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Quantifying the Role of Federal and State Taxes in Mitigating Income Inequality

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Abstract:
Income inequality has risen dramatically in the United States since at least 1980. This paper quantifies the role that the tax policies of the federal and state governments have played in mitigating this income inequality. The analysis, which isolates the contribution of federal taxes and state taxes separately, employs two approaches. 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, with most of the compression of the income distribution attributable to federal taxes. Nevertheless, there is substantial cross-state variation in the extent to which state tax policies compress the income distribution attributable to federal taxes. Cross-state differences in gasoline taxes have a surprisingly large impact on income compression, as do sales tax exemptions for food and clothing. The results of the second approach indicate that there has been little change since the early 1980s in the impact of tax policy on income inequality across almost all states.

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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; Karoly, 1993). An important component of this increase has been a widening of the wage structure. Wage differentials associated with education, occupation, and experience have risen. Over the same period, wage dispersion within these broad groups has also increased (Katz and Autor, 1999; Autor, Katz, and Kearney, 2008). The increase in wage inequality has, in turn, produced increases in broader measures of income inequality and in consumption inequality (Cutler and Katz, 1992; Karoly and Burtless, 1995).

The tax policies of the federal and state governments are a potential compensating factor in the rise in wage and income inequality, particularly as they relate to progressivity or the rate at which taxes tend to rise with income. This paper quantifies the role of taxes in mitigating income inequality. Our analysis has two components, and considers separately the influence of the federal and state tax systems. Because the influence of state taxes on inequality has received less attention than the influence of the federal code, we emphasize the role of state policies. Our first approach is cross-sectional in nature and compares before- and after-tax inequality across the 50 states. States are ranked by the extent to which their tax codes compress the after-tax distribution of income relative to the before-tax distribution. On average, the compression achieved by state taxes is equal to only around 12 percent of the compression achieved by the federal tax code. Although average state compression is relatively small, we find some economically meaningful differences across the states. In a few states, such as Minnesota, Oregon, and Wisconsin, state tax compression amounts to about one-third or more of the compression brought about by federal taxes. On the other hand, the tax systems in eight states—including Florida, Texas, and Illinois—actually widen the distribution of income. We find that the state-levied gasoline tax plays a surprisingly large role in the amount of compression across the states. On average, it is estimated to offset roughly 20 percent of the income compression achieved by state income and (general) sales taxes. Our analysis also shows that exemptions for food and clothing from some states' sales taxes also play a quantitatively important role in narrowing the after-tax income distributions of these states.

Our second approach assesses the evolution over time of tax-induced income compression. We find that income compression due to federal and state taxes has been remarkably stable over the past 25 years. The rapid increase in before-tax labor income inequality documented widely by other researchers has thus been transmitted nearly one-for-one into after-tax labor income. Our analysis concludes by combining the cross-sectional results with the time-series results. In most states the tax code has simply transmitted the rise in before-tax income inequality into after-tax income inequality over time, confirming the results of the aggregate time-series approach.

This paper is closely related to two distinct and large literatures—the wage inequality literature and the empirical tax incidence literature. Recent research on U.S. wage inequality suggests that there was a broad-based surge in 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 skill 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.[1,2]

A very long-running literature documents the incidence of federal taxes by income group (see Musgrave, 1951; Pechman and Okner, 1974; Pechman, 1985; Gramlich, Kasten, and Sammartino, 1993; Kasten, Sammartino, and Todder, 1994; Congressional Budget Office, 2007), and a substantially smaller literature considers the same issue for state taxes (see Metcalf, 1994; Berliant and Strauss, 1993; Galpher and Pollock, 1988). Most relevant for this paper is previous research that explicitly explores the connection between income inequality and taxes (Gramlich, Kasten, and Sammartino, 1993; Karoly, 1994). These papers, like our own, can be viewed as synthesizing the inequality and tax incidence literatures.

Our analysis makes several contributions. First, our results are driven primarily by the connection between taxes and wage inequality. Almost all previous tax incidence studies have focused on broader definitions of income inequality. However, the labor market is the primary source of income for most individuals and families, and the distribution of labor income is therefore the chief determinant of the overall distribution of economic well being Karoly (1993). Given the importance of wage inequality and its rapid rise in recent years, it is useful to carefully quantify how the tax system mediates this specific form of income inequality. Furthermore, there are a number of conceptual and methodological advantages to focusing on labor income inequality (see Section 2.4 below). Second, we provide an unusually rich analysis of the influence of state taxes over a long period of time. Past studies have tended to focus on a very short time period (such as immediately before and after the Tax Reform Act of 1986) and/or consider the impact of state tax codes as a group, instead of individually. We also capture the three largest state taxes — the personal income tax, the

[1]This discussion draws heavily from Autor, Katz, and Kearney (2008), which contains a review of the literature, recent evidence, and a discussion of the revisionist literature, which posits that the rise in wage inequality was an episodic event confined to the 1980s (see Card and DiNardo, 2002).

[2]There is also a literature on income inequality more broadly construed, focusing not just on labor income, but also on capital income and government transfer income (see Gottschalk and Smeeding, 2000). However, we largely confine our analysis to labor income.

general sales tax and the gasoline tax — with the analysis of the final two taxes based on expenditure data. Many previous studies have focused on one of these taxes—not all three—and only very limited attention has been given to state gas taxes and sales tax exemptions. Third, although we focus on state taxes, the federal tax analysis provides a useful baseline for comparing the magnitude and dispersion of the state results. In addition, the federal estimates run through 2008 and are therefore useful as an update to earlier estimates, which have become dated (see Kasten, Sammartino, and Todder, 1994; Gramlich, Kasten, and Sammartino, 1993).

The remainder of the paper proceeds as follows. Section 2 discusses our methodology and Section 3 presents the data. Section 4 discusses the results. Section 5 concludes.

2 Methodology

2.1 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 two complementary measures of inequality—the gini coefficient and 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 gini coefficient can range from a value of 0 (which would represent a perfectly equal distribution in which every person's income was exactly the same) to a value of 1 (which would represent a perfectly unequal distribution in which one person earned all of the income in the society).[3] The gini coefficient tends to be heavily influenced by the middle of the income distribution and generally underweights differences in income in the tails of the distribution. The 90/10 income split does a relatively better job of capturing differences in the tails of the income distribution and can be viewed as capturing overall inequality. We also present a few 90/50 and 50/10 income percentile splits to capture inequality in the upper and lower halves of the income distribution.

Our unit of analysis is the federal tax unit—typically a *household*—and we restrict our attention to tax units headed by full-time, full-year (FTFY) workers aged 16 to 64 years.[4] We are forced to use total income as our income metric, as it forms the base for the income tax, despite our focus on wage inequality. That said, by focusing on FTFY workers and using either the gini coefficient or the 90/10 income differential as the measures of inequality, our

[3]The gini coefficient can be interpreted relative to the Lorenz curve, which plots the percentage of total income held by a given percentage of the population. In particular, the gini coefficient equals two times the area between a 45-degree-line (perfect income equality) and the Lorenz curve.

[4]In most cases the tax unit is the household. Exceptions include children who are FTFY workers who are assumed to file their own tax returns.

conclusions about income inequality are bound to be driven by wage inequality. That is, the FTFY age 16–64 restriction excludes the vast majority of households with government transfer income. Medicare benefits are mostly eliminated, as are most transfers of Supplementary Security Income (SSI), unemployment insurance, most social security payments, etc. Furthermore, our measures are little influenced by capital income because such income is mostly located at the very upper end of the income distribution—very high incomes do not contribute to the calculation of the 90/10 income differential and have very little influence on the gini coefficient which is most responsive to the middle of the distribution.[5] On average, wages and salaries account for 84 percent of total income in our sample, and the median share of wages in our measure of total income is 1.[6]

As shown in Figure 1, measures of total income inequality are very similar to measures of wage inequality in our sample. The gini coefficients are strikingly similar over time (Panel A). Adding all other income to wages and salaries increases the gini by only around 2 percent on average. The 90/10 total income and 90/10 wage income differentials are somewhat more distinct from one another, as transfer income has some influence on the $10th$ percentile of the total income distribution and capital income similarly has some influence on the $90th$ percentile of income distribution (Panel B). Nonetheless, inequality measured by the 90/10 split evolves in a similar manner over time for both income measures, and adding all non-labor income to wages and salaries increases measured inequality by only around 20 percent on average. The 90/50 and 50/10 differentials display similar patterns (Panels C and D). Overall, using total income appears to be a reasonable approach for capturing wage inequality in our sample.

2.2 Interpreting the Income Compression Metrics

We quantify the effect of taxes on income inequality by comparing before-tax measures of inequality to the corresponding after-tax measures. The first income compression metric is the difference between the before and after-tax 90/10 income split. It is a double difference

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

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 approximates the

[5] At the $10th$ percentile of the income distribution, measured transfer income accounts for a bit less than 1 percent of total income. At the $90th$ percentile, measured capital income accounts for only 1 percent of total income.

[6] We currently include self-employed workers. A portion of the earnings of this group is properly seen as a return to capital investment. Excluding such workers is likely to somewhat reduce measured inequality, as the self-employed tend to have volatile income streams. Future versions of this paper will drop these workers from the sample.

percentage difference between before-tax incomes at the $90th$ and $10th$ percentiles, while the second term captures this percentage difference for after-tax incomes. A value of 0 indicates that the tax code has no influence on income inequality, while a value greater than 0 indicates that the tax code is compressing the after-tax income distribution relative to the before-tax distribution. The before-tax 90/10 income differential—the first term in brackets in equation (1)—has been widely used in the literature on wage inequality. The difference between this before-tax inequality measure and the corresponding after-tax measure therefore provides a natural and easily interpreted way to quantify how the tax system mitigates wage inequality.

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

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

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 $t_{90} = t_{10} \Longleftrightarrow comp_{90/10} = 0$. A progressive tax system, by definition, has average tax rates that increase with income (Musgrave and Thin, 1948; Kiefer, 2005): $t_{90} > t_{10}$. Such a system therefore produces compression because $t_{90} > t_{10} \Longleftrightarrow comp_{90/10} > 0$. 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.[7]

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, $\frac{\partial t_{90}}{\partial Y_{90}} > 0$ as 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, high marginal tax rate on a larger fraction of his income. 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. Assume that the tax system is "equally" progressive at both the $90th$ and

[7] The $comp_{90/10}$ metric is related to the residual income progression measure of Musgrave and Thin (1948), defined as the ratio of the percentage difference in income after tax to the percentage difference in income before tax. The $comp_{90/10}$ metric takes the *difference* in (approximations of) these percentage differences, as opposed to their *ratio*.

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

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.

Our second measure of tax compression is similar to $comp_{90/10}$, but replaces the 90/10 income differentials with gini coefficients

$$comp_{gini} = gini_{before-tax} - gini_{after-tax} \quad .$$

As previously noted, a value greater than 0 indicates compression of the after-tax income distribution relative to the before-tax distribution. A value greater than 0 can also be interpreted as indicating that the tax system causes a shift in income toward equality (as defined by the gini coefficient). A final compression measure is defined as:

$$comp_{ratio\_gini} = \frac{gini_{after-tax}}{gini_{before-tax}} \quad .$$

A ratio of 1 indicates no compression in the income distribution from the imposition of taxes, while a value less than 1 indicates some compression resulting from a tax system that is, on balance, progressive to some extent.[8]

2.3 Limitations

There are at least three important limitations to our analysis. First, all empirical studies of tax incidence, like ours, that consider a range of taxes must impose some simplifying assumptions. In so doing, we generally follow the previous literature: As in Musgrave (1951), Pechman (1985), Gramlich, Kasten, and Sammartino (1993), and numerous others, we assign the incidence of personal income and payroll taxes to the corresponding income source, and we assume that general sales and excise taxes are borne by those who consume the taxed commodity. These assumptions are useful in that they make large scale empirical incidence estimates, such as those calculated here, feasible. They are by no means innocuous,

[8]The $comp_{gini}$ index was used by Reynolds and Smolensky (1977) and is related to the progressivity index of Pechman and Okner (1974), defined as $\frac{gini_{after-tax} - gini_{before-tax}}{gini_{before-tax}}$. The $comp_{ratio\_gini}$ is similar to the effective progression measure of Musgrave and Thin (1948), defined as $\frac{1-gini_{after-tax}}{1-gini_{before-tax}}$.

though, and this is particularly true in the case of state taxes, which are more easily avoided through geographic mobility than are federal taxes. For instance, if workers avoid high personal income tax states, the incidence of the personal income tax is likely to be partly shifted onto employers — that is, the tax is shifted away from labor income onto capital income. Furthermore, we do not account for either corporate taxes or property taxes.

Future versions of this research will test the robustness of our conclusions to alternative incidence assumptions and will incorporate corporate taxes and perhaps property taxes.[9] We also acknowledge that we rely on annual incidence estimates, which can differ significantly from life-time tax incidence calculations (Fullerton and Rogers, 1993; Metcalf, 1994; Saez, 1991). Certain individuals, such as students and retirees, may have low annual income, but high permanent (or lifetime) income. Thus, static, point-in-time incidence calculations can differ greatly from dynamic incidence calculations based on a person's lifetime resources. We note, though, that the annual versus lifetime limitation is inherent in much, though not all, of the wage inequality literature. This literature generally lumps together permanent and transitory income inequality, and thus fails to distinguish between "lifetime" and "annual" wage inequality.

