Comments Welcome

Tax Bases, Tax Rates and the Elasticity of Reported Income: Can Policy Makers Control the Marginal Cost of Taxation?

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Abstract

Tax reforms usually change both tax rates and tax bases. Using a panel of income tax returns spanning the two major U.S. tax reforms of the 1980s, I find that the elasticity of income reported on personal income tax returns depends on the tax base and therefore it is not a structural parameter. The results suggest that base broadening reduces the efficiency cost of taxation and that ignoring non-tax instruments may result in misleading conclusions regarding the optimal direction of tax reform. My point estimates indicate that the Tax Reform Act of 1986 reduced the marginal cost of collecting a dollar of tax revenue by 2 cents, with roughly half of this reduction due to base broadening and the other half due to tax rate reduction. As a by-product, the analysis in this paper offers a reconciliation of disparate estimates obtained by previous studies of the tax responsiveness of income.

1 Motivation

Complexity is often considered to be an undesirable feature of the tax system, but this is usually postulated rather than derived from an economic model and its relationship to other criteria for evaluating tax policy is unclear. A recent paper of Slemrod and Kopczuk (2002) offers a formalized treatment of the impact of non-tax rate instruments that are controlled by policy makers. In particular, their analysis provides a specific example of framework for analyzing the cost of complexity in the tax system by interpreting it in terms of income tax base. A simple income tax is characterized by few deductions and, therefore, a broad tax base. Broadening the tax base increases revenue and affects administrative costs, but more subtly it is also likely to affect the excess burden of taxation: in their model, broader tax base is associated with lower elasticity of taxable income and therefore with lower excess burden. Thus, in that framework, simplicity of the tax system directly affects the efficiency cost of taxation.

In this paper, I evaluate the empirical value of such arguments by estimating the impact of the tax base on the elasticity of reported income. This elasticity is the key parameter necessary to evaluate the deadweight loss of income tax. My results highlight though that it is not a structural parameter, but rather it depends on non-rate aspects of the tax system that can be manipulated by policy makers. This effect is not just theoretically possible, it also turns out to be empirically relevant. Consequently, the results indicate that the extent of deadweight loss of taxation can be controlled by policy makers. In particular, and as an illustration, I can assess the efficiency gains from a shift to a broad-base low-rate tax system.

2 Context

The central importance of the elasticity of taxable income for public finance questions follows from two simple realizations. First, by the envelope theorem, the marginal tax rate (t) affects the utility of an individual in proportion to taxable income (I). The analytics of response are irrelevant. Second, with just income tax in place,[1] the marginal effect on revenue is $t\frac{\partial I}{\partial t} + I$, again depending only on the total taxable income. Therefore, having a measure of responsiveness of I is crucial for normative questions.[2] What is the relevant I? The traditional approach was to define $I \equiv wL$ where w is the wage rate and L is labor supply. With this assumption, the elasticity of labor supply can be used in place of the elasticity of taxable income. However, this approach ignores other potentially important responses to taxation such as tax avoidance, tax evasion and income shifting.

[1] In the presence of other taxes, the impact on other sources of revenue should be accounted as well. In practice, income shifting between personal and corporate income tax base should be taken seriously here.

[2] See Feldstein (1999) and Slemrod (1998) for a discussion of this argument and its limitations.

To address this concern, following Lindsey (1987) and Feldstein (1995), the literature concentrated directly on income reported on tax returns (Auten and Carroll, 1999; Carroll, 1998; Long, 1999; Sillamaa and Veall, 2001; Gruber and Saez, 2002; Goolsbee, 1999).[3] Several authors argued that changes in the definition of taxable income provide an additional source of identification as exogenous limiting or expanding of deductions pushes taxpayers into different tax brackets. Understanding consequences of such changes is important, because they occur at exactly the same time that the tax rates change. An implicit assumption in the literature is that such changes do not have an independent effect on income and that the elasticity of response to marginal tax rates is not affected by them. However, many changes in tax rules affect incentives. For example, the elimination of a non-itemizer charitable deduction by TRA'86 changed the relative price of charitable contributions and might have had an independent effect on income. Similarly, a change in the standard deduction affects the decision to itemize and, through this channel, the relative prices of itemizable activities for taxpayers who change their itemization status.

