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ABSTRACT

A central tax policy parameter that has recently received much attention, but about which there is substantial uncertainty, is the overall elasticity of taxable income. We provide new estimates of this elasticity which address identification problems with previous work, by exploiting a long panel of tax returns to study a series of tax reforms throughout the 1980s. This identification strategy also allows us to provide new evidence on both the income effects of tax changes on taxable income, and on variation in the elasticity of taxable income by income group. We find that the overall elasticity of taxable income is approximately 0.4; the elasticity of real income, not including tax preferences, is much lower. We also estimate small income effects on tax changes on reported income, implying that the compensated and uncompensated elasticities of taxable income are very similar. We estimate that this overall elasticity is primarily due to a very elastic response of taxable income for taxpayers who have incomes above $100,000 per year, who have an elasticity of 0.57, while for those with incomes below $100,000 per year the elasticity is less than one-third as large. Moreover, high income taxpayers who itemize are particularly responsive to taxation. We then derive optimal income tax structures using these elasticities. Our estimates suggest that the optimal system for most redistributional preferences consists of a large demogrant that is rapidly taxed away for low income taxpayers, with lower marginal rates at higher income levels.

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One of the most important features of economic policy-making during the 1980s were a series of tax reforms which dramatically lowered marginal income tax rates in the U.S., particularly for higher income families. The top marginal income tax rate at the federal level fell from 70% in 1980 to 28% by 1988, as the income tax schedule was reduced from fifteen brackets to four. There were parallel changes in state income tax systems over this decade as well; New York, for example, moved from a system in 1980 with 13 brackets and a top marginal rate of 14% to one in 1989 with 5 brackets and a top marginal rate of 7.875%.

The intellectual weight behind this dramatic reduction in marginal tax rates was the logic of supply side economics. A number of influential articles, such as Hausman (1981) and Boskin (1978), argued that behaviors such as labor supply and savings were very elastic with respect to their prices, and as a result lower tax rates could generate important increases in economic activity. A large body of subsequent literature, however, suggested that these behavioral elasticities were actually rather modest (Slemrod, 1990). While this subsequent literature may not be a driving factor, it is noticeable that the 1990s have seen a reversal of the tax reductions of the 1980s, with marginal rates rising to 39.6% at the top today.

Over the past few years, however, a new literature has emerged which has pointed out that these standard behavioral responses are only one component of what drives taxable income; other responses such as the form of compensation, unmeasured effort, and compliance also ultimately determine taxable income income, and these may be more elastic with respect to taxation. Feldstein (1995) in particular observed that it is the overall elasticity of taxable income which is relevant for assessing the implications of tax changes for revenue raising. His seminal article found that this elasticity was very high for the Tax Reform Act of 1986 (TRA86), in excess of one for his central estimates.

This striking conclusion has generated a substantial body of work on this central parameter. Unfortunately, this subsequent work has generated a wide range of estimated elasticities, ranging from Feldstein's estimate at the high end to close to zero at the low end. This extreme variation reflects a variety of differences between the approaches in these papers, along dimensions such as the definition of income (ranging from broad Haig-Simons type definitions to narrower taxable income definitions), the samples used (ranging from just focusing on high income taxpayers to using a full range of incomes), and, perhaps most importantly, the source of identification. As emphasized by Slemrod (1996) and Goolsbee (1997,2000), many of the studies have essentially shown that high income taxpayers, whose marginal rates were falling in the 1980s, increased their taxable income during this era. But there was a general widening of the income distribution during the 1980s, and disentangling the role of taxation, as opposed to other factors such as international trade and skill-biased demand shocks, is quite difficult.

Our paper makes four contributions to this empirical literature. First, we draw on the entire set of state and federal tax reforms during the 1980s to estimate the elasticity of taxable income. The use of multiple years of changes allows us to address the identification problem faced by previous work by controlling in a rich way for the relationship between income changes and lagged income levels. That is, since for every income group over this time period there are different changes in tax policy in different years, we can control for any general tendencies towards (for example) a widening income distribution over this period while identifying the impact of tax policy changes. Second, while the previous literature has focused only on uncompensated responses to tax changes, our empirical framework allows us to decompose these responses into compensated substitution and income effects. Third, by using this broad set of reforms, which affected not just taxpayers at the top of the income distribution, we can extend the literature by exploring the variation in this critical parameter along the income distribution. Since we have variation not just at the top of the distribution but throughout, we can examine the heterogeneity by income class in how taxpayers respond to tax changes. This allows us to advance the literature in a fourth important direction: performing simulations of an optimal non-linear income tax system. We draw on Saez (1998), who presents a framework for using empirically estimable elasticities to calculate optimal income tax schedules. With our new estimates of elasticities along the distribution, this framework can be used to illustrate the optimal four bracket tax system under a variety of assumptions for distributional preferences among policy makers.

These advances generate a number of important findings. We find that the overall elasticity of taxable income is 0.4, well below the original estimates of Feldstein but roughly at the mid-point of the subsequent literature. This response is much lower, however, for a broader definition of total income that does not exclude tax preferences such as exemptions and itemized deductions; this partly arises from the mechanical effect that the base for calculating the elasticity is larger, and partly from responsiveness of tax preferences to tax rates. We estimate small income effects of tax changes on reported income, implying that the compensated and uncompensated elasticities of taxable income are very similar. We also find that this response is driven largely by the behavior of high income taxpayers; the elasticity of taxable income for those with incomes above $100,000 is 0.57, while it is less than one-third that for other income groups. High income taxpayers who itemize appear to be particularly responsive to tax changes. Finally, our estimates suggest that the optimal system for most redistributional preferences consists of a large demogrant that is rapidly taxed away for low income taxpayers, with lower marginal rates at higher income levels.

Our paper proceeds as follows. Part I provides a review of the literature on the elasticity of taxable income, highlighting the variation in the estimates, and the differences in approach across these papers. Part II discusses our data and methodology. Part III presents our basic results. Part IV considers heterogeneity by income and marital status. Part V displays both revenue-maximizing and optimal income tax rates. Part VI concludes.

1 Previous Work

As noted in the introduction, there is a long tradition of work on the behavioral elasticities of labor supply and savings which determine the responsiveness of real behavior to taxation. The literature on labor supply has recently been reviewed in Blundell and MaCurdy (1999), and they conclude that the responsiveness of male labor supply to after-tax wages is low, although it is higher (and perhaps much higher) for female/secondary earner labor supply. There is less consensus on the responsiveness of savings to taxation, but Hall (1988) concludes that there is little evidence from time series data to suggest an important correlation between savings and rates of return. There is also a large literature on the responsiveness of other elements of taxable income to taxation, such as charitable giving and the form of compensation (as well as tax evasion), which suggests that these elements are fairly sensitive to taxation (Slemrod, 1990). But these literatures had proceeded in piecemeal fashion, each paper considering the response of a particular real or reporting behavior, but with little effort to integrate the findings.

The first article to attempt such an integration was Lindsey's (1987) study of the response of taxable income to the Economic Reform Tax Act of 1981 (ERTA 81), which significantly reduced tax rates on high income earners. He used a series of cross-sections of taxpayers to project what the distribution of earnings would have been like in 1982 had there been no change from 1979, other than uniform overall income growth. He then interpreted a change in the distribution of incomes towards the wealthy as evidence of a responsiveness to taxation, estimating an elasticity of taxable income with respect to taxation of 1.6 to 1.8. But, as highlighted by Navratil (1995), a critical problem with this approach is that the income distribution is not static, and if there is any growing skewness of incomes for other reasons, then the use of a constant real income cutoff will naturally lead to a finding that tax cuts for the wealthy are leading to higher taxable incomes in that group.

Feldstein's (1995) influential article addressed this problem by turning to panel data, allowing him to assess whether given individuals actually saw income changes, rather than simply whether income changed on average in a given income group. He studied the experience of the Tax Reform Act of 1986 (TRA 86), which further reduced tax rates at the top of the income distribution. He examined groups of taxpayers based on their pre-TRA income levels, and found that for those taxpayers for whom rates fell the most, taxable income increased the most. He estimated elasticities of taxable income with respect to taxation ranging from 1 to over 3, with a central estimate of 2.14.

Feldstein's article generated a significant amount of interest in this question, and led to the series of additional studies reviewed in Table 1. As is immediately apparent, there is significant disagreement among these studies about the appropriate elasticity estimate, with results ranging from zero to 0.8. But as is also apparent, there is significant difference across the studies in how the question is approached, along at least two important dimensions.

The first, and most important difference, is whether the studies attempt to control for mean reversion and, relatedly, for other trends in the income distribution which might confound the results. While panel data reduces the problem noted above with the Lindsey (1987) study, it introduces a new problem: if there is a mean-reverting transitory component to income in a given year, then it can cause high income taxpayers in one year to appear low income in the next, aside from any true behavioral response. At the same time, a countervailing factor is the fact that the distribution of income has been continually widening since the mid-1970s, with particularly large gains at the very top of the income distribution in the 1980s and 1990s. This corresponds to a series of tax reforms which have targeted their tax cuts (ERTA 81 and TRA 86) and increases (the 1993 tax increases studied by Goolsbee (1997) and Carroll (1998)) at the top of the income distribution. It is possible that these tax policies are themselves causally related to this widening of the pre-tax income distribution, but there are a variety of alternative explanations as well, ranging from the impacts of international trade to skill-biased technological change (see Katz and Murphy (1992)). While several of the studies reviewed here recognized the mean reversion problem, only Auten and Carroll (forthcoming) and Saez (1999) dealt with it in a manner that also potentially addressed concerns about omitted determinants of the income distribution (by including explicit controls in the regression for base year income group).

A second major issue is the definition of income used. Most studies reviewed here use taxable income as the income definition, in many cases excluding capital gains income. Whether this is the right definition depends very much on the question being asked; for local reforms, this is probably appropriate, but for thinking about larger reforms or optimal tax systems, it would be more appropriate to use a more comprehensive income definition. There is some suggestion in the literature of sensitivity to the income definition; Feldstein's estimate is significantly lower (although still above most of the subsequent literature) when a broader definition of income is used.