A second limitation of our study concerns 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 tax rate 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 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.[10]

[9]It is unlikely that accounting for the corporate income tax will significantly impact our federal tax results given the low share of capital income in total income in our sample and its corresponding small contribution to measured inequality. Furthermore, Gramlich, Kasten, and Sammartino (1993) find that even with broader income inequality measures, corporate income taxes have little impact on measured inequality. It is even less likely that incorporating state corporate income taxes will influence our results, as such taxes usually account for 5 percent or less of annual state tax collections. Turning to the property tax, one justification for its exclusion from this paper is that it comprises a negligible share of *state* tax collections — the focus of this study. It remains of significant interest, though, because it accounts for roughly three-quarters of local government tax collections. However, one view of the incidence of the property tax suggests it is not a tax at all, but instead is a payment for local public goods consumption within a Tiebout-style economy. Inman (1994) uses this logic to argue that the property tax is "irrelevant to matters of economic fairness and hence tax progressivity." Other views of the property tax suggest it is a tax on capital.

[10]According to Gramlich, Kasten, and Sammartino (1993) there are at least three ways in which taxes may influence the before-tax distribution of income. The first is supply-side adjustments such as labor supply changes and investment changes. The second is portfolio effects such as realizing accrued capital gains and shifts in the composition of compensation. The third is general equilibrium effects, which may alter the overall growth of the economy.

A final limitation is that our time-series estimates confound 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. Second, the tax code is often adjusted over time, and may even adjust directly in response to changes in inequality. Our estimates do not disentangle these effects, but we may address this issue in future work.

2.4 Advantages of Focusing on "Middle-Income" Inequality

The inequality measures used in this study, which mostly capture labor income inequality (see Figure 1), are particularly informative given the primary role of labor income in setting the distribution of overall economic well-being. They also provide evidence on the connection between taxes and the growth in wage inequality — arguably one of the central economic developments of the last 30 years. Moreover, these measures have significant conceptual and methodological advantages over broader measures of income inequality for at least four reasons.

First, from a policy perspective it may be useful to consider very low, middle, and very high income inequality separately. Policy aimed at income inequality at the high end of the income distribution must contend with issues, such as significant business and capital income and greater mobility of resources, that are not as relevant for earners in the middle of the income distribution. Similarly, the problems of the very poor likely go beyond having low-paying jobs. The measures used in this paper can therefore be thought of as capturing "middle-class" income inequality (see Cutler, 1994).

Second, measuring income in the far tails of the distribution is quite challenging. Properly measuring very high incomes involves a host of difficulties, including thin data, top coding and difficulty measuring capital income.[11] Such measurements are best left to studies focusing on the very top earners that are undertaken with income tax filing data (see Piketty and Saez, 2003; Saez and Veall, 2005) or specialized data such as executive compensation records (Frydman and Saks, 2010; Frydman and Molloy, 2012). Turning to the lower end of the distribution, transfer income is a critical component of total income for the poor. Unfortunately, measuring transfer income has become increasingly difficult. Reporting rates for transfer income in the *Current Population Survey* (CPS)—our source of income data—have fallen to around 50 percent in recent years for programs such as TANF and food stamps (see Meyer, Mok, and Sullivan, 2009). As a result, the examination of transfer income is also likely best left to very focused studies.

Third, behavioral responses to taxation are likely of only limited relevance for our measures of middle-income inequality. Recent research has found evidence of substantial behav-

[11] Some forms of capital income, such as capital gains, are not measured in standard datasets.

ioral response to taxes in the tails of the income distribution, but it has generally concluded that there is little evidence of a behavioral response in the broad middle of the distribution.[12] As a result, our decision to abstract from behavioral responses to taxes likely has only a limited influence on our conclusions.

Finally, our focus on FTFY workers will tend to significantly reduce the difference between our annual estimates of tax incidence and (uncalculated) life-time tax incidence, since our approach eliminates taxpayers who are out of the labor force (students, temporary disabled individuals, retirees, etc.) as well as those who are unemployed.

3 Data

We follow Autor, Katz, and Kearney (2008) and focus our analysis on full-time, full-year (FTFY) workers who are between 16 years old and 64 years old.[13]

The main data source for this paper is the March *Current Population Survey* (CPS). The March CPS, which we access through IPUMS at the University of Minnesota, contains detailed information on household earnings.[14] The CPS has collected annual income data for U.S. households since 1948 and includes households in all 50 states and the District of Columbia, allowing us to evaluate the impact of state tax policies across every state. There is little direct information, however, on households' income tax liability and other tax payments. 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

[12]Saez (2004) concludes that the bottom 99 percent of income earners display no evidence of a behavioral response to taxation. Similarly, Saez, Slemrod, and Giertz (2010) note that the economics profession has settled on a value near zero for the compensated labor supply elasticity, suggesting little labor supply response to taxes. 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. In terms of the tails of the distribution, Saez (2004) finds significant evidence of behavioral responses for the top 1 percent of earners. Auerbach (1988) documents that capital gains, which accrue mostly to high-income individuals, are quite responsive to changes in marginal tax rates. Chetty and Saez (2005) document that dividend income, which "accrues very disproportionately to wealthy individuals," is quite sensitive to tax changes. Finally, Saez (2010) finds evidence of bunching at kinks of the EITC and the first income tax bracket, indicating a behavioral response to taxes in the bottom tail of the income distribution.

[13]Full-time, full-year workers are those who work at least 35 hours a week for 40 or more weeks in a given year (see Autor, Katz, and Kearney, 2008, p. 303). As noted above, this sampling framework provides a close link between our estimates and the wage inequality literature and also carries a number of conceptual and methodological advantages.

[14]The 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 analysis for completeness, but do not analyze the effect of transfers on income inequality given our focus on "middle-income" inequality.

(Social Security and Medicare).

This paper uses a number of sample selection criteria to clean up the CPS data and to properly implement the TAXSIM module. A major task is to combine the individual level CPS data into tax units (single versus married filers), since the TAXSIM procedure uses tax units as the level of observation. Individuals over the age of 18 are defined 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. Tax units are identified 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 or she is unmarried but has dependents. Total earnings are defined as the sum of business, farm, and wage income.[15] When available, spouses' income data are combined with the primary tax payer's income data for all categories.

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 (TAXSIM #10). As a result, the standalone dividend income category is set to zero prior to 1988. In addition, the CPS does not have data on households' rent paid, child care expenditures, unemployment compensation, and/or short and long term capital gains (TAXSIM #s 14, 17, 18, 20, 21). These fields are also set to zero. Finally, we impute whether or not a tax unit itemizes its deductions, and its amount itemized (if applicable), based on tax return data collected by the Statistics of Income (SOI) section of the IRS. This imputation procedure matches itemization rates observed in the data with a tax unit's inflation-adjusted wages and marital status.

Households' estimated income taxes are added to their estimated sales tax and gas tax burdens to get a measure of their total tax burden. There are no direct data in the CPS on annual sales taxes and motor-fuel taxes paid by households. These data are inferred based on household expenditure data in the *Consumer Expenditure Survey* (CEX) and separate data on state sales tax rates and state and federal gas tax rates.

The CEX is nationally representative, but it contains a smaller sample than the CPS and the state identifiers for households living in a number of the smaller states in the U.S. are suppressed for confidentiality reasons. As a result, we calculate households' average expenditures on food, clothing, and other taxable goods by age and income groups.[16] Households are

[15] Business income includes earnings from self-employment.

[16] 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.

divided into 10-year age groups and average expenditures are calculated within age groups by income decile. The appendix discusses the selection criteria for the CEX sample. The CEX expenditure data are translated into the CPS based on the equivalent age and income groupings. The sales tax burden for each CPS tax unit 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.[17] [18]

Our approach to calculate households' gas tax burden is slightly different. We estimate a reduced-form demand equation for households' 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

$$g_{it} = \beta_1 p_t^s + \beta_2 Y_{it} * A_{it} + \beta_3 D_t + \epsilon_{it}, \tag{2}$$

where g_{it} is gallons of gas consumed by individual 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 region dummy variables to capture region and time-specific trends in gasoline consumption.[19] The β parameters from equation (2) are used to impute households' gallons of gasoline consumed in the CPS. A tax unit's gas tax burden is calculated based on state-specific fuel taxes and their imputed gasoline consumption.

Overall, we account for the three largest taxes applied to individuals at the state level — 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 households' tax burdens across states.

A final data issue worth noting is that the disaggregated income data in the CPS prior to 1996 are top-coded based on censor points that change over time. We adjust the income data to take this top-coding into account. In particular, we assign households with top-

[17]Data on state sales tax rates and sales tax exemptions come 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. Erich Muehlegger kindly provided yearly data on federal and state gas tax rates per gallon as well as data on before-tax fuel costs (per gallon) by state. These data allow us to calculate the total gas price (per gallon) by state and year.

[18]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 households' before-tax expenditures. A household's sales tax burden is the difference between its total expenditures and its before-tax expenditures.

[19]Households are divided into five 10-year age groups and 10 income groups. Regional effects are included because households in Wyoming may have different driving needs than those in Rhode Island or Massachusetts. Households' gasoline consumption (in gallons) is calculated based on reported CEX expenditures on gasoline and motor oil and the state-specific gas price in a given year.

coded income in a given category to have earnings equal to 150 percent of the top-coded amount. After 1996, the CPS changed to a procedure in which all income values are assigned and the top-coded values are adjusted so that aggregate income in the CPS matches total reported income in the non-public, uncensored CPS data. The pre-1996 and post-1996 data at the very top of the income distribution are therefore not directly comparable, due to this change in top-coding methodology. The analysis in this paper circumvents this problem by evaluating differences between the $90th$ and $10th$ percentile of the income distribution, as well as gini coefficients.[20] Although our estimated gini coefficients utilize the entire income distribution, variation in the tails of the income distribution have little influence on this measure of inequality.

Our final data sample includes all full-year, full-time workers in the CPS between 1984 and 2008 who are 16-to-64 years old. Percentile and other distributional analysis is weighted using the CPS household weights to take into account how representative given households are of the overall U.S. population.

4 Results

4.1 Cross-Sectional Approach

Figures 2 through 5 examine the variation in tax-based income compression across states. As already mentioned, the underlying data are annual observations from 1984 to 2008. Nominal income data are converted to real income using the personal consumption expenditure (PCE) deflator. In addition, the figures and tables refer to "gross income" when displaying before-tax income and "net income" when displaying after-tax income. We will use the terms "gross income" and before-tax income interchangeably. The same applies to "net income" and after-tax income.

Figure 2 compares gross income (before-tax) inequality to net income (after-tax) inequality across states. States beneath the 45-degree line are progressive — they compress the after-tax distribution of income relative to the before-tax distribution. The distance between a state and the 45-degree line quantifies the degree of progressivity. The overall tax code is progressive in all states regardless of whether you consider the $comp_{gini}$ metric (Panel A) or the $comp_{90/10}$ metric (Panel B). States with relatively progressive personal income taxes, such as California, New York, and Oregon, have the highest tax compression, while states without a broad-based income tax, such as New Hampshire, Tennessee, and Florida, are in the group of states with the least overall tax compression.

The effect of taxes on reducing labor income inequality across states can be decomposed

[20] The $90th$ percentile of the income distribution is not subject to top-coding.

into the impact of federal versus state tax policies. This breakdown is shown in Figure 3, which distinguishes federal tax compression (compression excluding state taxes) from state tax compression (compression excluding federal taxes).[21] The results demonstrate that federal taxes are by far the larger contributor to compressing the net income distribution relative to the gross income distribution. The gini coefficient analysis (Panel A) and the 90/10 split analysis (Panel C) further show that, 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 a downward vertical shift in the 45-degree line.

Panels B and D of Figure 3 further show that there is much greater dispersion across states in the extent to which state taxes influence inequality compared with federal taxes. States such as California, Oregon, Minnesota, and Maine, along with the District of Columbia exhibit the greatest reduction in labor income inequality due to state tax programs. In contrast, relatively regressive states such as Texas, Florida, Illinois, South Dakota, Tennessee, and Nevada have state tax structures that appear to increase inequality and effectively offset some of the progressive nature of the federal tax code.

Tables 1 and 2 provide more detailed analysis of income compression. Table 1 shows gross versus net income at the $90th$ percentile of the distribution and at the $10th$ percentile of distribution for each state. Net income in Table 1 incorporates both federal *and* state taxes. Equivalent tables that look at federal versus state income compression separately can be found in the appendix. Gross and net income data are shown in levels for clarity (in 1000s of 2000 dollars). The final column of Table 1 displays compression as quantified by the $comp_{90/10}$ metric. The results show that on average taxes reduce labor income inequality in a state by 22 percentage points (bottom row). To place this figure into perspective, 90/10 before-tax wage inequality rose roughly 1 percentage point per year over our sample period (see Panel B of Figure 1). Thus, taxes undo around 22 years worth of wage inequality growth. The reduction in inequality ranges from nearly 30 percentage points in states such as California, Oregon, and the District of Columbia to about 15 percentage points in less progressive states such as Tennessee, New Hampshire, and Florida.

Table 2 reports the same compression measure separately for federal taxes (column 1) and state taxes (column 2). A full set of federal and state compression results are shown in the appendix. The table also compares the relative magnitude of state versus federal compression (column 3). The results show that state taxes reduce labor income inequality by a relatively small amount compared with federal taxes. Specifically, the reduction in inequality due to state tax programs is only about 12 percent, on average, of the reduction achieved by federal

[21] 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 code.

tax programs (bottom row). This relatively low average, though, masks significant variation across the states. Tax policies in states such as Wisconsin, Oregon, Maine, and Hawaii, along with the District of Colombia, achieve a reduction in income inequality that is around one-third the size of federal compression. In contrast, tax policies in a number of other states including Wyoming, Texas, Tennessee, South Dakota, Mississippi, and Illinois undo some of the reduction in inequality achieved by the federal tax system.

Figure 4 graphically displays the $comp_{ratio\_gini}$ metric. Panel A plots the ratio of the net income (federal taxes only) gini coefficient to the gross income gini coefficient, while Panel B repeats this analysis for state taxes. The actual states included in each bin of the histogram are noted in the figure. The results confirm that the reduction in labor income inequality due to federal taxes is larger than the reduction due to state taxes, but that there is much more dispersion in the amount of compression achieved by state codes. Finally, Panel B shows that more than 20 percent of states have tax structures that increase measured labor income inequality.

