

# The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review

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## Abstract

This paper critically surveys the large and growing literature estimating the elasticity of taxable income with respect to marginal tax rates (ETI) using tax return data. First, we provide a theoretical framework showing under what assumptions this elasticity can be used as a sufficient statistic for efficiency and optimal tax analysis. We discuss what other parameters should be estimated when the elasticity is not a sufficient statistic. Second, we discuss conceptually the key issues that arise in the empirical estimation of the elasticity of taxable income using the example of the 1993 top individual income tax rate increase in the United States to illustrate those issues. Third, we provide a critical discussion of selected empirical analyses of the elasticity of taxable income in light of the theoretical and empirical framework we laid out. Finally, we discuss avenues for future research.

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# 1 Introduction

The notion of a behavioral elasticity occupies a critical place in the economic analysis of taxation. Graduate textbooks teach that the two central aspects of the public sector, optimal progressivity of the tax-and-transfer system, as well as the optimal size of the public sector, depend (inversely) on the compensated elasticity of labor supply with respect to the marginal tax rate. Indeed, until recently, the labor supply elasticity was the closest thing that public finance economics had to a central parameter. In a static model where people value only two commodities — leisure and a composite consumption good — the real wage in terms of the consumption good is the only relative price at issue. This real wage is equal to the amount of goods that can be consumed per hour of leisure foregone (or, equivalently, per hour of labor supplied). At the margin, substitution possibilities, and therefore the excess burden of taxation, can be captured by a compensated labor supply elasticity.

With some notable exceptions, the profession has settled on a value for this elasticity close to zero for prime-age males, although for married women the responsiveness of labor force participation appears to be significant. Overall, though, the compensated elasticity of labor appears to be fairly small. In models with only a labor-leisure choice, this implies that the efficiency cost per dollar raised of taxing labor income — to redistribute revenue to others or to provide public goods — is bound to be low, as well.

Although evidence of a substantial compensated labor supply elasticity has been hard to find, evidence that taxpayers respond to tax system changes more generally has decidedly not been hard to find. For example, the timing of capital gains realizations appears to react strongly to changes in capital gains tax rates, as evidenced by the surge in capital gains realizations in 1986, after the U.S. announced increased tax rates on realizations beginning in 1987 (Auerbach, 1988). Dropping the top individual tax rate to below the corporate tax rate in the same act led to a significant shift in business activity towards pass-through entities, which are not subject to the corporate tax (Auerbach and Slemrod, 1997).

Addressing these other margins of behavioral response is crucial because under some assumptions *all* responses to taxation are symptomatic of deadweight loss. Taxes trigger a host of behavioral responses intended to minimize the burden on the individual. In the absence of externalities or other market failure, and putting aside income effects, all such responses are sources of inefficiency, whether they take the form of reduced labor supply, increased charitable

contributions or mortgage interest payments, increased expenditures for tax professionals, or a different form of business organization, and thus they add to the burden of taxes from society's perspective. Because in principle the elasticity of taxable income (which we abbreviate from now on using the standard acronym ETI) can capture all of these responses, it holds the promise of more accurately summarizing the marginal efficiency cost of taxation than a narrower measure of taxpayer response such as the labor supply elasticity, and therefore is a worthy topic of investigation.

Although the literature reviewed in this article addresses the behavioral response to individual income taxation, many of the issues apply to any tax base. Certainly the idea that, under some assumptions, all responses are symptoms of inefficiency applies generally. For example, consider a state imposing a cigarette excise tax. Under some assumptions, the central empirical parameter is the elasticity of the cigarette tax base, which includes not only the response of smoking to tax rate changes but also the impact on the tax base of smuggling and tax-free Internet purchases.

The new focus (on the ETI) raises the possibility that the efficiency cost of taxation is significantly higher than is implied if labor supply is the sole, or principal, margin of behavioral response. Indeed, some of the first empirical estimates of the elasticity of taxable income implied very sizeable responses and therefore a very high marginal efficiency cost of funds. However, the subsequent literature found substantially smaller elasticities, and raised questions about both our ability to identify this key parameter and about the claim that it alone is a sufficient statistic for welfare analysis of the tax system. Whether the taxable income elasticity is an accurate indicator of the revenue leakage due to behavioral response, the ultimate indicator of efficiency cost, depends on the situation. First, if revenue leakage in current year tax revenue is substantially offset by revenue gain in other years or in other tax bases, it is misleading. Second, if some of the response involves changes in activities with externalities, such as charitable giving behavior, then the elasticity is not a sufficient statistic for welfare analysis. Third, the elasticity depends on the tax system. A tax system with a narrow base and many deductions and avoidance opportunities is likely to generate high elasticities and hence large efficiency costs. In that context, broadening the tax base and eliminating avoidance opportunities such as to reduce the elasticity is likely to be more efficient and more equitable than altering tax rates within the old system.

The remainder of the paper is organized as follows. Section 2 presents the theoretical framework underlying the taxable income elasticity concept. Section 3 presents the key identification issues that arise in the empirical estimation of the taxable income elasticity, using as an illustration the taxable income response to the 1993 top tax rate increase in the United States. Section 4 reviews the results of some selected empirical studies in light of our discussion of the conceptual and empirical issues. Section 5 concludes and discusses the most promising avenues for future research. Appendices present a summary of the key U.S. legislated tax changes that have been studied in the U.S. literature and a brief description of existing U.S. tax return data.

## 2 Conceptual Framework

### 2.1 Basic Model

In the standard labor supply model, individuals maximize a utility function  $u(c, l)$  where  $c$  is disposable income, equal to consumption in a one-period model, and  $l$  is labor supply measured by hours of work. Earnings are given by  $w \cdot l$ , where  $w$  is the exogenous wage rate. The (linearized) budget constraint is  $c = w \cdot l \cdot (1 - \tau) + E$  where  $\tau$  is the marginal tax rate and  $E$  is virtual income.

The taxable income elasticity literature generalizes this model by noting that hours of work are only one component of the behavioral response to income taxation. Individuals can respond to taxation through other margins such as intensity of work, career choices, form and timing of compensation, tax avoidance, or tax evasion. As a result, an individual's wage rate  $w$  might depend on effort and respond to tax rates, and reported taxable income might differ from  $w \cdot l$  as individuals split their gross earnings between taxable cash compensation and non-taxable compensation such as fringe benefits, or even fail to report their full taxable income because of tax evasion.

As shown by Feldstein (1999), a simple way to model all those behavioral responses is to posit that utility depends positively on disposable income (equal to consumption)  $c$  and negatively on reported income  $z$  (because activities that generate income are costly, for example because they may require foregoing leisure). Hence, individuals choose  $(c, z)$  to maximize a utility function  $u(c, z)$  subject to a budget constraint of the form  $c = (1 - \tau) \cdot z + E$ . Such maximization generates an individual "reported income" supply function  $z(1 - \tau, E)$  where  $z$  depends on the

net-of-marginal-tax rate  $1 - \tau$  and virtual income  $E$  generated by the tax/transfer system.<sup>1</sup> Each individual has a particular reported income supply function reflecting his/her skills, taste for labor, opportunities for avoidance, and so on.<sup>2</sup>

In most of what follows, we assume away income effects so that the income function  $z$  does not depend on  $E$  and depends only on the net-of-tax rate.<sup>3</sup> In the absence of compelling evidence about significant income effects in the case of overall reported income, it seems reasonable to consider the case with no income effects, which simplifies considerably the presentation of efficiency effects. It might seem unintuitive to assume away the effect of changes in exogenous *income* on (reported taxable) *income*. However, in the reported income context,  $E$  is defined exclusively as virtual income created by the tax/transfer budget constraint and hence is not part of taxable income  $z$ . Another difference is that the labor component of  $z$  is labor income ( $w \cdot l$ ) rather than labor hours ( $l$ ); this difference requires us to address the incidence of tax rate changes (i.e., their effect on  $w$ ), which we do briefly in Section 2.2.5.

The ETI literature has attempted to estimate the elasticity of reported incomes with respect to the net-of-tax rate, defined as

$$e = \frac{1 - \tau}{z} \cdot \frac{\partial z}{\partial(1 - \tau)}, \quad (1)$$

the percent change in reported income when the net-of-tax rate increases by one percent. With no income effects, this elasticity is equal to both the compensated and uncompensated elasticity. Importantly, and as recognized in the labor supply literature, the elasticity for a given individual may not be constant and depends on the tax system. As a result, an elasticity estimated around the current tax system may not apply to a hypothetical large tax change. As shown in Feldstein (1999), this elasticity captures not only the hours of work response, but also all other behavioral responses to marginal tax rates. Furthermore, it depends on features of the tax system, such

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<sup>1</sup>This reported income supply function remains valid in the case of non-linear tax schedules as  $c = (1 - \tau)z + E$  is the linearized budget constraint at the utility-maximizing point, just as in the basic labor supply model.

<sup>2</sup>We could have posited a more general model in which  $c = y - \tau z + E$ , where  $y$  is real income and  $z$  is reported income that may differ from real income because of, for example, tax evasion and avoidance. Utility would be  $u(c, y, y - z)$ , which is increasing in  $c$ , decreasing in  $y$  (earnings effort), and decreasing in  $y - z$  (costs of avoiding or evading taxes). Such a utility function would still generate a reported income supply function of the form  $z(1 - \tau, E)$  and our analysis would go through. We come back to such a more general model in Section 2.4.

<sup>3</sup>There is no consensus in the labor supply literature about the size of income effects, with many studies obtaining small income effects, but with several important studies finding large income effects (see Blundell and MaCurdy, 1999, for a survey). There is much less empirical evidence on the magnitude of income effects in the reported income literature. Gruber and Saez (2002) estimate both income and substitution effects in the case of reported incomes, and find small and insignificant income effects.

as the availability of deductions, and other avoidance opportunities — a very important point for the interpretation of empirical results, as we discuss below. Therefore, the elasticity is not a structural parameter depending solely on individual preferences.

As we discuss later, a number of empirical studies have found that the behavioral response to changes in marginal tax rates is concentrated in the top of the income distribution, with less evidence of any response for the middle and upper-middle income class (see Sections 3 and 4 below).<sup>4</sup> Moreover, in the United States, because of graduated rates as well as exemptions and low-income tax credits, individual income tax liabilities are very skewed: the top quintile (top percentile) tax filers remitted 86.3 percent (39.1 percent) of all individual income taxes in 2006 (Congressional Budget Office, 2009). Therefore, it is useful to focus on the analysis of the effects of changing the marginal tax rate on the upper end of the income distribution. Let us therefore assume that incomes in the top bracket, above a given reported income threshold  $\bar{z}$ , face a constant marginal tax rate  $\tau$ .<sup>5</sup>

As in the conceptual framework just described, we assume that individual incomes reported in the top bracket depend on the net-of-tax rate  $1 - \tau$ . Let us assume that there are  $N$  individuals in the top bracket (above  $\bar{z}$ ) when the top bracket rate is  $\tau$ . We denote by  $z^m(1 - \tau)$  the *average* income reported by those  $N$  top taxpayers, as a function of the net-of-tax rate. The aggregate elasticity of taxable income in the top bracket with respect to the net-of-tax rate is therefore defined as  $e = [(1 - \tau)/z^m] \cdot [\partial z^m / \partial(1 - \tau)]$ . This aggregate elasticity is equal to the average of the individual elasticities *weighted by individual income*, so that individuals contribute to the aggregate elasticity in proportion to their incomes.<sup>6</sup>

Suppose that the government increases the top tax rate  $\tau$  by a small amount  $d\tau$  (with no change in the tax schedule for incomes below  $\bar{z}$ ). This small tax reform has two effects on tax revenue. First, there is a “mechanical” increase in tax revenue due to the fact that taxpayers face a higher tax rate on their incomes above  $\bar{z}$ . The total mechanical effect is

$$dM \equiv N \cdot (z^m - \bar{z}) \cdot d\tau > 0. \quad (2)$$

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<sup>4</sup>The behavioral response at the low end of the income distribution is for the most part out of the scope of the present paper. The large literature on responses to welfare and income transfer programs targeted toward low incomes has, however, displayed evidence of significant labor supply responses (see, e.g., Meyer and Rosenbaum, 2001).

<sup>5</sup>For example, in the case of tax year 2008 federal income tax law in the United States, taxable incomes above  $\bar{z} = \$357,700$  are taxed at the top marginal tax rate of  $\tau = 0.35$ .

<sup>6</sup>Formally,  $z^m = [z_1 + \dots + z_N]/N$  and hence  $e = [(1 - \tau)/z^m] \cdot [\partial z^m / \partial(1 - \tau)] = (1 - \tau) \cdot [\partial z_1 / \partial(1 - \tau) + \dots + \partial z_N / \partial(1 - \tau)] / [N \cdot z^m] = [e_1 \cdot z_1 + \dots + e_N \cdot z_N] / [z_1 + \dots + z_N]$  where  $e_i$  is the elasticity of individual  $i$ .

This mechanical effect is the projected increase in tax revenue, absent any behavioral response.

Second, the increase in the tax rate triggers a behavioral response that reduces the average reported income of top  $N$  taxpayers by  $dz^m = -e \cdot z^m \cdot d\tau / (1 - \tau)$ .<sup>7</sup> A change in reported income of  $dz^m$  changes tax revenue by  $\tau dz^m$ . Hence, the aggregate change in tax revenue due to the behavioral response is equal to

$$dB \equiv -N \cdot e \cdot z^m \cdot \frac{\tau}{1 - \tau} \cdot d\tau < 0. \quad (3)$$

Summing the mechanical and the behavioral effect, we obtain the total change in tax revenue due to the tax change:

$$dR = dM + dB = N \cdot (z^m - \bar{z}) \cdot \left[ 1 - e \cdot \frac{z^m}{z^m - \bar{z}} \cdot \frac{\tau}{1 - \tau} \right] \cdot d\tau. \quad (4)$$

Let us denote by  $a$  the ratio  $z^m / (z^m - \bar{z})$ . Note that in general  $a \geq 1$ , and that  $a = 1$  when a single flat tax rate applies to all incomes, as in this case the top bracket starts at zero ( $\bar{z} = 0$ ). If the top tail of the distribution is Pareto distributed,<sup>8</sup> then the parameter  $a$  does not vary with  $\bar{z}$  and is exactly equal to the Pareto parameter. As the tails of actual income distributions are very well approximated by Pareto distributions, within a given year, the coefficient  $a$  is extremely stable in the United States for  $\bar{z}$  above \$300,000 and equals approximately 1.5 in recent years.<sup>9</sup> The parameter  $a$  measures the thinness of the top tail of the income distribution: the thicker the tail of the distribution, the larger is  $z^m$  relative to  $\bar{z}$ , and hence the smaller is  $a$ . Using the definition of  $a$ , we can rewrite the effect of the small reform on tax revenue  $dR$  simply as:

$$dR = dM \cdot \left[ 1 - \frac{\tau}{1 - \tau} \cdot e \cdot a \right]. \quad (5)$$

Formula (5) shows that the fraction of tax revenue lost through behavioral responses — the second term in the square bracket expression — is a simple function increasing in the tax rate

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<sup>7</sup>The change  $d\tau$  could induce a small fraction  $dN$  of the  $N$  taxpayers to leave (or join if  $d\tau < 0$ ) the top bracket. As long as behavioral responses take place only along the intensive margin, each individual response is proportional to  $d\tau$  so that the total revenue effect of such responses is second order ( $dN \cdot d\tau$ ) and hence can be ignored in our derivation.

<sup>8</sup>A Pareto distribution has a density function of the form  $f(z) = C/z^{1+\alpha}$ , where  $C$  and  $\alpha$  are constant parameters. The parameter  $\alpha$  is called the Pareto parameter. In that case  $z^m = \int_{\bar{z}}^{\infty} z \cdot f(z) \cdot dz / \int_{\bar{z}}^{\infty} f(z) \cdot dz = \bar{z} \cdot \alpha / (\alpha - 1)$  and hence  $z^m / (z^m - \bar{z}) = \alpha$ .

<sup>9</sup>Saez (2001) provides such an empirical analysis for 1992 and 1993 reported wage incomes using U.S. tax return data. Piketty and Saez (2003) provide estimates of thresholds  $\bar{z}$  and average incomes  $z^m$  corresponding to various fractiles within the top decile of the U.S. income distribution from 1913 to 2008, allowing a straightforward estimation of the parameter  $a$  for any year and income threshold. As U.S. income concentration has increased in recent decades, the Pareto parameter  $a$  has correspondingly fallen from about 2 in the 1970s to about 1.5 in most recent years.

$\tau$ , the elasticity  $e$ , and the Pareto parameter  $a$ . This expression is of primary importance to the welfare analysis of taxation because  $\tau \cdot e \cdot a / (1 - z)$  is exactly equal to the marginal deadweight burden created by the increase in the tax rate, under the assumptions we have made and that we discuss below. This can be seen as follows: Because of the envelope theorem, the behavioral response to a small tax change  $d\tau$  creates no additional welfare loss and thus the utility loss (measured in dollar terms) created by the tax increase is exactly equal to the mechanical effect  $dM$ .<sup>10</sup> However, tax revenue collected is only  $dR = dM + dB < dM$  because  $dB < 0$ . Thus  $-dB$  represents the extra amount lost in utility over and above the tax revenue collected  $dR$ . From (5) and because  $dR = dM + dB$ , the marginal excess burden per dollar of extra taxes collected is defined as

$$-\frac{dB}{dR} = \frac{e \cdot a \cdot \tau}{1 - \tau - e \cdot a \cdot \tau}. \quad (6)$$

In other words, for each extra dollar of taxes raised, the government imposes an extra cost equal to  $-dB/dR > 0$  on taxpayers. We can also define the “marginal efficiency cost of funds” (MECF) as  $1 - dB/dR = (1 - \tau)/(1 - \tau - e \cdot a \cdot \tau)$ . These formulas are valid for any tax rate  $\tau$  and income distribution as long as income effects are assumed away, even if individuals have heterogeneous utility functions and behavioral elasticities.<sup>11</sup> The parameters  $\tau$  and  $a$  are relatively straightforward to measure, so that the elasticity parameter  $e$  is the central parameter necessary to calculate formulas (5) and (6). Marginal deadweight burden or marginal efficiency cost of funds measure solely efficiency costs and abstract from distributional considerations. The optimal income tax progressivity literature precisely brings together the efficiency formulas derived here with welfare weights capturing distributional concerns. Therefore, the behavioral response elasticity is also a key parameter for characterizing optimal progressivity (Saez, 2001).

