.1 displays the evolution of the $90th$, $50th$ and $10th$ percentiles (Panels A, B, and C, respectively) of gross income (green line with solid circles), income net of federal taxes (blue line with solid diamonds), income net of state taxes (red line with hollow squares) and income net of both state and local taxes (orange line with solid squares).[29] The wedge between gross and net income shrinks somewhat over time at both the upper and middle portions of the income distribution, indicating that tax burdens as a share of income were declining. The decline, though, is greater at the 50th percentile than at the 90th percentile, consistent with an increase in tax compression of upper tail income inequality.

Panel C displays a significant narrowing of the difference between gross and net income at the 10th percentile. The narrowing is due to both the federal and state tax codes: the difference between gross income and income net of federal taxes (blue line with solid diamonds) and the difference between gross income and income net of state taxes (red line with hollow squares) both shrink between the mid-1980s and 2007. Significantly, by 2006 there is little difference between gross income and income net of federal taxes.

During and following the Great Recession, gross income at the 10th percentile fell dramatically, but income net of Federal taxes fell by much less. Notably, income net of federal taxes actually stands well *above* gross income over this period. Panel D reveals that this inversion of gross and net incomes is due to the Federal EITC as income net of all Federal taxes but the EITC (the grey line with hollow diamonds) remains below gross income. It

[29]The data shown in Figure A.1 are in logs. As a result, adding the amount of federal compression and the amount of state compression will not equal total (net) compression (that is, $log(A - B) \neq log(A) - log(B)$).

appears that the Federal EITC meaningfully reduced the effect of the Great Recession on lower tail incomes (but by no means eliminated the effect). More broadly, Panel D illustrates the growing importance of the Federal EITC for low-income earners: In 1984 the credit had little influence on lower tail incomes, but by 2011 it substantially boosted these incomes.

A.6 Evolution of Tax Compression over Time

Figure A.2 explores the evolution over time of tax compression on a state-by-state basis. In the top panel, the horizontal axis displays the 20-year change in the *gross* 90/10 log income differential, and the vertical axis displays the corresponding 20-year change in the *net* 90/10 split. Small cell sizes for some states cause the 90/10 splits to vary considerably from year to year. We use 3-year windows of 1984–1986 and 2004–2006 to calculate the 20-year changes in order to smooth through this variability.[30]

States on the 45-degree line passed the change in before-tax income inequality one-for-one into after-tax inequality. States below the line mitigated the rise in inequality by passing through less than 100 percent of the before-tax rise in income inequality to after-tax inequality. Finally, states above the line intensified the increase in inequality by passing through more than 100 percent of the before-tax rise in inequality to after-tax inequality. On average, the states are roughly clustered around a small, almost parallel, downward shift in the 45-degree line. These results therefore again indicate an increase in tax compression over the period of study. Both the state and federal codes play a role in the less-than-full pass-through of the rise in pre-tax inequality (Panels B and C).

A.7 Approach for Evaluating Labor Supply Response to EITC

In the paper we run a counter-factual that allows for a labor supply response to the EITC. We focus our attention on single women with children as this group accounts for most EITC expenditures.[31] The large literature on effect of the EITC on the labor supply of this group comes to remarkably consistent conclusions. First, it finds that there is a strong positive relationship between the EITC and employment rates. The range of estimated elasticities of labor force participation with respect to net income across the studies is narrow: 0.69 to 1.16. Second, there is little evidence of a labor supply response on the intensive margin (i.e. on hours worked conditional on being employed). See Eissa and Hoynes (2006) and Hotz and Scholz (2003) for reviews of this literature and discussion of the labor force participation elasticities.

Consistent with the above findings, we assume that the only labor supply response to the EITC occurs on the labor force participation margin for single women with children. We take the high end of the elasticity range identified in the literature, 1.16, and calculate the implied number of single women with children in our sample who are employed as a result of the EITC (assuming those with the highest EITC receipt are the ones induced to enter the labor force). We then assume that all the labor income of these women is due to the EITC,

[30] We avoid using the final years of the sample so we can compare two periods of economic expansion. This also prevents the comparison from reflecting the *temporary* tax measures enacted in response to the Great Recession.