A final cross-sectional analysis considers the impact of state gas taxes and sales tax exemptions on labor income inequality across states. Starting with the gas tax, previous studies of overall state tax incidence for the most part have 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 role played by gas taxes on income compression. The third column from the right in the table repeats the state compression measure from the middle column of Table 2. The second column from the right then shows the amount of state income compression assuming the counter-factual that state gas taxes are zero for all states. On average, compression is 2.3 percentage points with gas taxes included and 2.8 percentage points when gas taxes are *excluded* (bottom row). That is, state gas taxes undo the reduction in labor income inequality achieved by state tax systems as a whole by about 20 percent. Federal gas taxes also undo the progessivity of the tax system by an amount similar to state gas taxes—see Figure 5. Since federal taxes are the same across all states, there is much less between-state variation due to these taxes, and we therefore focus on the effect of state gas taxes.

A further examination of Table 3 shows that in some states, such as Georgia and Alaska, gas taxes have very little impact on state income compression. In contrast, gas taxes undo a substantial portion of the reduction in inequality achieved by other state tax policies in states such as Louisiana, New Hampshire, and West Virginia. In addition, gas taxes add noticeably to the increase in inequality caused by state tax programs in states such as Mississippi, Nevada, and Illinois. It is also worth noting that state gas taxes in Washington cause the impact of that state's tax policies to shift from being slightly progressive to being a touch regressive. Overall, gas taxes play an important role in the extent to which states' tax policies are able to reduce labor income inequality.

Turning to sales tax exemptions, many states exempt clothing and/or food from the sales tax on equity grounds.[22] Table 4 reveals that these exemptions significantly reduce wage income inequality. On average, the 90/10 difference in state compression when gas taxes are included is 2.3 percentage points, and it falls to 1.8 percentage points in the absence of the exemptions (bottom row). That is, sales tax exemptions account for around 20 percent of state tax compression on average — a large average share given that 18 states had no exemptions over the period of our study (and therefore contributed zeros to the average amount of compression calculation).

4.2 Time-Series Approach

In this subsection we explore how the influence of taxes on income inequality has evolved over time. Figure 1 displays the well-documented increase in overall gross (that is, before-tax) wage inequality over the period of our study, the mid-1980s through the late 2000s (Panels A and B). Consistent with the findings of the recent literature on the polarization of the labor market (see Autor, Katz, and Kearney, 2008), inequality in the upper half of the income distribution also rose sharply (90/50 differential; Panel C), but lower-half inequality was roughly flat (50/10 differential; Panel D). Figure 6 displays the evolution of the $90th$, $50th$ and $10th$ percentiles (Panels A, B, and C respectively) of gross wages (blue line), wages net of federal taxes (green line), wages net of state taxes (yellow line) and wages net of both state and local taxes (red line).[23] Although there are considerable changes over time in gross income—for example, persistent increases at the $90th$ percentile and a fall followed by an increase at the $10th$ percentile—the wedges between gross and net incomes are remarkably consistent. It therefore appears that taxed-based compression of the income distribution held steady over the past 25 years. This conclusion is verified by the measures of overall inequality (90/10 differential), upper-tail inequality (90/50 differential), and lower-tail inequality (50/10 differential) in Panels D, E, and F, respectively. In all cases the reduction in inequality achieved by the tax code is constant. Thus, it appears that the tax code has been a neutral factor in mitigating wage inequality over this period, as before-tax changes to the income distribution have been transmitted one-for-one into the after-tax distribution.

The neutrality of the combination of federal and state taxes with respect to the increase in wage inequality is perhaps surprising, given that our cross-sectional analysis suggests the

[22] Some states reduce, but do not eliminate, the sales tax on food and clothing. Our analysis captures these reductions. We do not, however, capture exemptions for items other than food and clothing (for example, prescription drugs are often exempt).

[23] The data shown in Figure 6 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, $log(A-B) \neq log(A) - log(B)$).

overall tax structure in the United States is progressive. 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 2.2). Thus, the contrast we have found between the cross-sectional and time-series results on the impact of taxes on income equality—and, hence, in the effective, overall progressivity of the tax system—suggests to us that the parameters of the tax system may have shifted over time so as to reduce its overall progressivity to some degree.

Figure 7 explores changes over time in income compression (and, thus, overall tax progressivity) 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 2006–2008 to calculate the 20-year changes in order to smooth through this measurement error. States on the 45-degree line passed the change in before-tax wage 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 inequality to after-tax inequality. Similarly, 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 the 45-degree line indicating one-for-one pass through. However, there is some indication that states with large changes in before-tax inequality tend to fall beneath the 45-degree line, while the states with small changes are above the line. Stated differently, states with large increases in inequality saw these rises mitigated by the tax code, while states with small increases saw them amplified.[24] The second and third panels perform the same exercise for only the federal tax code and only the state tax code, respectively. The variation across states appears to be mostly a function of the federal tax code, as the states are tightly clustered around the 45-degree line in the bottom panel, where we consider only the impact over time of state tax policy.

The final three panels of Figure 7 repeat the analysis using the gini coefficient. Although the states are again all near the 45-degree line, they tend to be clustered above the line, producing the conclusion that the tax code intensified the change in wage inequality. The variation across states again appears to be a function of the federal tax code, not the state tax codes.

Our final piece of analysis focuses solely on state taxes by performing a counterfactual exercise. Specifically, the gini coefficient and 90/10 inequality measures are recalculated after assuming that the *entire* sample (that is, residents of all states) is subject to the state tax code

[24] Almost all of the states above the line are small states, raising the possibility that measurement error is a partial explanation for this pattern.

of California (California net income)—a high-compression state—based on the analysis in Table 2. The same exercise is then repeated using the tax code of Mississippi (Mississippi net income)—a state that widens the income distribution through taxation. Figure 8 compares these counter-factual inequality measures over time to realized inequality. Actual net income inequality (red line) is calculated using taxpayers' true state of residence. California net income inequality (green line) is well below actual net income inequality, suggesting that if all states switched to California's tax code, after-tax wage inequality would fall. On the other hand, a switch by all states to the Mississippi tax code (yellow line) would serve to increase after-tax inequality.

5 Conclusions

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. The focus is on the distribution of wage income, given the substantial rise in wage inequality over the past 25 years. While federal taxes tend to mitigate income inequality across U.S. households to a significant extent among all states, we find that state-levied taxes on individuals, on average, mitigate wage inequality by a small amount. Looking at the average reduction in inequality, though, masks significant heterogeneity across states. A few states' income compression is equal to one-third or more of the compression caused by the federal code in the same state. On the other hand, the tax systems in several states actually widen their distributions of income. Over time, the effect of federal and state taxes on income inequality appears to have been remarkably constant, and essentially all of the rise in inequality among households in the before-tax income distribution since the mid-1980s has been transmitted to the after-tax distribution.

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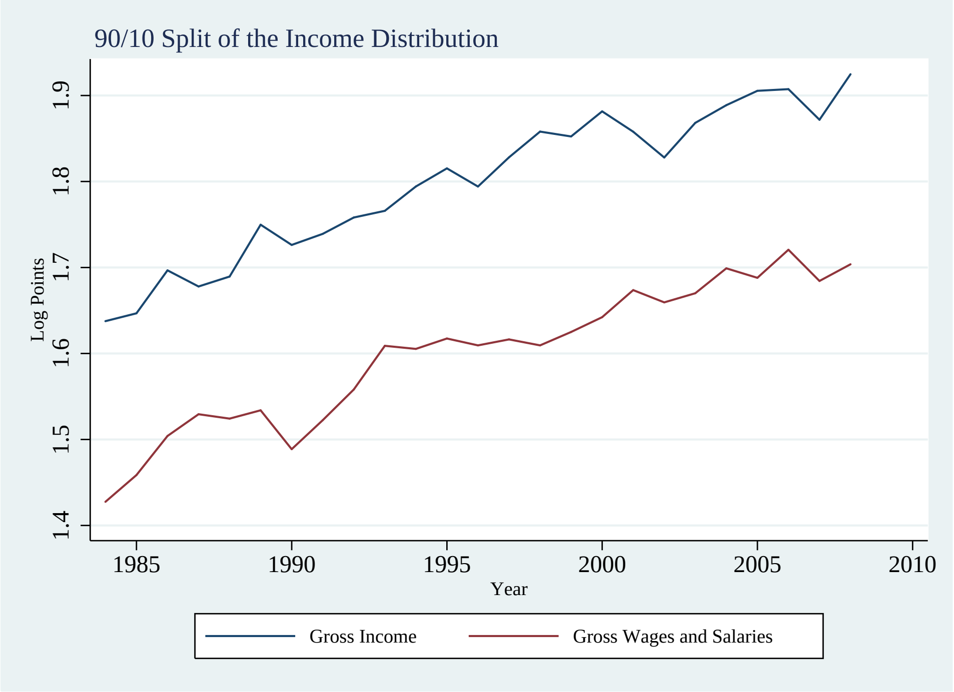
Figure 1: Inequality over Time

Panel A

Panel B



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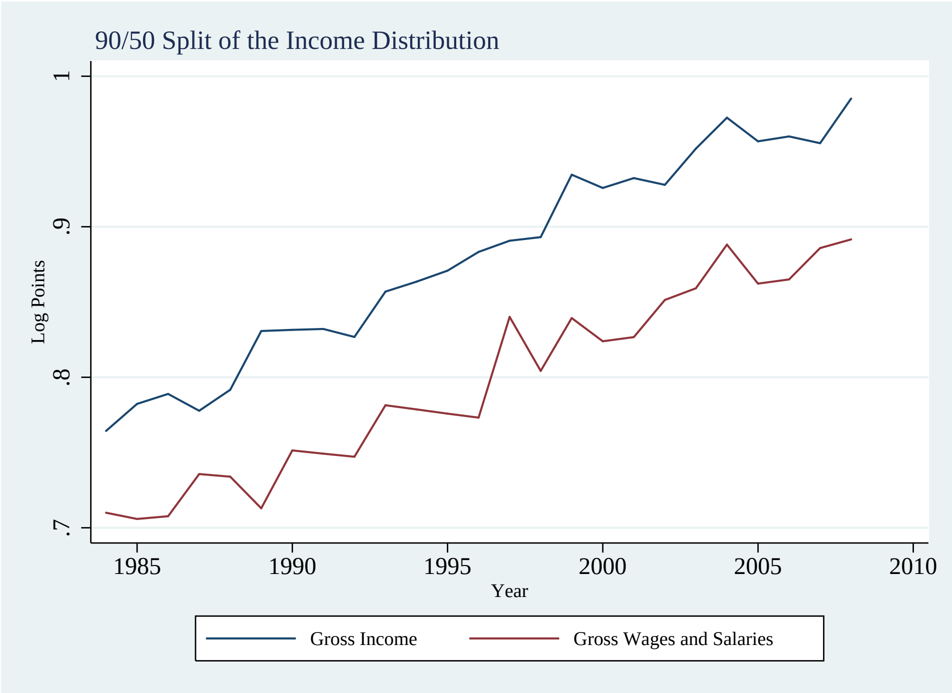
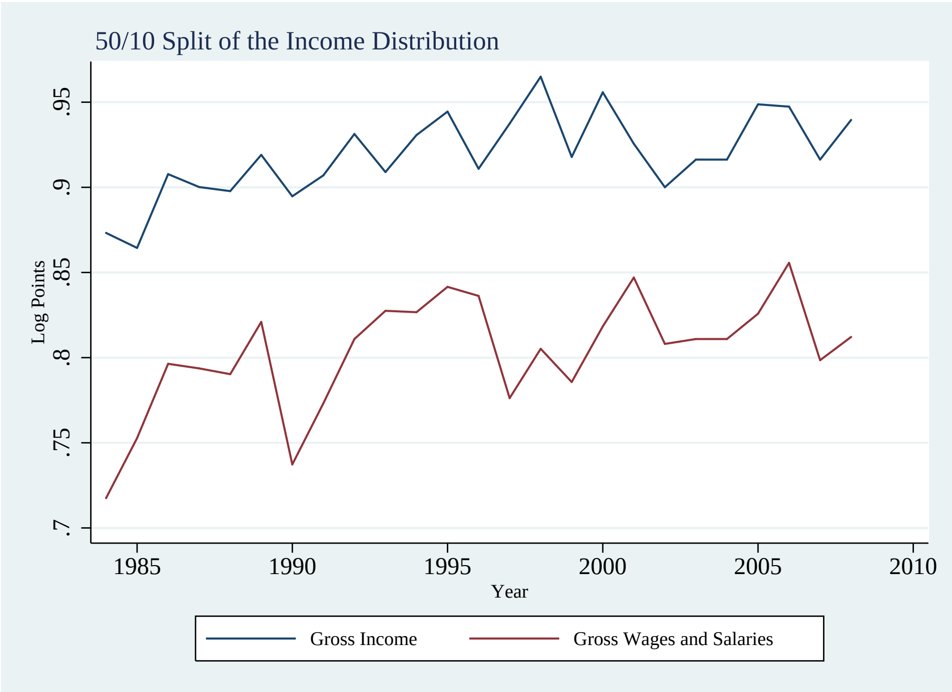


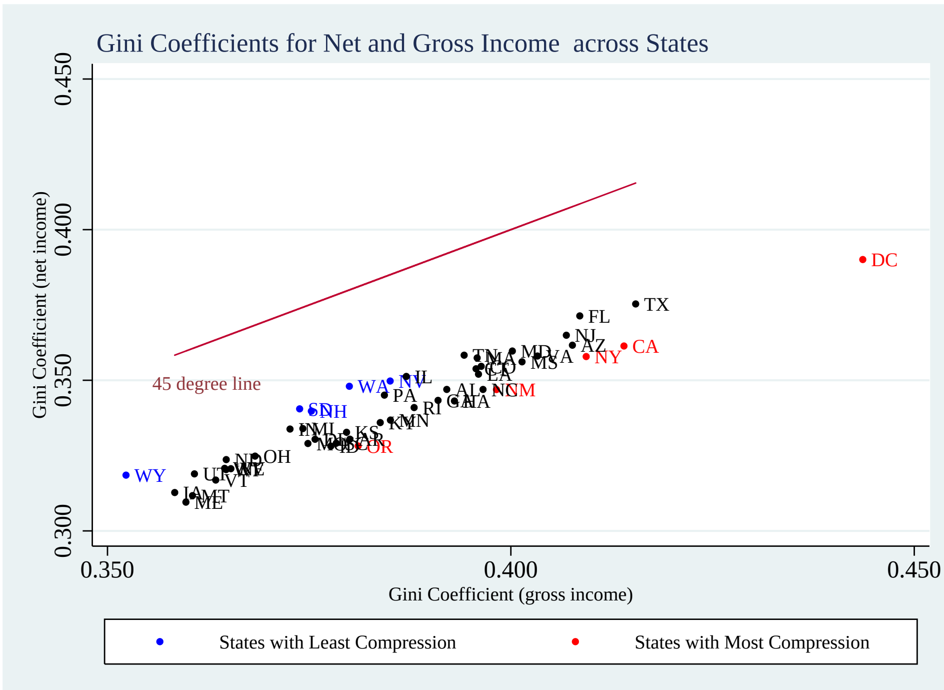
Panel D



Source: Authors' calculations using CPS data.