The effect stressed in this paper is that a change in the price of deductions, or more generally the price of legal avoidance or illegal evasion, is going to affect the potential behavioral elasticities. As argued by Slemrod (1994), taxable income is going to be more responsive when reducing it is cheap (e.g., because deductions are abundant), and it will be less responsive when it is expensive. This effect is conceptually separate from the effect on the level of taxable income and has far-reaching policy implications. Because behavioral elasticities measure the extent of excess burden, a policy that can affect their size can also determine the extent of inefficiency of taxation. Understanding the empirical relevance of such policies is important from the optimal policy design perspective (Slemrod and Kopczuk, 2002). It may also be important from the political economy point of view, because the supporters of the limited role of government may simultaneously have an incentive to pursue policies that make the tax system less efficient.

To address this issue, I concentrate on the behavior of a broad measure of income[4] and control for both changes in tax rates and rules. Measuring rules is of course difficult and it may explain why this issue has not yet been addressed. From the econometric point of view, an additional daunting problem is to have enough variation in any such measure to credibly identify the potential effects. In practice, time-variation alone is unlikely to provide such a source of variation. The framework considered in this paper is stylized, but it allows to get a quantifiable measure of non-rate aspects of the tax system in place that varies both over time and in the cross-section. The idea is to use the tax base as a summary statistic

[3] See Slemrod (1998) for a critical discussion of this literature.

[4] A broad income is a measure of all income reported on the tax returns that is consistently defined over time. The alternative would be to use a measure of taxable income. This would be preferred from the theoretical point of view. Such a measure is easy to obtain, but because its definition changes frequently it is difficult to incorporate in the analysis.

for tax rules in place. I rely on a taxpayer-specific measure of the size of the tax base: the ratio of *actual* taxable income to broad income. This is an easily observable quantity that is affected by tax reforms in a mechanical way (although it of course varies also due to endogenous taxpayers' responses). Tax reforms induce variation in both tax rates and tax bases and therefore provide an opportunity to separately identify the two effects.

The plan of this paper is as follows. In the next section, I describe a simple model that highlights the impact of the tax base and underlies the empirical specification. Following the discussion of the data, I present details of the empirical implementation. Apart from the proposed instrumental variable approach, the key question is how to control for trends in inequality and transitory components of income. Two issues are of interest in that context: the choice of control variables and sample selection. In particular, I present evidence indicating that different sample choices were responsible for differences in the results found in the previous literature. Following this discussion, I present my estimates of the elasticity of income and the strength of its dependence on the tax base.

The major contributions of this analysis lie in demonstrating that the elasticity of reported income is not a primitive parameter and in identifying the strength of its dependence on a particular administrative instrument of the tax base. It turns out that the elasticity of taxable income varies systematically with the tax base and that this effect is quantitatively important. This result indicates that the efficiency cost of taxation is a function of tax rules. The final section discusses some implications of this result.

3 Anatomy of Income Response

In order to highlight the effect of rule changes on taxable income and its responsiveness, I consider a stylized model.

Suppose that an individual has the total income of I that can be received in a form reported on the personal income tax return (B) or in a form that is not included on the personal tax return (F). Examples of B are wages, salaries, dividends, interests, self-employment income etc. Examples of F are fringe benefits, deferred compensation schemes, funds retained within a corporation, etc.[5] Without any frictions, F would be a preferred form of compensation. I assume though that substitution from B to F costs $M(F)$, where $M(\cdot)$ is a convex increasing function.[6] While F remains off the tax return and is not observable, broad income (B) is observed. Taxable income is obtained from broad income by excluding certain non-taxable components, subtracting income adjustments, deductions, exemptions and so on. I assume that deductions, adjustments and non-taxable components

[5] I assume that definitions of B and F are not affected by reforms.