2 Data and Methodology

2.1 Data

Our data source for this exercise is the NBER panel of tax returns over the 1979-1990 period. This panel, known as the Continuous Work History File, contains most of the individual line items from form 1040, as well as numerous other items from the other forms and schedules. The panel is constructed from all tax returns filed in a given year by selecting certain 4-digit endings of the social security number of the primary taxpayer listed on the form. From 1979-1981, five such endings were chosen, and the panel is quite large, with roughly 46,000 observations. However, in 1982 and 1984, only one ending was chosen, and in other years only two, so that the size of the panel was drastically reduced.

The empirical strategy is to relate changes in income between pairs of years to the change in marginal rates between the same pairs of years. This pair of years are called year 1 and year 2. The time length between year 1 and year 2 can be of one, two or three years. In our basic specification, the time length is three years, following Feldstein (1995). In that case, we relate year 1982 to year 1979, year 1983 to year 1980, ... and year 1990 to year 1987. These nine differences are stacked to obtain a single dataset of about 100,000 observations. We then exclude taxpayers whose marital status changes from year 1 to year 2, for whom we expect large reported taxable income changes unrelated to tax policy. It is unlikely that tax changes affected specifically marriage strategies and therefore discarding those observations should not bias the results.

We use two different types or definitions of income: broad income and taxable income. Broad income is an extensive definition of gross income that is consistent across the years 1979 to 1990. It includes most of the items that are summed to arrive at Total Income on Form 1040: wage income, interest income, dividends, business income, etc. The precise definition of broad income is given in appendix. Broad income is a grosser income definition than Adjusted Gross Income (AGI) because Broad Income does not incorporate the various adjustments such as IRA or retirement plans deductions that are substracted from Total Income to obtain AGI. Capital gains are excluded because their tax treatment is special. Before the TRA of 1986, only 40% of capital gains were included in taxable income and thus the marginal rate on capital gains was much lower than on other income. After the TRA, full capital gains were included in taxable income but the top rate for capital gains was limited to 28%. Because of these special rules for capital gains, most previous studies have also excluded capital gains from their analysis (see Table 1).

The Taxable Income definition we use is close to the actual definition of taxable income. Our definition is consistent over the years 1979-1990. It includes all the items and adjustments that can be computed from the data for all the years 1979-1990. For example, the secondary earner deduction that was in place from 1982 to 1986 is not included because it cannot be computed for the other years. As for Broad Income, Capital Gains have also been excluded from our Taxable Income definition. See the appendix for the precise definition of Taxable Income; this definition is very similar to what has been used in previous work.[1]

As our definition of taxable income is similar to the definition in place in 1990, our estimates can be viewed as the impact of taxes on a 1990-style taxable income definition. A limitation of this constant-definition approach is that we potentially understate the responsiveness of taxable income to taxation, even from the perspective of 1990. This is because if the 1990 definition were in place in earlier years, individuals may have undertaken different activities to avoid taxes that would have shown up in this definition; that is, if the avoidance avenues available in earlier years were made unavailable, other avenues might have been used instead that would have shown up in our data. Slemrod (1998) describes this point in detail. Offsetting this, however, is the problem that, like all other papers in this literature, we focus solely on the individual income tax base. A growing wedge between the individual and corporate tax rate could lead some individuals to shift their income generation from the non-corporate to corporate sectors; see Gordon and Mackie-Mason (1994) and Gordon and Slemrod (2000) for evidence of this type of shifting. Thus, we are overstating the total cost to the tax system from rising tax rates, since some of the reduced individual income that we estimate will show up in rising corporate sector income.

We also exclude taxpayers whose income is below $10,000 in year 1, to avoid very serious mean reversion at the bottom of the income distribution. In fact, as our elasticity results are weighted by income, including taxpayers with lower incomes does not significantly affect the results. We select taxpayers according to their *Broad Income* in year 1, even when looking at Taxable Income. Therefore, potential differences between Broad Income and Taxable Income estimates do not come from selection.

In Table 2, we present the means of the data for the three year difference case. The Table shows that average Broad Income is equal to about $43,000 and average Taxable Income equal to $25,000. 64% of our sample consist of married taxpayers and 28% of singles. All our dollar figures are expressed in terms of 1992 dollars.

[1] Contrary to Feldstein and Auten-Caroll, we do not add back losses to our income definitions because we find that adding back losses does not affect the results.

2.2 Empirical Strategy

Our goal is to measure the impact of a change in the tax schedule faced by a given individual on his income. To do so, we use the basic micro-economic framework with two goods (consumption and income). From this basic model, we derive a regression specification and we then discuss the identification assumptions.

- **The Model**

The budget constraint of a taxpayer on a linear part of the tax schedule is given by $c = z(1-\tau) + R$, where z is before tax income, τ is the marginal rate and R is virtual income. Utility maximization leads to an income supply function which depends on the slope of the budget line and on virtual income: $z = z(1-\tau, R)$. For a given individual, a tax change can be seen as a change in both virtual income R and marginal rate τ. Changes in R and τ affect income supply z as follows,

$$dz = -\frac{\partial z}{\partial(1-\tau)} d\tau + \frac{\partial z}{\partial R} dR$$

Introducing the (uncompensated) elasticity of income with respect to the net-of-tax rate $\zeta^u = [(1-\tau)/z]\partial z/\partial(1-\tau)$ and the income effect parameter $\eta = \partial z/\partial R$, we get,

$$dz = -\zeta^u \, z \frac{d\tau}{1-\tau} + \eta \, dR$$

Using the compensated elasticity of income $\zeta^c = [(1-\tau)/z]\partial z/\partial(1-\tau)|_u$ and the Slutsky equation $\zeta^c = \zeta^u - (1-\tau)\eta$, we obtain finally,

$$\frac{dz}{z} = -\zeta^c \frac{d\tau}{1-\tau} + \eta \frac{dR - z d\tau}{z} \tag{1}$$

$dR - z \, d\tau$ is the change in after-tax income due to the tax change for a given before tax income z. It is thus also equal to the change in tax liability for taxpayers with income z. This is illustrated on Figure 1.

- **Regression Specification**

Using (1), a natural regression specification to estimate the elasticity parameters can be written as follows,

$$\log(z_2/z_1) = \zeta \log[(1-T_2')/(1-T_1')] + \eta \log[(z_2 - T_2(z_2))/(z_1 - T_1(z_1))] + \epsilon \qquad (2)$$

where ζ is the compensated elasticity parameter and η is the income effects parameter. z_i is *real* income in year i, T_i' is the marginal tax rate in year i and $T_i(z_i)$ is the tax liability in year i. This specification resembles that used in previous studies, with an important difference: the inclusion of income effects. Figure 1 illustrates empirically how one can decompose a tax change into a tax rate effect (change in the slope of the budget constraint) and an income effect (change in tax liability). Any tax change generates both shifts in the slope of the income/tax relationship, as well as changes in after-tax income. In principle, since the shift in the slope affects equally all those on a segment of tax/income relationship, but the income effect varies by how far one is from a tax kink, and both income and substitution effects can be separately identified.

In order to simplify the discussion, let us assume first that there are no income effects ($\eta = 0$). The term capturing the tax rate change $\log[(1-T_2')/(1-T_1')]$ is correlated with ϵ because if there is a positive shock to income ($\epsilon > 0$) then, due to progressivity, the tax rate increases mechanically. Therefore, an OLS regression of equation (2) would lead to a biased estimate of the behavioral elasticity. The strategy to build instruments for this variable is to compute T_p' which is the marginal tax rate that the individual would face in year 2 if his real income did not change from year 1 to year 2; that is, to just use changes in tax laws to provide identification of the parameter of interest. The natural instrument for $\log[(1-T_2')/(1-T_1')]$ is thus $\log[(1-T_p')/(1-T_1')]$ which is the predicted log net-of-tax rate change if real income does not change from year 1 to year 2.

Running the IV regression of equation (2) might also lead to a biased estimate of the elasticity if ϵ is correlated with z_1. There are two different reasons why individuals at different points in the income distribution might experience different income growth rates, aside from tax changes. The first is mean reversion: high incomes in year 1 tend to be lower in the following years, producing a negative correlation between ϵ and first period income. The second is a change in the distribution of income. For example, if the income distribution widens, there will be a positive correlation between ϵ and z_1. As noted in the introduction, these opposing forces are both very likely to operate in the 1980s, and there is no reason to expect that they will cancel.

If ϵ depends on z_1, then the instrument (which is also a function of z_1) will be correlated with the error term, producing biased estimates. It is for this reason that Auten and Carroll (forthcoming) and Saez (1999) include lagged income as a control in their regression models. Auten and Carroll show that there is a significant increase to their coefficient when this control is added. But the problem with this solution is that the two effects do not necessarily operate linearly, particularly in combination with each other. Thus, in principle, richer controls for period 1 income might be called for. But, in practice, with only two years of data (and therefore only one tax change), a much richer set of controls for period 1 income may destroy identification. This problem is especially acute when the size of the tax rate change is directly correlated with the income level as in the TRA of 1986.[2]

As highlighted by Goolsbee (2000), what is required is a number of years of data, where there are different changes in after-tax shares over time. In this framework, one can control in a very rich way for lagged income and still identify tax effects. As we will demonstrate below, we use a variety of reforms that affected different points in the income distribution in different ways over time. As a result, we can add, in addition to log income, a 10 piece spline in log first period income (and our results are not sensitive to even richer splines in first period income). We also control for time (by including year dummies) and marital status.

Of course, even in this richer framework, we still rely on an identifying assumption: that mean reversion or changes in inequality are not changing year-to-year in a way that is correlated with year-specific changes in tax policy. In other words, we are allowing the relationship between ϵ and z_1 to be non-linear, but we are imposing that it is constant over time. Given the steadily widening income distribution over the time period we study, this identification assumption is likely to be innocuous. We present specification tests below that show that this assumption is robust to allowing in limited ways for year-specific variation in the relationship between ϵ and z_1.