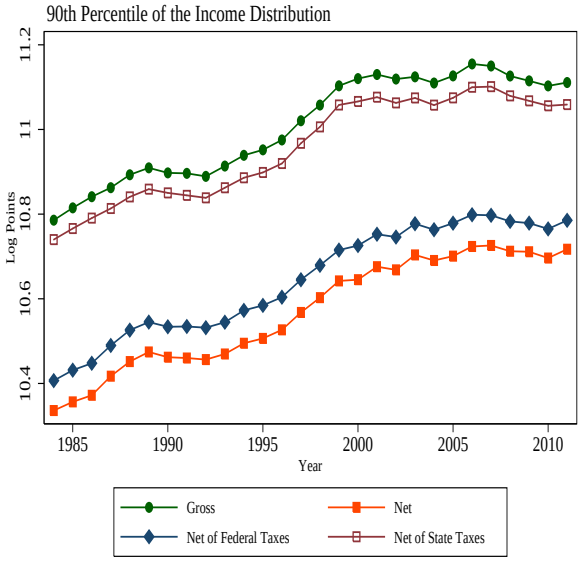
[31] Seventy-five percent of EITC expenditures go to single individuals with children. The disproportionate share of expenditures going to this group reflects the high eligibility rates of single women with children.

and thus set their pre-tax labor earnings to zero, but retain their positive labor earnings in the after-tax measure of income. Finally, we recalculate our compression measure.[32]

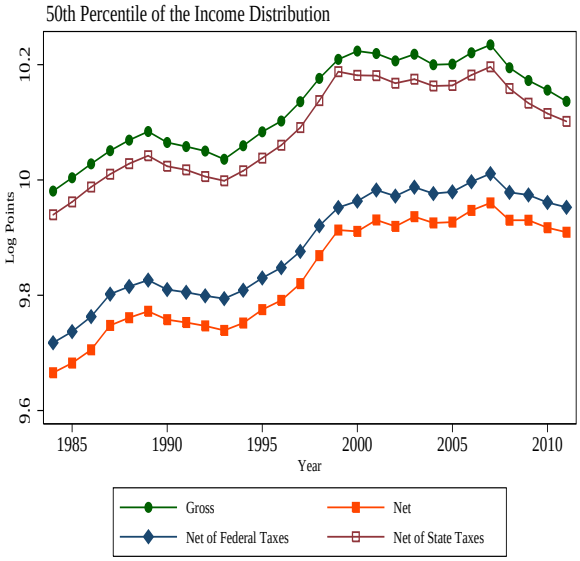
[32]In most states, over most of our sample period, the size of the federal EITC is substantially greater than the state EITC. We therefore only consider the federal EITC in this sensitivity analysis.

Figure A.1: Pre-Tax and Post-Tax Income over Time

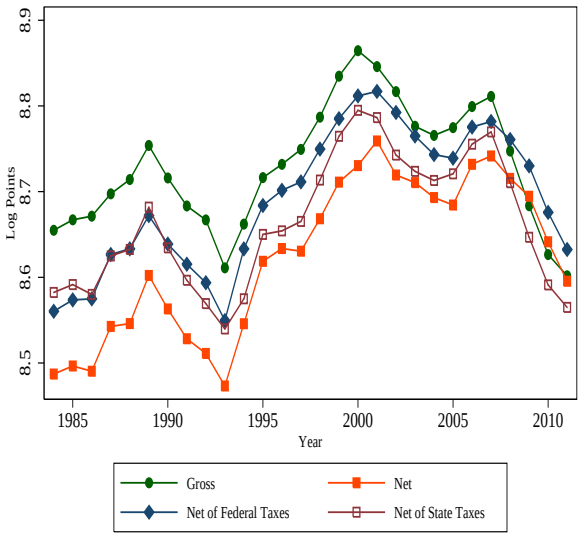
Panel A



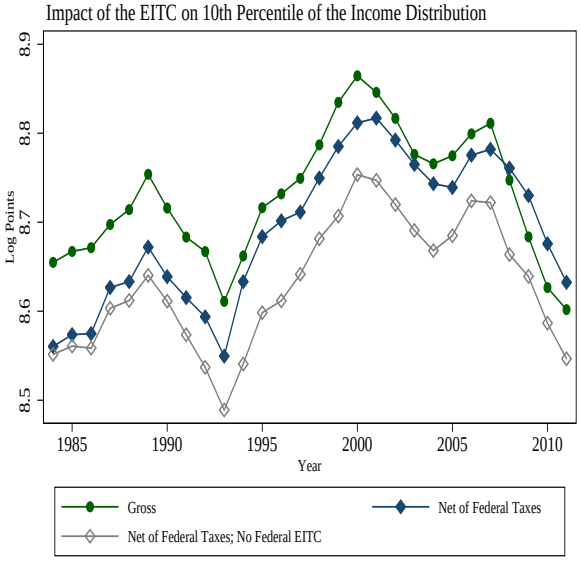
Panel B



Panel C



Panel D



Source: Authors' calculations using CPS data.