[6] See, for example, Mayshar (1991) and Slemrod (2001) for an analysis of individual behavior with this kind of avoidance technology.

can be expressed by GD where D is a typical deductible commodity and G is the number of deductible commodities. For example, non-itemizers with no adjustments to income would have $G = 0$, while others would have $G > 0$. I denote by $\bar{S}$ the applicable standard deduction. Consequently, total after-tax income C can be expressed as

$$C = F + B - t(B - GD - \bar{S}) - M(F)\,, \tag{1}$$

where $I = F + B$ and t is the tax rate (I will also use $\tau \equiv 1 - t$ to denote the net-of-tax rate). In what follows, I assume that $M(F)$ is not affected by tax reform, so that the tax system affects behavior through t, $\bar{S}$, and G. The budget constraint highlights that the tax rate has two independent effects. First, it determines the relative price of F and B, which is τ. Second, it determines the relative price of B and D. The latter effect is proportional to G. If G did not vary, the estimated tax elasticity of B would reflect the combination of these two effects. However, when G varies, there is no single tax elasticity so that estimating it is not a well-posed problem. The value of G is affected by tax reforms that eliminate or introduce deductions and adjustments. Additionally, G varies in cross-section: it depends on such things as the itemization status (which is chosen by the taxpayer), health shocks (that influence whether medical expenses exceed the floor for claiming deductions), home ownership (via mortgage deductions), taxes imposed by state and local governments, etc.

Equation 1 indicates that G affects individual incentives only through its interaction with the marginal tax rate. Indeed, if the tax rate was equal to zero, G would have no effect. This suggests an empirical specification with both the tax rate and its interaction with G being controlled for. However, measuring G explicitly is not practical. To motivate the proposed solution, consider the following setup that abstracts from sheltering but models the role of deductions. Let C_i, $i = 1, \cdots, N$ be commodities. Assume that utility is separable between these consumption goods and leisure and that the utility from consumption is given by

$$\sum_{i=1}^{N} v(C_i)\,. \tag{2}$$

The key assumption here is that all goods enter preferences symmetrically. Denote the generic relative price of broad income B by w and the price of good C_i by p_i. I assume that in the absence of taxes all prices are equal to 1. Expenditures on $G < N$ commodities are deductible from income. Because of the assumed symmetry, without loss of generality deductions may be taken to be the first G commodities. The after-tax prices are given by $w = \tau$, $p_i = \tau$ for $i \leq G$ and $p_i = 1$ for $i > G$. Demand for B is a function of all prices and the lump sum income. The elasticity of B with respect to the net-of-tax rate has to reflect the impact of all relative prices that are affected by the change. In order to incorporate nonlinear tax schedules, I additionally allow for varying virtual income R (so that the response to R is the income effect). Thus,

$$\begin{aligned}\Delta \ln(B)\Big|_{\Delta R,\Delta\tau} &\approx \left(\frac{\partial \ln(B)}{\partial \ln(w)} + \sum_{i=1}^{G}\frac{\partial \ln(B)}{\partial \ln(p_i)}\right)\Delta \ln(\tau) + \frac{\partial \ln(B)}{\partial R}\Delta R \\ &= \left(\frac{\partial \ln(B)}{\partial \ln(w)} + G\frac{\partial \ln(B)}{\partial \ln(p_1)}\right)\Delta \ln(\tau) + \frac{\partial \ln(B)}{\partial R}\Delta R\,. \end{aligned} \tag{3}$$