Following this same discussion, the term $\log[(z_2 - T_2(z_2))/(z_1 - T_1(z_1))]$ in equation (2) which captures the income shock, is mechanically correlated with ϵ and needs to be instrumented. A natural instrument is the log change in real after-tax income if there

[2] Note that the Auten and Carroll results are in principle also identified by state tax changes around TRA86, by the non-linearity introduced by the 33% "bubble rate" under TRA 86, and by changes in deduction rules.

were no behavioral response: $\log[(z_1 - T_p))/(z_1 - T_1(z_1))]$ where T_p is the real tax liability in year 2 that the taxpayer would face if his income did not change in real terms from year 1 to year 2. Additional income controls also remove the residual correlation between the error term ϵ and the income effect instrument.

Once again, for identifying the income effect it is important to control for base year income. In practice, rich controls for base year income make it very difficult to separately identify income and substitution effects with only one tax change. But since we are using many tax reforms, the two effects can be separately identified, as we show below.

The regression setting is thus the following,

$$\log(z_2/z_1) = \alpha_0 + \zeta \log[(1 - T_2')/(1 - T_1')] + \eta \log[(z_2 - T_2(z_2))/(z_1 - T_1(z_1))] +$$

$$\alpha_1 \log(z_1) + \sum_k \alpha_{2k} mars_k + \sum_j \alpha_{3j} YEAR_j + + \sum_{i=1}^{10} \alpha_{4i} SPLINE_i(z_1) + \epsilon \qquad (3)$$

$YEAR_j$ denote base year dummies and $mars_k$ dummies for marital status in base year. This equation is estimated by 2SLS using $\log[(1-T_p')/(1-T_1')]$ and $\log[(z_1 - T_2(z_1))/(z_1 - T_1(z_1))]$ as instruments. The first stage of this regression is very strong. The F-statistics for the coefficient of the tax rate instrument in the first stage regression are always above 20 and often around 100. The F-statistics for the coefficient of the income effect instrument in the first stage regression are weaker but always above 6 and often around 20.

Since we stack observations from nine pairs of years to form our estimates, we are using multiple observations on many of the same individuals. If there is individual-specific correlation in how income changes over time, then OLS will understate our associated standard errors. We therefore present estimates that correct the standard errors for intra-personal correlation.

- **Computation Issues and Sources of Variations**

All tax rate and tax liability variables are computed using the TAXSIM calculator developed at the NBER.[3] The tax computation includes federal and state tax rates. At the federal level, the Earned Income Tax Credit and various other characteristics of the tax rules are taken into account when computing the tax rates. In order to compute the

[3]Feenberg and Coutts (1993) provide an overview of the TAXSIM calculator.

predicted tax rate T'_p and predicted tax liability T_p, all sources of incomes in year 1 are first inflated using a nominal growth deflator (see the appendix for more details). Then, the TAXSIM calculator applies the income tax law of year 2 to this inflated observation. All income levels are expressed in real terms in 1992 dollars.

During the decade there have been two major tax reforms, ERTA 1981 and TRA 1986. In 1981, the Economic Recovery Tax Act (ERTA) decreased marginal rates in three years from 1982 to 1984. The top-rate was reduced from 70% to 50%. In 1986, the Tax Reform Act (TRA) introduced the largest changes in the income tax since World War II. The number of brackets was drastically reduced and the top-rate was further reduced to 28%. The TRA also increased substantially the standard deduction and personal exemption levels in order to be roughly redistributionnaly neutral (see Slemrod (1990) for a more detailed description of the TRA). In 1987, the Earned Income Tax Credit was also significantly expanded, producing significant changes in the tax rates faced by low income households with children.

There have also been numerous state tax reforms during that decade, with many states decreasing the number of brackets and reducing the top tax rates. At the same time, a few states increased their income tax rates. And about half of the states have experienced very little variation in their tax rules.[4]

Table 3 shows the extent of variation in our data. We provide information for each year in our sample on the value of our instrument for the elasticity of taxable income, the predicted log change in the net-of-tax rate, for the full sample and for three different income groups, defined by broad income: $10,000 to $50,000; $50,000 to $100,000; and $100,000 and above. The instrument is negative for a tax rate increase and positive for a tax rate cut. We show the results for a three year difference between years; we discuss further below the implications of different lengths of differences. We show both the average value of the instrument, and, in square brackets, the standard deviation in this value.

As the results show, there is substantial variation in the mean values of this instrument, over time, across income group, and within group over time. Over the 1979-82 period,

[4] The biggest tax cuts have been in Alaska (from a top rate equal to 14.5% to no taxation at all), Delaware (top rate decreased from 16.7% to 7.7%), Minnesota (from 17% to 8%), New York (from 14% to 7.8%) and Wisconsin (from 10% to 6.9%). Ohio and North Dakota experienced the biggest tax increases.

the values are negative (except for the top group), due to the bracket creep explored by Saez (1999). Then, from 1980-83, the first effects of ERTA 1981 are felt, with a large rise in the after-tax share at the very top of the income distribution, while it is close to zero at the bottom due to continued bracket creep. By the next year, there are increases in the after-tax share for most of the income distribution, and they persist to 1982-85. Then, in 1983-86, the values become small again, before rising in 1984-87 and 1986-89 as a result of TRA 1986. Once again, these increases are largest at the top of the income distribution. By 1987-90, the instrument values are small once again (except at the very top because of the phasing in of the TRA 86).

Clearly, the most sizeable variation in the means is at the top of the income distribution. But there are non-trivial movements in many years at the bottom and middle income levels as well. Moreover, there is enormous heterogeneity within groups, as is illustrated by the standard deviations. This heterogeneity arises from numerous federal and state tax reforms during the period.

3 Overall Results

3.1 Basic Results

Since the focus of the previous literature has been solely on the elasticity of taxable income, we first estimate (3) without income effect controls; we return to a discussion of income effects in the next section. We include in all models controls for base period marital status, and dummies for each base year; the latter are not reported.

Our basic results from doing so are reported in Table 4. The table has six columns, expressing three alternative methods for dealing with the issue of mean reversion/income distribution changes, for our two income concepts. In the first two columns, we do not include any control. In the second two columns, we control for log income, as in Auten and Carroll (forthcoming). Finally, in the third set of columns, we further include a 10 piece spline in income, to allow for non-linearities in the widening of the income distribution; our results are insensitive to higher order spline terms. We show the results for both definitions of income, broad and taxable. All estimates are weighted by income to reflect the relative contribution to total revenues. However, to avoid the undue influence of a few very high income observations, we censor our weights at $1 million; this affects only 13 observations. We also censor the change in log income at 7, so that the 11 observations who report changes income ratios across the two years of more than 1000 or less than 1/1000 are censored at those endpoints. In practice, the results are fairly sensitive to the first restriction; our overall elasticity is only about three-quarters as large when we use an uncapped weight, and the elasticity at the top of the income distribution is only about 60% as large. The results are not very sensitive to the second restriction.

Our findings reflect substantial sensitivity to controlling for income, and to the form of the controls. For the models in the first column that exclude any control for mean reversion and income distribution changes, we obtain large wrong-signed elasticities for both broad and taxable income.

Once log income is included in the model, however, the results change quite radically. For broad income, the elasticity becomes a positive 0.17, and for taxable income, the effect is dramatic, with the elasticity rising to 0.61. This estimate lies in the upper end of the post-Feldstein literature discussed above. Log income itself has a highly significant negative coefficient, suggesting that on average mean reversion dominates income dispersion in our sample period.

As noted earlier, the problem with this specification is that it assumes that any changes in the income distribution are a (log) function of lagged income. It is difficult to effectively weaken this assumption with only one change, as in most previous work, since it destroys identification of the tax effects. But, since we have a number of tax changes over this period, we can weaken this assumption in the third column, by including as well a ten-piece spline in lagged income. In fact, we find that adding this spline significantly decreases our taxable income estimate, with the elasticity falling to 0.4, and lowers slightly our broad income estimate, with the elasticity falling to 0.12. As noted earlier, this estimate is robust to the inclusion of additional splines, cubics, or other forms of income controls.

The coefficients on the splines themselves support the contention that base period income should not be entered in a simple log-linear fashion. For broad income, there is a positive coefficient on the 1st spline, presumably reflecting mean reversion, and then a sizeable negative coefficient on the second spline, perhaps reflecting worsening income prospects for low income groups over this time period. The coefficients then demonstrate significant non-linearities throughout the rest of the income distribution. For taxable income, the splines are highly negative at the bottom of the income distribution, and then once again vary non-linearly as income rises. In all specifications except with no controls, we find positive coefficients on dummies for marrieds and negative coefficients on dummies for single implying that married household experience increases in income from year to year relative to single taxpayers.

The large difference between our broad and taxable income elasticities is striking. There are two sources of difference here. The first is mechanical; broad income has a larger base, so that a given dollar response will result in a smaller elasticity.[5] The second is behavioral; taxable income includes itemized deductions, which might respond to changes in taxes (as well as exemptions, which could respond if family size is endogenous to taxation).

To decompose these effects, we have estimated some models with "pseudo-taxable" income, created by subtracting from both period 1 and period 2 incomes the period 1 level of exemptions and deductions. Doing so normalizes the income change for the magnitude of the exemptions and deductions, but does not allow them to respond to taxation, and thereby captures the mechanical but not the behavioral effect of taxation. We have estimated models using pseudo-taxable income, using splines in both broad and taxable incomes as controls. Doing so, we find that the pseudo-taxable income elasticity is 33-45% of the way between our broad and taxable income elasticities, depending on which controls we use. This is sensible, given that, as shown in Table 3, the mean of taxable income is only 60% as large as the mean of broad income. Thus, the mechanical effect appears to explain about two-fifths of the gap between broad and taxable income. The remainder is behavioral responses through changing itemization (and possibly exemption) behavior.[6]

To summarize, our most complete specification suggests that there is a sizeable response of taxable income to tax changes, with an elasticity of 0.4. This is well below Feldstein's estimates but is within the range of the subsequent literature, despite our ability to include much richer controls for changes in the income distribution. On the

[5] Another form of mechanical effect here is that with taxable income, higher state tax rates will result in a larger deduction on federal income taxes, leading to an mechanical negative correlation between state taxes and federal taxable income. We are grateful to Gary Engelhardt for pointing this out to us.