To illustrate these formulas consider the following example using U.S. data. In recent years, for the top 1 percent income cut-off (corresponding approximately to the top 35 percent federal income tax bracket in that year), Piketty and Saez (2003) estimate that  $a = 1.5$ . When combining the maximum federal and average state income, Medicare, and typical sales tax rates

<sup>10</sup>Formally,  $V(1 - \tau, E) = \max_z u(z(1 - \tau) + E, z)$  so that  $dV = u_c \cdot (-zd\tau + dE) = -u_c \cdot (z - \bar{z}) \cdot d\tau$ . Therefore, the (money-metric) marginal utility cost of the reform is indeed equal to the mechanical tax increase, individual by individual.

<sup>11</sup>In contrast, the Harberger triangle (Harberger, 1964) approximations are valid only for small tax rates. This expression also abstracts from any marginal compliance costs caused by raising rates, and from any marginal administrative costs unless  $dR$  is interpreted as revenue net of administrative costs. See Slemrod and Yitzhaki (2002).

in the United States, the top marginal tax rate for ordinary income is 42.5 percent as of 2009.<sup>12</sup> For an elasticity estimate of  $e = 0.25$  (corresponding, as we discuss later, to the mid range of the estimates from the literature), the fraction of tax revenue lost through behavioral responses ( $-dB/dM$ ), should the top tax rate be slightly increased, would be 27.7 percent, slightly above a quarter of the mechanical (i.e., ignoring behavioral responses) projected increase in tax revenue. In terms of marginal excess burden, increasing tax revenue by  $dR = \$1$  causes a utility loss (equal to the MECF) of  $1/(1 - 0.277) = \$1.38$  for taxpayers, and hence a marginal excess burden of  $-dB/dR = \$.38$ , or 38 percent of the extra \$1 tax collected.

Following the supply-side debates of the early 1980s, much attention has been focused on the revenue-maximizing tax rate. The revenue maximizing tax rate  $\tau^*$  is such that the bracketed expression in equation (5) is exactly zero when  $\tau = \tau^*$ . Rearranging this equation, we obtain the following simple formula for the tax revenue maximizing rate  $\tau^*$  for the top bracket:

$$\tau^* = \frac{1}{1 + a \cdot e}. \quad (7)$$

A top tax rate above  $\tau^*$  is inefficient because decreasing the tax rate would both increase the utility of the affected taxpayers with income above  $\bar{z}$  and increase government revenue, which could in principle be used to benefit other taxpayers.<sup>13</sup> The optimal income taxation literature following Mirrlees (1971) shows that formula (7) is the optimal top tax rate if the social marginal utility of consumption decreases to zero when income is large (see Saez, 2001). At the tax rate  $\tau^*$ , the marginal excess burden becomes infinite as raising more tax revenue becomes impossible. Using our previous example with  $e = 0.25$  and  $a = 1.5$ , the revenue-maximizing tax rate  $\tau^*$  would be 72.7 percent, much higher than the current US top tax rate of 42.5 percent when combining all taxes. Keeping state income and sales taxes, and Medicare taxes constant, this would correspond to a top Federal individual income tax rate of 68.4 percent, very substantially higher than the current 35 percent but lower than the top Federal income tax rate prior to 1982.

Note that when the tax system has a single tax rate (i.e., when  $\bar{z} = 0$ ), the tax revenue maximizing rate becomes the well-known expression  $\tau^* = 1/(1 + e)$ . As  $a \geq 1$ , the revenue-

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<sup>12</sup>A top federal tax rate of 35 percent, combined with an average top state income tax rate of 5.9 percent, the Medicare 2.9 percent payroll tax, and an average sales tax rate of 2.3 percent generate a total top marginal tax rate of 42.5 percent, when considering that state income taxes are deductible when calculating federal income taxes and the employer's share of the Medicare tax is deductible for both state and federal income tax calculations.

<sup>13</sup>Formally, this a second-best Pareto-inefficient outcome as there is a feasible government policy which can produce a Pareto improvement, ignoring the possibility that the utility of some individuals enters negatively in the utility functions of others.

maximizing flat rate is always larger than the revenue-maximizing rate applied to high incomes only. This is because increasing just the top tax rate collects extra taxes only on the portion of incomes above the bracket threshold  $\bar{z}$ , but produces a behavioral response for high-income taxpayers as large as an identical across-the-board increase in marginal tax rates.

Giertz (2009) applies the formulas presented in this section to tax return data from published Statistics of Income tables produced by the Internal Revenue Service (IRS) to analyze the impact of the potential expiration of the Bush administration tax cuts in 2011. Giertz shows that exactly where the ETI falls within the range found in the empirical literature has significant effects on the efficiency and revenue implications for tax policy. For example, Giertz reports that for ETIs of 0.2, 0.5 and 1.0, behavioral responses would respectively erase 12, 31 and 62 percent of the mechanical revenue gain. When offsets to payroll and state income taxes are taken into account, these numbers increase by 28 percent. Likewise, estimates for the marginal cost of public funds and the revenue-maximizing rates are quite sensitive to this range of ETIs.

In the basic model we have considered, the ETI  $e$  is a sufficient statistic to estimate the efficiency costs of taxation as it is not necessary to estimate the structural parameters of the underlying individual preferences. Such sufficient statistics for welfare and normative analysis have been used in various contexts in the field of public economics in recent years (see Chetty, 2009c for a recent survey). However, it is important to understand the limitations of this approach and the strong assumptions required to apply it, as we show in the next sub-sections.

## **2.2 Fiscal Externalities and Income Shifting**

The analysis has assumed so far that the reduction in reported incomes due to a tax rate increase has no other effect on tax revenue. This is a reasonable assumption if the reduction in incomes is due to reduced labor supply (and hence an increase in untaxed leisure time), or due to a shift from taxable cash compensation toward untaxed fringe benefits or perquisites (more generous health insurance, better offices, company cars, etc.) or tax evasion. However, in many instances the reduction in reported incomes is due in part to a shift away from taxable individual income toward other forms of taxable income such as corporate income, or deferred compensation that will be taxable to the individual at a later date (see Slemrod, 1998). For example, Slemrod (1996) and Gordon and Slemrod (2000) argue that part of the surge in top individual incomes after the Tax Reform Act of 1986 in the United States, which reduced individual income tax

rates relative to corporate tax rates (see appendix A), was due to a shift of taxable income from the corporate sector toward the individual sector.

For a tax change in a given base  $z$ , we define a fiscal externality as a change in the present value of tax revenue that occurs in any tax base  $z'$  other than  $z$  due to the behavioral response of private agents to the tax change in the initial base  $z$ . The alternative tax base  $z'$  can be a different tax base in the same time period or the same tax base in a different time period. The notion of fiscal externality is therefore dependent on the scope of the analysis both along the base dimension and the time dimension. In the limit, where the analysis encompasses all tax bases and all time periods (and hence focuses on the total present discounted value of total tax revenue), there can by definition be no fiscal externalities.

To see the implication of income shifting, assume that a fraction  $s < 1$  of the income that disappears from the individual income tax base following the tax rate increase  $d\tau$  is shifted to other bases and is taxed on average at rate  $t$ . For example, if half of the reduction in individual reported incomes is due to increased (untaxed) leisure and half is due to a shift toward the corporate sector, then  $s = 1/2$  and  $t$  would be equal to the effective tax rate on corporate income.<sup>14</sup> In the general case, a behavioral response  $dz$  now generates a tax revenue change equal to  $(\tau - s \cdot t) \cdot dz$ . As a result, the change in tax revenue due to the behavioral response becomes:

$$dB = -N \cdot e \cdot z^m \cdot \frac{\tau}{1 - \tau} \cdot d\tau + N \cdot e \cdot z^m \cdot \frac{s \cdot t}{1 - \tau} \cdot d\tau. \quad (8)$$

Therefore, formula (5) for the effect of a small reform on total tax revenue becomes:

$$dR = dM + dB = dM \cdot \left[ 1 - \frac{\tau - s \cdot t}{1 - \tau} \cdot e \cdot a \right]. \quad (9)$$

The same envelope theorem logic applies for welfare analysis: the income that is shifted to another tax base at the margin does not generate any direct change in welfare because the taxpayer is indifferent between reporting marginal income in the individual income tax base versus the alternative tax base. Therefore, as above,  $-dB$  represents the marginal deadweight burden of the individual income tax, and the marginal excess burden expressed in terms of extra taxes collected can be written as

$$-\frac{dB}{dR} = \frac{e \cdot a \cdot (\tau - s \cdot t)}{1 - \tau - e \cdot a \cdot (\tau - s \cdot t)}. \quad (10)$$

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<sup>14</sup>It is possible to have  $t > \tau$ , for example if there are (non-tax) advantages to the corporate form. If all the response is shifting ( $s = 1$ ),  $d\tau > 0$  would actually then lead to behavioral responses increasing total tax revenue and hence reducing deadweight burden.

The revenue-maximizing tax rate (7) becomes:

$$\tau_s^* = \frac{1 + s \cdot t \cdot a \cdot e}{1 + a \cdot e} > \tau^*. \quad (11)$$

If we assume again that  $a = 1.5$ ,  $e = .25$ ,  $\tau = 0.425$ , but that half ( $s = 0.5$ ) of marginal income disappearing from the individual base is taxed on average at  $t = 0.3$ ,<sup>15</sup> the fraction of revenue lost due to behavioral responses drops from 27.7 percent to 17.9 percent, and the marginal excess burden (expressed as a percentage of extra taxes raised) decreases from 38 percent to 22 percent. The revenue-maximizing tax rate increases from 72.7 percent to 76.8 percent.

This simple theoretical analysis shows therefore that, in addition to estimating the elasticity  $e$ , it is critical to analyze whether the source or destination of changes in reported individual incomes is another tax base, either a concurrent one or in another time period. Thus two additional parameters, in addition to the taxable income elasticity  $e$ , are crucial in the estimation of the tax revenue effects and marginal deadweight burden: (1) The extent to which individual income changes in the first tax base  $z$  shift to another form of income that is taxable, characterized by parameter  $s$ , and (2) The tax rate  $t$  at which the income shifted is taxed. In practice, there are many possibilities for such shifting and measuring empirically all the shifting effects is challenging, especially in the case of shifting across time. The recent literature has addressed several channels for such fiscal externalities. Alternatively, one could identify shifting by looking directly at the overall revenue from all sources.

### 2.2.1 Individual versus Corporate Income Tax Base

Most countries tax corporate profits with a separate corporate income tax.<sup>16</sup> Unincorporated business profits (such as sole proprietorships or partnerships) are in general taxed directly at the individual level. In the United States, closely held corporations with few shareholders (less than 100 currently) can elect to become Subchapter S corporations and be taxed solely at the individual level. Such businesses are also called pass-through entities. Therefore, the choice

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<sup>15</sup>We show below that  $s = 0.5$  and  $t = 0.3$  are realistic numbers to capture the shift from corporate to individual taxable income following the Tax Reform Act of 1986.

<sup>16</sup>Net-of-tax corporate profits are generally taxed again at the individual level when paid out as dividends to individual shareholders. Many OECD countries alleviate such double taxation of corporate profits by providing tax credits or preferential tax treatment for dividends. If profits are retained in the corporation, they increase the value of the company stock and those profits may, as in the United States, be taxed as realized capital gains when the individual owners eventually sell the stock. In general, the individual level of taxation of corporate profits is lower than the ordinary individual tax on unincorporated businesses so that the combined tax on corporate profits and distributed profits may be lower than the direct individual tax for individuals subject to high marginal individual tax rates.

of business organization (regular corporation taxed by the corporate income tax versus pass-through entity taxed solely at the individual level) might respond to the relative tax rates on corporate versus individual income.

For example, if the individual income tax rate increases, some businesses taxed at the individual level may choose to incorporate where they would be subjected to the corporate income tax instead.<sup>17</sup> In that case, the standard taxable income elasticity might be large and the individual income tax revenue consequences significant. However, corporate income tax revenue will increase and partially offset the loss in revenue on the individual side. It is possible to provide a micro-founded model capturing those effects.<sup>18</sup> If businesses face heterogeneous costs of switching organizational form (representing both transaction costs and non-tax considerations) and the aggregate shifting response to tax rate changes is smooth, then marginal welfare analysis would still be applicable. As a result, formula (9) is a sufficient statistic to derive the welfare costs of taxation in that case.<sup>19</sup> Estimating  $s$  and  $t$  empirically would require knowing the imputed corporate profits of individual shareholders.

This issue was quite significant for analyses of the Tax Reform Act of 1986 because of the sharp decline (and change in sign!) in the difference between the top personal and corporate tax rates, which created an incentive to shift business income from the corporation tax base to pass-through entities such as partnerships or Subchapter S corporations, so that the business income shows up in the individual income tax base (see appendix A for a description of the 1986 tax reform). This phenomenon was indeed widespread immediately after the Tax Reform Act of 1986 (documented by Slemrod, 1996, Carroll and Joulfaian, 1997, and Saez, 2004 among others).

### 2.2.2 Timing Responses

If individuals anticipate that a tax increase will happen soon, such as when President Clinton was elected in late 1992 on a program to raise top individual tax rates, which was indeed implemented in 1993, they have incentives to accelerate taxable income realizations before the

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<sup>17</sup>Again, to the extent that dividends and capital gains are taxed, shareholders would not entirely escape the individual income tax.

<sup>18</sup>Alvaredo and Saez (2009) develop such a model in the case of the Spanish wealth tax, under which stock in closely held companies is excluded from the wealth tax for individuals who own at least 15 percent of the business and are substantially involved in management.

<sup>19</sup>It is a reduced-form formula because a change in the rules about business organization would in general change the behavioral elasticity.

tax change takes place.<sup>20</sup> As a result, reported taxable income just after the reform will be lower than otherwise. In that case, the tax increase has a positive fiscal externality on the pre-reform period that ought to be taken into account in a welfare analysis.

As we will see below, this issue of re-timing is particularly important in the case of realized capital gains<sup>21</sup> and stock-option exercises (Goolsbee, 2000a) because individuals can easily time the realization of such income. Parcell (1995) and Sammartino and Weiner (1997) document the large shift of taxable income into 1992 from 1993 (even when excluding capital gains) in response to the tax increase on high-income earners promised by President-elect Bill Clinton, and enacted in early 1993.

The labor supply literature started with a static framework and then developed a dynamic framework with inter-temporal substitution to distinguish between responses to temporary versus permanent changes in wage rates (MaCurdy, 1981). In this framework, differential responses arise because, and only because, the income effects of temporary versus permanent changes differ.<sup>22</sup> The ETI literature has focused on a simpler framework (usually) with no income effects and within which inter-temporal issues cannot be modeled adequately. This is an important issue to keep in mind when evaluating existing empirical studies of the ETI; future research should develop an inter-temporal framework to account for expected future tax rate changes, so as to distinguish responses to temporarily high, or low, tax rates. Such a dynamic framework has been developed for specific components of taxable income such as realized capital gains (Burman and Randolph, 1994) and charitable contributions (Bakija and Heim, 2008).

If current income tax rates increase, but long-term future expected income tax rates do not, individuals might decide to defer some of their incomes, for example, in the form of future pension payments<sup>23</sup> (deferred compensation) or future realized capital gains.<sup>24</sup> In that case, a current tax increase might have a positive fiscal externality in future years; such a fiscal

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<sup>20</sup>Anticipated tax decreases would have the opposite effect.

<sup>21</sup>A well-known example is the U.S. Tax Reform Act of 1986, which increased the top tax rate on realized long-term capital gains from 20 percent to 28 percent beginning in 1987, and generated a surge in capital gains realizations at the end of 1986 (Auerbach, 1988; Burman, Clausing, and O'Hare, 1994).

<sup>22</sup>In the labor supply literature, responses to temporary wage rate changes are captured by the Frisch elasticity, which is higher than the compensated elasticity with respect to permanent changes.

<sup>23</sup>In the United States, individual workers can electively set aside a fraction of their earnings into pension plans (traditional IRAs and 401(k)s) or employers can provide increased retirement contributions at the expense of current compensation. In both cases, those pension contributions are taxed as income when the money is withdrawn.

<sup>24</sup>For example, companies, on behalf of their shareholders, may decide to reduce current dividend payments and retain earnings that generate capital gains that are taxed later when the stock is sold.

externality affects the welfare cost of taxation as we described above. A similar issue applies whenever a change in tax rates affects business investment decisions undertaken by individuals. If, for example, a lower tax rate induces sole proprietors or principals in pass-through entities to expand investment, the short-term effect on taxable income may be negative, reflecting the deductible net expenses in the early years of an investment project.

As already noted, the ETI and MDWL concepts are relevant for the optimal provision of public goods, because they increase the true social cost of providing these goods, and the optimal progressivity of the tax system, because they increase the economic cost of the higher marginal tax rates needed to effect redistribution. Importantly, though, they do not enter directly into an evaluation of deficit-financed tax cuts (or deficit-reducing tax increases). This is because, with a fixed time pattern of government expenditure, tax cuts now must eventually be offset by tax increases later. Ignoring the effects of one period's tax rate on other periods' taxable income, if the ETI is relatively large a current tax cut will cause a relatively large increase in current taxable income. Offsetting this, however, is the fact that when the offsetting tax increases occur later, the high ETI (and there is no reason to think it will go up or down over time) will generate relatively big decreases in taxable income at that time. Accounting for the intertemporal responses, both of the real and income-shifting variety, to time-varying tax rate changes suggests that a deficit-financed tax cut that, by definition, collects no revenue in present value will cause deadweight loss by distorting the timing of taxable income flows.