Figure A.2: Changes in Income Inequality 1980s to 2000s

Source: Authors' calculations using CPS data.

Table A.1: Total Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	68.2	46.6	8.2	7.7	31.5
AL	50.8	33.9	4.8	4.3	28.5
AR	46.1	30.7	4.9	4.3	27.0
AZ	59.5	39.1	5.7	5.1	31.7
CA	70.3	43.0	6.2	5.7	39.9
CO	65.6	42.0	7.7	6.9	34.2
CT	73.5	46.3	8.9	7.9	34.3
DC	86.7	50.7	4.9	4.4	42.4
DE	60.4	39.0	8.2	7.6	36.2
FL	57.8	39.9	6.0	5.3	25.1
GA	57.5	36.9	5.9	5.5	36.0
HA	65.1	40.8	7.4	6.6	35.5
IA	51.0	33.3	7.3	6.5	30.4
ID	49.9	32.1	6.5	5.8	32.5
IL	62.5	40.4	6.5	5.6	28.7
IN	52.9	35.0	6.7	5.8	27.8
KS	55.0	35.4	6.9	6.2	33.7
KY	50.8	33.1	4.8	4.3	31.4
LA	52.0	34.7	4.1	3.5	26.3
MA	71.5	44.3	7.4	6.7	37.7
MD	71.8	44.9	9.0	7.9	34.0
ME	51.3	33.2	6.5	5.9	33.1
MI	59.7	38.4	6.0	5.6	35.8
MN	61.7	38.4	8.2	7.4	37.3
MO	55.2	35.9	6.4	5.7	31.4
MS	45.9	30.9	4.2	3.5	21.6
MT	46.9	31.7	5.6	5.2	31.3
NC	53.9	34.3	6.1	5.4	33.6
ND	48.1	32.9	6.6	5.9	26.5
NE	52.2	34.2	7.5	6.7	30.9
NH	63.3	43.6	10.0	9.1	27.8
NJ	75.1	47.3	8.4	7.5	34.8
NM	53.6	35.2	4.6	4.1	31.8
NV	58.5	40.0	7.6	6.7	25.5
NY	66.6	41.6	5.3	4.9	39.6
OH	55.7	36.4	6.2	5.6	32.4
OK	52.3	33.9	5.6	5.0	31.7
OR	57.2	36.4	6.5	6.1	38.4
PA	58.9	38.7	6.6	5.9	31.1
RI	61.5	39.4	7.1	6.4	33.9
SC	51.1	33.2	5.8	5.0	28.7
SD	48.1	34.0	6.3	5.5	21.5
TN	50.3	34.8	5.2	4.4	21.1
TX	58.8	40.0	5.7	5.2	28.9
UT	53.0	34.2	8.0	7.0	31.4
VA	69.8	43.4	7.9	7.0	35.0
VT	54.8	35.7	7.7	7.1	34.4
WA	62.7	42.6	7.4	6.6	26.8
WI	54.8	35.0	7.8	7.1	35.1
WV	46.2	30.4	4.2	3.4	22.4
WY	51.7	36.2	7.1	6.5	25.8
Total	58.0	37.7	6.6	5.9	31.5

Source: Authors' calculations using CPS data. Notes: [1] Percentage points.