[6] It is impossible to examine more directly itemization behavior using our methodology, since we would only be able to include taxpayers with itemized deductions in both periods, leading to a substantial sample selection bias.

other hand, we find that the responsiveness of broad income is much lower than that of taxable income. Roughly 40% of that gap is explained by the mechanical effect that broad income has a larger base so that elasticities will be calculated to be smaller for a given dollar response to taxation; the remainder arises through changes in itemization and exemption behavior.

3.2 Income Effects

As noted above, one advantage of our empirical framework is that we can separately identify the income effects of taxation on taxable income. To obtain income effects, we run the regression specification (3) including the income effect term and all the full set of control variables. In fact, it is theoretically unclear what sign to expect for the income effect estimates for constructs such as broad or taxable income. For the labor component of total income, we might expect relatively small negative estimates, following on the findings of the labor supply literature (e.g. Pencavel (1986) and more recently Blundell and MaCurdy (1999)). But it is feasible that capital income reacts positively to a positive income shock if savings (and thus future capital income) increase. And it is even more difficult to conceive of how activities such as tax evasion or shifts in the form of compensation react to income increases.

In contrast to the estimates in Table 4, our estimates of this equation are unweighted. This is because the income effect coefficient $\eta = \partial z / \partial R$ gives the direct (and not the percentage) change in reported income due a change in tax liability. Therefore, the tax revenue effect due to income effects should not be weighted by income.

Table 5 presents our results. We first show our unweighted overall elasticities.[7] The unweighted taxable income elasticity is very similar to the weighted taxable income elasticity in Table 4, while the unweighted broad income elasticity is substantially lower than the unweighted elasticity in Table 4. As we will discuss below, this reflects the fact that

[7] It is worth noting that the elasticities estimated in this model are not necessarily uncompensated elasticities, since with a non-linear tax schedule the tax changes that we study may change both the after-tax share and after-tax incomes. For example, when the tax schedule is a flat tax with constant rate and the tax reform is a simple change in the tax rate with no change in the intercept then the response is given by the uncompensated elasticity. On the other hand, if the tax change changes tax rates without changing the tax liability then the response is given by the compensated elasticity. Figure 1 illustrates this point.

most of the response of income to taxation comes from those with high broad but not necessarily high taxable incomes, due to the central role of itemization.

We then show substitution and income effects from full estimation of equation (3). The income effects are negative, but they are highly insignificant in both cases, and they are quite small.

For interpretation, it is worth noting that the coefficient η estimated in equation (2) does not correspond exactly to the theoretical parameter η of equation (1) because after-tax income $z - T(z)$ is smaller than before tax income z. The estimated η from (2) is equal to the theoretical η from (1) multiplied by the average after-tax income over income ratio $[z - T(z)]/z$. At the same time, the Slutsky equation states that the difference between the compensated and uncompensated income elasticities is $-\eta(1-\tau)$, which is thus approximately equal to our empirical estimate. Our empirical results show therefore that the difference between uncompensated and compensated elasticities is 0.135 for taxable income. This is small relative to the magnitude of the elasticities that are presented in Table 4. These small income effects are perhaps unsurprising, given that income effects on labor earnings are generally found to be small, at least for primary earners, and income effects on other forms of income could perhaps even be positive.

Therefore, we can safely assume that compensated and uncompensated elasticity are identical and drop the income effect variable (and instrument) in specification (3). We thus present the remainder of our results, and our optimal tax simulations, without including income effects.

3.3 Variations in Timing

Following the previous literature, we have used a three year difference in computing our measures of both the change in taxable income and the change in after-tax shares. But our framework allows us to explore the sensitivity of our finding to the length of this differencing "window". The implications of changing the window of observation are not clear. If, on the one hand, individuals react slowly to tax changes, then using a longer difference might increase the estimated elasticity. If, however, as suggested by Goolsbee (1997) and Sammartino and Weiner (1997), responses to tax changes are largely through the timing of income reporting, then a longer difference might reduce the elasticity.

We explore these issues of timing in Table 6. In this and all subsequent tables, we use our richest specification from Table 4, including the splines in first period income. The Table proceeds by narrowing the window used first to two and then to one year. In fact, we find that the estimate of the elasticity of taxable income to the window length is fairly robust; the estimate falls significantly for a two year window but then rises for a one year window almost back to its level in Table 4. The timing impacts on broad income are similar, although the elasticity with a one year window is now higher than the elasticity with a three year window. Thus, overall, the estimated impacts of taxation are not particularly sensitive to the window over which the response is observed; the response of real income is slightly lower, and the response of taxable income is virtually identical, over a three year window relative to a one year window. Since a long run response seems of most interest, and since this is the focus of most previous work, we continue to use a three year window for the remainder of the paper.

3.4 Controlling for Time-Varying Income Distribution Changes

As noted earlier, our identifying assumption in these data is that there were no differences in the relationship between first period income and the change in income over time that are correlated with differences in tax policy. While we believe that this is a reasonable assumption, we can assess our sensitivity to alternatives which modestly weaken our assumption.

We consider two such alternatives in Table 7. The first is to allow for a linear time trend in the splines in income that form our central controls. This allows for a general trend in the widening of the income distribution over time. The second is to interact log income with a full set of year dummies. This allows for year-specific changes in the income distribution, but only in a way that is linearly related to base-period income. Both of these alternatives, and particularly the second, remove some of the variation from the large federal reforms in our sample, much as including log income in a pre-post 1986 comparison (as in Auten and Carroll) removes much of the variation of that reform. But if our results are robust to these controls, it suggests that changes in the relationship between lagged income and income changes are not driving our results.

In fact, as Table 7 shows, our results are robust to these two sets of controls. Our standard errors rise somewhat, but in both cases the key coefficients are similar to those in Table 4. Thus, while we cannot rule out year-specific non-linear changes in the relationship between lagged income and income changes, it seems unlikely that these would occur in precisely the same way as tax changes and therefore unlikely that they can explain our results.

4 Heterogeneity

An important feature of the U.S. tax system is that taxes are not linear and do not apply equally to all population subgroups. Tax rates differ both over the income range and between groups such as married and single taxpayers. In the next two sub-sections, we explore whether there is significant heterogeneity in the response to taxation among these groups.

4.1 Income Group Heterogeneity

We first consider heterogeneity across income groups. There is significant reason to believe that the responsiveness of taxable income to taxes might be higher for higher income groups, since more of their income comes in forms that are more readily manipulable for tax purposes. That is, most of the income to lower income groups is labor income, which is withheld for tax purposes, so the only way to manipulate income earning is to work more or less. But with higher income families, capital income will be more prominent, and this is more readily manipulated through, for example, asset allocation decisions.

A key advantage of our framework is that it allows us to explore heterogeneous responses by income groups. With only one change, as in most previous papers, most of the variation comes across income groups, so it is very hard to identify group-specific responses. But, by exploiting the series of reforms that we have at our disposal, which impacted different points in the distribution at different times, we are able to identify group-specific effects.

In Table 8 we show the results by income group. An interesting question in this context is which income concept to use when dividing the sample for analyzing the responsiveness of taxable income. On the one hand, it seems natural to divide the sample by taxable income, to replicate the tax bracket structure of the income tax. On the other hand, this makes it quite difficult to compare the estimated elasticities of broad and taxable income. Thus, we split the sample by income both ways in Table 8. In the second column, we divide the sample into those with broad incomes from $10,000-50,000; incomes from $50,000-100,000; and incomes above $100,000. In the third column, we cut the sample by taxable incomes that correspond to roughly the same division of sample size: $10,000-$32,000; $32,000-75,000; and above $75,000.

The results in the second column, where the sample is divided by base period broad income, provide strong evidence that the responsiveness to taxable income that we have seen is driven by the highest income taxpayers. There are modest elasticities of taxable income of 0.18 for those in the $10,000-$50,000 income range, and of only 0.11 in the $50,000-$100,000 range. But there is a much larger elasticity of 0.57 for those in the very top income category. For broad income, the estimates are actually negative (but smaller than their standard errors) for those below $100,000, but positive (although still insignificant) for those above $100,000.

This finding explains to some extent the difference between our overall elasticity estimates and those of Feldstein and Auten and Carroll, which are higher. The TRA 1986 reform on which they focus almost provided tax variation mostly at the top of the income scale, so that their overall estimates are identified primarily by reactions of high income taxpayers. If this is the most responsive group, as our findings suggest, then it is not surprising that their estimates are higher.

The results in the third column, however, paint a somewhat different story. When taxpayers are ordered by base period taxable income, there is a much flatter response along the income distribution. This interesting finding arises because the most responsive taxpayers are those taxpayers with high real incomes, but lower taxable incomes, through itemization. Indeed, while $75,000 of taxable income corresponds to roughly the same cutoff in the sample as does $100,000 of broad income, 15% of taxpayers with broad incomes above $100,000 have taxable incomes below $75,000. These taxpayers have large amounts itemized on their taxes, and they are the ones who appear particularly responsive to taxation. As a result of large base period itemization, they are more equally distributed in the base period taxable income distribution than in the base period broad income distribution, and this results in a more equal distribution of responsiveness of taxable income.

To illustrate this further, the next panel of Table 8 shows the responsiveness of taxable income by itemizers and non-itemizers. The elasticity of both taxable and broad income is much higher for itemizers, and they are in fact negative (but insignificant) for non-itemizers. Moreover, we estimate that for itemizers, the elasticity of taxable income of those with broad income above $100,000 in the base period is 0.66 (0.33). It is these itemizers with very high real incomes, but not necessarily as high taxable incomes, who are most responsive to taxation.

Given the imprecision of these estimates by income group, the patterns can only be taken as suggestive. But the findings do confirm the standard intuition that the highest income taxpayers are the ones that are most responsive to taxation, as well as further confirming the important role played by itemization in determining the elasticity of taxable income.

4.2 Marital Status

Another relevant source of heterogeneity, in the context of current debates over the "marriage penalty" in the U.S. tax code, is heterogeneity by marital status in the base year. Families of different marital status face different tax schedules, both in terms of exemptions and bracket cutoffs. Thus, if either single or married filers are found to be particularly responsive to taxation, it would be straightforward (conceptually, if not politically) to alter the parameters of the system to reflect this. Moreover, given that married taxpayers have more margins along which they can respond to taxation (e.g. the labor supply of two earners), it is possible that they would be more responsive to tax changes.