### **2.2.3 Long-Term Responses**

One might expect short-term tax responses to be larger than longer-term responses because people may be able to easily shift income between adjacent years without altering real behavior. However, adjusting to a tax change might take time (as individuals might decide to change their career or educational choices or businesses might change their long-term investment decisions) and thus the relative magnitude of the two responses is theoretically ambiguous. The long-term response is of most interest for policy making although, as we discuss below, the long-term response is more difficult to identify empirically. The empirical literature has primarily focused on short-term (1 year) and medium-term (up to 5 year) responses, and is not able to convincingly identify very long-term responses.

The issue of long-term responses is particularly important in the case of capital income,

as capital income is the consequence of past savings and investment decisions. For example, a higher top income tax rate might discourage wealth accumulation or contribute to the dissipation of existing fortunes faster. Conversely, reductions in this rate might trigger an increase in the growth rate of capital income for high-income individuals. The new long-term wealth distribution equilibrium might not be reached for decades or even generations, which makes it particularly difficult to estimate. Estimating the effects on capital accumulation would require developing a dynamic model of tax responses, which has not yet been developed in the context of the ETI literature. This would be a promising way to connect the ETI literature to the macroeconomic literature on savings behavior.

#### **2.2.4 Tax Evasion**

Suppose that a tax increase leads to a higher level of tax evasion.<sup>25</sup> In that case, there might be increases in taxes collected on evading taxpayers following audits. This increased audit-generated tax revenue is another form of a positive fiscal externality. In practice, most empirical studies are carried out using tax return data before audits take place, and therefore do not fully capture the revenue consequences. Chetty (2009b) makes this point formally and shows that, under risk neutrality assumptions, at the margin an individual is indifferent between evading one dollar more and facing a marginally higher audit rate, and therefore the tax revenue lost due to increased tax evasion is exactly recouped (in expectation) by increased fines collected by the government. As a result, in that case the elasticity that matters for deadweight burden is not the elasticity of *reported* income, but instead the elasticity of *actual* income.

#### **2.2.5 Other Fiscal Externalities**

Changes in reported incomes might also have consequences for bases other than federal income taxes. An obvious example is the case of state income taxes in the United States. If formula (6) is applied to the federal income tax only, it will not capture the externality on state income tax revenue (as states in general use almost the same income tax base as the federal government). Thus our original analysis should be based on the combined federal and state income tax rates. Changes in reported individual income due to real changes in economic behavior (such as reduced labor supply) can also have consequences for consumption taxes. In particular, a broad-based

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<sup>25</sup>Whether in theory one would expect this response is not clear. See Yitzhaki (1974).

value added tax is economically equivalent to an income tax (with expensing) and therefore should also be included in the tax rate used for welfare computations.

Finally, fiscal externalities may also arise due to classical general equilibrium tax incidence effects. For example, a reduced tax rate on high incomes might stimulate labor supply of workers in highly paid occupations, and hence could decrease their pre-tax wage rate while reducing labor supply and thus increasing pre-tax wage rates of lower-paid occupations.<sup>26</sup> Such incidence effects are effectively transfers from some factors of production (high-skilled labor in our example) to other factors of production (low-skilled labor). If different factors are taxed at different rates (due for example to a progressive income tax), then those incidence effects will have fiscal consequences. However, because those incidence effects are transfers, in principle the government can readjust tax rates on each factor to undo those incidence effects at no fiscal cost. Therefore, in a standard competitive model, incidence effects do not matter for the efficiency analysis or for optimal tax design.<sup>27</sup>

### 2.3 Classical Externalities

There are situations where individual responses to taxation may involve classical externalities. Two prominent examples are charitable giving and mortgage interest payments for residential housing, which in the United States and some other countries may be deductible from taxable income, a tax treatment which is often justified on the grounds of classical externalities. Contributions to charitable causes create positive externalities when the contributions increase the utility of the beneficiaries of the nonprofit organizations. To the extent that mortgage interest deductions increase home ownership, they arguably create positive externalities in neighborhoods. (Note, though, that the level or even the existence of such a net home ownership externality is debated, as discussed by Glaeser and Shapiro, 2003). Moreover, granting the existence of such externalities does not imply that the implicit rate of subsidy approximates marginal social benefit. Expenditures on such deductible items may rise following a tax increase because

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<sup>26</sup>Such effects are extremely difficult to convincingly estimate empirically. Kubik (2004) attempts such an analysis and finds that, controlling for occupation-specific time trends in wage rates, individuals in occupations that experienced large decreases in their median marginal tax rates due to the Tax Reform Act of 1986 received lower pre-tax wages after 1986 as the number of workers and the hours worked in these professions increased.

<sup>27</sup>Indeed, Diamond and Mirrlees (1971) showed that optimal tax formulas are the same in a model with fixed prices of factors (with no incidence effects) and in a model with variable prices (with incidence effects).

their net price is equal to the net-of-tax rate  $1 - \tau$  when deductions are itemized.<sup>28</sup> Increased expenditures on these items will decrease taxable income on returns with itemized deductions.

Suppose a fraction  $s$  of the taxable income response to a tax rate increase  $d\tau$  is due to higher expenditures on activities such as charitable giving that create an externality with a social marginal value of exactly  $t$  dollars per dollar of additional expenditure. In that case, formula (8) applies by just substituting the alternative tax base rate  $t$  with  $-1$  multiplied by the per dollar social marginal value of the externality. For example, in the extreme case where all the taxable income response comes from tax expenditures ( $s = 1$ ) with income before tax expenditures being unresponsive to tax rates, and if  $t = \tau$  (the social marginal value of tax expenditures externalities is equal to the income tax rate  $\tau$ ) then there is zero marginal excess burden from taxation as it is a pure Pigouvian tax.<sup>29</sup> More generally, to the extent that the behavioral response to higher tax rates generates some positive externalities, formula (3) will overstate the marginal efficiency cost of taxation.

Because the bulk of items that are deductible from taxable income in the United States — state and local income taxes, mortgage interest deductions, and charitable giving — may generate fiscal or classical externalities, the elasticity of a broader, pre-deduction, concept of income (such as adjusted gross income in the United States) is of interest in addition to a taxable income elasticity. That is why many conceptual and empirical analyses focus on adjusted gross income — which is not net of such deductible items — rather than taxable income. The elasticity of taxable income and the elasticity of a broader measure of income may bracket the elasticity applicable to welfare analysis.

Classical externalities might also arise in agency models where executives set their own pay by expending efforts to influence the board of directors.<sup>30</sup> It is conceivable that such pay-setting efforts depend on the level of the top income tax rate and would increase following a top tax rate cut. In such a case, top executives' compensation increases come at the expense of shareholders' returns, which produces a negative externality.<sup>31</sup> Such an externality would reduce the efficiency

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<sup>28</sup>There is a large literature finding significant responses of charitable giving to individual marginal income tax rates. See, for example, Auten, Sieg and Clotfelter (2002), Clotfelter and Schmalbeck (1996), Randolph (1995) and Karlan and List (2007).

<sup>29</sup>Saez (2004b) develops a simple optimal tax model to capture those effects.

<sup>30</sup>Under perfect information and competition, executives would not be able to set their pay at a different level from their marginal product. In reality, the marginal product of top executives cannot be perfectly observed, which creates scope for influencing pay, as discussed extensively in Bebchuk and Fried (2004).

<sup>31</sup>Such externalities would fit into the framework developed by Chetty (2009b). Following the analysis of Chetty and Saez (2010), such agency models produce an externality only if the pay contract is not second-best

costs of taxation (as in that case correcting the externality dictates a positive tax).

## 2.4 Changes in the Tax Base Definition and Tax Erosion

As pointed out by Slemrod (1995) and Slemrod and Kopczuk (2002), how broadly the tax base is defined affects the taxable income elasticity. In their model, the more tax deductions that are allowed, the higher will be the taxable income elasticity. This implies that the taxable income elasticity depends not only on individual preferences (as we posited in our basic model in Section 2.1), but also on the tax structure. Therefore, the tax base choice affects the taxable income elasticity. Thus, as Slemrod and Kopczuk (2002) argue, the ETI can be thought of as a policy choice. The same logic applies to the enforcement of a given tax base, which can particularly affect the behavioral response to tax rate changes of avoidance schemes and evasion.

To see this point, suppose that we estimate a large taxable income elasticity because the tax base includes many loopholes making it easy to shelter income from tax (we discuss in detail such examples using U.S. tax reforms below). In the model of Section 2.1, this suggests that a low tax rate is optimal. However, in a broader context, a much better policy may be to eliminate loopholes so as to reduce the taxable income elasticity and the deadweight burden of taxation.<sup>32</sup> For example, Gruber and Saez (2002) estimate that the taxable income elasticity for upper income earners is 0.57, leading to a revenue maximizing rate of only 54 percent using formula (7) with  $a = 1.5$ . However, they find a much lower elasticity of 0.17 for a broader income definition for upper incomes, implying that the revenue maximizing tax rate would be as high as 80 percent if the income tax base were broadened.

Consider a simple example that illustrates this argument. As in our basic model, individuals supply effort to earn income  $z$ . Now allow that individuals can, at some cost, shelter part of their income  $z$  into another form that might receive preferable tax treatment. Let us denote  $w + y = z$ , where  $y$  is sheltered income and  $w$  is unsheltered income. Formally, individuals maximize a utility function of the form  $u(c, z, y)$  that is decreasing in  $z$  (earning income requires effort) and  $y$  (sheltering income is costly). Suppose we start from a comprehensive tax base where  $z$  is taxed at rate  $\tau$ , so that  $c = (1 - \tau) \cdot z + E$  ( $E$  denotes a lump-sum transfer). In that case, sheltering income is costly and provides no tax benefit; individuals choose  $y = 0$ , and the

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Pareto efficient, e.g., it is set by executives and large shareholders on the board without taking into account the best interests of small shareholders outside the board.

<sup>32</sup>This possibility is developed in the context of an optimal linear income tax in Slemrod (1994).

welfare analysis proceeds as in Section 3.1 where the relevant elasticity is the elasticity of total income  $z$  with respect to  $1 - \tau$ .

Now recognize that the tax base is eroded by excluding  $y$  from taxation. In that case  $c = (1 - \tau) \cdot w + y + E = (1 - \tau) \cdot z + \tau \cdot y + E$ . Therefore, individuals will find it profitable to shelter their income up to point where  $\tau \cdot u_c = u_y$ . We can define the indirect utility  $v(c', w) = \max_y u(c' + y, w + y, y)$  and the analysis of Section 3.1 applies using the elasticity of taxable income  $w$  with respect to  $1 - \tau$ . Because  $w = z - y$  and sheltered income  $y$  responds (positively) to the tax rate  $\tau$ , the elasticity of  $w$  is larger than the elasticity of  $z$  and hence the deadweight burden of taxation per dollar raised is higher with the narrower base. Intuitively, giving preferential treatment to  $y$  induces taxpayers to waste resources to shelter income  $y$ , which is pure deadweight burden. As a result, starting from the eroded tax base and introducing a small tax  $dt > 0$  on  $y$  actually *reduces* the deadweight burden from taxation, showing that the eroded tax base is a suboptimal policy choice.<sup>33</sup>

Therefore, comprehensive tax bases with low elasticities are preferable to narrow bases with large elasticities. Of course this conclusion abstracts from possible legitimate reasons for narrowing the tax base, such as administrative simplicity (as in the model of Slemrod and Kopczuk, 2002),<sup>34</sup> redistributive concerns and externalities such as charitable contributions, as discussed above.<sup>35</sup>

## 3 Empirical Estimation and Identification Issues

### 3.1 A Framework to Analyze the Identification Issues

To assess the validity of the empirical methods used to estimate the ETI and to explicate the key identification issues, it is useful to consider a very basic model of income reporting behavior. In year  $t$  individual  $i$  reports income  $z_{it}$  and faces a marginal tax rate of  $\tau_{it} = T'(z_{it})$ . Assume that reported income  $z_{it}$  responds to marginal tax rates with elasticity  $e$  so that  $z_{it} = z_{it}^0 \cdot (1 - \tau_{it})^e$ , where  $z_{it}^0$  is income reported when the marginal tax rate is zero, which we call *potential income*.<sup>36</sup>

<sup>33</sup>This can be proved easily in a separable model with no income effects where  $u(c, z, y) = c - h^1(z) - h^2(y)$ .

<sup>34</sup>In many practical cases, however, tax systems with a comprehensive tax base (such as a value added tax) may be administratively simpler than a complex income tax with many exemptions and a narrower base.

<sup>35</sup>The public choice argument that narrow bases constrain Leviathan governments would fall in that category, as a Leviathan government produces a negative externality.

<sup>36</sup>A quasi-linear utility function of the form  $u(c, z) = c - z^0(z/z^0)^{1+1/e}/(1 + 1/e)$  generates such income response functions.

Therefore, using logs, we have:

$$\log z_{it} = e \cdot \log(1 - \tau_{it}) + \log z_{it}^0. \quad (12)$$

Note, in light of our previous preceding discussion, the assumptions that are embedded in this simple model: (1) There are no income effects on reported income (as virtual income  $E$  is excluded from specification (12)), (2) The response to tax rates is immediate and permanent (so that short-term and long-term elasticities are identical), (3) The elasticity  $e$  is constant over time and uniform across individuals at all levels of income,<sup>37</sup> (4) Individuals have perfect knowledge of the tax structure and choose  $z_{it}$  after they know the exact realization of potential income  $z_{it}^0$ . We revisit these assumptions below.

Even within the context of this simple model, an OLS regression of  $\log z_{it}$  on  $\log(1 - \tau_{it})$  would not identify the elasticity  $e$  in the presence of a graduated income tax schedule because  $\tau_{it}$  is positively correlated with potential log-income  $\log z_{it}^0$ ; this occurs because the marginal tax rate may increase with realized income  $z$ . Therefore, it is necessary to find instruments correlated with  $\tau_{it}$ , but uncorrelated with potential log-income,  $\log z_{it}^0$ , to identify the elasticity  $e$ .<sup>38</sup> The recent taxable income elasticity literature has used changes in the tax rate structure created by tax reforms to obtain such instruments. Intuitively, in order to isolate the effects of the net-of-tax rate, one would want to compare observed reported incomes after the tax rate change to the incomes that would have been reported had the tax change not taken place. Obviously, the latter are not observed and must be estimated. We describe in this Section the methods that have been proposed to estimate  $e$  and to address this identification issue.

### 3.2 Simple before and after Reform Comparison

One simple approach uses reported incomes before a tax reform as a proxy for reported incomes after the reform (had the reform not taken place). This simple difference estimation method amounts to comparing reported incomes before and after the reform and attributing the change in reported incomes to the changes in tax rates.

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<sup>37</sup>This assumption can be relaxed in most cases, but it sometimes has important consequences for identification, as we discuss below.

<sup>38</sup>This issue arises in any context where the effective price of the studied behavior depends on the marginal income tax rate, such as charitable contributions. In a case such as this, though, a powerful instrument is the marginal tax rate that would apply in the event of zero contributions, a “first-dollar” marginal tax rate. When the studied behavior is taxable income, this instrument is not helpful, as it is generally zero for everyone.

Suppose that all tax rates change at time  $t = 1$  because of a tax reform. Using repeated cross sections spanning the pre and post-reform periods, one can estimate the following two-stage-least-squares regression:

$$\log z_{it} = e \cdot \log(1 - \tau_{it}) + \varepsilon_{it}, \quad (13)$$

using the post-reform indicator  $1(t \geq 1)$  as an instrument for  $\log(1 - \tau_{it})$ . This regression identifies  $e$  if  $\varepsilon_{it}$  is uncorrelated with  $1(t \geq 1)$ . In the context of our simple model (12), this requires that potential log-incomes are not correlated with time. This assumption is very unlikely to hold in practice, as real economic growth creates a direct correlation between income and time. If more than two years of data are available, one could add a linear trend  $\beta \cdot t$  in (13) to control for secular growth. However, as growth rates vary year-to-year due to macroeconomic business cycles, the elasticity estimate will be biased if economic growth happens to be different from year  $t = 0$  to year  $t = 1$  for reasons unrelated to the level of tax rates; in this case the regression will ascribe to the tax change the impact of an unrelated, but coincident change in average incomes.

In many contexts, however, tax reforms affect subgroups of the population differentially, and in some cases they leave tax rates essentially unchanged for most of the population. For example, in the United States during the last three decades, the largest absolute changes in tax rates have taken place at the top of the income distribution, with much smaller changes on average in the broad middle. In that context, one can use the group less (or not at all) affected by the tax change as a control and hence proxy unobserved income changes in the affected group (absent the tax reform) with changes in reported income in the control group. Such methods naturally lead to consideration of difference-in-differences estimation methods discussed in Section 3.4.

### 3.3 Share analysis

When the group affected by the tax reform is relatively small, one can simply normalize incomes of the group affected by a tax change by the average income in the population to control for macro-economic growth. Indeed, recently the most dramatic changes in U.S. marginal federal income tax rates have taken place at the top percentile of the income distribution. Therefore, and following Feenberg and Poterba (1993) and Slemrod (1996), a natural measure of the evolution

of top incomes relative to the average is the change in the share of total income reported by the top percentile.<sup>39</sup> Figure 1A displays the average marginal tax rate (weighted by income) faced by the top percentile of income earners (scaled on the left y-axis) along with the share of total personal income reported by the top percentile earners (scaled on the right y-axis) from 1960 to 2006.<sup>40</sup> The figure shows that since 1980 the marginal tax rate faced by the top 1 percent has declined dramatically. It is striking to note that the share received by the top 1 percent of income recipients started to increase precisely after 1981 — when marginal tax rates started to decline. Furthermore, the timing of the jump in the share of top incomes from 1986 to 1988 corresponds exactly with a sharp drop in the weighted average marginal tax rate from 45 percent to 29 percent after the Tax Reform Act of 1986. These correspondences in timing, first noted by Feenberg and Poterba (1993), provide circumstantial, but quite compelling evidence that the reported incomes of the high-income individuals are indeed responsive to marginal tax rates.