Figure 2: Across State Differences

Panel A



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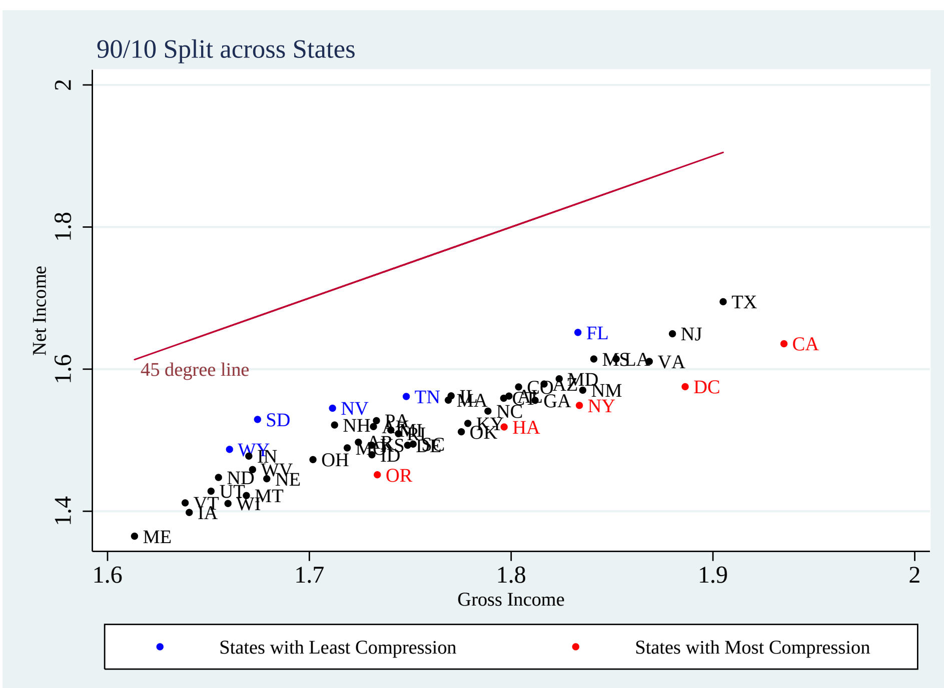
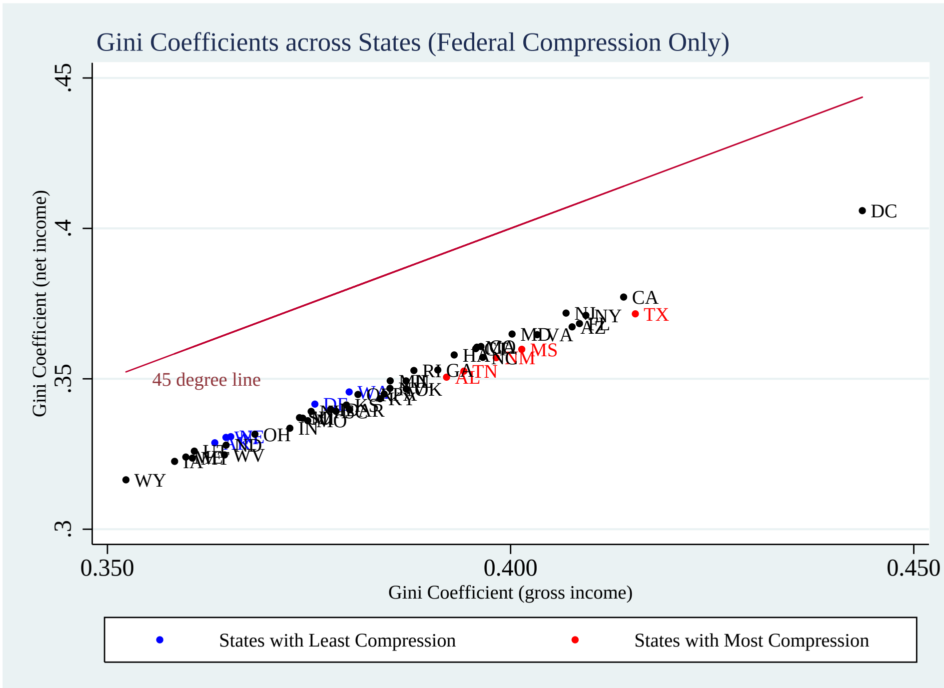


Source: Authors' calculations using CPS data.

Figure 3: Federal and State Compression across States

Panel A



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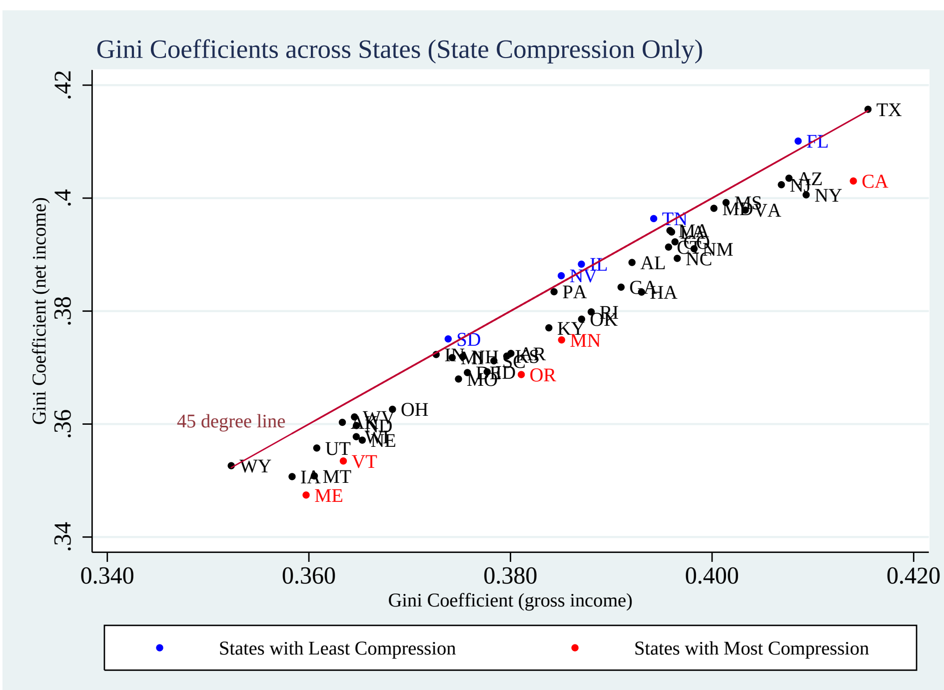

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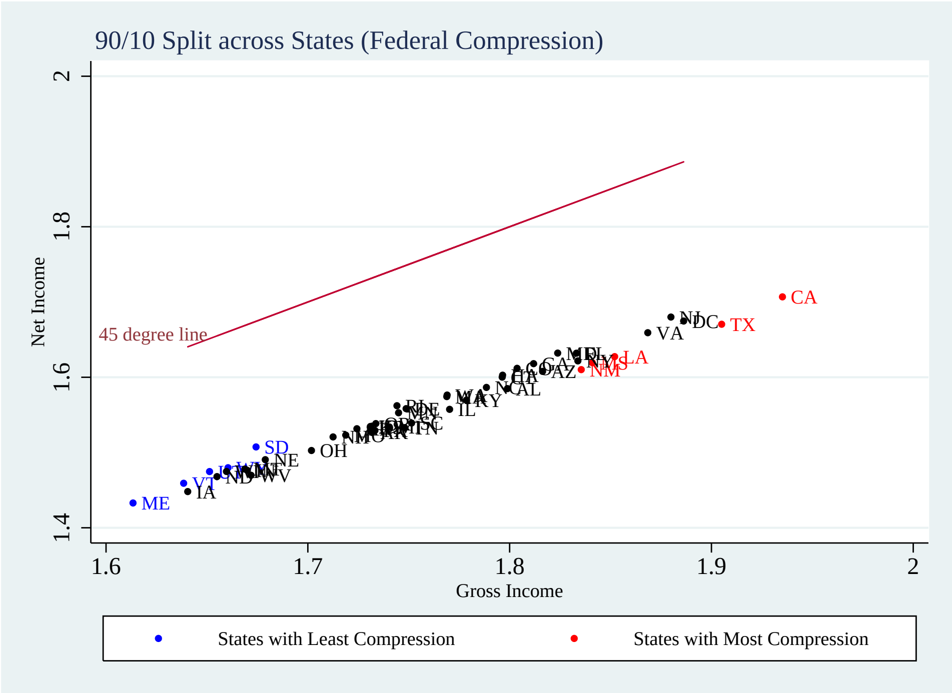

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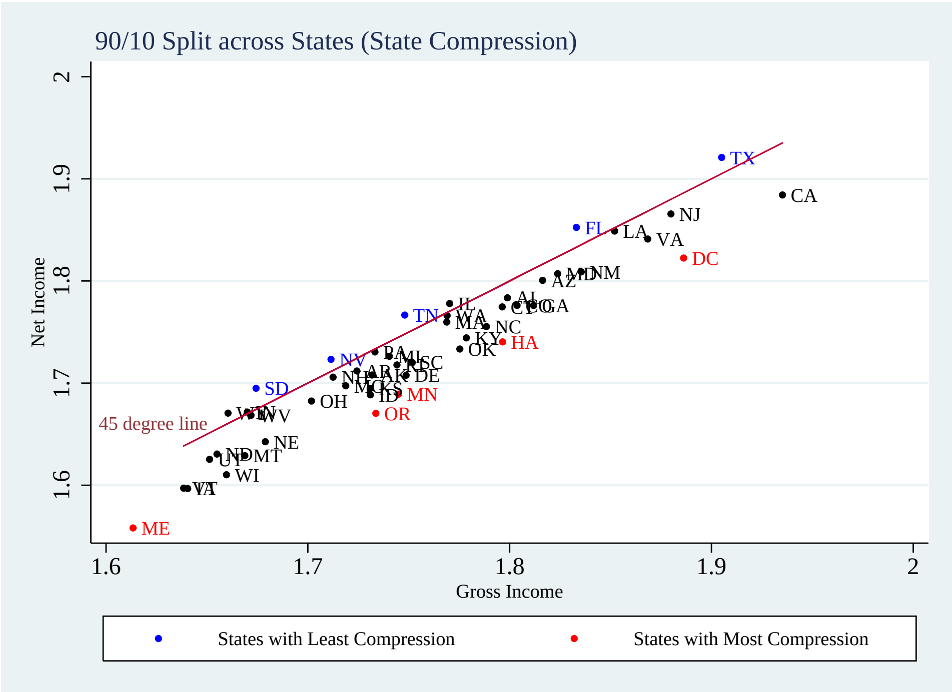
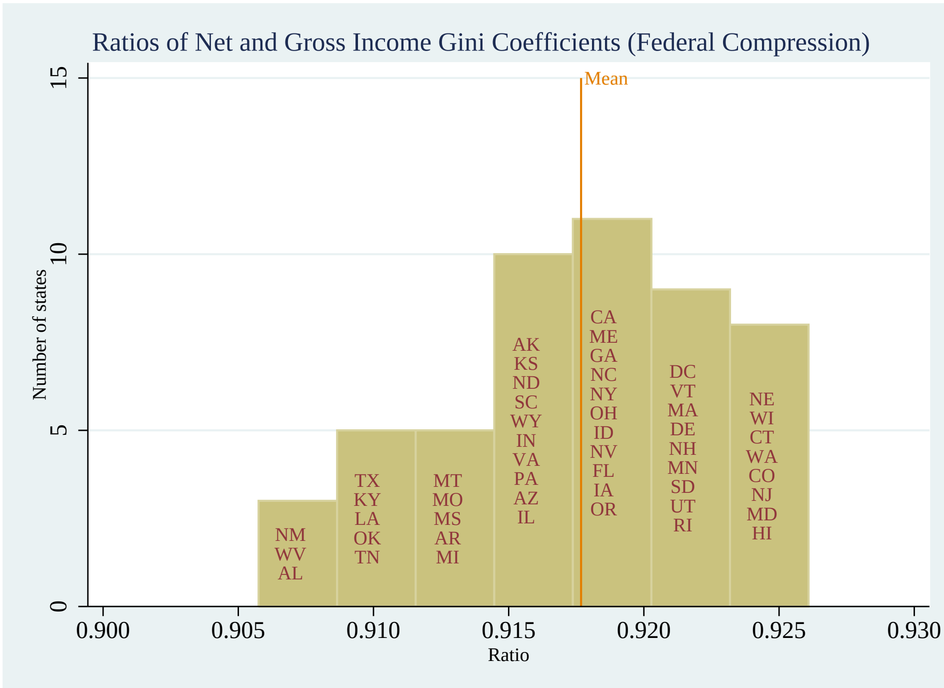


Source: Authors' calculations using CPS data.