In fact, as Table 8 shows, we find no evidence that married taxpayers are more responsive than single taxpayers in terms of taxable income. Indeed, for broad income, we find a much higher elasticity for single taxpayers.

It is unclear why singles would be found to be more responsive than married couples, particularly in light of Eissa's (1995) evidence of the responsiveness of high income wives to the tax rates on their husband's income. We have obtained some suggestive evidence that Eissa's results may not apply to the full income distribution: while the responsiveness of singles is much higher in the $10,000-$100,000 income range, that of married taxpayers is much higher in the $100,000 and upwards range. This would be consistent with the notion that it is very high income wives that are the most elastic; but the comparison is imprecise because there are very few high income single taxpayers.

5 Optimal Taxation

Throughout the tumultuous period in the history of the income tax studied in this paper, economists have been peculiarly absent in the normative discussion of the optimal progressivity of our tax system. To be sure, economic evidence supporting (or disputing) the importance of supply side incentives for labor supply and savings have been central in the debates over tax structure. But, despite the enormous theoretical importance of the optimal income tax literature that grew out of Mirrlees (1971) classic study, there was little use of the optimal income tax framework to provide guidance as to how taxes should be set. This likely reflects two limitations of this framework and its successors. First, the theoretical development is rather esoteric, and difficult to translate to empirically relevant quantities; this led subsequent simulations of the optimal tax system (such as Stern (1976) or Tuomala (1990)) to rely solely on crude calibrations. Second, the set of predictions that were generated from these models, such as the conclusion that the marginal tax rate should be zero on the highest income taxpayer, were of little relevance for real world tax design.

In this section, we attempt to draw on our empirical framework to provide a computation of the optimal income tax system that is both theoretically rigorous, and empirically based. To do so, we draw on Saez (1998), who showed how the optimal income tax formula could be expressed in terms of income and substitution effects. In our application, given the existence of only negligible income effects, we can simplify the analysis further by considering the model of Saez (1998) with only substitution effects.

5.1 Theory

The tax schedule is defined by the rates in each bracket and the guaranteed income level that is redistributed to all taxpayers. As we have derived elasticity results for three income ranges ($10,000-$50,000, $50,000-$100,000 and above $100,000), we naturally derive the optimal tax rates in each of those three brackets. We also derive the optimal tax rate in the bottom bracket (incomes between $0 and $10,000) in order to complete the characterization of the optimal tax structure. However, even our comprehensive estimation approach does not allow us to estimate an elasticity in such a fine income range. Therefore, we assume that the elasticity of both broad and taxable income for those in this range is equal to 0.4 as suggested by Moffitt's (1992) review of the literature on behavioral responses of the low income population to welfare program parameters.

Let us introduce some notation. As optimal rates are computed from the top to the bottom, indices go from the top to the bottom.

- z_1, z_2, z_3 are the income cut-off levels \$100,000, \$50,000 and \$10,000 defining the brackets.
- $\bar{z}_1, \bar{z}_2, \bar{z}_3, \bar{z}_4$ are the mean of incomes in each of the four brackets $[z_1, +\infty)$, $[z_2, z_1]$, $[z_3, z_2]$ and $[0, z_3]$.
- $\tau_1, \tau_2, \tau_3, \tau_4$ are the optimal rates in each of the four brackets.
- h_1, h_2, h_3, h_4 are the share of taxpayers in each of the four brackets. The sum of the h_i's is normalized to one.
- g_1, g_2, g_3, g_4 are the average social marginal weights in each of the four brackets. These weights represent the redistributive tastes of the government. The government is indifferent between giving g_i dollars to taxpayers in bracket j and g_j dollars to taxpayers in bracket i.
- $\bar{\zeta}_1, \bar{\zeta}_2, \bar{\zeta}_3, \bar{\zeta}_4$ are the average elasticities (weighted by incomes) in each of the four brackets.

The top rate bracket is the easiest to derive. At the optimum value τ_1, a small change $d\tau_1$ has no first order effect on welfare. Increasing τ_1 by $d\tau_1$ increases mechanically tax revenues (in the absence of behavioral responses) by $h_1[\bar{z}_1 - z_1]d\tau_1$. However, each dollar raised in the top bracket is valued only $(1 - g_1)$ by the government because it reduces the welfare of the top bracket taxpayers. The net benefit for the government is thus,

$$(1 - g_1)h_1[\bar{z}_1 - z_1]d\tau_1 \tag{4}$$

The government loses revenue because of behavioral responses. As there are no income effects, the behavioral response is due uniquely to the marginal rate change in the top bracket. By definition of $\bar{\zeta}_1$ (which is the elasticity with respect to the net-of-tax rate), this response reduces reported income in the top bracket by $dz_1 = \bar{z}_1\bar{\zeta}_1 d\tau_1/(1-\tau_1)$. Therefore, the total tax revenue lost in the top bracket is equal to,

$$h_1 \bar{z}_1 \bar{\zeta}_1 \frac{\tau_1}{1 - \tau_1} d\tau_1 \tag{5}$$

At the optimum, the sum of (4) and (5) must be zero and thus the optimal top rate is,

$$\frac{\tau_1}{1-\tau_1} = \frac{(1-g_1)[\bar{z}_1 - z_1]}{\bar{z}_1\,\bar{\zeta}_1} \tag{6}$$

Note that the well-known zero marginal rate at the top is obtained when z_1 is close to the top taxpayer because in that case $\bar{z}_1$ tends to z_1 and τ_1 tends to zero.

The optimal rate in the second bracket can be computed in a similar way. We now assume that the top rate remains fixed at τ_1 and we consider a small change $d\tau_2$. Each top bracket taxpayer pays $[z_1 - z_2]d\tau_2$ additional taxes. Taxpayers in the second top bracket pay on average $[\bar{z}_2 - z_2]d\tau_2$ additional taxes. The mechanical effect (net of welfare loss) is thus given by:

$$((1-g_2)h_2[\bar{z}_2 - z_2] + (1-g_1)h_1[z_1 - z_2])\,d\tau_2$$

The behavioral response comes only from the second bracket taxpayers (because there are no income effects). It can be written exactly as (5) with index 2 replacing index 1. Therefore, the optimal rate in the second bracket is:

$$\frac{\tau_2}{1-\tau_2} = \frac{(1-g_2)h_2[\bar{z}_2 - z_2] + (1-g_1)h_1[z_1 - z_2]}{\bar{z}_2\; h_2\; \bar{\zeta}_2} \tag{7}$$

The optimal rates in the two remaining brackets can be derived by repeating the same exercise.

$$\frac{\tau_3}{1-\tau_3} = \frac{(1-g_3)h_3[\bar{z}_3 - z_3] + [(1-g_2)h_2 + (1-g_1)h_1][z_2 - z_3]}{\bar{z}_3\; h_3\; \bar{\zeta}_3} \tag{8}$$

$$\frac{\tau_4}{1-\tau_4} = \frac{(1-g_4)h_4\bar{z}_4 + [(1-g_3)h_3 + (1-g_2)h_2 + (1-g_1)h_1]z_3}{\bar{z}_4\; h_4\; \bar{\zeta}_4} \tag{9}$$

The logic behind these optimal tax formulas is simple. Increasing the rate in a bracket produces a negative behavioral response in that bracket (proportional to the average elasticity and the number of taxpayers in the bracket) but allows the government to raise more revenue from all the taxpayers above that bracket. Saez (1998) derives the optimal (non-linear) tax formula by considering the limiting case of an infinite number of infinitesimal brackets. In the absence of income effects, the structure and the logic of that non-linear tax formula is the same as equations (6) to (9).

The government also chooses the guaranteed income level that is redistributed to everybody as a lump-sum. At the optimum, the government values equally one additional dollar of public funds and one additional dollar for the guaranteed income level. The welfare effect of the latter change (expressed in terms of public funds) is simply $g_1h_1 + g_2h_2 + g_3h_3 + g_4h_4$. As there are no behavioral responses induced by this change (no income effects), it must be the case that this sum is equal to one. The guaranteed income level is then equal to total tax receipts (per capita) minus government consumption (per capita) which is taken as exogenously given.

The values of the g_i's are the social marginal weights *at the optimum*. Therefore, an increase in government consumption would not decrease the guaranteed income level one for one because of the indirect effect it would have on social weights and thus on the optimal tax system. However, for our simulations, we simply choose values for the weights at the optimum. It should nevertheless be remembered that these weights represent the redistributive tastes of the government around the optimal tax system. In other words, the same redistributive weights imply more taste for redistribution with a generous tax system in place rather than with a less generous tax system.[8]

5.2 Revenue Maximizing Constant Rate

Before moving to the numerical implementation of this optimal tax framework, it is worth considering a more straightforward application of our estimated elasticities: the revenue maximizing constant linear tax rate. This rate is the maximum rate that the government can set before starting to lose revenue. It can be derived in a straightforward way from equation (6) setting $z_1 = 0$ (single bracket starting at the bottom) and $g_1 = 0$ (government wants to maximize revenue and thus puts no weight on the welfare loss of taxpayers). In that case, the revenue maximizing rate τ^* is simply $\tau^* = 1/(1+\bar{\zeta})$, where $\bar{\zeta}$ is the average elasticity weighted by incomes. Using our results in Table 4 (columns (5) and (6)), we obtain a tax revenue maximizing rate equal to 71% for Taxable Income (elasticity 0.400)

[8]It should also be noted that the density weights h_i's in formulas (6) to (9) are the density weights at the optimum and that these might differ somewhat from the empirical density weights we are using because of behavioral responses to taxation. However, simulations taking into account this effect show that this affects very little optimal rates and does not change any of our conclusions. Therefore, we have decided to present simple simulations using directly empirical density weights.

and equal to 89% for Broad Income (elasticity 0.120).[9]

5.3 Numerical Implementation

We present two sets of numerical implementation results, one for Broad Income and another one for Taxable Income. Which is relevant depends on the underlying thought exercise. If the social planner is free to reshape the tax system and remove all the deductions and exemptions embodied in the current law, then the Broad Income simulation is most appropriate; this represents the optimal rates where the social planner can choose the broadest possible base. But, if the planner is constrained to operate within the basic exemption and deduction structure of the existing income tax, then the Taxable Income simulation is most relevant; this represents the optimal rates when the planner is constrained on the tax base but can choose the tax rates freely.