Table A.2: Federal Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	68.2	46.6	8.2	7.7	31.8
AL	50.8	36.3	4.8	4.7	31.7
AR	46.1	33.3	4.9	4.8	29.6
AZ	59.5	41.7	5.7	5.4	30.6
CA	70.3	48.0	6.2	6.0	34.4
CO	65.6	45.3	7.7	7.2	30.0
CT	73.5	49.8	8.9	8.3	31.4
DC	86.7	58.8	4.9	4.8	35.8
DE	60.4	42.1	8.2	7.7	30.3
FL	57.8	40.6	6.0	5.7	30.3
GA	57.5	40.1	5.9	5.7	32.4
HA	65.1	45.8	7.4	6.9	28.8
IA	51.0	36.2	7.3	6.8	26.9
ID	49.9	35.8	6.5	6.2	28.6
IL	62.5	43.2	6.5	6.2	33.0
IN	52.9	37.4	6.7	6.3	29.1
KS	55.0	38.7	6.9	6.5	30.4
KY	50.8	36.2	4.8	4.6	30.5
LA	52.0	36.8	4.1	3.9	31.6
MA	71.5	48.7	7.4	7.1	33.6
MD	71.8	48.9	9.0	8.3	30.0
ME	51.3	36.7	6.5	6.3	29.2
MI	59.7	41.6	6.0	5.9	33.0
MN	61.7	42.7	8.2	7.6	29.0
MO	55.2	38.8	6.4	6.1	30.1
MS	45.9	33.3	4.2	4.1	29.5
MT	46.9	34.0	5.6	5.4	27.6
NC	53.9	38.0	6.1	5.8	31.0
ND	48.1	34.5	6.6	6.2	27.6
NE	52.2	37.2	7.5	7.1	27.5
NH	63.3	43.7	10.0	9.2	28.1
NJ	75.1	50.7	8.4	7.8	32.0
NM	53.6	38.1	4.6	4.4	32.0
NV	58.5	40.8	7.6	7.1	29.0
NY	66.6	46.2	5.3	5.1	33.8
OH	55.7	39.3	6.2	6.0	31.9
OK	52.3	37.0	5.6	5.4	29.9
OR	57.2	40.7	6.5	6.2	29.7
PA	58.9	41.1	6.6	6.4	32.7
RI	61.5	43.0	7.1	6.8	31.6
SC	51.1	36.4	5.8	5.5	29.5
SD	48.1	34.6	6.3	5.9	27.1
TN	50.3	35.8	5.2	5.0	30.5
TX	58.8	40.7	5.7	5.5	33.1
UT	53.0	37.5	8.0	7.4	27.1
VA	69.8	47.7	7.9	7.4	31.4
VT	54.8	38.7	7.7	7.3	28.9
WA	62.7	43.5	7.4	7.0	30.6
WI	54.8	38.9	7.8	7.3	28.0
WV	46.2	33.4	4.2	4.0	28.7
WY	51.7	36.7	7.1	6.8	28.6
Total	58.0	40.6	6.6	6.3	30.4

Source: Authors' calculations using CPS data. Notes: [1] Percentage points.

Table A.3: State Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	68.2	68.2	8.2	8.1	-0.3
AL	50.8	48.5	4.8	4.4	-5.1
AR	46.1	43.4	4.9	4.5	-3.5
AZ	59.5	56.7	5.7	5.3	-1.5
CA	70.3	65.4	6.2	5.9	1.6
CO	65.6	62.3	7.7	7.5	2.2
CT	73.5	70.0	8.9	8.5	0.6
DC	86.7	78.8	4.9	4.6	1.5
DE	60.4	57.2	8.2	8.0	3.5
FL	57.8	57.2	6.0	5.6	-5.5
GA	57.5	54.1	5.9	5.7	1.2
HA	65.1	60.0	7.4	7.0	3.5
IA	51.0	48.0	7.3	7.0	2.0
ID	49.9	46.2	6.5	6.1	0.9
IL	62.5	59.6	6.5	5.8	-5.5
IN	52.9	50.5	6.7	6.2	-2.9
KS	55.0	51.8	6.9	6.5	1.2
KY	50.8	47.8	4.8	4.4	-1.9
LA	52.0	49.9	4.1	3.6	-7.1
MA	71.5	67.1	7.4	7.0	1.4
MD	71.8	67.9	9.0	8.7	2.3
ME	51.3	47.9	6.5	6.2	1.0
MI	59.7	56.6	6.0	5.7	0.1
MN	61.7	57.2	8.2	8.0	5.2
MO	55.2	52.4	6.4	6.0	-1.5
MS	45.9	43.5	4.2	3.6	-9.5
MT	46.9	44.5	5.6	5.5	2.4
NC	53.9	50.1	6.1	5.7	0.0
ND	48.1	46.5	6.6	6.2	-2.8
NE	52.2	49.3	7.5	7.2	1.5
NH	63.3	63.1	10.0	10.0	-0.2
NJ	75.1	71.7	8.4	8.1	0.9
NM	53.6	50.8	4.6	4.2	-1.4
NV	58.5	57.6	7.6	7.3	-3.5
NY	66.6	62.2	5.3	5.1	3.2
OH	55.7	52.9	6.2	5.8	-1.5
OK	52.3	49.0	5.6	5.2	-1.2
OR	57.2	53.1	6.5	6.3	5.3
PA	58.9	56.6	6.6	6.2	-2.8
RI	61.5	57.8	7.1	6.7	0.0
SC	51.1	47.8	5.8	5.3	-2.6
SD	48.1	47.4	6.3	5.9	-5.6
TN	50.3	49.4	5.2	4.6	-10.0
TX	58.8	58.0	5.7	5.3	-4.9
UT	53.0	49.5	8.0	7.6	2.1
VA	69.8	65.5	7.9	7.5	0.9
VT	54.8	51.7	7.7	7.5	3.0
WA	62.7	61.8	7.4	7.0	-4.0
WI	54.8	50.9	7.8	7.5	3.8
WV	46.2	43.3	4.2	3.6	-9.1
WY	51.7	51.1	7.1	6.8	-3.1
Total	58.0	55.1	6.6	6.2	-0.9