Figure 1B shows the same income share and marginal tax rate series for the next 9 percent of highest-income tax filers (i.e., the top decile excluding the top 1 percent from Panel A). Their marginal tax rate follows a different pattern, first increasing from 1960 to 1981 due primarily to bracket creep (as the tax system in this period was not indexed for inflation), followed by a decline until 1988 and relative stability afterwards. In contrast to the top 1 percent, however, the share of the next 9 percent in total income is very smooth and trends slightly upward during the entire period. Most importantly, it displays no correlation with the level of the marginal tax rate either in the short run or in the long run. Thus, the comparison of Panel A and Panel B suggests that the behavioral responses of the top 1 percent are very different from those of the rest of top decile, and hence that the elasticity  $e$  is unlikely to be constant across income groups.

Using the series displayed in Figure 1, and assuming that there is no tax change for individuals outside the top groups, one can estimate the elasticity of reported income around a tax

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<sup>39</sup>In what follows, we always exclude realized capital gains from our income measure, as realized capital gains in general receive preferential tax treatment, and there is a large literature analyzing specifically capital gains realization behavior and taxes (see Auerbach 1988 for a discussion of this topic). This issue is revisited in Section 4.1.

<sup>40</sup>This figure is an update of a figure presented in Saez (2004a).

reform episode taking place between pre-reform year  $t_0$  and post-reform year  $t_1$  as follows:

$$e = \frac{\log p_{t_1} - \log p_{t_0}}{\log(1 - \tau_{p,t_1}) - \log(1 - \tau_{p,t_0})}, \quad (14)$$

where  $p_t$  is the share of income accruing to the top 1 percent (or the next 9 percent) earners in year  $t$  and  $\tau_{p,t}$  is the average marginal tax rate (weighted by income) faced by taxpayers in this income group in year  $t$ . This method identifies the elasticity if, absent the tax change, the top 1 percent income share would have remained constant from year  $t_0$  to year  $t_1$ . As shown in Table 1, Panel A, applying this simple method using the series depicted in Figure 1 around the 1981 tax reform by comparing 1981 and 1984 generates an elasticity of 0.60 for the top 1 percent. Comparing 1986 and 1988 around the Tax Reform Act of 1986 yields a very large elasticity of 1.36 for the top 1 percent.<sup>41</sup> In contrast, column (2) in Table 1 shows that the elasticities for the next 9 percent are much closer to zero around those two tax episodes. The 1993 tax reform also generates a substantial elasticity of 0.45 for the top 1 percent when comparing 1992 and 1993. Strikingly, though, comparing 1991 to 1994 yields a *negative* elasticity for the top 1 percent. This difference in elasticities is likely due to re-timing of income around the 1993 reform, which produced a large short-term response, but perhaps no long-term response. Hence, Table 1 shows that the elasticity estimates obtained in this way are sensitive to the specific reform, the income group, as well as the choice of years — important issues we will come back to later on.

A natural way to estimate the elasticity  $e$  using the full time-series evidence is to estimate a time-series regression of the form:

$$\log p_t = e \cdot \log(1 - \tau_{p,t}) + \varepsilon_t. \quad (15)$$

As reported in Table 1, such a regression generates a very high estimate of the elasticity  $e$  of 1.71 for the top 1 percent.<sup>42</sup> However, this is an unbiased estimate only if, absent any marginal tax rate changes, the top 1 percent income share series would have remained constant or moved in a way that is uncorrelated with the evolution of marginal tax rates. But it is entirely possible that inequality changed over time for reasons unrelated to tax changes: the secular increase in income concentration in the United States since the 1960s was almost certainly not entirely

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<sup>41</sup>Goolsbee (2000b) found a similarly large elasticity using the Tax Reform Act of 1986 and a related methodology.

<sup>42</sup>The estimated elasticity for the next 9 percent is very small ( $e = 0.01$ ), and not significantly different from zero.

driven by changes in the top tax rates, hence biasing upward the estimate of  $e$ .<sup>43</sup> For example, Figure 1 shows that there was a sharp increase in the top 1 percent income share from 1994 to 2000 in spite of little change in the marginal tax rate faced by the top 1 percent, which suggests that changes in marginal tax rates are not the sole determinant of the evolution of top incomes (at least in the short run).<sup>44</sup>

It is possible to add controls for various factors affecting income concentration through channels other than tax rates in regression (15), as in Slemrod (1996). Unfortunately, we do not have a precise understanding of what those factors might be. An agnostic approach to this problem adds time trends to (15). As shown in Table 1, such time trends substantially reduce the estimated elasticity, although it remains significant and above 0.5. The key problem is that we do not know exactly what time-trend specification is necessary to control for non-tax related changes, and adding too many time controls necessarily destroys the time-series identification.

It could be fruitful to extend this framework to a multi-country time-series analysis. In that case, global time trends will not destroy identification, although it is possible that inequality changes differentially across countries (for non-tax related reasons), in which case country-specific time trends would be required and a similar identification problem would arise. Atkinson and Leigh (2010) and Roine, Vlachos, and Waldenstrom (2008) propose first steps in that direction. The macro-economic literature has recently used cross-country time-series analysis to analyze the effects of tax rates on aggregate labor supply (see e.g., Ohanian, Raffo, and Rogerson, 2008), but has not directly examined tax effects on reported income, let alone on reported income by income groups.

### 3.4 Difference-in-Differences Methods

Most of the recent literature has used micro-based regressions using “difference-in-differences” (DD) methods<sup>45</sup> in which changes in reported income of a treatment group (experiencing a tax change) are compared to changes for a “control” group (which does not experience the same, or any, tax change).<sup>46</sup>

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<sup>43</sup>See Katz and Autor (1999) for a comprehensive analysis of trends in wage inequality in the United States since 1960. Reverse causality is also a possibility. If incomes of the already affluent increase, the group might have more political influence and success in lobbying the government to cut top tax rates.

<sup>44</sup>Slemrod and Bakija (2001) call the behavior of reported taxable income over this period a “non-event study.”

<sup>45</sup>For earlier reviews of this literature, see Slemrod (1998) and Giertz (2004).

<sup>46</sup>Note that share analysis is conceptually related to the DD method as share analysis compares the evolution of incomes in a given quantile (the numerator of the share is the treatment group) relative to the full population

To illustrate the identification issues that arise with DD methods, we will examine the 1993 tax reform in the United States that introduced two new income tax brackets — raising rates for those at the upper end of incomes from 31 percent (in 1992 and before) to 36 percent or 39.6 percent (in 1993 and after) and enacted only minor other changes (see appendix A for details). Figure 1 shows that the average marginal tax rate for the top 1 percent increased sharply from 1992 to 1993, but that the marginal tax rate for the next 9 percent was not affected. Our empirical analysis is based on the Treasury panel of tax returns described in Giertz (2008). As discussed in appendix B, those panel data are created by linking the large annual tax return data stratified by income used by U.S. government agencies. Therefore, the data include a very large number of top 1 percent taxpayers.

### 3.4.1 Repeated Cross-Section Analysis

Let us denote by  $T$  the group affected by the tax change (the top 1 percent in our example) and by  $C$  a group not affected by the reform (the next 9 percent in our example).<sup>47</sup> We denote by  $t_0$  the pre-reform year and by  $t_1$  the post-reform year. Generalizing our initial specification (13), we can estimate the two-stage-least-squares regression:

$$\log z_{it} = e \cdot \log(1 - \tau_{it}) + \alpha \cdot 1(t = t_1) + \beta \cdot 1(i \in T) + \varepsilon_{it}, \quad (16)$$

on a repeated cross-section sample including both the treatment and control groups and including the year  $t_0$  and year  $t_1$  samples, and using as an instrument for  $\log(1 - \tau_{it})$  the post-reform and treatment group interaction  $1(t = t_1) \cdot 1(i \in T)$ .

Although we refer in this section to income tax rate schedule changes as a treatment, they certainly do not represent a classical treatment in which a random selection of taxpayers is presented with a changed tax rate schedule, while a control group of taxpayers is not so subject. In fact, in any given year all taxpayers of the same filing status face the same rate schedule. However, when the rates applicable at certain income levels change more substantially than the rates at other levels of income, some taxpayers are more likely to face large changes in the applicable marginal tax rate than other taxpayers. However, when the likely magnitude of the tax rate change is correlated with income, any non-tax-related changes in taxable income (i.e.,

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(the denominator of the share is implicitly the control group).

<sup>47</sup>Restricting the control group to the next 9 percent increases its similarity (absent tax changes) to the treatment group.

$z_{it}^0$ ) that vary systematically by income group will need to be disentangled from the effect on taxable incomes of the rate changes.

The two-stage-least-squares estimate from (16) is a classical difference-in-difference estimate equal to:

$$e = \frac{[E(\log z_{it_1}|T) - E(\log z_{it_0}|T)] - [E(\log z_{it_1}|C) - E(\log z_{it_0}|C)]}{[E(\log(1 - \tau_{it_1})|T) - E(\log(1 - \tau_{it_0})|T)] - [E(\log(1 - \tau_{it_1})|C) - E(\log(1 - \tau_{it_0})|C)]}. \quad (17)$$

Thus, the elasticity estimate is the ratio of the pre- to post-reform change in log incomes in the treatment group minus the same ratio for the control group to the same difference-in-differences in log net-of-tax rates.

Using repeated cross-sectional data from 1992 (pre-reform) and 1993 (post-reform), we define the treatment group as the top 1 percent and the control group as the next 9 percent (90th percentile to 99th percentile). This designation is made separately for each of the pre- and post-reform years. Note that being in the treatment group depends on the taxpayer's behavior. Table 2, Panel A shows an elasticity estimate of 0.284, which reflects the fact that the top 1 percent incomes decreased from 1992 to 1993 while the next 9 percent incomes remained stable as shown in Figure 1. However, comparing 1991 to 1994 generates a *negative* elasticity, as the top 1 percent incomes increased faster than the next 9 percent incomes from 1991 to 1994 (Figure 1). The sign switch mirrors the results of Table 1, column 1.<sup>48</sup>

As is standard in the case of DD estimation, formula (17) will yield an unbiased estimate of the elasticity  $e$  only if the parallel trend assumption holds: absent the tax change, the numerator would have been zero, i.e., log-income changes pre- to post-reform would have been the same in the treatment and control groups. In the case of our example, that means that the incomes of the top 1 percent would have grown at the same rate as the incomes of the next 9 percent (absent the tax change). Such an assumption can be examined using pre-reform years or post-reform years to construct placebo differences-in-difference estimates. As is clear from Figure 1, the top 1 percent incomes increase sharply from 1994 to 2000 relative to average incomes,

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<sup>48</sup>Estimates from Table 2, panel A are unweighted (i.e., not weighted by income,  $z_{it}$ ). In a previous version of this paper (Saez, Slemrod and Giertz, 2009), similar estimates are presented when weighting by income. Income-weighting is standard in the ETI literature because it gives proportionally more weight to high-income taxpayers, because their response contributes proportionately more to the aggregate elasticity (as discussed in Section 2.1). Here, cross-sectional estimates are not income-weighted because of concerns from weighting by the dependent variable. The estimates here are qualitatively similar to the earlier income-weighted estimates, however, the absolute magnitude of the estimates is smaller, especially for the positive estimates reported in rows two and four.

while the share of the next 9 percent income is almost flat. Therefore, the DD identification assumption is clearly violated in the post-reform period.

In cases where the parallel trend assumption does not hold, we can generalize equation (16) by pooling together several pre-reform years and post-reform years and running the following two-stage-least-squares regression (assuming the tax change takes place in year  $\bar{t}$ ):

$$\log z_{it} = e \cdot \log(1 - \tau_{it}) + \alpha \cdot 1(t \geq \bar{t}) + \beta \cdot 1(i \in T) + \gamma_C \cdot t + \gamma_T \cdot t \cdot 1(i \in T) + \varepsilon_{it}, \quad (18)$$

where we have added separate time trends for the control and treatment groups and where the instrument is the post-reform and treatment interaction  $1(t \geq \bar{t}) \cdot 1(i \in T)$ .

As shown in Table 2, Panel A, with no time trends, the regression produces a negative elasticity estimate of  $e = -0.40$  because the top 1 percent incomes increase faster than next 9 percent incomes over the period 1991 to 1997 in spite of the top tax rate increase. However, adding separate time trends generates a statistically significant and positive elasticity estimate of  $e = 0.47$ . This positive elasticity is consistent with Figure 1: from 1991 to 1997, the share of income reported by the top 1 percent incomes increases relative to the next 9 percent, but from 1992 to 1993, incomes for the top 1 percent incomes *fall* overall and relative to the next 9 percent of the income distribution, coinciding exactly with the tax change. Hence, the pooled regression (18) assumes that this reversal is due to a large immediate and permanent elasticity of reported income with respect to tax rates. We discuss below the issue of short-term versus long-term responses, which is central to this particular tax episode. Column (2) in Table 2 shows that those repeated cross-section estimates are not sensitive to broadening the control group from the next 9 percent to the next 49 percent, because incomes for both the next 9 percent and the next 49 percent move together, exhibiting very slow growth over the period.

Finally, note that if the control group faces a tax change, DD estimates will be consistent only if the elasticities are the same for the two groups. To see this, refer back to equation (17). Suppose that the control group experiences a change in tax rates that is half the size of the tax rate change for the treatment group, so that  $E(\log(1 - \tau_{it_1})|C) - E(\log(1 - \tau_{it_0})|C) = 0.5 \cdot [E(\log(1 - \tau_{it_1})|T) - E(\log(1 - \tau_{it_0})|T)]$ . Assume further that the DD identification assumption holds, but that the elasticity in the control group is zero while the elasticity is  $e_T > 0$  in the treatment group. In that case, we have  $E(\log z_{it_1}|T) - E(\log z_{it_0}|T) = e_T \cdot [E(\log(1 - \tau_{it_1})|T) - E(\log(1 - \tau_{it_0})|T)]$  and  $E(\log z_{it_1}|C) - E(\log z_{it_0}|C) = 0$  and hence formula (17) leads to  $e = 2 \cdot e_T$ : the estimated elasticity is twice as large as the true elasticity in the treatment group. This

possibility might be relevant for interpreting the effect of the Tax Reform Act of 1986; Table 1 shows that, based on share elasticities, the elasticity around that episode may be large for the top 1 percent, but close to zero for the next 9 percent (and the next 9 percent experiences a tax rate cut that is about half of the tax rate cut for the top 1 percent from 1986 to 1988). This may partly explain why Feldstein (1995) obtained such large elasticities around the Tax Reform Act of 1986, a point made originally by Navratil (1995).

### 3.4.2 Panel Analysis

Following the influential analysis of Feldstein (1995), the great majority of empirical studies of the ETI have used panel data. With panel data, we can define the treatment group  $T$  as the top 1 percent of income earners and the control group  $C$  as the next 9 percent of tax filers based on income *in pre-reform year*  $t_0$ , and follow those tax filers into the post-reform year  $t_1$ . We can then run the two-stage-least-squares panel regression:

$$\log \frac{z_{it_1}}{z_{it_0}} = e \cdot \log \left( \frac{1 - \tau_{it_1}}{1 - \tau_{it_0}} \right) + \varepsilon_{it}, \quad (19)$$

using  $1(i \in T)$  as the instrument. This regression estimates a difference-in-difference parameter:

$$e = \frac{E \left( \log \frac{z_{it_1}}{z_{it_0}} | T \right) - E \left( \log \frac{z_{it_1}}{z_{it_0}} | C \right)}{E \left[ \log \left( \frac{1 - \tau_{it_1}}{1 - \tau_{it_0}} \right) | T \right] - E \left[ \log \left( \frac{1 - \tau_{it_1}}{1 - \tau_{it_0}} \right) | C \right]}. \quad (20)$$

As shown in Table 2, Panel B, such a regression generates a very large elasticity of 1.40, as the top 1 percent income earners in 1992 experience a drop in reported taxable income of about 15 percent in 1993, while the next 9 percent income earners in 1992 experience a drop of less than 5 percent. As noted above, this elasticity estimate is unbiased if, absent the tax change, the numerator of (19) is zero: log income changes are the same in the treatment and control group. As we described in our discussion of repeated cross-section analyzes, this assumption might be violated if there are secular changes in income inequality: the top 1 percent incomes might have increased faster than the next 9 percent earners even in the absence of a tax change. In the case of panel analysis, however, another problem arises. Even in the absence of changes in the income distribution, the identification assumption might not hold because of mean reversion: the top 1 percent incomes in base year  $t_0$  are likely to decrease because many individuals were in the top 1 percent in year  $t_0$  due to having large positive transitory incomes.

To mitigate the mean reversion bias as well as potential changes in income inequality, following Auten and Carroll (1999), one can add year  $t_0$  income controls in regression (20), either in a simple way by including  $\log z_{it_0}$ , or in a richer way by including either polynomials or splines in base-year income.<sup>49</sup> As shown in Table 2, adding such income controls has a dramatic effect on the estimates: the estimated elasticities become negative with large absolute values and large standard errors.<sup>50</sup>

With only two years of data, adding too many base-year income controls destroys identification by absorbing much of the independent variation in tax rates, as the tax-rate instrument — a dummy for those with incomes in the top 1 percent in the base year — is also a function of base-year income. Therefore, we are skeptical that convincing estimates of the ETI can be obtained from a panel analysis using only two years of data when the tax rate changes are concentrated in a single part of the distribution (such as the top percentile in our example).