We take the density distribution by brackets (the h_i's) and the average income in each bracket (the $\bar{z}_i$'s) from the empirical distribution of Income for our full sample. These numbers are displayed in the first two rows in Tables 9 (Broad Income) and 10 (Taxable Income). The average elasticities $\bar{\zeta}_i$ by bracket are given by our empirical results for Broad Income (Table 9) and Taxable Income (Table 10) that were presented in Table 8. For the two intermediate brackets for Broad Income, our elasticities results were below zero. Zero elasticities imply that optimal rates should be 100%. Therefore, we posit small but positive elasticities for those two groups (0.05). As noted above, for the bottom bracket, we choose an elasticity equal to 0.4, following Moffitt's (1992) summary of the literature. In fact, the estimated pattern of rates and demogrants is fairly insensitive to the elasticity of the bottom income group. For taxable income, we use the sample divided by taxable income groups to estimate optimal tax rates.

These elasticity assumptions are displayed on row 3 of Tables 9 and 10. Government revenue need per household is taken as given at the level of total income tax revenue collected on average from 1979 to 1990. Expressed in 1992 dollars, this value is equal to \$6,200. Therefore the optimal income schedule we compute raises as much revenue as the current income tax but and also provides transfers to low incomes. We make a number of assumptions for the redistributive tastes of the government.

[9]Though our estimates are computed only for incomes above \$10,000, the estimates are hardly affected when including lower incomes because the elasticity $\bar{\zeta}$ is weighted by income.

1) Rawlsian objective: the government cares only about the poorest members of society and thus sets the tax rates so as to maximize tax revenue (all the g_i's are zero).

Utilitarian objective: the government values redistribution and chooses a declining pattern for the g_i's. We take two possibilities:

2) Progressive Liberal. There is a steep declining pattern for the g_i's: $g_1 = 0$, $g_2 = g_3/2$, $g_3 = g_4/2$. $g_1 = 0$ means that the government sets the top rate so as to maximize revenue collected from top bracket taxpayers (soak the rich).

3) Compassionate conservative. There is no difference between rich, middle-class and lower middle class but some compassion toward really poor individuals (incomes below \$10,000): $g_1 = g_2 = g_3 = g_4/2$.

4) Finally, we consider the No redistributive objective: the g_i's are the same for everybody. The government simply wants to raise a given amount of revenue and minimize excess burden. Therefore, the guaranteed income level is set to zero.

5) Actual Tax Schedule. In that case, the tax rates in each bracket are taken from the actual tax schedule. Implicit weights g_i are derived from the optimal tax formulas (6) to (9). These weights represent the implicit tastes of the actual government; even if the government does not consciously maximize a social welfare function, it is behaving as if it were indeed maximizing a social welfare function with those particular weights. This is known as the inverse optimum problem in optimal taxation. It has been applied a number of times in the commodity taxation case (see e.g. Ahmad and Stern (1984)). Recently, Gabaix (1998) outlined a method for solving the inverse optimum problem in the case of the income tax that is similar in spirit to what is attempted here. We present this case for Taxable Income only because the relevant elasticities for the actual tax schedule are the elasticities of Taxable Income. For the bottom income group, we use an overall tax rate (incorporating transfer programs as well) of 0.45, from Dickert, Houser and Scholtz (1995) (p. 20).

The results of the simulations are displayed in Tables 9 and 10. Each Table is divided into panels corresponding to each of the cases described above. In each case, we report the social weights, the optimal rates in each bracket, the optimal guaranteed income level (last column) and the average rates of taxation in each bracket (average tax paid over average income). The guaranteed income level is equal to total taxes collected (per capita) minus government consumption per capita (set equal to \$6,200). The average rates are negative at the bottom because income is redistributed from rich to poor through the guaranteed income (except of course in panel 4). It is constructive to think of the high rates on low income groups as phaseout rates for the lump sum transfer amount.

The results show that the low elasticities of Broad Income imply fairly high tax rates. Because elasticities are very low for the middle income groups, their tax rates are very high. The tax rates which maximize tax revenue are above 96% for the first two brackets. The top rate is relatively smaller at 73% because the elasticity at the top is higher.

With a utilitarian criterion, the tax rate in the bottom bracket is reduced and the rate is highest in the $10,000-$50,000 tax bracket. This is because, since there is more weight on this middle income range, optimal tax policy will produce a slower phaseout at the bottom so that this income group benefits more from the lump sum guarantee amount. The rates for the top two brackets are lower especially in Panel 3 with mild redistributive tastes. However, in both cases, the tax structure is highly progressive on average due to the large guaranteed income level.

In Panel 4, with no redistributive tastes, the tax rates are highest at the bottom because (almost) everybody pay those rates but the distortion is borne only by the low income people who contribute little to tax revenue. Therefore, the tax structure is regressive and the top rate is extremely low (3%). This tax structure minimizes deadweight burden and raises as much revenue as the current income tax system.[10]

To summarize, our small elasticities for Broad Income imply that the government has the option of extending considerably the redistributive structure of the income tax even if its tastes are only mildly redistributive. Optimal tax theory suggests that the most efficient way to do so is to implement a large negative income tax program with a high guaranteed income and fairly steep rates in the first two brackets (from $0 to $50,000).

However, these recommendations are valid only in the context of a tax on the Broad Income base where all deductions and exemptions rules have been removed. Our empirical results show that Taxable Income is much more tax sensitive than Broad Income implying that under the current system, imposing these high optimal Broad Income tax rate would be sub-optimal.

Table 10 displays the optimal tax results for Taxable Income. The elasticities for

[10]Note that this efficient tax structure is very similar to the actual Social Security payroll tax which applies a flat rate to wage income below some cap (around $65,000).

Taxable Income are considerably higher than the Broad Income elasticities and the corresponding optimal rates are thus lower. In particular, the top rate maximizing tax revenue is significantly lower (49%) and we obtain a decreasing pattern of marginal rates at the top in three of the four cases. The tax system is however still progressive in the top 3 Panels (as evidenced by the pattern of average rates) because redistribution is still taking place through the universal guaranteed income level. Note however that this guaranteed income is substantially lower than for the Broad Income case because the tax base is smaller and more responsive to tax rates. With mild redistributive tastes in Panels 3 and 4, the top rate is very low (18% and 5% respectively) because it is inefficient to tax sharply the very elastic incomes of the rich.

Panel 5 displays the implicit welfare weights using Taxable Income elasticities. The results show that the government is implicitly weighting roughly equally the welfare of the bottom three brackets, and much less the welfare of the top bracket. The weight for the top bracket is particularly low because the tax rate is high relative to the top maximizing revenue rate of 49%.[11]

These optimal tax simulations are subject to two important caveats. First, we have applied a model designed in the context of earnings taxation to apply to taxation of full income. This is only theoretically appropriate if general equilibrium effects of income taxation are negligible. If capital taxation, for example, affects the capital stock then the marginal product of labor and capital might be affected and our partial equilibrium simulation would not capture this effect.

Second, we are relying on differences in estimated elasticities across income groups that are imprecise. It is worth noting, however, that our general pattern results is not very sensitive to the values of the elasticities used. So long as elasticities are higher at the top of the income distribution, a contention which is consistently supported by our estimates, redistribution should not take place through an increasing pattern of marginal rates unless there is dramatically lower social weight on the very rich than on the middle and upper

[11] To understand the pattern of weights below the top, remember that the optimal rate in a given bracket depends on how the government values a lump-sum tax levied on all taxpayers in the brackets above. Since the weight is so low on the top group, the fact that the marginal rate is not very high for the third group implies a high weight on that group. Therefore, the social weight in a given bracket does not depend only on the elasticity and tax rate in that bracket but also on the social weights in all the brackets above.

middle class. Rather, redistribution should occur through adding a large negative income tax component to the tax system, with guaranteed income that is taxed at fairly high rates at the bottom of the income distribution.

6 Conclusion

Over the last few years, economists have recognized the centrality of the elasticity of taxable income as a parameter of interest for evaluating tax policy. But the substantial variability in the estimates of this central parameter have made it difficult to draw conclusions about the role that taxes play in determining income generation. Moreover, the fact that we have a non-linear tax system implies that it is critical to estimate not just an overall elasticity, but how that elasticity varies along the income distribution.

We have presented a framework that provides new estimates of the elasticity of taxable income that surmounts some problems with previous work. We find that the elasticity is 0.4, which is large but well below early estimates of its value. We also find much lower elasticities for real, broadly defined, income; about two-fifths of the difference between these results arises from the mechanical effect that the base of broad income is smaller, but the majority arises from the fact that tax preferences are sensitive to tax rates. And we find that the income effects of tax changes on taxable income are small, implying little difference between compensated and uncompensated elasticities.

Moreover, this framework allows us to explore the variation in this elasticity along the income distribution, and we find that it is primarily driven by the response of very high real income taxpayers to changes in tax rules. We then use these findings to implement a model of optimal income tax schedules, and find that they suggest for most distributional preferences a tax system which is progressive on average but not on the margin, with a large demogrant that is rapidly taxed away at the bottom of the income distribution, but with marginal rates that fall, rather than rise, with income.

One important difference between our study and previous work is the size of the tax changes being studied. Most of the previous literature has focused on the Tax Reform Act of 1986, which imposed large changes in tax rates on upper income taxpayers, whereas our variation comes in addition from bracket creep, state tax changes, and changes through ERTA and TRA on other groups which were more modest. If individuals react more strongly to large, and presumably as a result better understood, changes, then by "muddying the waters" with these smaller change we may be reducing the estimated elasticity relative to the previous literature. Of course, it is not at all obvious why the reaction to the large changes of TRA 86 only are more relevant for projection purposes than are the reactions to all tax changes in the 1980s; TRA was more dissimilar than it was similar to the modal post-war tax reform. Thus, our estimates are probably the preferred ones for the types of modest (relative to TRA 86) reforms that are currently contemplated by Congress.