Source: Authors' calculations using CPS data. Notes: [1] Percentage points.

Table A.4: Federal and State Compression (Select States)

	Gross 90/10 -Net 90/10 Federal[1]	Gross 90/10 -Net 90/10 State[1]	State as % Federal
AK	31.8	-0.3	-1.1%
AL	31.7	-5.1	-16.2%
AR	29.6	-3.5	-11.8%
AZ	30.6	-1.5	-4.8%
CA	34.4	1.6	4.8%
CO	30.0	2.2	7.4%
CT	31.4	0.6	1.9%
DC	35.8	1.5	4.2%
DE	30.3	3.5	11.6%
FL	30.3	-5.5	-18.1%
GA	32.4	1.2	3.7%
HA	28.8	3.5	12.1%
IA	26.9	2.0	7.6%
ID	28.6	0.9	3.2%
IL	33.0	-5.5	-16.8%
IN	29.1	-2.9	-10.1%
KS	30.4	1.2	3.9%
KY	30.5	-1.9	-6.1%
LA	31.6	-7.1	-22.4%
MA	33.6	1.4	4.2%
MD	30.0	2.3	7.5%
ME	29.2	1.0	3.5%
MI	33.0	0.1	0.4%
MN	29.0	5.2	18.1%
MO	30.1	-1.5	-5.1%
MS	29.5	-9.5	-32.2%
MT	27.6	2.4	8.6%
NC	31.0	0.0	0.0%
ND	27.6	-2.8	-10.2%
NE	27.5	1.5	5.4%
NH	28.1	-0.2	-0.8%
NJ	32.0	0.9	2.9%
NM	32.0	-1.4	-4.4%
NV	29.0	-3.5	-12.0%
NY	33.8	3.2	9.4%
OH	31.9	-1.5	-4.8%
OK	29.9	-1.2	-4.2%
OR	29.7	5.3	17.7%
PA	32.7	-2.8	-8.5%
RI	31.6	0.0	0.0%
SC	29.5	-2.6	-8.9%
SD	27.1	-5.6	-20.8%
TN	30.5	-10.0	-32.7%
TX	33.1	-4.9	-14.8%
UT	27.1	2.1	7.7%
VA	31.4	0.9	2.7%
VT	28.9	3.0	10.2%
WA	30.6	-4.0	-13.0%
WI	28.0	3.8	13.7%
WV	28.7	-9.1	-31.6%
WY	28.6	-3.1	-10.9%
Total	30.4	-0.9	-2.9%

Source: Authors' calculations using CPS data.
Notes: [1] Percentage points. A full set of state results can be found in the online appendix.