To overcome this issue, one would want to assess whether the numerator of (20) is uniquely large when a tax reform happens (relative to times when no tax reform happens). Therefore, following Gruber and Saez (2002), we can add additional years in regression (20) by stacking differences for years 1991 to 1992, 1992 to 1993, ..., 1996 to 1997, and adding year dummies as follows:

$$\log \frac{z_{it+1}}{z_{it}} = e \cdot \log \left( \frac{1 - \tau_{it+1}}{1 - \tau_{it}} \right) + f(z_{it}) + \alpha_t + \varepsilon_{it}, \quad (21)$$

where  $f(z_{it})$  denotes controls in base-year income. In that case, we use as an instrument  $1(i \in T_t) \cdot 1(t = 1992)$ , i.e., the interaction of being in the top 1 percent in the base year and the tax reform year 1992. Table 2 shows that, compared to the elasticity estimate of 1.395 with no base-year income controls, the estimate falls to around 0.5 to 0.6 when adding base-year income controls. The key identifying assumption in this case is that, absent the tax change, the extent of year-to-year mean reversion and year-to-year income inequality changes are stable over the period 1991 to 1997. Note that the estimates are no longer highly sensitive to the number of income controls (and, as the income controls  $f(z_{it})$  are not year-specific, they do not destroy the identification).

## • Additional Issues in Panel Analysis

<sup>49</sup>Decile-based splines are a set of 10 variables. The  $p$ -th spline is constant outside decile  $p$  (of the distribution of log income) and varies like log income within the  $p$ -th decile.

<sup>50</sup>Adding base-year income controls in the 1991 to 1994 comparison also makes the elasticity estimates become negative and very imprecisely estimated.

A troubling issue with panel analysis (relative to repeated cross-section analysis) is that the identification assumptions lack transparency because they mix assumptions regarding mean reversion and assumptions regarding changes in income inequality. As a result, it is not possible to informally assess the validity of the panel approach by examining graphs such as Figure 1. When base-year income controls are added this problem becomes even more severe. For example, it is often impossible to tell to what extent the income controls are adjusting for mean reversion and to what extent they are controlling for divergence in the income distribution. Worse yet, these income controls could hamper identification by absorbing informative variation in the tax rates, which are correlated with income. Our empirical analysis also reveals considerable sensitivity of panel regressions even in the case where many years are pooled and many base-year income controls are included (as in Table 2, Panel B2).

First, comparing columns (1) and (2) on Table 2, Panel B2, we note that the panel-based estimates are somewhat sensitive to the choice of the control group, probably due to differences in mean reversion across control groups. Therefore, in situations with mean reversion, it is useful to include episodes of both increases and decreases in tax rates for identification, as mean reversion creates biases in opposite directions in the case of tax increases versus tax decreases.

Second, the panel regressions are sensitive to the choice of the instrument for the marginal tax rate. We have so far defined the instrument based on membership in the top 1 percent group to exploit the fact that the 1993 tax change was concentrated among the top 1 percent. However, to account for tax schedule changes throughout the income distribution, many studies have instead used a different instrument: the predicted change in log net-of-tax rates assuming that income, often inflation-adjusted income, remains the same as in the base year (allowing the tax schedule to change).<sup>51</sup> Such an instrument has the advantage of taking account of all changes in the tax rate schedule. In the case of the 1993 reform, the choice of the instrument should not matter much because the tax rate change was concentrated among the top 1 percent. However, the elasticity estimates, shown in the fourth row of Panel B2, are much smaller when using the predicted change in the log of the net-of-tax tax rate as an instrument. This may be due to the fact that predicted marginal tax rate changes are sometimes non-zero due to minor changes in the tax code or various provisions that are not indexed for inflation. If tax filers are

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<sup>51</sup>We estimated the predicted marginal tax rate in year  $t + 1$  by inflating year  $t$  incomes using the inflation adjustment used in the tax code. As a result, only statutory changes in the tax law such as the top rate reduction in 1993 or elements of the tax code that are not indexed can produce a change in predicted net-of-tax rates.

unlikely to respond to such minor changes, this may explain why estimates using the traditional instrument are smaller than those using the top 1 percent instrument.

Some authors have proposed alternatively to construct the instrument based either on the *average* of pre and post-reform income (Carroll, 1998) or on income in a year midway between the years used to construct the difference (Blomquist and Selin, 2009).<sup>52</sup> While using average income helps with mean reversion, changes in the distribution of income remain a potential issue. Practically, empirical attempts at using such alternative instruments have shown that estimates are quite sensitive to the choice of instruments, suggesting that the standard methods do not control fully adequately for mean reversion.

### • Advantages of Panel Analysis

Under some assumptions, panel analysis offers several advantages. First, in principle, panel analysis is useful (relative to repeated cross-section analysis) if individual income in a base year is a good predictor of income after the reform (absent any tax change). This is restating in a positive way the point that the presence of income mobility weakens the case for using panel data.<sup>53</sup> In reality, there is substantial persistence of individual income from year to year and therefore panel estimates tend to have smaller standard errors than repeated cross-section estimates (keeping sample size the same). In practice, this advantage is counter-balanced by the fact that there is a non-negligible fraction of individuals who experience very substantial mobility and — based on our computations — can have a significant influence on panel estimates, so that some trimming of outliers is needed to obtain more stable estimates.

Second, panel analysis is also useful when one wants to analyze a tax change targeted to a specific group and there is a concern that the composition of this group will change significantly over time in the repeated cross sections. Consider again the case of the 1993 reform, which affected the top 1 percent income earners. Suppose that the increase in the top 1 percent income share is due entirely to new tax filers who entered the high-income category in 1993 for reasons unrelated to the tax change and who were not part of the control group either (e.g., a student starting a successful new dot-com company), and that neither the top 1 percent

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<sup>52</sup>Weber (2010) argues for constructing the tax rate instrument to be a function of income lagged one or more years before the base year, with the appropriate lag depending on the degree of serial correlation of transitory income; in this framework, addressing heterogeneous income trends requires that one-year income controls be instrumented with income from the same lag as for the tax rate variables.

<sup>53</sup>To see this, note that in the extreme case where potential incomes  $z_{it}^0$  are iid, there would be no point in using panel data.

income earners nor the next 9 percent control group in 1992 experienced any change in income (absent the tax change). In that case, the repeated cross-section analysis is biased because of composition effects (that change the cross-section distribution of income for non-tax reasons), but the panel analysis is unbiased because (1) there is no mean reversion among the 1992 top 1 percent income earners relative to the control group and (2) there is no change in inequality from 1992 to 1993 between the top 1 percent and the control group defined based on 1992 incomes. Obviously these two assumptions never hold exactly, as there is substantial mobility with respect to the top 1 percent. For example, Slemrod (1992) reports that, in the 1980s, between 28 and 40 percent of the households in the top 1 percent of the income distribution were new from one year to the next.

Finally, panel data are required to study some questions other than the overall response of reported incomes. For example, if one wants to study how a tax change affects income mobility (for example, do more middle-income individuals become successful entrepreneurs following a tax rate cut?), panel data is clearly necessary.

In sum, those considerations lead us to conclude that the advantage of longitudinal analysis relative to repeated cross-section analysis has been somewhat exaggerated in the empirical literature following Feldstein (1995), especially when one wants to analyze tax changes happening primarily at the top of the income distribution. In some contexts, repeated cross-section analysis or share-based time-series analysis may be a more robust and transparent approach.<sup>54</sup>

### 3.4.3 Short-term versus long-term responses

Figure 1 illustrates the difficulty of obtaining convincing estimates of the (short- and long-term) elasticity of reported income with respect to the net-of-tax rate. As already discussed, the anticipated high-end tax rate increases of 1993 seem to have generated a temporary decline in top 1 percent incomes in 1993 and a temporary upward spike in 1992 as tax filers moved reported taxable income from 1993 into 1992 to take advantage of the lower 1992 tax rate. As a result, the elasticity estimated using only the years 1992 and 1993 is large. We know something about the nature of this short-term response. For executives, Goolsbee (2000a) showed that indeed a significant fraction of the response was due to timing in the realization of stock options, and

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<sup>54</sup>Obviously, access to panel data is never worse than access to repeated cross-sectional data, as it is always possible to ignore the longitudinal aspect of panel data and carry out a repeated cross-section analysis with panel data.

Parcell (1995) and Sammartino and Weiner (1997) document the extent of year-end re-timing of taxable income in the form of bonuses. In these cases, we would expect the long-term response to be much smaller.

An important question is whether the clearly visible short-term responses persist over time. In particular, how should we interpret the continuing rise in top incomes after 1994? If one thinks that this surge is evidence of diverging trends between high-income individuals and the rest of the population that are independent of tax policy, then the long-term response to the tax change is less than estimated. Alternatively, one could argue that the surge in top incomes since the mid-1990s was the long-term consequence of the decrease in tax rates in the 1980s, and that such a surge would not have occurred had high-income tax rates remained as high as they were in the 1960s and 1970s. It is, though, very difficult to disentangle those various scenarios with a single time series of top incomes and top tax rates. As mentioned above, cross-country time-series analysis might be a fruitful area to make progress, taking advantage of varying time patterns of tax rate changes.

The literature on capital gains realizations has developed dynamic micro-econometrics models to estimate simultaneously short-term and long-term responses to tax changes (see e.g., Burman and Randolph, 1994). In the case of the ETI, such explicit modeling has only been used in a few studies (Holmlund and Soderstrom, 2008, Giertz, forthcoming, and Heim, 2007 and 2009). These papers augment the traditional panel specification (21) by adding a lagged change in the marginal tax rate term and sometimes a prospective rate change term. If some components of taxable income respond with a one-year lag then, in principle, the lagged term will capture this effect; a future tax rate term could pick up timing responses to anticipated tax rate changes. This method could be useful to disentangle short-term from medium-term responses, although obtaining compelling identification is difficult.

#### **3.4.4 Alternative control groups**

The tax code offers some possibilities to generate alternative control groups that might be more comparable to treatment groups than the income-based control groups used in the analyses discussed heretofore. For example, inflation (before the inflation adjustment of the U.S. income tax schedule after the Tax Reform Act of 1986) or the loss of a personal exemption can also push taxpayers into a higher bracket, and in some cases married and unmarried couples experience

different changes in their tax schedules. Those changes have been explored by Saez (2003), Looney and Singhal (2006), Singleton (2007), and Feldman and Katuscak (2009). The advantage of studying those changes is that one can compare taxpayers who are very similar both in income and initial marginal tax rate — but yet face different prospects for changes in marginal tax rates — and hence potentially make a much more convincing case for identification.

The main drawback of this strategy is that taxpayers may not be aware of the minute details of the tax code, and hence might not respond to very localized changes in their marginal tax rate situation. As a result, elasticities obtained from those studies might not be relevant to predict behavioral responses to well-advertised, more salient, and broader tax rate changes. This lack of perfect information might also explain why there does not appear to be significant bunching at the kink points of the tax schedule (Saez 2009) as predicted in the standard model.<sup>55</sup> Chetty et al. (2009) use Danish tax return data and show that large kinks generate disproportionately stronger bunching responses than small kinks, consistent with the hypothesis that tax filers do not pay as much attention to small tax changes as they do to large changes. As a result, elasticities estimated from large changes may be larger than elasticities estimated from small changes, an important point formally developed in Chetty (2009c). More generally, to the extent that informational considerations are a central aspect of the size of the behavioral response, it is important to develop models of how and when individuals learn about their budget set and to consider the consequences of the learning process for the optimal design of tax and transfer policies. Tax response analysis thus faces this fundamental tension: large reforms are the most likely to be noticed and understood by taxpayers, but often do not generate fully convincing control groups for identification. Small reforms or quirks in the tax code can generate better control groups, but might not lead to meaningful, generalizable estimates if most taxpayers are not aware of such tax changes or provisions.<sup>56</sup>

### 3.4.5 Tax base changes

Although estimation of the ETI focuses on changes in the schedule of tax rates, the definition of the tax base subject to the rate schedule also changes periodically, often at the same time the rates change as part of comprehensive tax reform legislation. This raises a number of issues that

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<sup>55</sup>Chetty and Saez (2009) show that providing information to EITC recipients does produce changes in subsequent reported incomes, indicating that tax filers do not have perfect information about the tax system.

<sup>56</sup>Chetty (2009a) develops an econometric method to set bounds on elasticities when responses are incomplete due to lack of awareness of taxpayers.

are especially important when, as in the Tax Reform Act of 1986, multiple tax base changes accompanied the tax rate changes, and are much less important in cases like the 1993 change, when the top marginal tax rate changed with little base definition change. That income tax rates changes often coincide with changes in the definition of taxable income is not a coincidence, because the theme of many income tax reforms since the 1980s has been to broaden the tax base and lower the rates applied to the base in a revenue-neutral way.

Identifying the taxable income elasticity when both the tax base and tax rates change becomes problematic because the taxable income elasticity is plausibly different in the post-reform era compared to the pre-reform era. For example, the Tax Reform Act of 1986 broadened the tax base by both reducing deductions and the attractiveness of tax “shelters.” It is likely that, due to these changes, the taxable income elasticity post-1986 was lower than pre-1986, as documented by Kopczuk (2005). In this situation even an otherwise well-specified estimation strategy will yield an estimate of neither the pre- nor post-reform elasticity, but rather a weighted average of the two, where the weights need not be positive.

Second, when the definition of the tax base changes, using as the dependent variable a concurrent definition of taxable income runs the risk of confounding tax-induced changes in behavior with purely definitional changes. For example, the base broadening of the Tax Reform Act of 1986 would, *ceteris paribus*, show taxable incomes to have increased, perhaps to different degrees at different income levels.<sup>57</sup> This problem suggests using either a consistent pre- or post-reform definition.<sup>58</sup> When the issue is changing deductions or credits, for data availability reasons it is generally easier to use the broader definition (i.e., not net of the deductions), because otherwise the investigator needs, but will not have, measures of deductions or credits that are not reported in the year with the broader base; the argument is reversed when new sources of income are added to the tax base. Because the former type of broadening was more prevalent, those studying the Tax Reform Act of 1986 have attempted to analyze a post-1986 definition of taxable income; this cannot, though, be done in a completely satisfactory manner.

Even if a consistent measure of taxable income could be constructed, the choice of which

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<sup>57</sup>This is why Slemrod (1996) adjusted downward the post-1986 Feenberg and Poterba (1993) measures of the high-income shares; otherwise, the change from including 40 percent of capital gains in taxable income in the years up to 1986 to 100 percent inclusion afterward would increase the measured high-income share even in the absence of any behavioral response because capital gains comprise a disproportionately high fraction of income for high-income people.

<sup>58</sup>Alternatively one could, like Kopczuk (2005), employ a model where independent variables account for changes to the tax base.

constant-law definition of taxable income to use is by no means an innocuous one.<sup>59</sup> If the objective is to estimate the leakage from a given base when the rate of tax is altered, either method has problems. As discussed in Auerbach and Slemrod (1997), the response to a reform that changes both the marginal tax rate and the tax base does not, without further assumptions, reveal the impact of a tax change for a given base. If the broader definition of taxable income is used, the measured response mixes two things: the response of the old base to an increase in the net-of-tax rate, and the response of the newly-included base to a decrease in the net-of-tax rate. On the other hand, the response of the pre-reform base will probably overestimate the partial elasticity of the base with respect to a change in the tax rate. Using a consistent post-reform definition will produce a change in taxable income that is less than what is obtained using the pre-reform definition.

### **3.5 Multiple tax rates: The special case of capital gains realizations**

Another complicating factor is capital gains. Although real accrued gains are income according to the Haig-Simons definition, those countries that tax capital gains at all do so upon realization (usually sale), and those countries that do tax realizations now generally subject them to a lower rate than applies to other income. In the United States, the extent of preferential tax has varied significantly since 1980. Before the Tax Reform Act of 1986, 40 percent of long-term gains were included in taxable income; with a top rate of 50 percent, the top rate on realizations was 20 percent. When the Tax Reform Act of 1986 lowered the top rate to 28 percent, the exclusion was eliminated, so that the top rate on long-term capital gains was also 28 percent. Since 1986, the top rate on ordinary income has risen and a preferential rate has been re-introduced; since 2003, the two rates have been 35 percent and 15 percent, respectively.

Almost all studies of the ETI in the U.S. have excluded capital gains realizations from the measure of taxable income or broad income, on the reasonable grounds that they are generally subject to a different marginal tax rate than other income. It is also true that they are especially responsive to anticipated changes in the applicable tax rate. (See Burman, Clausing and O'Hare, 1994). However, ignoring capital gains completely raises some difficult issues. As background, in the United States, they constitute a very large fraction of the taxable income of the top

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<sup>59</sup>An exception would arise if the elasticity of substitution between activities whose tax status changes and those whose status does not change equals zero (Heim, 2007).

income groups.<sup>60</sup> Second, they fluctuate year-to-year much more than other income, both in the aggregate and, especially, for given taxpayers. Thus, for example, much of the year-to-year change in which taxpayers are in the top 1 percent income group, capital gains included, may be due to changes in capital gains realizations.

Some taxpayers have opportunities for converting wage and salary income to capital gains income – and these opportunities are exercised when the tax advantages of so doing are sufficient. Because the tax advantage depends on the differential between the rate on ordinary income and capital gains, this rate matters and should ideally be controlled for in analyses of how the tax rate on ordinary income affects the reported amount of ordinary income. Furthermore, converting ordinary income to capital gains income often is accompanied by deferral of the realization of the latter for tax purposes, so the offsetting revenue may not come for several years, if ever.

Another issue is that, in micro-econometric analysis, the standard procedure is to calculate the marginal tax rate on ordinary income assuming no capital gains income. This would be appropriate if decisions that trigger ordinary income were made before decisions regarding capital gains realizations, but this is unrealistic and thus this procedure causes error in measuring the actual MTR. The same issues arise in share analysis. Slemrod (1996) includes capital gains in his measure of adjusted gross income, and includes as explanatory variables the top rates on both ordinary income and capital gains. He finds no evidence that a higher capital gains tax rate is associated with a higher share of wages and salaries, though. Ideally, one would need a model of joint determination of capital gains and ordinary income as a function of the marginal tax rates on capital gains and ordinary income in the general methodology of the elasticity of taxable income.