These findings have a three potentially important implications for tax policy. First, they highlight the value of having low tax rates on a broad tax base, a position long advocated by economists. The large elasticities that we observe are driven by "holes" in the tax base that allow taxpayers, particularly at higher income levels, to reduce their tax burdens. With a broader tax base we would distort behavior less and could therefore raise revenues more efficiently.

Second, they suggest that the substantial concern currently expressed about the distorting impact of high implicit tax rates at the bottom of the income distribution may be overblown. Most of the concern is focused on the $10,000 to $50,000 income range that we examine where the EITC is phased out. But we find no evidence that, at least for the explicit taxes that arise through the federal and state income tax system, taxpayers in this range are substantially changing either their real incomes or reported taxes in response to tax policy. This suggests that the distributional advantages of tightly income targeted tax subsidies may outweigh the efficiency costs of high implicit tax rates on the lower middle income taxpayers, as is illustrated by the high optimal rates in this bracket in our simulations.

Of course, our study does not consider non-filers and individuals who move into filing status between a pair of years. If these individuals are particularly responsive, then there still may be concern about the high implicit rates arising through transfer programs. This type of responsiveness is indeed suggested by the high elasticities of labor force participation with respect to taxation estimated in Meyer and Rosenbaum (1999). This potential dichotomy between the responsiveness of those inside and outside of the tax system suggests that attention be paid to incentives that reward work per se rather than marginal increments to hours worked.

Third, we do find that there is substantial responsiveness of taxable income to taxes among the highest income taxpayers. This suggests that the optimal tax system should feature declining (or at least not increasing) marginal rates, although perhaps increasing average rates. These findings stand in contrast to the actual pattern of marginal rates that we observe in most developed countries. As our final simulations show, the high rates for upper income taxpayers imply very low social weight on that group. It is an interesting political economy question why tax systems have universally evolved towards progressive marginal rate structures.

Appendix

Income Definitions

Broad Income is defined as the sum of all the items that compose Total Income less Capital Gains and Social Security Benefits. Capital Gains are excluded because their tax treatment is special and thus the relevant marginal rate is not the same as for other income. Social Security benefits are also excluded because they were fully exempted from taxation before 1984 and thus are not present in the data for the years 1979 to 1983. Broad Income includes Wages, salaries and tips, Interest Income (taxable and exempted), Dividends (taxable and exempted), Alimony received, Business income (or loss), Total IRA distributions, Total Pensions and Annuities, Income reported on Schedule E (Partnerships, Trusts, etc.), Farm Income, full Unemployment Compensation and Other income.

Taxable Income is a definition consistent over the years and closest to the 1990 definition of taxable income. Taxable Income is defined as our Broad Income definition minus all the adjustments that are made to arrive at taxable income. Because the definition of taxable income changes from year to year due to the numerous tax reforms, we have included in the our Taxable Income definition only the adjustments that can be computed in all the years from 1979 to 1990. In order to get a consistent definition, exemptions are fixed in real value at the 1990 level before being substracted from Broad Income. The standard deduction (also fixed at the real level of 1990 standard deduction) is also deducted. Finally, real itemized deductions in excess of the real 1990 standard deduction are deducted to arrive at our definition of Taxable Income.

Inflation Parameters

The inflation parameters are applied to incomes to obtain real incomes over the period and to impute lagged tax rates using the TAXSIM calculator. These inflation parameters were computed as the average income growth of Broad Income for each of the years 1980 to 1990 using our tax return data. Taking year 1992 as base year index 100), the incomes for years 1979 to 1990 have been deflated using the following indices: 50.3 55.1 59.9 63.7 66.3 70.4 73.9 76.6 79.7 86.0 89.0 92.9. Our results are not sensitive to small changes in those inflation parameters.

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Figure 1: Income and Substitution Effects of a Tax Change

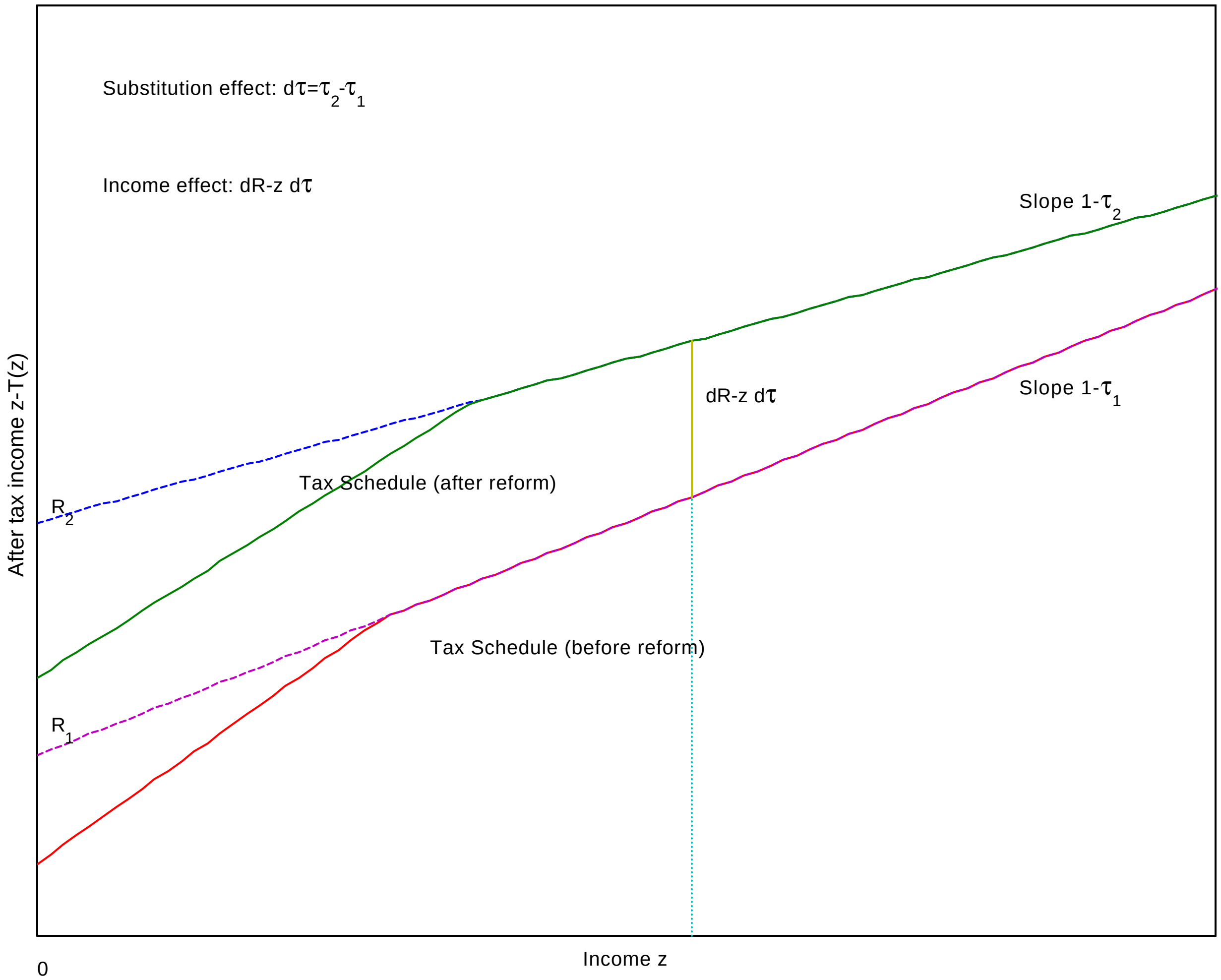

Table 1: Previous Studies

Author (Date)	Data (Years)	Tax Change	Sample	Controls for Mean Reversion and Income Distribution	Income Definitions	Elasticity Results
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lindsey (1987)	Repeated Tax Cross-Sections (1980 to 1984)	ERTA 81	AGI>$5K	None	Taxable Income	Elast.: 1.05 to 2.75 Central Estimate: 1.6
Feldstein (1995)	NBER Tax Panel (1985 and 1988)	TRA 86	Married, Non-Aged non-S corp creating Income>$30K	None	AGI Taxable Income	Elast. of AGI: 0.75-1.3 Elast. of Taxable Income: 1.1 - 3.05
Navratil (1995)	NBER Tax Panel (1980 and 1983)	ERTA 81	Married, Income>$25K	Use Average Income	Taxable Income	Elast. of Taxable Income: 0.8
Auten-Carroll (1997)	Treasury Tax Panel (1985 and 1989)	TRA 86	Single and Married age 25-55, Inc.>$15K Non-S corp creating	Include Log Income in base year	Gross Income Taxable Income	Elast. of Gross Inc.: 0.66 Elast. of Taxable Income: 0.75
Sammartino and Weiner (1997)	Treasury Tax Panel (1985 to 1994)	OBRA 1993	Less than 62 years old	None	AGI	Close to zero permanent response of AGI
Goolsbee (1998)	Panel of Corp. Exec. (1991 to 1994)	OBRA 1993	Corporate Executives 95% with income>$150K	Use Average Income	Wages, Bonus and Stock Options	Short Run Elast.: 1 Long Run Elast.: 0.1
Caroll (1998)	Treasury Tax Panel (1987 and 1996)	OBRA 1993	Married aged 25-55 Income>$50K	Use Average Income	Taxable Income	Elast.: 0.5
Saez (1999)	NBER Tax Panel (1979 to 1981)	Bracket Creep	Married and Singles only	Include Log Income and Polynomials in Income	AGI Taxable Income	Elast. of AGI: 0.25 Elast. of Taxable Income: 0.4
Moffitt and Wilhelm (2000)	SCF Panel (1983 and 1989)	TRA 86	High Incomes Oversampled	Use Various Sets of Instruments	AGI	Elast. of AGI: 0 to 2 depends on Instruments
Goolsbee (1999)	Tax Statistics Tables (1922 to 1989)	Various Tax Ref.	Incomes >$30K	None	Taxable Income	Elast. from -1.3 to 2 depending on Tax Reform

Table 2: Summary Statistics

	Mean	Standard Deviation
	(1)	(2)
Broad Income	$43,334	55,104
Taxable Income	$25,873	45,508
Married Dummy	0.645	
Single Dummy	0.28	
Itemizer Status	0.41	
Federal Tax Rate	23	8.8
State Tax Rate	4	3.5
Average net-of-tax rate	73	10.6
Federal Tax Liability	$6,737	23,555
State Tax Liability	$1,072	1,694
Number of Observations	69,202	

Notes: Summary Statistics given for all observations with Broad Income above $10,000.
All dollar values are expressed in 1992 dollars.