Figure 4: State and Federal Compression

Panel A

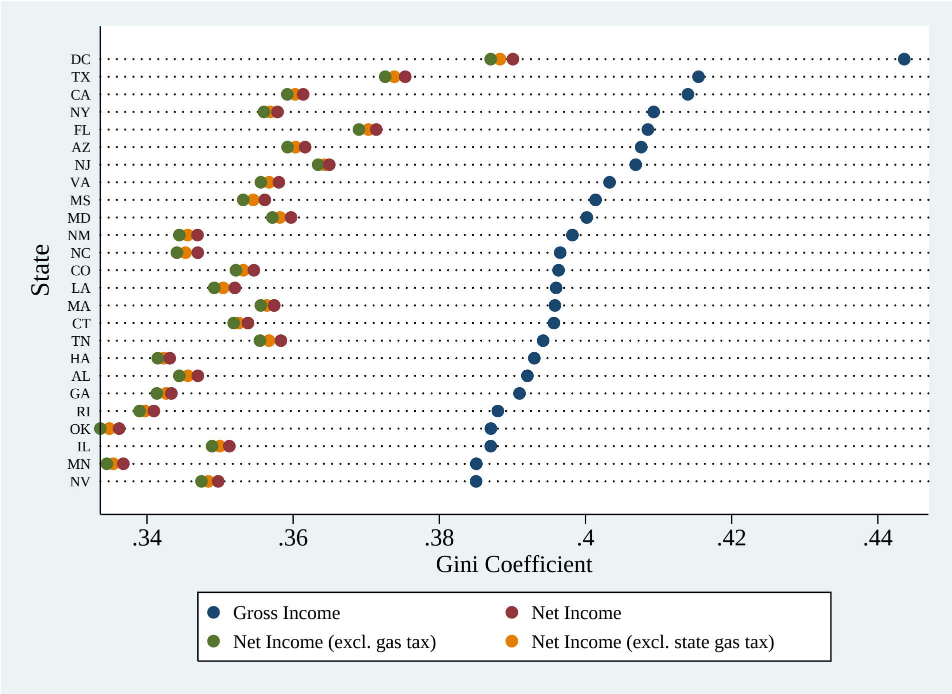


Panel B

Source: Authors' calculations using CPS data.

Figure 5: Impact of Gas Taxes Across States

Panel A



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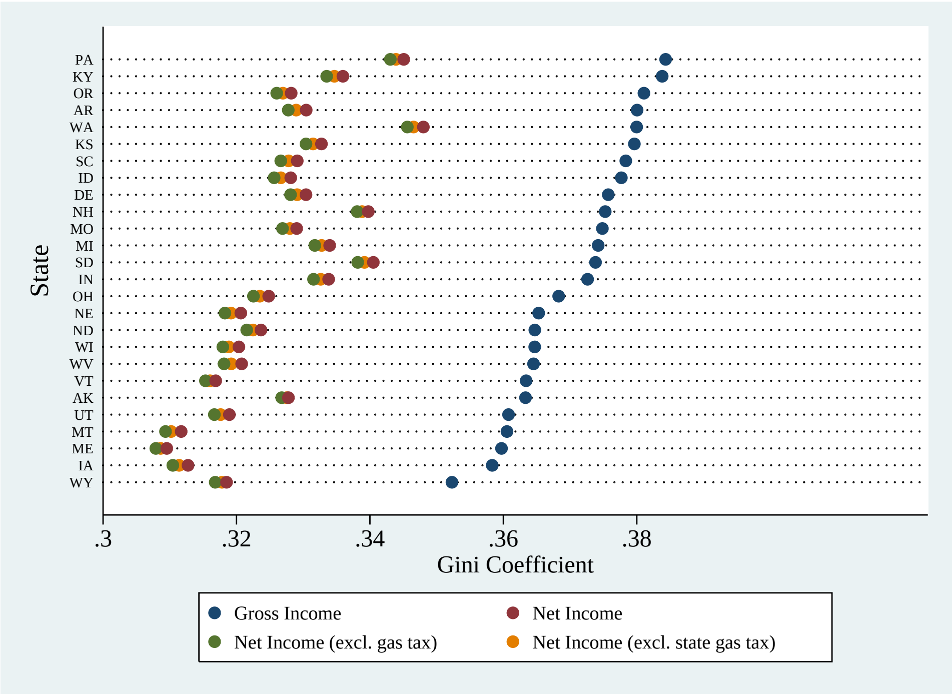

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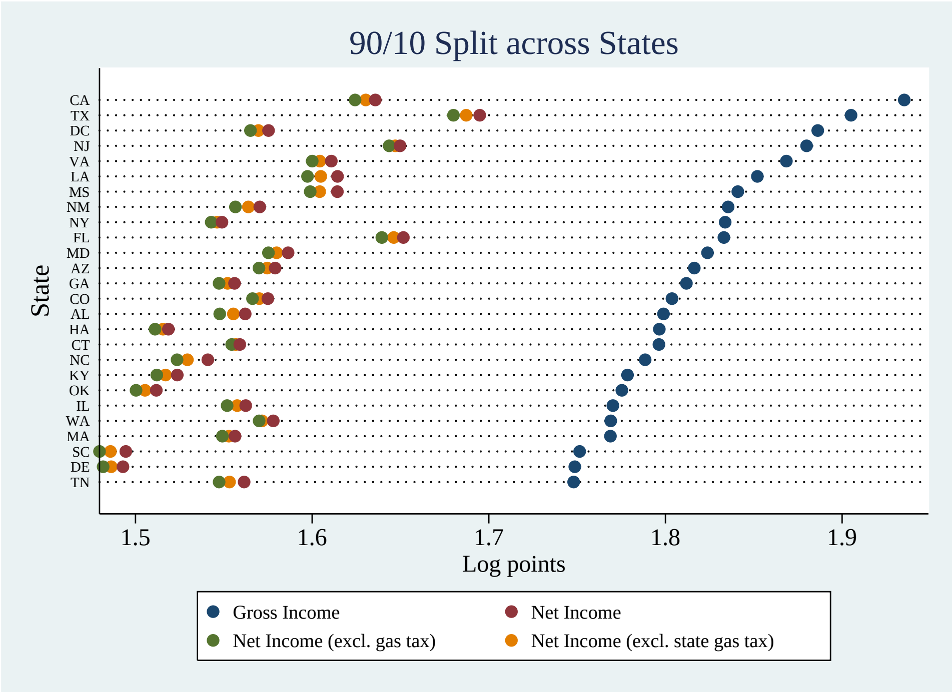

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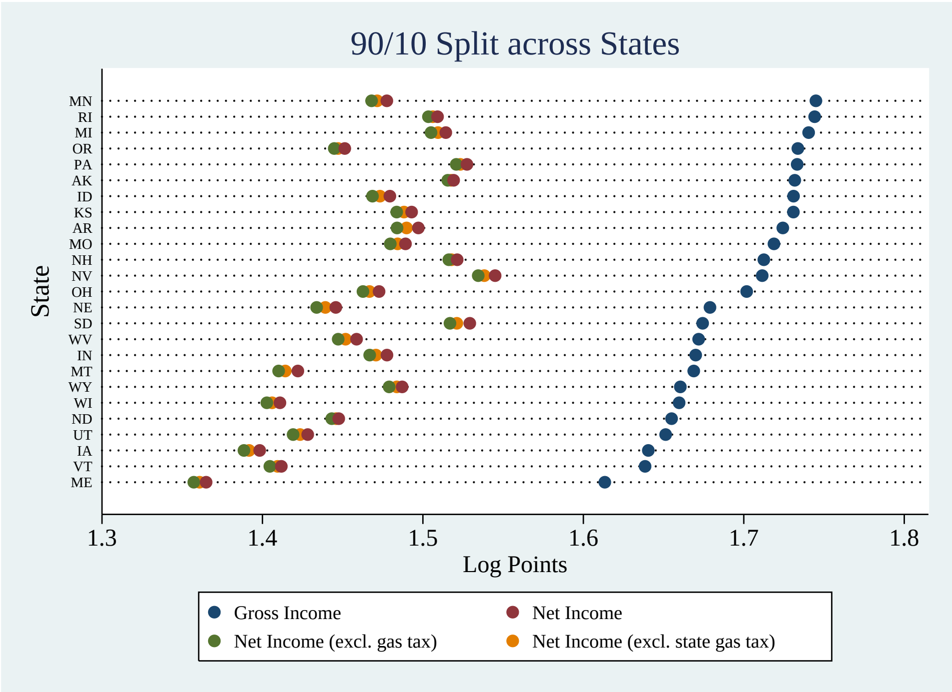
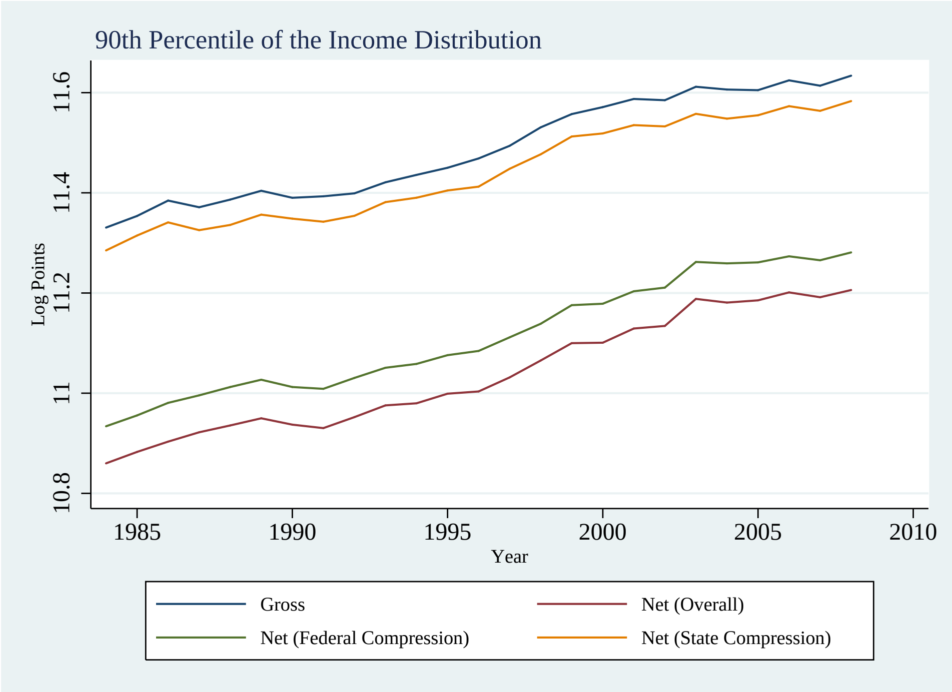


Source: Authors' calculations using CPS data.

Figure 6: Inequality over Time

Panel A



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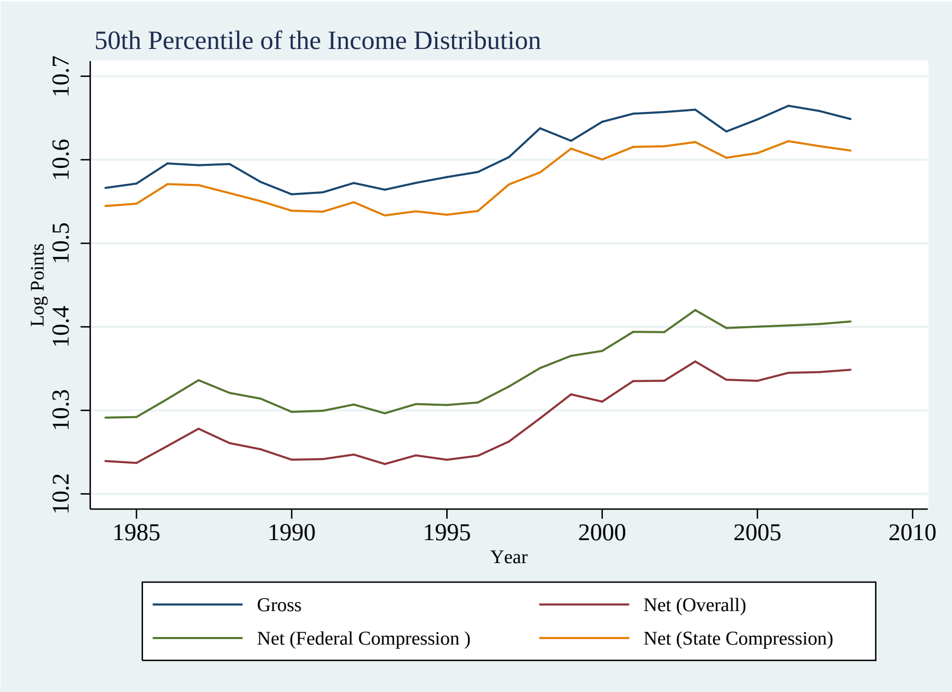