### **3.6 Income Shifting: The Anatomy of Behavioral Responses**

We have argued that estimating taxable income elasticities in a fully convincing way is challenging because of the difficulty of untangling tax-related from non-tax-related changes in reported incomes. Furthermore, our conceptual analysis in Section 2 showed that, in addition to measuring the reported taxable income elasticity, to obtain a welfare-relevant elasticity it may be important to assess fiscal externalities. A way to make progress on those two issues is to ana-

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<sup>60</sup>In 2005, for example, for taxpayers with AGI exceeding \$500,000, who represent just less than 1 percent of all taxable returns, taxable net capital gain comprised 33.3 percent of AGI, compared to 3.8 percent of AGI for all other taxable returns.

lyze the “anatomy of the behavioral response” (Slemrod, 1996) by examining the components of reported income.

Figure 2 (updated from Saez 2004) displays the share and composition of the top 0.01 percent of income earners in the U.S. since 1960 along with the average marginal tax rate they faced (in bold line on the right y-axis). We focus on this very top group because tax rate changes and tax responses are arguably the strongest and most salient at the very top. The figure divides income into seven income components: (1) wages and salaries (which include bonuses and profits from qualified exercised stock options), (2) dividends, (3) interest income, (4) sole proprietorship profits (profits from small businesses that are fully owned by the taxpayer, this includes most forms of self-employment income), (5) partnership profits (profits from businesses where the taxpayer is a partner such as a law or medical practice partnership), (6) profits from subchapter S corporations (taxed solely at the individual level), and (7) other income.

Four points are worth noting about Figure 2. First, the top 0.01 percent income earners faced extremely high marginal tax rates in the early 1960s (around 80 percent) that were reduced significantly by the Kennedy tax cuts in 1964-5 (to about 65 percent). This implies a 75 percent increase in the net-of-tax rate, a much larger increase than either the 1981 tax cuts and the Tax Reform Act of 1986 tax rate reductions. In spite of this large rate cut, the top 0.01 percent income share remains flat in the 1960s, and well into the 1970s, suggesting little behavioral response in both the short and the long run. This stands in contrast to the sharp response of the top 0.01 percent income share to the 1981 and 1986 tax changes, consistent with the view that the elasticity is not an immutable parameter, but instead depends on the tax system.

Second, Figure 2 shows clearly that about one-third of the response to the Tax Reform Act of 1986 from 1986 to 1988 was due to a surge in S-corporation income.<sup>61</sup> Partnership income also rose dramatically immediately after 1986, mostly because of the disappearance of partnership losses. The sudden jump in S-corporation income, exactly at the time of the tax reform, strongly suggests that this was the consequence of a one-time shift of taxable income from the corporate sector, and the one-time closing of the partnership loss tax shelters (Slemrod 1996, Gordon and Slemrod 2000). The surge in business income reported on individual returns in the 1980s thus cannot be interpreted as a “supply-side” success, as most of those individual income gains came either at the expense of taxable corporate income, or were obtained from the closing of tax

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<sup>61</sup>The 1981 tax act also produced a sudden increase of S-corporation income (which was negligible up to 1981), which explains most of the increase in top incomes from 1981 to 1984 first documented by Lindsey (1987).

shelters by imposing stricter rules on losses from passive businesses.

Third, Figure 2 displays a dramatic shift in the composition of very top incomes away from dividends (which represented more than 60 percent of top incomes in the early 1960s) toward wage income and S-corporation and partnership income. In the early 1960s, when the top 0.01 percent incomes were facing marginal tax rates of about 80 percent on average, tax rates on long-term capital gains were around 25 percent. Thus, dividends were a very disadvantaged form of income for the rich, suggesting that those top income earners had little control over the form of payment, and thus might have been in large part passive investors. The Kennedy tax cuts apparently did not reduce the top individual rate enough (the top rate became 70 percent) to make the S-corporation form attractive relative to the C-corporation form, explaining perhaps the contrast in behavioral responses between the Kennedy tax cuts episodes and the tax changes of the 1980s. Interestingly, Figure 2 also displays an increase in the dividend income component after 2003, when the tax rate on dividend income was lowered to 15 percent.<sup>62</sup>

Fourth, and related, the wage income component of the top 0.01 percent has experienced a dramatic secular growth since the 1970s. The wage component exhibits clear spikes in 1988 and 1992, which are likely to reflect short-term responses to the tax changes due to re-timing of compensation.<sup>63</sup> The difficult question to resolve is to what extent the secular growth in top wage incomes was due to the dramatic decline in top marginal tax rates since the 1960s. This question cannot be resolved solely looking at U.S. evidence. Evidence from other countries on the pattern of top incomes and top tax rates (Atkinson, Piketty and Saez, forthcoming) suggests that reducing top tax rates to levels below 50 percent is a necessary — but not sufficient — condition to produce a surge in top incomes. Countries such as the United States or the United Kingdom have experienced both a dramatic reduction in top tax rates and a surge in top incomes (Brewer, Saez and Shephard, 2010), while other countries such as Japan have also experienced significant declines in top tax rates, but no comparable surge in top incomes over recent decades (Moriguchi and Saez, 2008).

Overall, the compositional graph displayed on Figure 2 casts significant light on the anatomy of the behavioral response and helps to distinguish short-term from long-term effects, as well as

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<sup>62</sup>This is consistent with the firm-based analysis of Chetty and Saez (2005), who show that dividends paid out by publicly traded U.S. companies rose sharply after the dividend tax cut was enacted.

<sup>63</sup>There is also a very large spike in 2000 that is likely due to the boom and bust in the dot-com sector, where stock-option exercises, which generally generate income classified as wages, peaked in 2000 before collapsing in 2001 and 2002.

effects due to income shifting from the corporate base to the individual base or due to tighter regulations regarding business losses. Therefore, we believe that supplementing the focus on the taxable income elasticity with a more granular understanding of the various components of behavioral responses to taxation is fruitful both to predict the effects of future tax reforms as well as to analyze the overall welfare and fiscal consequences of actual tax changes. As this discussion has shown, there is compelling evidence of substantial responses of upper income taxpayers to changes in tax rates, at least in the short run. However, in all cases, the response is either due to short-term retiming or income shifting. There is no compelling evidence to date of *real* responses of upper income taxpayers to changes in tax rates.

Following the interpretation of Atkinson, Piketty, and Saez (forthcoming) in their analysis of the evolution of top income shares in the long run, it is conceivable that the drop in top marginal tax rates since the 1980s could lead to more wealth and capital income concentration decades later, as top income individuals can accumulate wealth more easily when top tax rates are lower. In this case, the surge in the top income share due to capital income displayed in Figure 2 could be the long-term consequence of past top tax rate cuts. The ETI has not yet developed a framework to analyze such long-term responses through the savings and wealth accumulation channels.

## 4 Empirical Analysis

Since the early 1990s, a large literature has sought to estimate the ETI and elasticities for related income measures. Most of this literature on the ETI has focused on individual taxable income in the U.S., although some studies have examined individual taxable income in Canada and Western Europe. The analyses in the literature vary widely in the extent to which they address — or even attempt to address — the issues discussed in the previous section. Rather than comprehensively survey this literature, in what follows we selectively discuss the studies — focusing on studies that use the type of data and empirical approaches most likely to yield reliable estimates of the elasticity of taxable income or of a broader measure of income. We emphasize how, and how well, each study addresses the methodological issues discussed in the previous section.<sup>64</sup>

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<sup>64</sup>The working paper version of this paper (Saez, Slemrod, and Giertz, 2009) contains a narrative description of a wider set of studies.

## 4.1 Analysis Using Aggregated Time-Series Data

Feenberg and Poterba (1993) were the first to use aggregate tax return data to shed light on the high-income share of reported aggregate income in the United States and to what extent this might be influenced by changes to the tax rate structure. They calculate for 1951 to 1990 the share of AGI and several components of AGI that were received by the top 0.5 percent of households ranked by AGI. Consistent with Figure 1, the four-decade time series is sharply U-shaped, beginning with a steady decline from over 8 percent in the early 1950s to just below 6 percent around 1970. Then, after remaining roughly flat at about 6.0 percent from 1970 to 1981, the high-income share of income begins in 1982 to continuously increase to 7.7 percent in 1985, then jumps sharply in 1986 to 9.2 percent. There is a slight increase in 1987 to 9.5 percent, then another sharp increase in 1988 to 12.1 percent. Although they conduct no formal analysis of the dataset they construct, Feenberg and Poterba (1993) argue that this time-series pattern is consistent with a behavioral response to the reductions in the top marginal tax rate, especially during the Tax Reform Act of 1986 episode.

Slemrod (1996) uses high-income share data for 1954 to 1990<sup>65</sup> to examine in a regression framework the tax and non-tax causes of inequality. The data up to 1986 are taken directly from Feenberg and Poterba (1993), but the data from 1987 to 1990 are adjusted to correspond to a pre-Tax Reform Act of 1986 definition of AGI so as to get closer to a consistent (or constant-law) definition over time. Dependent variables studied include the high-income share of AGI and four components of income. Explanatory variables in the regressions include measures of the contemporaneous, one-year-lagged, and one-year-leading top tax rates for both ordinary individual income and long-term capital gains. To control for exogenous, non-tax-related, income trends, Slemrod includes a measure of earnings inequality between the 90th and 10th percentiles not based on tax return data as well as macroeconomic variables that might differentially influence incomes across the income distribution (e.g., the real level of stock prices and the average nominal corporate AAA bond rate). Regressions are estimated using data up to 1985 and then again using data up to 1990 to investigate whether or not there was a break in the structure of the model in 1986. The analysis reveals that, up to 1985, changes in the top tax rate on individual income play almost no role in explaining the variation in the high-income share of

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<sup>65</sup>Slemrod examines both the top 0.5 percent as well as the top 1 percent of taxpayers, although all regressions exclusively use the top 0.5 percent.

AGI; indeed, more than two-fifths of the increase in high-income share between 1973 and 1985 can be associated with the increase in 90-10 wage inequality. However, when data up to 1990 are included in the regression, the coefficient on the top tax rate term becomes large in absolute value and statistically significant.

After analyzing different components of AGI, including wages and salaries, Subchapter S income, and partnership income, Slemrod (1996) concludes that the regression results are likely driven by the changes to the structure of the tax base instituted by the Tax Reform Act of 1986. This new structure provided very different incentives and opportunities for high-income individuals to report income (and losses) via the individual tax system. He cautions that the results do not necessarily imply that taxpayer responses to marginal tax rates, holding the tax structure constant, were higher post-1986. Instead the tax rate variables, which changed dramatically at the same time the structure changed, may be picking up some of the effect of this structural change.<sup>66</sup> Because of the simultaneity of the tax rate changes and scores of tax base changes, the high tax rate elasticity estimated over the sample up to 1990 is not an unbiased estimate of the true elasticity, either before or after the reform.

Saez (2004a) examines IRS data from 1960 to 2000. He regresses the log of average income for the top 1 percent of the distribution on the log of the average net-of-tax rate for the top 1 percent over the time period and finds large elasticities, even when including time trends or instrumenting the log net-of-tax rate using the statutory top marginal tax rate. Saez (2004a) goes on to investigate which categories of income drive the overall response, primarily to ascertain to what extent the estimated ETIs reflect income shifting. He, like Slemrod (1996), finds a break in the series following the Tax Reform Act of 1986. When he examines categories of gross income, he finds that income shifting can explain most of the rise in Subchapter S and partnership income. What remains unclear is whether any portion of the post-1986 wage and salary growth is attributable to the decline in marginal tax rates, or is simply another form of income shifting. Saez concludes that it is very difficult to distinguish the long-term effect of tax cuts from a non-tax related secular widening in the disparity of earnings.

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<sup>66</sup>Fullerton (1996), in a comment on Slemrod (1996), emphasizes this interpretation.

## 4.2 Analysis using panel data

Feldstein (1995) pioneered the use of panel data to estimate the ETI for the Tax Reform Act of 1986 by using the U.S. public-use panel tax data (see Appendix B.1). He groups taxpayers by their 1985 marginal tax rates and uses a tabulated difference-in-differences methodology to estimate the ETI with respect to the net-of-tax rate. Specifically, to compute elasticities, the difference in the percent change in taxable income (in 1988, relative to adjusted 1985 income) between two groups is divided by the difference in the percent change in the average net-of-tax-rate between the two groups. This method generates large ETI estimates, ranging from 1 to 3 in alternative specifications. Although based on a much smaller sample (Feldstein's top group included only 57 tax returns), the Feldstein (1995) results apparently corroborated the conclusion of Feenberg and Poterba (1993) based on observing the time-series of share-of-income data that something extraordinary had happened to the dispersion of taxable income at the same time as the Tax Reform Act of 1986.

Subsequent research using panel data addresses the econometric issues raised earlier in this paper such as mean reversion or secular income trends. Auten and Carroll (1999) address mean reversion and attempt to control for divergence within the income distribution by including control variables for region and occupation. Auten and Carroll adopt a two-stage least-squares regression approach, regressing the change in constant-law (log) AGI<sup>67</sup> between 1985 and 1989 against the change in the log of the net-of-tax rate and a set of other exogenous variables. They instrument for the change in the net-of-tax rate by inflating adjusted 1985 incomes by the CPI to 1989 levels and then applying 1989 law to these incomes, as discussed in Section 3.4.2. When adding non-tax factors that may have been correlated with the rise in income inequality over this period (such as age, age-squared, occupation, region, and — notably — 1985 income), they report an elasticity estimate of 0.55.

Moffitt and Wilhelm (2000) investigate behavioral responses to the Tax Reform Act of 1986, using panel data from the 1983 and 1989 Survey of Consumer Finances (SCF) instead of income tax return data. Due to data limitations, they study an income concept close to AGI rather than taxable income. When using Feldstein's (1995) approach, they report tax elasticities for AGI from 1.76 to 1.99, similar to Feldstein's taxable income elasticity estimates. Moffitt

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<sup>67</sup>The constant-law calculations are based on post-1986 law. They do a robustness test and find that using pre-1986 laws does not significantly change the results.

and Wilhelm then turn to a two-stage least-squares regression approach, employing several alternative instruments for the change in the net-of-tax rate, including education and measures of illiquid assets, and conclude that those instruments that are successful in discriminating between the high-income group and the balance of the population yield tax elasticity estimates that range from 0.35 to 0.97. Note that these instruments for tax rates are not available with individual tax return data. As in Auten and Carroll (1999), such estimates based on comparing only two years are sensitive to mean reversion. Indeed, when including 1983 AGI as a control for mean reversion, their elasticities increase by between 0.3 and 0.5; recall that because the Tax Reform Act of 1986 reduced top MTRs, mean reversion (at the top of the income distribution) biases downward estimated ETIs.

Interestingly, because SCF data include labor supply measures (hours of work), Moffitt and Wilhelm also estimate labor supply responses and conclude that the surge in the taxable income of high-income individuals between 1983 and 1989 was not accompanied by an increase in reported hours of work. This result of no response along a real economic margin is fully consistent with the overall conclusion that clearly visible responses are generally due to retiming or avoidance, with no compelling evidence of real economic responses. It would certainly be valuable to follow upon Moffitt and Wilhelm (2000) and systematically compare income reporting responses to tax changes with real economic responses such as labor supply or output.

Gruber and Saez (2002) use the public-use version of the panel tax data for the years 1979 to 1990 to examine both taxable income and broad income responses to both the 1981 tax change and the Tax Reform Act of 1986. Broad income is defined as income before deductions. They measure behavioral changes (between paired observations) over three-year intervals, which provides them with variation in tax rates across time for all income levels and a longer period for behavioral responses to occur. Furthermore, because they incorporate state as well as federal income tax changes, they also have cross-sectional variations in tax rate changes within income groups.

Gruber and Saez devote much attention to the issues of mean reversion and secular income trends, and separately estimate income and substitution effects of the tax change. They instrument for the change in the net-of-tax rate using an instrument very similar to that used by Auten and Carroll (1999): the change in the net-of-tax rate assuming each filer's income grows at the rate of overall nominal income growth between the base and subsequent year. They also

construct an analogous instrument for capturing the income effect, the log change in after-tax income assuming that base year income grows at the same rate as total income. The second stage regresses the log of (taxable or broad) income growth against the change in the log of the net-of-tax rate, year fixed effects, and dummies for marital status. As they use multiple years simultaneously, they can include a rich set of controls for base income.

Gruber and Saez's elasticity estimate for broad income, 0.12, is notably smaller than their corresponding estimate for taxable income, suggesting that much of the taxable income response comes through deductions, exemptions, and exclusions. Consistent with this conclusion, they find that most of the response can be attributed to itemizers (for taxable income, the elasticity is 0.65, whereas for non-itemizers, it is negative and insignificant). Although estimates by income group are not statistically distinguishable from each other, they do vary greatly and are generally higher for higher-income taxpayers (0.57 for people with incomes over \$100,000, 0.11 for those from \$50,000-\$100,000 and 0.18 for those with income from \$10,000 to \$50,000). Importantly, Gruber and Saez find much lower elasticities for broad income than for taxable income. Even for upper income earners, the elasticity of broad income is small (0.17). Those findings suggest that the current tax system creates significant efficiency costs because of its many avoidance opportunities, but that a broader income tax base might substantially lower the efficiency costs of taxation and increase the ability of the government to raise taxes from the upper income groups.