Table 3: Variation in After-Tax Shares log(1-T'p/1-T'1)

Year	$10K and above	$10K to $50K	$50K to $100K	$100K and above
(1)	(2)	(3)	(4)	(5)
1979-1982	-0.019	-0.015	-0.039	0.043
	[0.058]	[0.055]	[0.045]	[0.118]
	5,465	3,846	1,411	208
1980-1983	0.026	0.020	0.026	0.132
	[0.059]	[0.050]	[0.052]	[0.111]
	10,864	7,762	2,660	442
1981-1984	0.042	0.032	0.056	0.158
	[0.063]	[0.052]	[0.060]	[0.109]
	5,720	4,059	1,428	233
1982-1985	0.029	0.021	0.045	0.071
	[0.050]	[0.047]	[0.053]	[0.057]
	5,794	4,160	1,394	240
1983-1986	0.001	0.004	-0.004	-0.033
	[0.082]	[0.041]	[0.115]	[0.210]
	5,180	3,598	1,327	255
1984-1987	0.037	0.028	0.053	0.102
	[0.077]	[0.074]	[0.070]	[0.108]
	5,969	4,296	1,418	255
1985-1988	0.042	0.025	0.068	0.183
	[0.092]	[0.085]	[0.076]	[0.113]
	11,918	8,589	2,780	548
1986-1989	0.042	0.024	0.067	0.186
	[0.091]	[0.084]	[0.075]	[0.105]
	6,122	4,385	1,444	293
1987-1989	0.009	-0.001	0.022	0.084
	[0.057]	[0.053]	[0.052]	[0.060]
	12,091	8,663	2,826	602

Notes: Means, standard deviation and number of observations reported. Income cuts based on Broad income definition.

Table 4: Basic Elasticity Results

Income Controls	None		Log Income		Log Income 10-piece Spline	
	Broad Income	Taxable Income	Broad Income	Taxable Income	Broad Income	Taxable Income
	(1)	(2)	(3)	(4)	(5)	(6)
Elasticity	-0.300	-0.462	0.170	0.611	0.120	0.400
	(0.120)	(0.194)	(0.106)	(0.144)	(0.106)	(0.144)
Dummy for Marrieds	-0.008	-0.062	0.045	0.049	0.050	0.055
	(0.010)	(0.018)	(0.014)	(0.023)	(0.012)	(0.021)
Dummy for Singles	-0.037	-0.053	-0.034	-0.032	-0.036	-0.027
	(0.012)	(0.019)	(0.013)	(0.022)	(0.013)	(0.021)
Log(income) control			-0.083	-0.167		
			(0.015)	(0.021)		
Spline 1st decile control					0.225	-0.884
					(0.086)	(0.039)
Spline 2nd decile control					-2.74	-0.538
					(1.13)	(0.047)
Spline 3rd decile control					-0.317	-0.279
					(0.055)	(0.057)
Spline 4th decile control					-0.071	-0.445
					(0.051)	(0.069)
Spline 5th decile control					-0.197	-0.003
					(0.054)	(0.075)
Spline 6th decile control					-0.074	-0.253
					(0.053)	(0.081)
Spline 7th decile control					-0.127	-0.124
					(0.056)	(0.083)
Spline 8th decile control					-0.061	-0.172
					(0.057)	(0.083)
Spline 9th decile control					-0.027	-0.057
					(0.076)	(0.125)
Spline 10th decile control					-0.072	-0.126
					(0.041)	(0.064)
Observations:	69,129	59,199	69,129	59,199	69,129	59,199

Notes: Estimates from 2SLS regressions. Income range is $10,000 and above. Regressions weighted by income. All regressions include dummies for marital status and dummies for each base year.

Table 5: Subsitution and Income Effects

	Broad Income	Taxable Income
	(1)	(2)
A. No Income Effect Included		
Elasticity	0.071	0.396
	(0.066)	(0.114)
N. Obs	69,129	45,765
B. Income Effect Included		
Sustitution Effect	0.072	0.430
	(0.069)	(0.121)
Income Effect	-0.071	-0.135
	(0.096)	(0.108)
N. Obs	69,089	45,728

Notes: Estimates from 2SLS regressions. Regressions are unweighted. Income Range: broad income above $10,000 in column (1) and taxable income above $10,000 in column (2). Regressions include 10 splines in log(income).
All regressions include dummies for marital status and dummies for each base year.

Table 6: Variations in Timing

	3 Year Lag	2 Year Lag	1 Year Lag
	(1)	(2)	(3)
Broad Income	0.120	0.085	0.192
	(0.106)	(0.104)	(0.105)
Number of Obs.	69,129	116,250	145,550
Taxable Income	0.400	0.331	0.410
	(0.144)	(0.138)	(0.164)
Number of Obs.	59,199	100,385	127,644

Notes: Estimates from 2SLS regressions. Income range is $10,000 and above. Regressions weighted by income. Regressions include 10 splines in log(income).
All regressions include dummies for marital status and dummies for each base year.

Table 7: Adding Year-Specific Income Controls

	Broad Income	Taxable Income
	(1)	(2)
A. Time Trend*Splines included		
Elasticity Estimate	0.125	0.477
	(0.109)	(0.149)
Number of Obs.	69,129	59,199
B. Year Dummies*log(income) included		
Elasticity Estimate	0.095	0.459
	(0.137)	(0.218)
Number of Obs.	69,129	59,199

Notes: Estimates from 2SLS regressions. Income range is $10,000 and above. Regressions weighted by income. All regressions include 10 splines in log(income).
All regressions include dummies for marital status and dummies for each base year.
Regressions in panel A include additional Time Trend*splines interactions.
Regressions in panel B include additional year dummies*log(income) interactions.

Table 8: Elasticity
Results by Heterogenous Groups

	Broad Income	Taxable Income	Taxable Income (using taxable income cuts)
	(1)	(2)	(3)
PANEL A: Income Ranges			
Income Range	-0.044	0.180	0.284
\$10K to \$50K (\$10K to \$32K col. (3))	(0.085)	(0.164)	(0.180)
N. Obs	49,364	39,902	26,635
Income Range	-0.065	0.106	0.265
\$50K to \$100K (\$32K to \$75K col. (3))	(0.154)	(0.219)	(0.192)
N. Obs	16,688	16,293	16,338
Income Range	0.171	0.567	0.484
\$100K and above (above \$75K col. (3))	(0.240)	(0.298)	(0.316)
N. Obs	3,076	3,004	2,792
PANEL B: Itemizing Status			
Itemizers	0.266	0.647	
\$10K and above	(0.068)	(0.099)	
N. Obs	28,117	25,746	
Non-Itemizers	-0.210	-0.179	
\$10K and above	(0.079)	(0.122)	
N. Obs	41,012	33,569	
PANEL C: Marital Status			
Married	0.071	0.352	
\$10K and above	(0.130)	(0.176)	
N. Obs	44,623	37,685	
Single	0.189	0.385	
\$10K and above	(0.208)	(0.254)	
N. Obs	19,349	17,562	

Notes: Estimates from 2SLS regressions. Regressions weighted by income. Income ranges in columns (1) and (2) based on Broad Income in base year. Income ranges in column (3) based on Taxable Income in base year. All regressions include dummies for marital status and dummies for each base year and 10 income control splines.

Table 9: Optimal Tax Results, Broad Income Elasticities

Income Groups	$0-$10K	$10K-$50K	$50K-$100K	$100K and above	Guaranteed Income Level
	(1)	(2)	(3)	(4)	(5)
Average Elasticities	0.4	0.05	0.05	0.171	
Mean Income	$5,200	$26,800	$66,200	$185,100	
Density Weights (h's)	0.200	0.590	0.178	0.032	
1. Maximizing Tax Revenue (Rawlsian)					
Social Weights (g's)	0	0	0	0	
Optimal Rates	96	96	88	73	$25,900
Average Tax Rates	-403	-1	55	69	
2. Utilitarian: Progressive					
Social Weights (g's)	2	1	0.5	0	
Optimal Rates	66	88	84	73	$21,700
Average Tax Rates	-350	-1	51	67	
3. Utilitarian: Conservative					
Social Weights (g's)	1.66	0.83	0.83	0.83	
Optimal Rates	61	79	56	30	$17,200
Average Tax Rates	-270	8	45	40	
4. No Redistribution					
Optimal Rates	20	21	8	3	
Average Tax Rates	20	21	18	9	$0

Notes: Optimal Rates are computed using formulas (6) to (9). Average Rates are total tax liability (including guaranteed income level) over income.

Table 10: Optimal Tax Results, Taxable Income Elasticities

Income Groups	$0-$10K	$10K-$32K	$32K-$75K	$75K and above	Guaranteed Income Level
	(1)	(2)	(3)	(4)	(5)
Average Elasticities	0.4	0.284	0.265	0.484	
Mean Income	$4,800	$20,050	$46,200	$138,100	
Density Weights (h's)	0.301	0.404	0.250	0.045	
1. Maximizing Tax Revenue (Rawlsian)					
Social Weights (g's)	0	0	0	0	
Optimal Rates	94	82	64	49	$15,300
Average Tax Rates	-224	12	46	51	
2. Utilitarian: Progressive					
Social Weights (g's)	2	1	0.5	0	
Optimal Rates	68	66	56	49	$11,000
Average Tax Rates	-161	12	40	47	
3. Utilitarian: Conservative					
Social Weights (g's)	1.66	0.83	0.83	0.83	
Optimal Rates	59	51	29	18	$6,400
Average Tax Rates	-73	24	33	25	
4. No Redistribution					
Optimal Rates	43	19	8	5	$0
Average Tax Rates	43	31	21	11	
5. Actual Schedule					
Social Weights (g's)	0.84	1.03	1.01	0.13	
Actual Rates	45	23	35	45	

Notes: Optimal Rates are computed using formulas (6) to (9). Average Rates are total tax liability (including guaranteed income level) over income.