Table A.5: State Compression: Gas Tax Analysis

	90th Percentile			10th Percentile			90/10	90/10	(7) - (8)[2]
	Gross Inc.	Net Inc.	Net Inc. x Gas[1]	Gross Inc.	Net Inc.	Net Inc. x Gas[1]	Compression[2]	Compression x Gas[1,2]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AK	68.2	68.2	68.3	8.2	8.1	8.2	-0.3	-0.0	-0.3
AL	50.8	48.5	48.6	4.8	4.4	4.5	-5.1	-2.7	-2.5
AR	46.1	43.4	43.6	4.9	4.5	4.6	-3.5	-1.0	-2.5
AZ	59.5	56.7	56.9	5.7	5.3	5.5	-1.5	0.6	-2.0
CA	70.3	65.4	65.6	6.2	5.9	6.0	1.6	2.8	-1.1
CO	65.6	62.3	62.5	7.7	7.5	7.6	2.2	3.4	-1.2
CT	73.5	70.0	70.2	8.9	8.5	8.6	0.6	1.6	-1.0
DC	86.7	78.8	79.1	4.9	4.6	4.7	1.5	4.2	-2.7
DE	60.4	57.2	57.5	8.2	8.0	8.2	3.5	4.8	-1.2
FL	57.8	57.2	57.3	6.0	5.6	5.7	-5.5	-4.1	-1.4
GA	57.5	54.1	54.2	5.9	5.7	5.7	1.2	2.0	-0.8
HA	65.1	60.0	60.1	7.4	7.0	7.1	3.5	4.3	-0.8
IA	51.0	48.0	48.2	7.3	7.0	7.1	2.0	3.1	-1.0
ID	49.9	46.2	46.5	6.5	6.1	6.2	0.9	2.4	-1.5
IL	62.5	59.6	59.8	6.5	5.8	5.9	-5.5	-4.1	-1.5
IN	52.9	50.5	50.7	6.7	6.2	6.3	-2.9	-1.5	-1.4
KS	55.0	51.8	52.0	6.9	6.5	6.6	1.2	2.5	-1.3
KY	50.8	47.8	47.9	4.8	4.4	4.5	-1.9	0.1	-2.0
LA	52.0	49.9	50.1	4.1	3.6	3.8	-7.1	-4.0	-3.1
MA	71.5	67.1	67.3	7.4	7.0	7.1	1.4	2.3	-0.9
MD	71.8	67.9	68.1	9.0	8.7	8.9	2.3	3.2	-1.0
ME	51.3	47.9	48.0	6.5	6.2	6.3	1.0	2.3	-1.3
MI	59.7	56.6	56.7	6.0	5.7	5.9	0.1	1.9	-1.8
MN	61.7	57.2	57.4	8.2	8.0	8.1	5.2	6.5	-1.3
MO	55.2	52.4	52.5	6.4	6.0	6.1	-1.5	-0.1	-1.4
MS	45.9	43.5	43.6	4.2	3.6	3.8	-9.5	-6.6	-2.9
MT	46.9	44.5	44.7	5.6	5.5	5.6	2.4	4.6	-2.2
NC	53.9	50.1	50.4	6.1	5.7	5.8	0.0	2.3	-2.3
ND	48.1	46.5	46.7	6.6	6.2	6.3	-2.8	-1.1	-1.7
NE	52.2	49.3	49.5	7.5	7.2	7.3	1.5	2.5	-1.1
NH	63.3	63.1	63.3	10.0	10.0	10.1	-0.2	0.3	-0.6
NJ	75.1	71.7	71.8	8.4	8.1	8.2	0.9	1.4	-0.5
NM	53.6	50.8	50.9	4.6	4.2	4.3	-1.4	0.4	-1.8
NV	58.5	57.6	57.9	7.6	7.3	7.4	-3.5	-2.1	-1.3
NY	66.6	62.2	62.3	5.3	5.1	5.2	3.2	4.7	-1.6
OH	55.7	52.9	53.1	6.2	5.8	5.9	-1.5	0.3	-1.8
OK	52.3	49.0	49.2	5.6	5.2	5.3	-1.2	0.6	-1.8
OR	57.2	53.1	53.3	6.5	6.3	6.5	5.3	6.6	-1.3
PA	58.9	56.6	56.8	6.6	6.2	6.3	-2.8	-1.3	-1.4
RI	61.5	57.8	58.1	7.1	6.7	6.8	0.0	1.7	-1.7
SC	51.1	47.8	47.9	5.8	5.3	5.4	-2.6	-0.6	-2.0
SD	48.1	47.4	47.6	6.3	5.9	6.0	-5.6	-3.8	-1.8
TN	50.3	49.4	49.6	5.2	4.6	4.8	-10.0	-7.2	-2.8
TX	58.8	58.0	58.3	5.7	5.3	5.5	-4.9	-3.2	-1.7
UT	53.0	49.5	49.7	8.0	7.6	7.7	2.1	3.0	-1.0
VA	69.8	65.5	65.6	7.9	7.5	7.6	0.9	1.9	-1.0
VT	54.8	51.7	51.9	7.7	7.5	7.6	3.0	3.7	-0.7
WA	62.7	61.8	62.1	7.4	7.0	7.2	-4.0	-2.5	-1.5
WI	54.8	50.9	51.1	7.8	7.5	7.7	3.8	5.3	-1.4
WV	46.2	43.3	43.5	4.2	3.6	3.7	-9.1	-5.8	-3.3
WY	51.7	51.1	51.2	7.1	6.8	6.9	-3.1	-2.3	-0.9
Total	58.0	55.1	55.3	6.6	6.2	6.4	-0.9	0.6	-1.5

Source: Authors' calculations using CPS data. Notes: [1] Post-tax income excludes state gas taxes. [2] Percentage points. All income data values are in $1000s of 2000 dollars.