Kopczuk (2005) investigates the hypothesis that the ETI is not a structural parameter, but rather a function of the tax base (which he defines as taxable income divided by total income). The motivating idea is that available deductions lower the cost of shifting income outside the tax base. Therefore, as the tax base narrows, the responsiveness to changes in tax rates should increase. After first-differencing (he uses three-year intervals, following the methodology of Gruber and Saez (2002)), he follows a two-stage least-squares approach with instruments for both the change in the log net-of-tax rate and for the interaction of that variable with the share of income that is deductible. For instruments, he uses the log of the predicted changes of these variables, absent any behavioral response. Including both instrumented changes in marginal tax rates and an interaction term between the change in tax rate and change in tax base, generates income-weighted elasticity estimates (for married filers) of 0.12 with no deductions and 1.06 for the deductible-share interaction term. These estimates imply that the roughly 4.5 percentage

point increase in Kopczuk's definition of the tax base as a result of the Tax Reform Act of 1986 would lower the ETI by roughly 5 percentage points, from 0.25 to 0.20. Because itemizers' deductible share of income is much higher, the same estimated coefficients would imply a pre-1986 ETI of 0.42 versus a post-1986 ETI of 0.36. Kopczuk (2005) concludes that the results imply that an individual who has no access to any deductions would not respond to changes in tax rates (at least over a three-year interval). The more deductions are available, the stronger the response. This result is consistent with findings from Gruber and Saez's finding that the behavioral response is substantial for taxable income, but much smaller for broad income.<sup>68</sup>

Giertz (2007) applies the methods of Gruber and Saez (2002) to larger panel data sets of tax returns from 1979 to 2001 available only within government agencies (see appendix B.1). Using first the data from the Continuous Work History Survey which does not oversample higher income earners, he shows that Gruber and Saez's approach yields an estimated elasticity of taxable income (ETI) for the 1990s of 0.20 — or about half the size of the corresponding estimate for the 1980s. However, when he uses broad income, instead of taxable income, the estimated elasticity is 0.15, as opposed to 0.12 for the 1980s. This significant difference between the taxable income estimates and small difference between the broad income estimates is consistent with the results from Kopczuk (2005) suggesting that the availability of deductions and exemptions matter in determining the ETI because the fraction of taxpayers choosing to itemize was approximately 25 percent lower in 1993 compared to 1986. Calculating the ETI over the period 1979 to 2001, Giertz obtains an estimate of 0.30.

This concludes our selective summary of what is known about the value of the ETI. Of note is that estimated values of the ETI for the 1990s, identified largely off of the 1990 and 1993 tax changes, are generally lower than those for the 1980s, identified largely off of the 1981 and 1986 changes. There are two broad, and not mutually exclusive, categories of explanations for this pattern of results.

The first suggests there is no reason to expect a universal parameter in the first place. Leading proponents of this hypothesis are Slemrod and Kopczuk (2002), who argue that the ETI is not a structural parameter and is a function of not only preferences, but also the breadth of the tax base and tax enforcement parameters. Kopczuk (2005) found empirical support for this hypothesis, and Giertz (2007) found that the elasticity with respect to taxable income

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<sup>68</sup>Another innovation to Gruber and Saez's approach made by Kopczuk (2005) is the inclusion of separate variables to control for mean reversion and secular divergence in the income distribution.

varies much more by decade than the elasticity with respect to broad income, supporting the argument that changing rules for deductions affects the taxable income elasticity.

The second category of explanations points to methodological issues as the driving reason behind the differences between decades. One such argument proposed by Carroll (1998) and Giertz (2007), among others, suggests that (for at least some periods) the model is unable to adequately control for exogenous income trends. As a result, the rising, and non-tax-related, income inequality trend could bias ETI estimates upward when top tax rates fall and downward when they rise. Another potential source of bias that varies across periods could arise if the models fail to capture some potentially important types of income shifting, such as the shifting between the corporate and individual income tax base. Incentives for this type of shifting were greater in the 1980s than in the 1990s.

Due to space limitations, we do not comprehensively review the substantial literature estimating the ETI using data from countries other than the United States.<sup>69</sup> However, some recent work using Danish data is worth noting, largely because of the especially rich longitudinal data available to researchers that span over two decades and also include a variety of demographic variables not available on U.S. (or most other countries') tax returns.

Kleven and Schultz (2009) use panel tax return data since 1980 to analyze behavioral responses to various income tax reforms over the period 1984 to 2005 in Denmark using a method similar to Gruber and Saez (2002). Their study has three key advantages relative to U.S.-based studies. First, they can use the full universe of Danish tax filers over a long period, generating a very large longitudinal dataset that also contains detailed socio-economic information. Second, the Danish income distribution has been very stable over this period compared to the U.S. distribution, making tax effects easier to identify. Third, the Danish tax reforms spanning 1984-2005 generated substantial variation in tax rates that is not systematically correlated with income, as different reforms affected different brackets and consisted of both rate increases and decreases for a given bracket. Furthermore, many changes apply only to specific income components as the Danish tax system imposes different rates on different income components. As a

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<sup>69</sup>Although see the working paper version of our paper, Saez, Slemrod, and Giertz (2009), which does discuss this literature. We reiterate that, for reasons discussed earlier, there is no reason to expect that the ETI would be the same across countries because it is a function not only of arguably relatively uniform aspects of preferences, but also of the details of countries' tax systems. Slemrod and Kopczuk (2002) develop a model of the "optimal" elasticity of taxable income and show that it will be lower in countries with more egalitarian social welfare functions and with a lower cost of administering and enforcing a broad tax base.

result, they can control for a rich set of base-year incomes. They find that (1) population-wide elasticities are modest compared to most existing studies, (2) elasticities for capital income are larger than for labor income, (3) elasticities for negative income (deductions, negative capital income) are larger than for positive income, (4) elasticities for the self-employed are larger than for employees, (5) elasticities are monotonically increasing in income level and are 2 to 3 times larger in the top quintile of the distribution than in the bottom quintile of the distribution, and (6) income effects are very small.

Chetty et al. (2009) also use population tax files from Denmark and estimate the ETI using bunching evidence around kink points where marginal tax rates jump, building upon the method developed in Saez (2010) in the U.S. case. They develop a new method of estimating the long-run elasticity in an environment where adjustment costs attenuate short-run behavioral responses by comparing the short-run effects of small versus large tax changes. Consistent with the existence of large adjustment costs, the amount of bunching they obtain is a highly convex function of the size of the change in the net-of-tax rate at the kink. In other words, the implied elasticity is larger from large changes in marginal tax rates than for small changes in marginal tax rates. The degree of bunching varies across demographic groups and occupations in a manner that appears to be correlated with the flexibility of labor supply and is much more pronounced for secondary earners and especially the self-employed. Their results suggest that adjustment frictions create heterogeneity in the size of the elasticity response in the short-run and that such effects need to be taken into account to obtain the long-run elasticity that is of most interest for policy making.

## 5 Conclusions and Future Work

### 5.1 What we have learned

Under certain assumptions *all* behavioral responses to income tax rate changes are symptoms of inefficiency, and all such responses are captured by the elasticity of taxable income. This insight, raised in Feldstein (1995, 1999), is central to tax policy analysis. Because of its centrality to the evaluation of tax structure and because of the growing availability of longitudinal tax return data, much effort has been devoted to identifying its magnitude.

Attracting even more attention was the fact that the early empirical literature, focusing on the U.S. tax cuts of 1981 and particularly 1986, produced elasticity estimates large enough

to suggest that, not only was the marginal efficiency cost of tax rates high, but that the U.S. might be on the wrong side of the Laffer curve. Subsequent research generated considerably lower estimates, in part because of better data and improved methodology, but also because the variety of tax rate changes after 1986 facilitated separating out the impact of tax rate changes from non-tax-related changes in the inequality of pre-tax income. While there are no truly convincing estimates of the long-run elasticity, the best available estimates range from 0.12 to 0.40. At the approximate midpoint of this rate — an ETI of 0.25 — the marginal excess burden per dollar of federal income tax revenue raised of 0.195 for an across-the-board proportional tax increase, and 0.339 for a tax increase focused on the top one percent of income earners.<sup>70</sup>

Even at the top of this range the U.S. marginal top rate is far from the top of the Laffer curve, but that the elasticity relevant to measuring the marginal efficiency cost of raising tax rates is higher than one would calculate if the sole behavioral response were labor supply. There is also much evidence to suggest that the ETI is higher for high-income individuals who have more access to avoidance opportunities, especially deductible expenses.

The main attraction of the ETI concept—that it is a sufficient statistic for welfare analysis and therefore one need not inquire into the anatomy of behavioral response—has proven to be overstated for two important reasons.

First, the welfare relevance of the elasticity depends on the extent of fiscal externalities — whether taxable income is shifted to or from another tax base, or to and from the same tax base at a different time. Moreover, if classical externalities apply to often-deductible items such as charitable contributions, the ETI must be adjusted for welfare purposes. Examining which components of taxable income respond to tax rates (the “anatomy” of response) can help clarify the extent of these externalities. This brings us back to the pre-ETI attention to each of the many margins of behavioral response to tax rate changes.

Second, while there is compelling U.S. evidence of strong behavioral responses to taxation at the upper end of the distribution around the main tax reform episodes since 1980, in all cases those responses fall in the first two tiers of the Slemrod (1990, 1995) hierarchy—timing and avoidance. In contrast, there is no compelling evidence to date of *real* economic responses

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<sup>70</sup>These calculations are based on 2005 tax return data; details are available from the authors. Note that the ETI for top earners could conceivably be higher than 0.25, especially if the top tax rate is increased while keeping the tax rate on realized capital gains constant hence fueling tax avoidance opportunities. With an elasticity of 0.5 for the top 1 percent income earners, the marginal excess burden per dollar of revenue doubles to 0.678 for a tax increase on top percentile income earners.

to tax rates (the bottom tier in Slemrod's hierarchy) at the top of the income distribution. In the narrow perspective where the tax system is given (and abstracting from fiscal and classical externalities), the type of behavioral response is irrelevant. However, in the broader perspective where changes in tax system such as broadening the tax base, eliminating avoidance opportunities, or strengthening enforcement are possible options, the type of behavioral response becomes crucial. While such policy options may have little impact on *real* responses to tax rates (such as labor supply or saving behavior), they can have a major impact on responses to tax rates along the avoidance or evasion channels. In other words, if behavioral responses to taxation are large in the current tax system, the best policy response would not be to lower tax rates, but instead broaden the tax base and eliminate avoidance opportunities to lower the size of behavioral responses. Those findings also highlight the importance of the fact that the ETI is not an immutable parameter, but can be influenced by government policies. For this reason, it is likely to vary across countries and within countries over time when non-rate aspects of tax systems change.

The empirical methods are most convincing in estimating the short-term response to tax rate changes, and in that case one must be careful to distinguish the response to anticipated versus unanticipated changes. Estimates of the elasticity of taxable income in the long run (i.e., exceeding a few years) are plagued by extremely difficult issues of identification, so difficult that we believe that there are no convincing estimates of the long-run elasticity of reported taxable income to changes in the marginal tax rate.<sup>71</sup> Analysis of panel data does not seem likely to resolve the identification issues raised by trends in income inequality and mean reversion at the top and bottom ends of the income distribution. Repeated cross-section analysis based on longer time series is very useful to analyze changes in the share of income accruing to various income groups and assess whether those changes are systematically related to changes in marginal tax rates. However, evidence from a single country is in general not enough to conclusively estimate behavioral elasticities because many factors besides tax rate shape the income distribution. Time-series share analysis, coupled with compositional analysis, can be useful to detect large short-term changes due to behavioral responses.

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<sup>71</sup>Many of these problems are not unique to identifying the long-run ETI, but apply to the estimation of all behavioral responses.

## 5.2 What we need to learn

First, future research that attempts to quantify the welfare cost of higher tax rates should attempt to measure the components of behavioral responses as well as their sum. It needs to be more attentive to the extent to which the behavioral response reflects shifting to other bases and the extent to which the behavioral response comes from margins with substantial externalities.

Second, empirical analyses should look more systematically at non-U.S. experience to potentially validate the conclusions based on U.S. experience and to sharpen our understanding of how the environment, writ large, affects the ETI. As discussed above, this line of research is already under way and indeed the most promising and innovative recent studies on the ETI have been based on non-US data. Part of the reason is that several OECD countries, especially in Scandinavia, are now making individual-level tax data, often linked with demographic information, much more widely-available for research purposes than is the United States. This trend is likely to continue unless the United States broadens access to population tax return data.

Third, researchers should be seeking better sources of identification; for example, parallel income tax systems that differentially affect taxpayers over a long period of time. Conceivably, field experiments could be designed where individuals are randomly assigned to different tax schedules in the spirit of the older negative income tax experiments in the United States.<sup>72</sup>

Fourth, researchers should be sensitive to the possibility that non-standard aspects of tax systems and the behavioral response to them—such as salience, information, popular support, and asymmetric response to increases versus decreases—might affect the size of behavioral response. The recent approach of Chetty (2009a) is particularly promising. His meta-analysis, which includes most ETI studies, shows that discrepancies across estimates could be explained by imperfect optimization and frictions such as adjustment costs. In that context, large and salient changes in tax rates provide much more informative estimates of the long-run ETI than small or non-salient changes.

Finally and related, the ETI literature could be fruitfully connected to the macro-economic literature along two dimensions. First, a number of recent macro-economic studies have estimated the effects of taxes on labor supply using cross-country analysis. Instead of considering only aggregate labor supply, it could be possible to carry out an analysis by income groups to sharpen the identification and capture a broader set of behavioral responses. Second, as

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<sup>72</sup>See Munnell (1987).

we have pointed out, tax rates can have long-term effects on reported capital incomes through saving and wealth accumulation channels. Estimating such effects would naturally require the development of a dynamic framework as in the macro-economic savings literature.

## A Recent legislated tax changes in the United States

In this appendix section, we briefly outline the major changes in the U.S. individual income tax since the mid 1950s. Table A1 reports the top statutory marginal federal income tax rates on (1) ordinary individual income, (2) earned income, (3) long-term realized capital gains, as well as the corporate tax rate since 1952. The table also describes briefly the most important additional provisions affecting high-income tax rates.

Although Congress regularly amends the tax code, only occasionally does it make major reforms. The 1954 Internal Revenue Code represented an important and fundamental reform to the U.S. tax system. The 1954 Code created 24 tax brackets with marginal tax rates increasing with income from 20 to 91 percent, but with a maximum tax rate of 25 percent applied to capital gains; the top corporate tax rate was 52 percent. (While the 1954 act represented a fundamental change to the U.S. tax system, it did not alter MTRs on top incomes.) The 1954 Code was amended many times, but remained in place until 1986. The 1960s saw a couple of important tax changes. One was the Revenue Act of 1964, inspired by President John Kennedy, but enacted under President Lyndon Johnson. This act reduced individual and corporate tax rates, notably lowering the top marginal income tax rate from 91 percent to 70 percent. The Tax Reform Act of 1969 introduced a new rate schedule. While the top individual income tax rate remained at 70 percent, the top rate on earned income was lowered (over the next few years) to 50 percent.<sup>73</sup> The 1970s saw federal tax revenues (and effective marginal tax rates) increase as a result of “bracket creep” brought on by the combination of unusually high inflation and tax brackets not indexed for inflation. In response to this, a series of tax acts were passed, most of which lowered tax revenues by increasing allowable tax deductions and credits.

Congress has changed federal marginal tax rates several times since 1980. The Economic Recovery Tax Act of 1981 reduced the top rate from 70 percent to 50 percent, and lowered all other tax rates in three annual steps by a total of about 23 percent (not 23 percentage points). The Tax Reform Act of 1986 represented the most comprehensive tax reform since 1954. It dropped the top marginal tax rate to 28 percent in two steps from 1986 to 1988, and made smaller cuts across the income distribution. The Tax Reform Act of 1986 also eliminated the exclusion of 60 percent of long-term capital gains, lowered the corporate tax rate from 46 percent

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<sup>73</sup>The 1969 Act also extended a 5 percent income tax surcharge. Additionally, it established both the individual and corporate Alternative Minimum Tax.

to 34 percent, and contained scores of other provisions several of which reduced deductions and tax sheltering opportunities.

The tax changes of the Omnibus Budget Reconciliation Acts of 1990 and 1993 were smaller and more focused on high-income filers than those of the 1980s. The 1990 tax change increased the top tax rate from 28 to 31 percent. The 1993 tax change further increased the top rate from 31 to 36 percent and applied this rate to individuals with lower incomes. It also created a new top marginal tax rate of 39.6 percent by legislating a 10 percent surtax. Top tax rates on earned income increased by roughly another 2.9 percentage points because the cap on income subject to the Medicare portion of the payroll tax was lifted. Unlike the Tax Reform Act of 1986, the 1990 and 1993 tax changes incorporated only very few additional changes to the tax code. Also in the 1990s, the Taxpayer Relief Act of 1997 substantially lowered capital gains tax rates, among other things. This Act did not change tax rates on earned income other than capital gains.

Tax rates have also changed since 2000. In 2001, the Economic Growth Tax Relief and Reconciliation Act lowered marginal tax rates, reduced the number of tax brackets and expanded allowable credits and deductions. Different aspects of the 2001 tax change were scheduled to phase in over a number of years, with the act expiring completely in 2011. In 2003, the Jobs Growth Tax Relief and Reconciliation Act accelerated all of the marginal rate cuts from the 2001 tax change that were not set to fully phase-in until 2006. Additionally, it substantially lowered tax rates on capital gains and dividends down to 15 percent. These changes will also expire in 2011, absent action by Congress.

Before proceeding, note that, as a practical matter, a number of studies in the empirical literature (as well the empirical exercise in Section 3) examine adjusted gross income (AGI) in place of taxable income. Taxable income equals AGI minus the value of personal exemptions and either the standard or itemized deductions. Many data sets do not include enough information to calculate taxable income in a consistent way over many years. This is especially true for data sets spanning many decades, over which the definition of taxable income changes substantially. Creating a constant-law income measure (see the previous section) often requires information that is not reported, and therefore not available to researchers, in many years. Many taxable income responses are also captured in AGI; however, changes in itemized deductions are not observed. Also, recall from Section 2 that the potential for positive externalities associated

with some itemized deductions could argue for examining responses to AGI — even when good measures of taxable income are available.

## **B Tax Return Data**

As discussed in the paper, the estimation of behavioral responses of reported income to tax changes relies critically on the availability of high quality individual income tax data. In this appendix section, we discuss briefly data availability in the United States and we describe in more detail the data we used in Section 3.4.

### **B.1 U.S. Tax Return Data**

The Statistics of Income (SOI) division at the Internal Revenue Service has created large annual micro-datasets of individual tax returns since 1960. The SOI data are stratified random samples of about 250,000 tax returns and include most of the information reported on the filers’ tax returns, plus some additional demographic information. Sampling rates vary by income (and other tax return characteristics). The SOI heavily over samples high-income filers with 100 percent sampling rates at the top of the distribution, a key advantage as top incomes play a critical role in determining overall responses to changes in tax rates.