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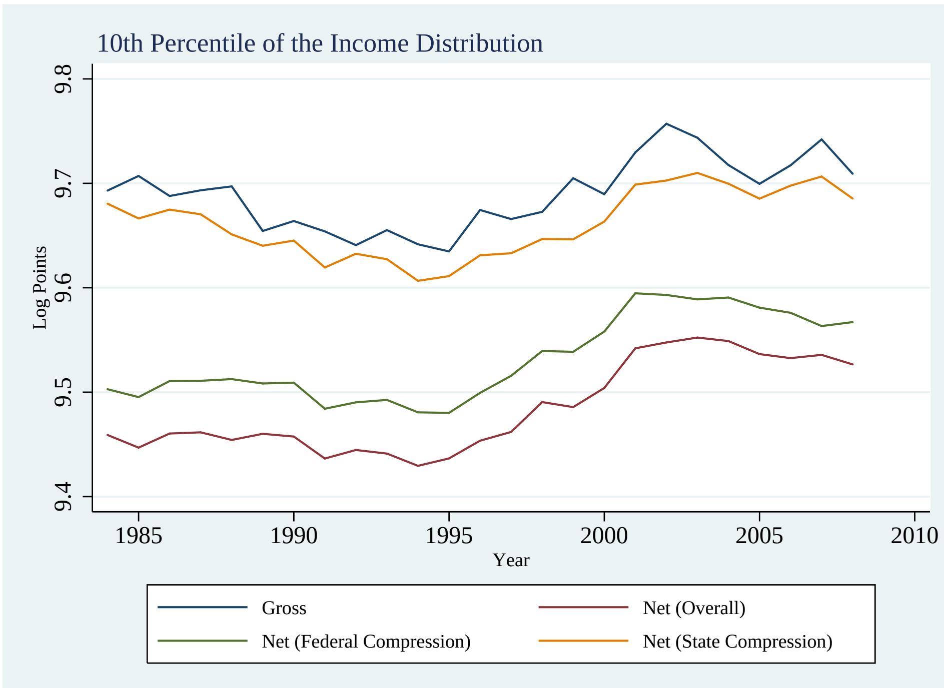

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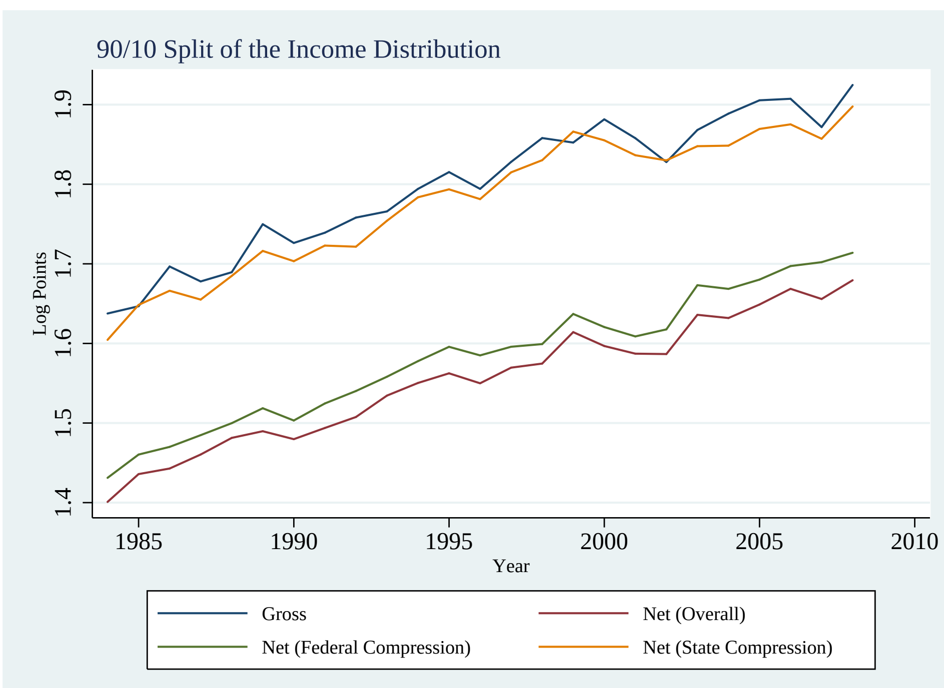

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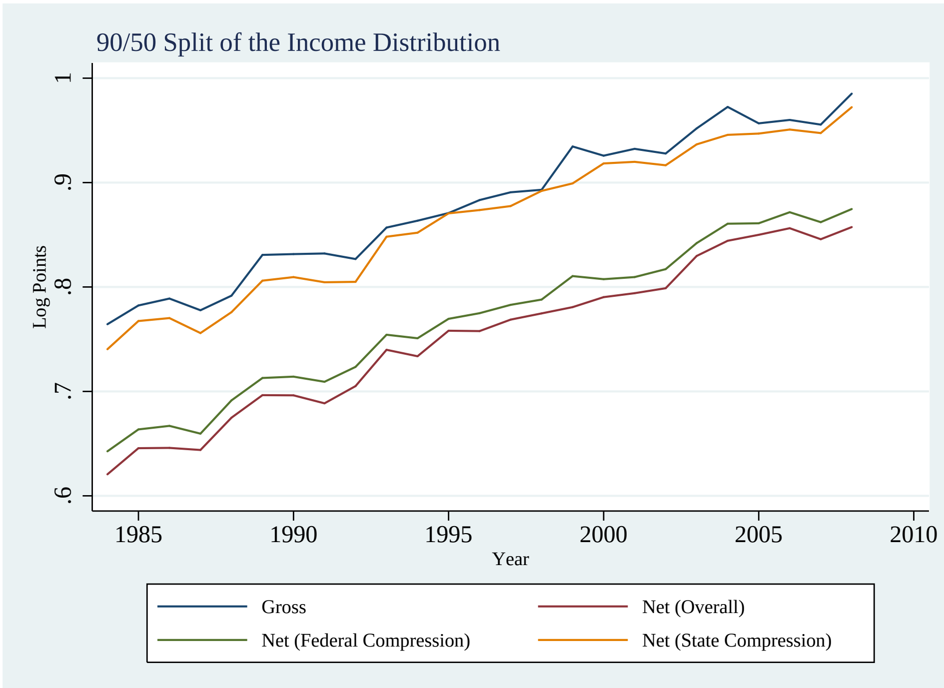
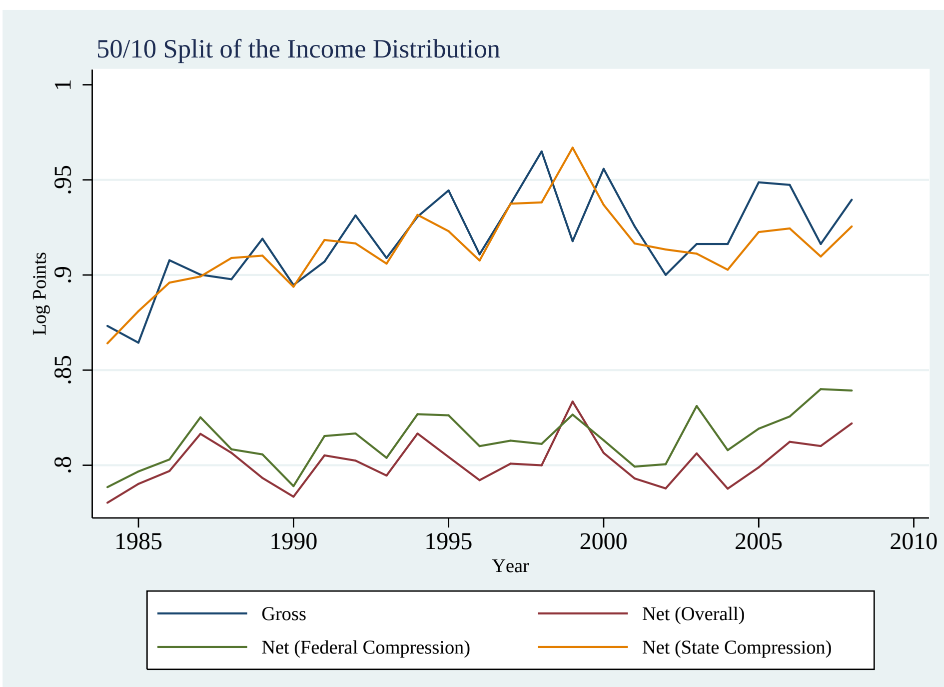
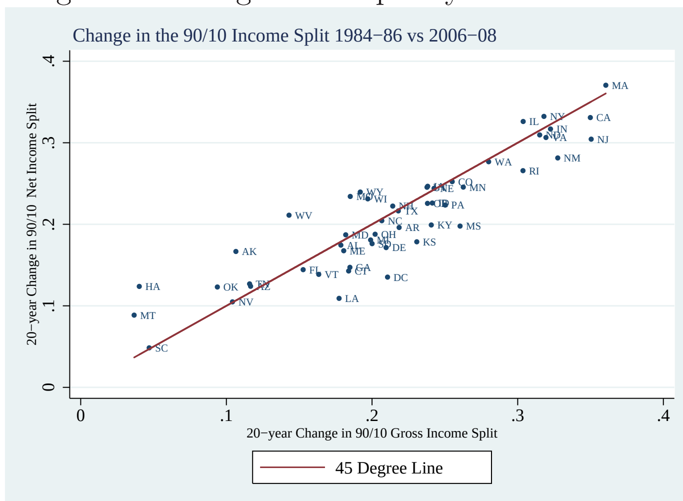


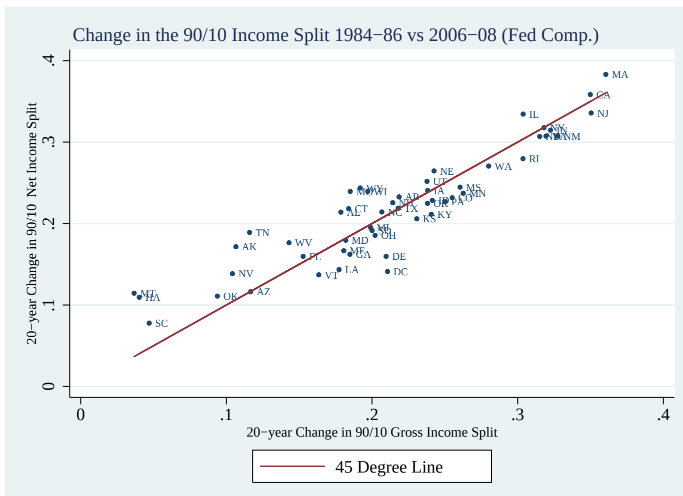
Panel F

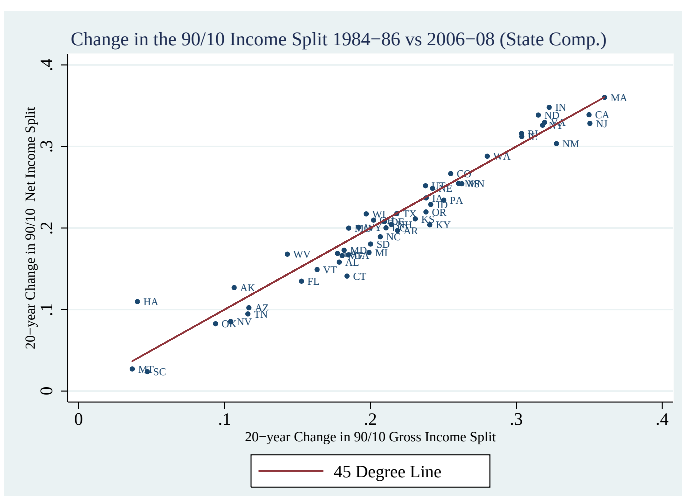


Source: Authors' calculations using CPS data.

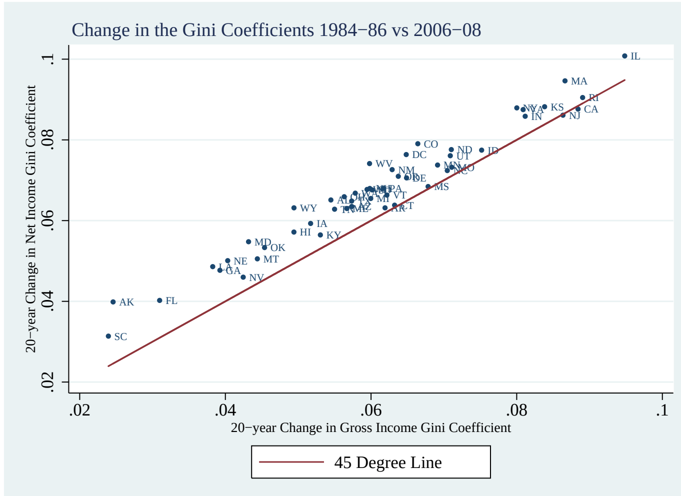
Figure 7: Changes in Inequality 1980s to 2000s

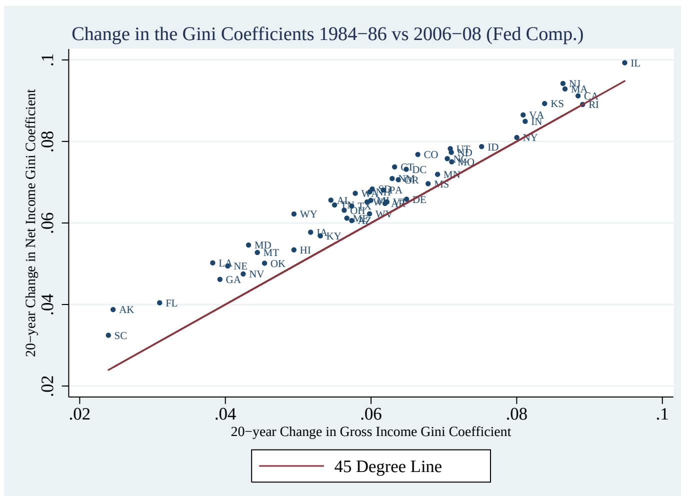


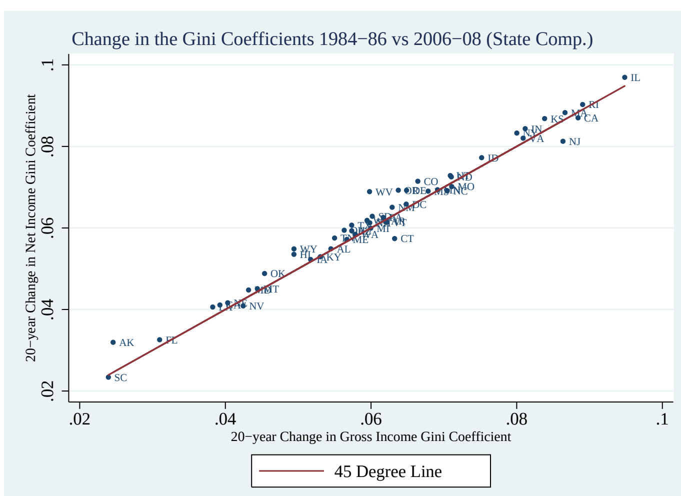




Source: Authors' calculations using CPS data.