Table A.6: State Compression: Sales Tax Exemption Analysis (Selected States)

	90th Percentile				10th Percentile				90/10	90/10	90/10	(9)-(10)[3]	(9)-(11)[3]
	Gross Inc.	Net Inc.	Net Inc. no Ex.[1]	Net Inc. Full Ex.[2]	Gross Inc.	Net Inc.	Net Inc. no Ex.[1]	Net Inc. Full Ex.[2]	Comp-ression[3]	Compression No Ex.[1,3]	Compression Full Ex.[1,3]		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
AK	68.2	68.2	68.2	68.2	8.2	8.1	8.1	8.1	-0.3	-0.3	-0.3	0.0	0.0
AL	50.8	48.5	48.5	48.7	4.8	4.4	4.4	4.5	-5.1	-5.1	-2.2	0.0	-2.9
AR	46.1	43.4	43.4	43.6	4.9	4.5	4.5	4.6	-3.5	-3.5	-0.4	0.0	-3.1
AZ	59.5	56.7	56.5	56.8	5.7	5.3	5.2	5.4	-1.5	-3.5	-1.0	2.0	-0.5
CA	70.3	65.4	65.1	65.5	6.2	5.9	5.8	5.9	1.6	-0.4	2.1	2.0	-0.5
CO	65.6	62.3	62.2	62.4	7.7	7.5	7.4	7.5	2.2	1.5	2.4	0.7	-0.2
CT	73.5	70.0	69.6	70.0	8.9	8.5	8.4	8.5	0.6	-0.9	0.7	1.5	-0.1
DC	86.7	78.8	78.4	78.9	4.9	4.6	4.4	4.6	1.5	-1.8	2.3	3.3	-0.8
DE	60.4	57.2	57.2	57.2	8.2	8.0	8.0	8.0	3.5	3.5	3.5	0.0	0.0
FL	57.8	57.2	56.9	57.2	6.0	5.6	5.4	5.6	-5.5	-7.7	-4.9	2.2	-0.6
GA	57.5	54.1	54.0	54.2	5.9	5.7	5.6	5.7	1.2	0.4	2.3	0.8	-1.1
HA	65.1	60.0	60.0	60.2	7.4	7.0	7.0	7.2	3.5	3.5	4.9	0.0	-1.5
IA	51.0	48.0	47.8	48.0	7.3	7.0	6.9	7.0	2.0	0.7	2.3	1.3	-0.3
ID	49.9	46.2	46.2	46.5	6.5	6.1	6.1	6.2	0.9	0.9	2.8	0.0	-1.9
IL	62.5	59.6	59.6	59.9	6.5	5.8	5.8	6.0	-5.5	-6.1	-3.4	0.6	-2.1
IN	52.9	50.5	50.3	50.6	6.7	6.2	6.1	6.2	-2.9	-4.6	-2.6	1.7	-0.4
KS	55.0	51.8	51.8	52.0	6.9	6.5	6.5	6.7	1.2	1.2	2.8	0.0	-1.6
KY	50.8	47.8	47.5	47.8	4.8	4.4	4.3	4.4	-1.9	-4.6	-1.2	2.8	-0.6
LA	52.0	49.9	49.9	50.1	4.1	3.6	3.6	3.7	-7.1	-8.2	-4.5	1.1	-2.6
MA	71.5	67.1	66.8	67.1	7.4	7.0	6.8	7.0	1.4	-0.8	1.4	2.2	0.0
MD	71.8	67.9	67.7	68.0	9.0	8.7	8.7	8.8	2.3	1.6	2.7	0.7	-0.5
ME	51.3	47.9	47.7	47.9	6.5	6.2	6.0	6.2	1.0	-0.9	1.5	1.9	-0.4
MI	59.7	56.6	56.3	56.6	6.0	5.7	5.6	5.8	0.1	-1.9	0.6	2.0	-0.5
MN	61.7	57.2	56.8	57.2	8.2	8.0	7.8	8.0	5.2	3.4	5.2	1.8	0.0
MO	55.2	52.4	52.4	52.6	6.4	6.0	6.0	6.1	-1.5	-1.5	0.5	0.0	-2.1