Sampling into the SOI data is based on (a random transformation of) Social Security numbers of tax filers. These assigned numbers do not change from year to year, and beginning with year 1979, enable researchers to link SOI annual cross-sections into a panel dataset. (For more detail on the SOI data and the SOI’s sampling strategy, see the discussion below on the data used in section 3.) In particular, a core set of five last 4 digits of the Social Security numbers are always sampled and hence are a pure longitudinal sample of 0.05 percent of US tax returns. This core longitudinal sample within the SOI data is called the Continuous Work History Sample (CWHS).

In several cases, SOI has supplemented the core SOI cross sections by creating additional panel data drawing from the full population of individual tax returns. One such example is the Treasury’s Family Panel, which is a stratified random sample of tax filers followed from 1987 to 1996. The Family Panel begins with 88,000 tax returns in 1987, follows filers and their dependents through 1996 and includes “refreshments” to remain representative of the overall filing population. Treasury’s 1999 Edited Panel, which begins in 1999, is designed similarly to

the Family Panel. It currently runs through 2005. Another example is the Sales of Capital Assets Panel, which follows a sample of tax filers reporting sales of capital assets (on Schedule D of IRS Form 1040).

SOI has released to the public the so-called “Public Use File” (PUF) version of the SOI annual cross-sections. To protect the identity of taxpayers, those public use files have a lower sampling rate at the very top (1/3 instead of 1) and they also blur some variables for very high incomes by combining several tax returns together. The PUF contain about 100,000 tax returns per year. However, the PUF do not contain longitudinal identifiers and hence cannot be linked into panel data. Another important limitation of the PUF is that they do not report separately income items of each spouse in the case of married joint filers, limiting the ability to measure the important secondary earner response to tax changes.<sup>74</sup>

A public-use version of the CWSHS was also made public for years 1979 to 1990. The public version of the panel also included some “blurring” of information to protect the identity of taxpayers. The public-use version of the CWSHS goes by various names, including the “University of Michigan Tax Panel” or “NBER Tax Panel.” The absence of publicly available U.S. panel data since 1990 has severely limited the ability of academic researchers to study more recent tax changes. As a result, most of the recent studies have been carried out by researchers within government agencies (in a few cases in collaboration with outside academics).

Due to improvements in information technology, it has now become feasible for SOI to use the complete population files of tax returns, i.e., about 140 million tax returns each year. Those samples can of course be linked longitudinally. The extremely large size of the population files could be used to broaden the scope of tax changes that can be analyzed. Indeed, the United States offers very rich variation at the state level. Most existing data samples are too small to analyze convincingly local changes. The availability of population files for research use could spur new work on responses to tax changes.

## **B.2 Tax Return Data Used in Section 3**

The panel of individual tax returns used in Section 3 are from the Statistics of Income (SOI) and spans years 1991 to 1997. Marginal tax rates are imputed using Congressional Budget Office’s

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<sup>74</sup>The SOI files can be merged within SOI to individual wage income information to obtain the breakdown of income by spouse.

federal tax model. Income, denoted  $z_{it}$ , is a constant-law measure of AGI (adjusted gross income for individual  $i$  at time  $t$ ), excluding capital gains and including all Social Security benefits, such that  $z_{it} = \text{reportedAGI} - \text{realizedCG} + \text{nontaxableSSbenefits} + \text{deductedmovingexpenses}$ . Dollar values are adjusted by the IRS's inflation adjustment factors, using 1991 as the base. Marginal tax rates are imputed for only the federal income tax using the Congressional Budget Office's internal tax calculators. The rate imputations exclude changes to the payroll tax (which only applies to earned income) and to changes in state tax rates. While this leaves an incomplete measure of the marginal tax rate, it has the virtue of simplicity. Because of the stratification structure of the SOI panel, (paired) observations are weighted by the reciprocal of their probability of appearing in the sample as done in Auten and Carroll (1999) and subsequent researchers working with the SOI panel.

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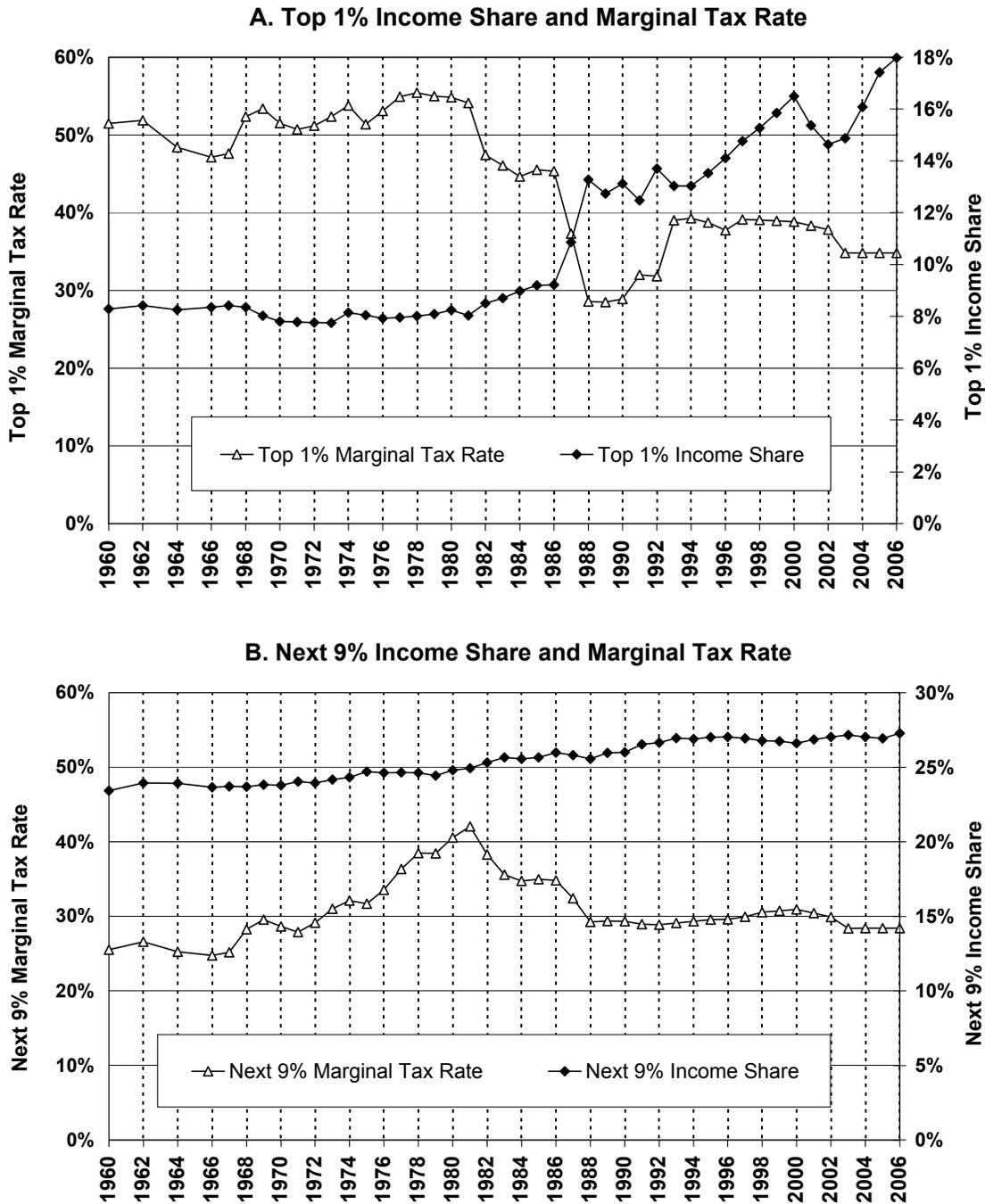
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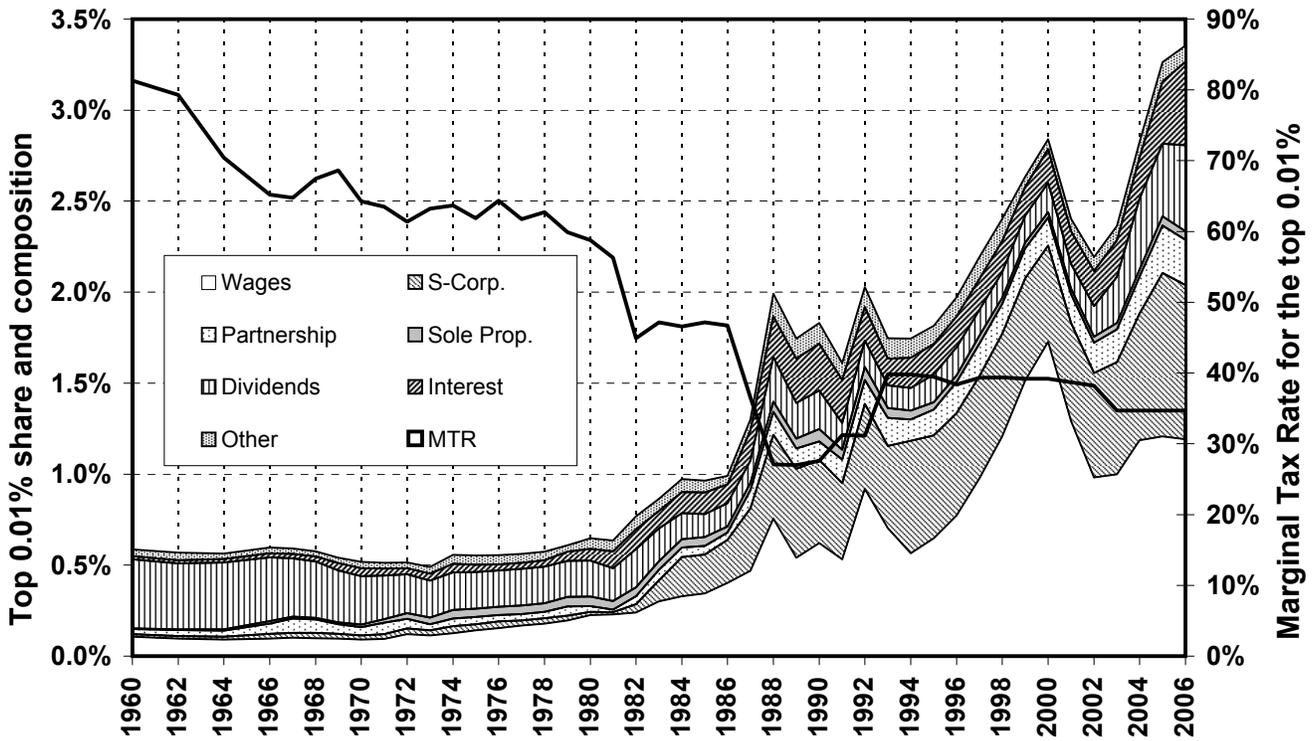
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**FIGURE 1**  
**Top Income Shares and Marginal Tax Rates, 1960-2006**

Source: Updated version of Figure 8 in Saez (2004). Computations based on income tax return data. Income excludes realized capital gains, as well as Social Security and unemployment insurance benefits. The figure displays the income share (right y-axis) and the average marginal tax rate (left y-axis) (weighed by income) for the top 1% (Panel A) and for the next 9% (Panel B) income earners.



**FIGURE 2.**

**The Top 0.01% US Income Share, Composition, and Marginal Tax Rate, 1960-2006**

Source: Updated version of Figure 8 in Saez (2004). Computations based on income tax return data. The figure displays the income share of the top .01% tax units, and how the top .01% incomes are divided into seven income components: wages and salaries (including exercised stock options), S-corporation profits, partnership profits, sole proprietorship profits, dividends, interest income, and other income. The figure also displays the average marginal tax rate (weighted by income) for the top 0.01% in a bold line on the right y-axis.

**Table 1.**  
**Elasticity estimates using top income share time series**

	Top 1%	Next 9%
	(1)	(2)
<b>A. Tax Reform Episodes</b>		
1981 vs. 1984 (ERTA 1981)	0.60	0.21
1986 vs. 1988 (TRA 1986)	1.36	-0.20
1992 vs. 1993 (OBRA 1993)	0.45	
1991 vs. 1994 (OBRA 1993)	-0.39	
<b>B. Full Time Series 1960-2006</b>		
No time trends	1.71 (0.31)	0.01 (0.13)
Linear time trend	0.82 (0.20)	-0.02 (0.02)
Linear and square time trends	0.74 (0.06)	-0.05 (0.03)
Linear, square, and cube time trends	0.58 (0.11)	-0.02 (0.02)

Notes: Estimates in panel A are obtained using series from Figure 1 and using the formula  $e = \frac{\log(\text{income share after reform}) - \log(\text{income share before reform})}{\log(1 - \text{MTR after reform}) - \log(1 - \text{MTR before reform})}$

Estimates in Panel B are obtained by time-series regression of log(top 1% income share) on a constant, log (1 - average marginal tax rate), and polynomials time controls from 1960 to 2006 (44 observations). OLS regression. Standard Errors from Newey-West with 8 lags.

**Table 2.**  
**Elasticity estimates using the 1993 top rate increase among top 1% incomes**

Control group	next 9%	next 49%
	(1)	(2)
<b>A. Repeated Cross Sections Analysis</b>		
<b>A1. Comparing two years only</b>		
1992 and 1993	0.284 (0.069)	0.231 (0.069)
1991 and 1994	-0.363 (0.077)	-0.524 (0.075)
<b>A2. Using all years 1991 to 1997</b>		
1991 to 1997 (no time trends controls)	-0.373 (0.053)	-0.641 (0.052)
1991 to 1997 (with time trends controls)	0.467 (0.073)	0.504 (0.071)
<b>B. Panel Analysis</b>		
<b>B1. Comparing two years only</b>		
1992 to 1993 changes (no controls)	1.395 (0.107)	1.878 (0.184)
1991 to 1994 changes (no controls)	2.420 (0.221)	3.352 (0.446)
1992 to 1993 changes (log base year income control)	-0.721 (0.213)	0.814 (0.149)
1992 to 1993 changes (+splines income controls)	-1.669 (1.052)	-1.866 (0.711)
<b>B2. Using all 1991-1992, ..., 1996-1997 changes</b>		
No income controls	1.395 (0.296)	1.878 (0.338)
Base year log income control	0.537 (0.264)	0.955 (0.247)
Base year log income + splines controls	0.564 (0.259)	0.723 (0.260)
Base year log income + splines controls (using predicted MTR change instrument)	0.143 (0.200)	0.237 (0.077)

Notes: Estimates based on a panel of tax returns (see appendix and Giertz, 2008).

Panel A estimates are obtained from 2SLS regression:  $\log(z_{it}) = e \cdot \log(1 - \tau_{it}) + \alpha \cdot 1(\text{top } 1\%) + \beta \cdot 1(\text{post reform}) + \varepsilon_{it}$  using  $1(\text{top } 1\%) \cdot 1(\text{post reform year})$  as instrument. Time controls in the last row of Panel A2 are group specific:  $\gamma_1 \cdot 1(\text{top } 1\%) + \gamma_2 \cdot 1(\text{not top } 1\%)$

Panel B1 estimates are obtained from 2SLS panel regression:  $\Delta \log(z_{it}) = e \cdot \Delta \log(1 - \tau_{it}) + \varepsilon_{it}$  using  $1(\text{top } 1\% \text{ in base year})$  as instrument. Base year income controls  $\log(z_{it})$  and 10 splines in  $z_{it}$  are added in last two rows. In Panel B2, comparisons 1991 to 1992, ..., 1996 to 1997 are stacked and year dummies are included in the 2SLS regression. The instrument is  $1(\text{top } 1\% \text{ in base year}) \cdot 1(t=1992)$ . Instrument MTR predicted change  $\log\left[\frac{1 - \tau_{it}^p}{1 - \tau_{it}}\right]$  is used in the 4th row of estimates where  $\tau_{it}^p$  is the marginal tax rate in year  $t+1$  using (inflation adjusted) year  $t$  income.

In column (1), the estimates are run using the top 10% tax filers (so that the treatment group is the top 1% and the control group is the top 10% excluding the top 1%, "The next 9%"). In column (2), the estimates are run using the top 50% tax filers (so that the control group is the top 50% excluding the top 1%, "The next 49%").

**Table A1.  
Top Federal Marginal Tax Rates**

Year	Ordinary Income	Earned Income	Capital Gains	Corporate Income
	(1)	(2)	(3)	(4)
1952-1963	91.0	91.0	25.0	52
1964	77.0	77.0	25.0	50
1965-1967	70.0	70.0	25.0	48
1968	75.3	75.3	26.9	53
1969	77.0	77.0	27.9	53
1970	71.8	71.8	32.3	49
1971	70.0	60.0	34.3	48
1972-1975	70.0	50.0	36.5	48
1976-1978	70.0	50.0	39.9	48
1979-1980	70.0	50.0	28.0	46
1981	68.8	50.0	23.7	46
1982-1986	50.0	50.0	20.0	46
1987	38.5	38.5	28.0	40
1988-1990	28.0	28.0	28.0	34
1991-1992	31.0	31.0	28.0	34
1993	39.6	39.6	28.0	35
1994-1996	39.6	42.5	28.0	35
1997-2000	39.6	42.5	20.0	35
2001	39.1	42.0	20.0	35
2002	38.6	41.5	20.0	35
2003-2009	35.0	37.9	15.0	35

Notes: MTRs apply to top incomes. In some instances, lower income taxpayers may face higher MTRs because of income caps on payroll taxes or the so-called 33 percent "bubble" bracket following TRA 86. From 1952 to 1962, a 87% maximum average tax rate provision made the top marginal tax rate 87% instead of 91% for many very top income earners. From 1968 to 1970, rates include surtaxes. For earned income, MTRs include the Health Insurance portion of the payroll tax beginning with year 1994. Rates exclude the effect of phaseouts, which effectively raise top MTRs for many high-income filers. MTRs on realized "long-term" capital gains are adjusted to reflect that, for some years, a fraction of realized gains were excluded from taxation. Since 2003, dividends are also tax favored with a maximum tax rate of 15%.