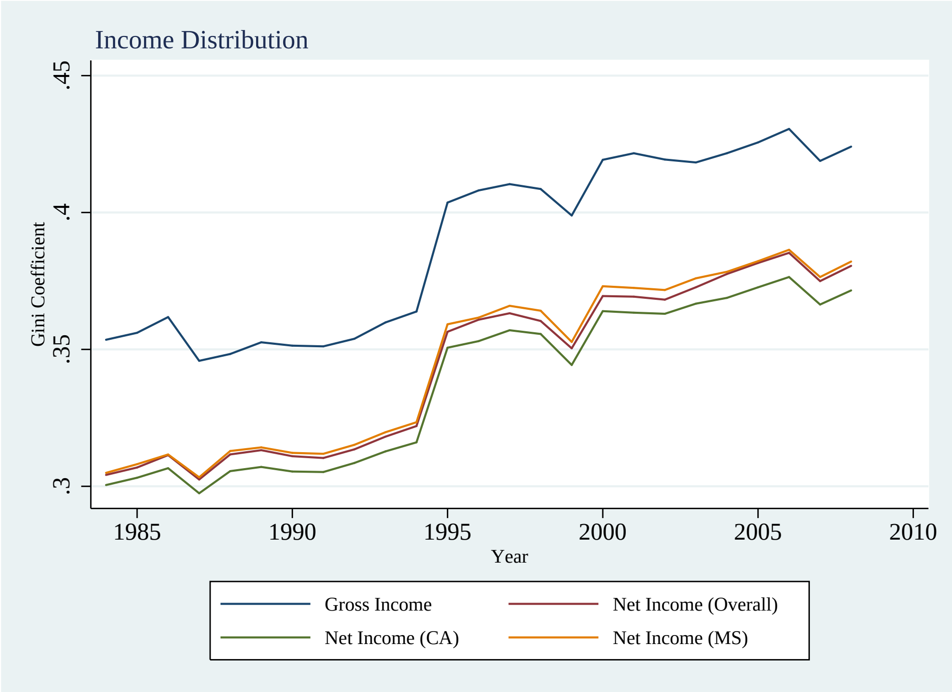


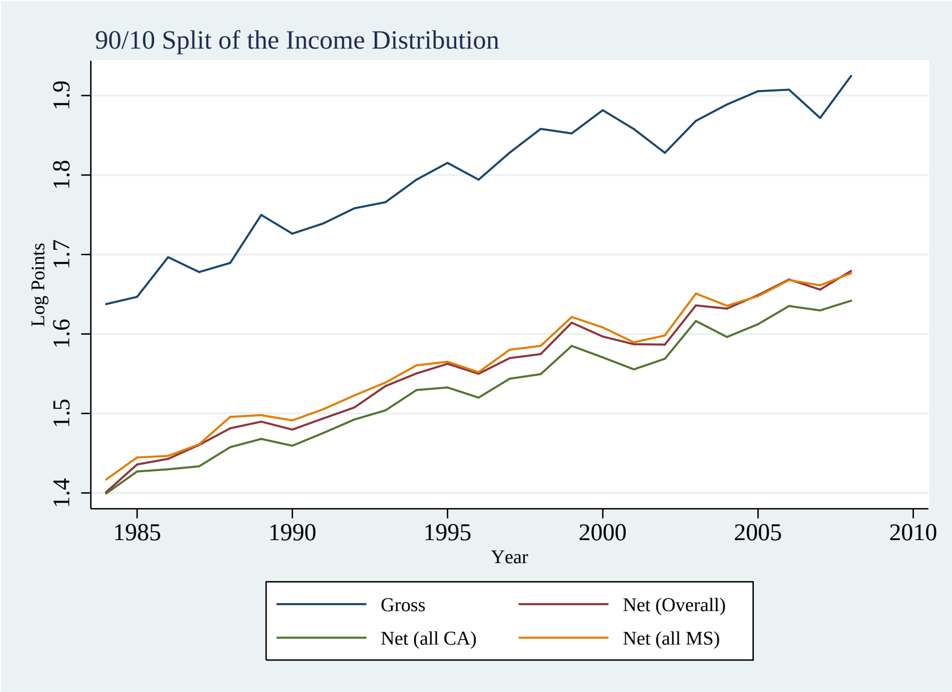




Source: Authors' calculations using CPS data.

Figure 8: Counterfactual State Tax Schemes





Source: Authors' calculations using CPS data.

Table 1: Total Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	113.9	77.3	20.3	16.8	19.6
AL	89.4	58.1	14.6	11.9	22.9
AR	80.0	51.6	14.3	11.5	22.1
AZ	92.7	60.0	14.9	12.2	23.2
CA	104.9	63.6	14.7	11.8	27.7
CO	108.5	68.7	17.4	13.6	21.4
CT	127.2	76.9	19.6	14.9	22.7
DC	112.4	64.6	16.5	12.8	29.9
DE	98.4	62.0	16.9	13.6	24.5
FL	92.9	62.0	14.7	11.6	16.4
GA	96.9	60.6	15.4	12.5	25.4
HA	98.6	59.7	16.2	12.6	25.7
IA	91.1	57.8	17.3	13.8	22.8
ID	86.5	54.7	15.3	12.5	25.4
IL	101.2	62.8	16.9	12.6	18.4
IN	93.9	60.1	17.1	13.3	19.9
KS	95.2	60.0	16.7	13.2	22.7
KY	91.2	58.3	15.2	12.4	24.6
LA	92.3	59.6	14.3	11.4	21.3
MA	109.2	65.6	19.1	14.0	19.9
MD	118.3	72.5	18.1	13.9	22.4
ME	88.6	55.6	17.1	13.5	23.2
MI	101.3	62.6	17.8	13.5	20.5
MN	108.0	65.8	18.2	14.3	25.5
MO	93.5	59.8	16.4	13.2	22.7
MS	81.8	53.2	13.0	10.5	21.4
MT	78.9	51.2	14.9	12.3	23.8
NC	88.6	54.6	14.9	11.8	24.8
ND	83.0	55.8	15.9	12.8	18.6
NE	90.6	57.8	16.6	13.2	22.4
NH	111.5	73.7	19.2	14.8	14.9
NJ	116.6	71.0	17.6	13.1	19.9
NM	84.9	54.7	14.0	11.5	24.2
NV	90.9	61.4	16.2	12.8	15.7
NY	102.1	60.8	16.1	12.5	25.9
OH	94.5	59.2	17.1	13.5	23.1
OK	89.5	56.4	15.1	12.3	26.1
OR	96.1	58.3	16.4	13.1	27.4
PA	98.7	62.3	17.2	13.0	18.3
RI	106.0	65.1	17.4	13.1	20.9
SC	87.6	55.1	15.0	12.1	24.9
SD	84.3	57.3	15.7	12.2	13.4
TN	88.2	60.0	15.3	12.3	16.8
TX	92.7	62.0	14.0	11.2	18.3
UT	92.3	58.6	17.4	13.4	19.4
VA	112.2	68.5	16.9	13.2	24.9
VT	92.8	58.5	17.5	13.3	18.9
WA	104.9	69.8	17.6	14.1	18.2
WI	95.0	57.8	17.5	13.4	23.3
WV	80.8	52.0	15.0	11.9	20.9
WY	89.7	62.2	16.9	13.9	17.3
Average	98.3	61.9	16.3	12.8	22.0

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

Table 2: Federal and State Compression

	Gross 90/10 -Net 90/10 Federal[1]	Gross 90/10 -Net 90/10 State[1]	State as % Federal
AK	20.9	1.9	9.2%
AL	21.7	1.6	7.6%
AR	18.9	1.5	7.9%
AZ	20.9	1.9	8.9%
CA	22.8	4.1	18.1%
CO	19.2	2.5	12.9%
CT	20.0	3.0	14.9%
DC	21.3	6.9	32.2%
DE	18.5	3.6	19.4%
FL	20.5	-1.8	-8.8%
GA	19.9	3.4	17.4%
HA	18.8	5.8	30.9%
IA	18.4	4.1	22.4%
ID	20.1	4.1	20.3%
IL	21.1	-0.8	-3.9%
IN	21.0	0.4	1.7%
KS	20.0	3.3	16.3%
KY	21.4	3.7	17.1%
LA	22.2	0.1	0.6%
MA	19.4	1.5	7.6%
MD	20.3	2.2	10.9%
ME	18.7	5.9	31.7%
MI	20.4	1.4	6.9%
MN	20.2	6.8	33.7%
MO	19.5	2.5	12.6%
MS	21.8	-1.0	-4.7%
MT	19.6	4.9	25.1%
NC	20.4	2.7	13.2%
ND	19.2	2.9	14.9%
NE	18.6	3.8	20.6%
NH	19.0	0.1	0.5%
NJ	20.6	1.5	7.3%
NM	21.5	2.4	11.4%
NV	18.5	-1.5	-8.2%
NY	21.4	5.3	24.6%
OH	20.3	2.8	13.7%
OK	21.6	4.1	18.9%
OR	20.4	6.4	31.5%
PA	20.4	0.3	1.7%
RI	19.1	2.7	14.1%
SC	20.8	2.8	13.3%
SD	17.3	-1.4	-8.2%
TN	20.4	-2.3	-11.2%
TX	22.2	-1.9	-8.7%
UT	17.8	2.8	15.6%
VA	21.1	2.8	13.5%
VT	16.4	3.6	22.0%
WA	19.4	-0.1	-0.4%
WI	19.7	5.7	28.7%
WV	20.6	0.1	0.5%
WY	18.7	-0.9	-5.0%
Total	20.1	2.3	11.6%

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

Table 3: 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	113.9	115.5	115.6	20.3	21.0	21.0	1.9	2.0	-0.1
AL	89.4	84.9	85.2	14.6	14.1	14.2	1.6	2.3	-0.6
AR	80.0	75.1	75.4	14.3	13.6	13.8	1.5	2.3	-0.8
AZ	92.7	89.0	89.3	14.9	14.6	14.7	1.9	2.4	-0.5
CA	104.9	98.1	98.4	14.7	14.4	14.4	4.1	4.5	-0.4
CO	108.5	103.4	103.8	17.4	17.0	17.1	2.5	2.9	-0.5
CT	127.2	120.7	121.0	19.6	19.2	19.3	3.0	3.4	-0.5
DC	112.4	101.7	102.0	16.5	16.0	16.1	6.9	7.6	-0.7
DE	98.4	93.5	93.9	16.9	16.7	16.9	3.6	4.3	-0.8
FL	92.9	91.8	92.0	14.7	14.3	14.4	-1.8	-1.1	-0.7
GA	96.9	91.3	91.4	15.4	15.0	15.1	3.4	3.8	-0.3
HA	98.6	90.8	91.0	16.2	15.8	15.8	5.8	5.9	-0.1
IA	91.1	85.9	86.2	17.3	17.0	17.1	4.1	4.6	-0.5
ID	86.5	80.7	81.1	15.3	14.9	15.0	4.1	4.7	-0.7
IL	101.2	96.7	97.0	16.9	16.1	16.2	-0.8	-0.3	-0.5
IN	93.9	89.5	89.8	17.1	16.3	16.4	0.4	0.7	-0.3
KS	95.2	89.6	90.0	16.7	16.3	16.4	3.3	3.8	-0.5
KY	91.2	85.7	86.0	15.2	14.8	14.9	3.7	4.4	-0.7
LA	92.3	88.8	89.2	14.3	13.8	14.0	0.1	1.1	-0.9
MA	109.2	102.2	102.5	19.1	18.1	18.2	1.5	1.8	-0.4
MD	118.3	111.8	112.1	18.1	17.5	17.7	2.2	2.9	-0.7
ME	88.6	82.7	83.0	17.1	16.9	17.1	5.9	6.4	-0.5
MI	101.3	96.1	96.4	17.8	17.1	17.3	1.4	2.0	-0.6
MN	108.0	100.3	100.6	18.2	18.1	18.2	6.8	7.3	-0.5
MO	93.5	88.5	88.8	16.4	15.9	16.0	2.5	2.8	-0.4
MS	81.8	77.9	78.1	13.0	12.2	12.4	-1.0	-0.2	-0.9
MT	78.9	75.1	75.6	14.9	14.9	15.1	4.9	5.6	-0.7
NC	88.6	82.5	82.9	14.9	14.3	14.4	2.7	3.5	-0.8
ND	83.0	80.7	81.0	15.9	15.9	16.0	2.9	3.2	-0.4
NE	90.6	85.7	86.1	16.6	16.3	16.5	3.8	4.5	-0.7
NH	111.5	110.8	111.0	19.2	19.1	19.2	0.1	0.4	-0.3
NJ	116.6	111.7	111.9	17.6	17.2	17.2	1.5	1.9	-0.3
NM	84.9	80.6	80.9	14.0	13.6	13.7	2.4	3.2	-0.7
NV	90.9	89.8	90.1	16.2	15.8	15.9	-1.5	-1.0	-0.5
NY	102.1	95.3	95.6	16.1	15.9	16.0	5.3	5.6	-0.3
OH	94.5	89.6	89.9	17.1	16.7	16.8	2.8	3.4	-0.6
OK	89.5	84.0	84.3	15.1	14.7	14.9	4.1	4.7	-0.6
OR	96.1	88.7	89.0	16.4	16.2	16.3	6.4	7.0	-0.6
PA	98.7	94.6	94.9	17.2	16.5	16.6	0.3	0.7	-0.3
RI	106.0	99.9	100.4	17.4	16.8	16.9	2.7	3.0	-0.3
SC	87.6	82.2	82.4	15.0	14.5	14.6	2.8	3.5	-0.8
SD	84.3	83.3	83.6	15.7	15.3	15.4	-1.4	-1.0	-0.4
TN	88.2	86.7	87.1	15.3	14.7	14.9	-2.3	-1.7	-0.6
TX	92.7	91.8	92.1	14.0	13.6	13.7	-1.9	-1.1	-0.8
UT	92.3	86.2	86.6	17.4	16.7	16.9	2.8	3.3	-0.6
VA	112.2	105.1	105.4	16.9	16.3	16.4	2.8	3.4	-0.5
VT	92.8	87.8	88.1	17.5	17.1	17.3	3.6	4.0	-0.3
WA	104.9	103.6	104.0	17.6	17.4	17.6	-0.1	0.6	-0.7
WI	95.0	88.4	88.8	17.5	17.2	17.4	5.7	6.2	-0.6
WV	80.8	75.7	76.1	15.0	14.1	14.2	0.1	1.0	-0.9
WY	89.7	89.6	89.8	16.9	16.7	16.8	-0.9	-0.7	-0.2
Average	96.5	91.8	92.1	16.4	16.0	16.1	2.3	2.8	-0.5