MS	45.9	43.5	43.5	43.8	4.2	3.6	3.6	3.9	-9.5	-9.5	-4.3	0.0	-5.2
MT	46.9	44.5	44.5	44.5	5.6	5.5	5.5	5.5	2.4	2.4	2.4	0.0	0.0
NC	53.9	50.1	50.1	50.3	6.1	5.7	5.6	5.7	0.0	-0.6	1.3	0.6	-1.3
ND	48.1	46.5	46.3	46.6	6.6	6.2	6.0	6.3	-2.8	-5.2	-2.2	2.4	-0.6
NE	52.2	49.3	49.1	49.4	7.5	7.2	7.1	7.3	1.5	0.5	1.7	1.0	-0.2
NH	63.3	63.1	63.1	63.1	10.0	10.0	10.0	10.0	-0.2	-0.2	-0.2	0.0	0.0
NJ	75.1	71.7	71.3	71.7	8.4	8.1	7.9	8.1	0.9	-0.8	0.9	1.8	0.0
NM	53.6	50.8	50.7	51.0	4.6	4.2	4.2	4.4	-1.4	-1.6	1.3	0.2	-2.7
NV	58.5	57.6	57.3	57.7	7.6	7.3	7.1	7.3	-3.5	-5.2	-3.1	1.8	-0.4
NY	66.6	62.2	62.0	62.2	5.3	5.1	5.0	5.1	3.2	1.2	3.5	1.9	-0.4
OH	55.7	52.9	52.7	52.9	6.2	5.8	5.7	5.8	-1.5	-3.4	-1.1	1.8	-0.5
OK	52.3	49.0	49.0	49.2	5.6	5.2	5.2	5.3	-1.2	-1.2	0.9	0.0	-2.1
OR	57.2	53.1	53.1	53.1	6.5	6.3	6.3	6.3	5.3	5.3	5.3	0.0	0.0
PA	58.9	56.6	56.2	56.6	6.6	6.2	6.0	6.2	-2.8	-5.2	-2.8	2.5	0.0
RI	61.5	57.8	57.5	57.8	7.1	6.7	6.4	6.7	0.0	-2.9	0.0	2.9	0.0
SC	51.1	47.8	47.7	48.0	5.8	5.3	5.2	5.4	-2.6	-2.7	-0.0	0.1	-2.6
SD	48.1	47.4	47.4	47.6	6.3	5.9	5.9	6.0	-5.6	-5.6	-3.5	0.0	-2.2
TN	50.3	49.4	49.4	49.7	5.2	4.6	4.6	4.8	-10.0	-10.0	-6.3	0.0	-3.7
TX	58.8	58.0	57.8	58.1	5.7	5.3	5.2	5.4	-4.9	-7.2	-4.3	2.3	-0.6
UT	53.0	49.5	49.5	49.7	8.0	7.6	7.6	7.7	2.1	2.1	3.2	0.0	-1.1
VA	69.8	65.5	65.5	65.7	7.9	7.5	7.5	7.6	0.9	0.9	2.2	0.0	-1.3
VT	54.8	51.7	51.5	51.7	7.7	7.5	7.4	7.5	3.0	1.4	3.2	1.5	-0.2
WA	62.7	61.8	61.5	61.9	7.4	7.0	6.9	7.1	-4.0	-5.7	-3.6	1.7	-0.4
WI	54.8	50.9	50.7	51.0	7.8	7.5	7.4	7.6	3.8	2.6	4.2	1.3	-0.3
WV	46.2	43.3	43.2	43.5	4.2	3.6	3.5	3.7	-9.1	-9.8	-5.4	0.7	-3.7
WY	51.7	51.1	51.1	51.2	7.1	6.8	6.8	6.9	-3.1	-3.2	-1.9	0.0	-1.2
Total	58.0	55.1	54.9	55.2	6.6	6.2	6.2	6.3	-0.9	-1.9	0.2	1.0	-1.1

Source: Authors' calculations using CPS data. Notes: [1] Post-tax income excludes state sales tax exemptions. [2] Post-tax income assume food and clothing are exempt from sales taxes in all states. [3] Percentage points. All income data values are in $1000s of 2000 dollars.