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

Table 4: State Compression: Sales Tax Exemption Analysis

	90th Percentile			10th Percentile			90/10	90/10	(7) - (8)[2]
	Gross Inc.	Net Inc.	Net Inc. x Exempt[1]	Gross Inc.	Net Inc.	Net Inc. x Exempt[1]	Compression[2]	Compression x Exempt[1,2]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AK	113.9	115.5	115.5	20.3	21.0	21.0	1.9	1.9	0.0
AL	89.4	84.9	84.9	14.6	14.1	14.1	1.6	1.6	0.0
AR	80.0	75.1	75.1	14.3	13.6	13.6	1.5	1.5	0.0
AZ	92.7	89.0	88.5	14.9	14.6	14.4	1.9	0.7	1.1
CA	104.9	98.1	97.6	14.7	14.4	14.1	4.1	2.7	1.4
CO	108.5	103.4	103.1	17.4	17.0	16.9	2.5	2.1	0.4
CT	127.2	120.7	120.0	19.6	19.2	18.9	3.0	2.0	0.9
DC	112.4	101.7	101.1	16.5	16.0	15.7	6.9	6.0	0.9
DE	98.4	93.5	93.5	16.9	16.7	16.7	3.6	3.6	0.0
FL	92.9	91.8	91.4	14.7	14.3	14.0	-1.8	-3.2	1.4
GA	96.9	91.3	91.0	15.4	15.0	14.9	3.4	2.9	0.5
HA	98.6	90.8	90.8	16.2	15.8	15.8	5.8	5.8	0.0
IA	91.1	85.9	85.5	17.3	17.0	16.8	4.1	3.6	0.6
ID	86.5	80.7	80.7	15.3	14.9	14.9	4.1	4.1	0.0
IL	101.2	96.7	96.6	16.9	16.1	16.0	-0.8	-1.2	0.4
IN	93.9	89.5	89.2	17.1	16.3	16.1	0.4	-0.6	1.0
KS	95.2	89.6	89.6	16.7	16.3	16.3	3.3	3.3	0.0
KY	91.2	85.7	85.3	15.2	14.8	14.5	3.7	2.3	1.3
LA	92.3	88.8	88.8	14.3	13.8	13.7	0.1	-0.3	0.4
MA	109.2	102.2	101.6	19.1	18.1	17.9	1.5	0.8	0.7
MD	118.3	111.8	111.5	18.1	17.5	17.3	2.2	1.5	0.7
ME	88.6	82.7	82.3	17.1	16.9	16.8	5.9	5.3	0.6
MI	101.3	96.1	95.7	17.8	17.1	16.9	1.4	0.7	0.7
MN	108.0	100.3	99.7	18.2	18.1	17.8	6.8	5.8	1.0
MO	93.5	88.5	88.5	16.4	15.9	15.9	2.5	2.5	0.0
MS	81.8	77.9	77.9	13.0	12.2	12.2	-1.0	-1.0	0.0
MT	78.9	75.1	75.1	14.9	14.9	14.9	4.9	4.9	0.0
NC	88.6	82.5	82.5	14.9	14.3	14.3	2.7	2.7	0.0
ND	83.0	80.7	80.3	15.9	15.9	15.6	2.9	2.0	0.9
NE	90.6	85.7	85.4	16.6	16.3	16.1	3.8	3.1	0.8
NH	111.5	110.8	110.8	19.2	19.1	19.1	0.1	0.1	0.0
NJ	116.6	111.7	111.1	17.6	17.2	16.9	1.5	0.5	1.0
NM	84.9	80.6	80.5	14.0	13.6	13.6	2.4	2.3	0.1
NV	90.9	89.8	89.3	16.2	15.8	15.5	-1.5	-2.6	1.0
NY	102.1	95.3	95.0	16.1	15.9	15.7	5.3	4.5	0.7
OH	94.5	89.6	89.2	17.1	16.7	16.5	2.8	1.9	0.9
OK	89.5	84.0	84.0	15.1	14.7	14.7	4.1	4.1	0.0
OR	96.1	88.7	88.7	16.4	16.2	16.2	6.4	6.4	0.0
PA	98.7	94.6	94.0	17.2	16.5	16.2	0.3	-0.8	1.1
RI	106.0	99.9	99.3	17.4	16.8	16.5	2.7	1.4	1.3
SC	87.6	82.2	82.2	15.0	14.5	14.5	2.8	2.6	0.1
SD	84.3	83.3	83.3	15.7	15.3	15.3	-1.4	-1.4	0.0
TN	88.2	86.7	86.7	15.3	14.7	14.7	-2.3	-2.3	0.0
TX	92.7	91.8	91.3	14.0	13.6	13.3	-1.9	-3.4	1.5
UT	92.3	86.2	86.2	17.4	16.7	16.7	2.8	2.8	0.0
VA	112.2	105.1	105.1	16.9	16.3	16.3	2.8	2.8	0.0
VT	92.8	87.8	87.3	17.5	17.1	17.0	3.6	3.1	0.5
WA	104.9	103.6	103.0	17.6	17.4	17.1	-0.1	-1.1	1.0
WI	95.0	88.4	88.0	17.5	17.2	17.0	5.7	5.0	0.7
WV	80.8	75.7	75.7	15.0	14.1	14.0	0.1	0.1	0.1
WY	89.7	89.6	89.4	16.9	16.7	16.7	-0.9	-1.2	0.2
Average	96.5	91.8	91.5	16.4	16.0	15.8	2.3	1.8	0.5

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

6 Appendix

6.1 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 interview survey, households are followed for up to four consecutive quarters.[25] Since the interview survey collects household spending data for a longer horizon than the diary survey, the interview part of CEX is used in this paper and others.

The sample selection for the CEX data follows the standard approach in the literature. The primary criteria are that households must be in the sample for all four interviews, and they must have complete income responses.[26] 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 households' annual expenditures. If a household 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 approach in Blundell, Pistaferri, and Preston (2006).

[25] 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 household.

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

Table A-1: Federal Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	113.9	78.5	20.3	17.2	20.9
AL	89.4	63.0	14.6	12.8	21.7
AR	80.0	57.5	14.3	12.4	18.9
AZ	92.7	65.3	14.9	13.0	20.9
CA	104.9	72.1	14.7	12.7	22.8
CO	108.5	75.2	17.4	14.6	19.2
CT	127.2	86.8	19.6	16.3	20.0
DC	112.4	76.1	16.5	13.8	21.3
DE	98.4	68.8	16.9	14.2	18.5
FL	92.9	64.6	14.7	12.5	20.5
GA	96.9	68.1	15.4	13.2	19.9
HA	98.6	69.1	16.2	13.7	18.8
IA	91.1	65.0	17.3	14.8	18.4
ID	86.5	62.1	15.3	13.5	20.1
IL	101.2	69.7	16.9	14.4	21.1
IN	93.9	65.3	17.1	14.7	21.0
KS	95.2	66.9	16.7	14.4	20.0
KY	91.2	64.7	15.2	13.3	21.4
LA	92.3	64.7	14.3	12.5	22.2
MA	109.2	74.0	19.1	15.7	19.4
MD	118.3	80.8	18.1	15.1	20.3
ME	88.6	63.4	17.1	14.8	18.7
MI	101.3	69.7	17.8	15.0	20.4
MN	108.0	75.1	18.2	15.5	20.2
MO	93.5	65.7	16.4	14.0	19.5
MS	81.8	58.6	13.0	11.6	21.8
MT	78.9	56.7	14.9	13.0	19.6
NC	88.6	61.9	14.9	12.8	20.4
ND	83.0	59.7	15.9	13.8	19.2
NE	90.6	64.6	16.6	14.2	18.6
NH	111.5	76.6	19.2	16.0	19.0
NJ	116.6	79.2	17.6	14.7	20.6
NM	84.9	60.5	14.0	12.4	21.5
NV	90.9	64.1	16.2	13.7	18.5
NY	102.1	70.2	16.1	13.8	21.4
OH	94.5	65.5	17.1	14.5	20.3
OK	89.5	63.0	15.1	13.2	21.6
OR	96.1	67.2	16.4	14.1	20.4
PA	98.7	68.2	17.2	14.6	20.4
RI	106.0	73.8	17.4	14.6	19.1
SC	87.6	61.9	15.0	13.1	20.8
SD	84.3	60.6	15.7	13.4	17.3
TN	88.2	62.7	15.3	13.3	20.4
TX	92.7	64.9	14.0	12.2	22.2
UT	92.3	65.9	17.4	14.9	17.8
VA	112.2	77.3	16.9	14.4	21.1
VT	92.8	65.9	17.5	14.6	16.4
WA	104.9	73.0	17.6	14.9	19.4
WI	95.0	66.8	17.5	15.0	19.7
WV	80.8	58.0	15.0	13.2	20.6
WY	89.7	64.2	16.9	14.6	18.7
Average	98.3	68.4	16.3	13.9	20.5

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

Table A-2: State Compression

	90th Percentile		10th Percentile		Gross 90/10
	Gross Inc.	Net Inc.	Gross Inc.	Net Inc.	-Net 90/10[1]
AK	113.9	115.5	20.3	21.0	1.9
AL	89.4	84.9	14.6	14.1	1.6
AR	80.0	75.1	14.3	13.6	1.5
AZ	92.7	89.0	14.9	14.6	1.9
CA	104.9	98.1	14.7	14.4	4.1
CO	108.5	103.4	17.4	17.0	2.5
CT	127.2	120.7	19.6	19.2	3.0
DC	112.4	101.7	16.5	16.0	6.9
DE	98.4	93.5	16.9	16.7	3.6
FL	92.9	91.8	14.7	14.3	-1.8
GA	96.9	91.3	15.4	15.0	3.4
HA	98.6	90.8	16.2	15.8	5.8
IA	91.1	85.9	17.3	17.0	4.1
ID	86.5	80.7	15.3	14.9	4.1
IL	101.2	96.7	16.9	16.1	-0.8
IN	93.9	89.5	17.1	16.3	0.4
KS	95.2	89.6	16.7	16.3	3.3
KY	91.2	85.7	15.2	14.8	3.7
LA	92.3	88.8	14.3	13.8	0.1
MA	109.2	102.2	19.1	18.1	1.5
MD	118.3	111.8	18.1	17.5	2.2
ME	88.6	82.7	17.1	16.9	5.9
MI	101.3	96.1	17.8	17.1	1.4
MN	108.0	100.3	18.2	18.1	6.8
MO	93.5	88.5	16.4	15.9	2.5
MS	81.8	77.9	13.0	12.2	-1.0
MT	78.9	75.1	14.9	14.9	4.9
NC	88.6	82.5	14.9	14.3	2.7
ND	83.0	80.7	15.9	15.9	2.9
NE	90.6	85.7	16.6	16.3	3.8
NH	111.5	110.8	19.2	19.1	0.1
NJ	116.6	111.7	17.6	17.2	1.5
NM	84.9	80.6	14.0	13.6	2.4
NV	90.9	89.8	16.2	15.8	-1.5
NY	102.1	95.3	16.1	15.9	5.3
OH	94.5	89.6	17.1	16.7	2.8
OK	89.5	84.0	15.1	14.7	4.1
OR	96.1	88.7	16.4	16.2	6.4
PA	98.7	94.6	17.2	16.5	0.3
RI	106.0	99.9	17.4	16.8	2.7
SC	87.6	82.2	15.0	14.5	2.8
SD	84.3	83.3	15.7	15.3	-1.4
TN	88.2	86.7	15.3	14.7	-2.3
TX	92.7	91.8	14.0	13.6	-1.9
UT	92.3	86.2	17.4	16.7	2.8
VA	112.2	105.1	16.9	16.3	2.8
VT	92.8	87.8	17.5	17.1	3.6
WA	104.9	103.6	17.6	17.4	-0.1
WI	95.0	88.4	17.5	17.2	5.7
WV	80.8	75.7	15.0	14.1	0.1
WY	89.7	89.6	16.9	16.7	-0.9
Total	98.3	93.6	16.3	15.8	2.1

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