The last step makes use of the assumed symmetry of all deductible commodities. This formula depends on G, the number of deductible commodities which is unlikely to be observed. However, using the Slutsky identity, symmetry of the Slutsky matrix and $p_1 = \tau = w$, one can obtain

$$\Delta \ln(B)\Big|_{\Delta R,\Delta\tau} \approx \left(\frac{\partial \ln(B^*)}{\partial \ln(w)} + \frac{GC_1}{B}\frac{\partial \ln(C_1^*)}{\partial \ln(w)}\right)\Delta \ln(\tau) + \frac{\partial \ln(B)}{\partial R}\Big[\Delta R + \Delta\tau(B - GC_1)\Big]\,, \tag{4}$$

where the superscript "$*$" denotes the compensated effect. The first two terms form the compensated elasticity of B with respect to the tax rate: it depends on the elasticity with respect to own price w as in the standard analysis, but it also depends on the cross elasticity of deductible goods with respect to w multiplied by the share of deductible goods.

So far, a response to changes in G was ignored. However, it can be analyzed in a similar manner. Consider an increase in G by ΔG (the case of a decrease would be analyzed identically). It corresponds to prices of goods $G+1$ to $G+\Delta G$ falling from 1 to τ. Therefore, assuming that ΔG is small relative to N,

$$\begin{aligned}\Delta \ln(B)\Big|_{\Delta G} &\approx \sum_{i=G+1}^{G+\Delta G}\frac{\partial \ln(B)}{\partial \ln(p_i)}(\ln(\tau) - \ln(1)) \approx \frac{\partial \ln(B)}{\partial \ln(p_{G+1})}\ln(\tau)\Delta G \approx \frac{\partial \ln(B)}{\partial \ln(p_1)}\ln(\tau)\Delta G \\ &= \frac{\partial \ln(C_1^*)}{\partial \ln(w)}\frac{C_1\Delta G}{B}\ln(\tau) - \frac{\partial \ln(B)}{\partial R}tC_1\Delta G\,. \end{aligned} \tag{5}$$

Combining equation 4 and 5 provides an expression for the response of broad income to a change in the economic environment. To express it succinctly, define $\gamma \equiv \frac{GD}{B}$, where D is used in place of C_1 to denote a typical deductible commodity. Then, evaluated at the original point, $\Delta(\gamma\ln(\tau)) = \frac{C_1\Delta G}{B}\ln(\tau) + \gamma\Delta\ln(\tau)$. Consequently, the response of B can be expressed as

$$\Delta \ln(B) = \frac{\partial \ln(B^*)}{\partial \ln(w)}\Delta \ln\tau + \frac{\partial \ln(C_1^*)}{\partial \ln(w)}\Delta(\gamma\ln(\tau)) + \frac{\partial \ln(B)}{\partial R}\Big[\Delta R - \Delta T\Big]\,, \tag{6}$$

where ΔT is a change in the tax liability.

Two points should be taken from this discussion. First, the response to tax changes depends on G. Second, the impact of deductions is measured by the cross-elasticity and it is proportional to (observable) share of deductions in total income $\gamma \equiv \frac{GC_1}{B}$. This suggests using a natural specification where one is controlling for both the tax rate and its interaction with the share of deductible commodities, attempting to identify both $\frac{\partial \ln(B^*)}{\partial \ln(w)}$ and $\frac{\partial \ln(C_1^*)}{\partial \ln(w)}$.[7] Of course, γ is endogenous but it also reflects the exogenous parameter G. As long as γ is affected by changes of G, the two parameters may be separately identified.

Therefore, instead, of measuring G explicitly, I rely on the share of broad income that is spent on non-taxable commodities $\gamma \equiv \frac{GD}{B}$, and control for both τ and its interaction with the tax base γ. Note that γ is affected by the tax reforms through their mechanical effect on G. On the other hand, γ also varies in the cross-section. My goal is to estimate parameters ε and β of the following generic specification

$$\ln(B) = \varepsilon \ln(\tau) + \beta\gamma \ln(\tau) + \text{other terms}\,. \tag{7}$$

In this specification, ε is the elasticity that would prevail if $\gamma = 0$, i.e. if not deductions were available. The actual size of elasticity is $\varepsilon + \beta\gamma$: if the policy makers can affect γ, they can affect this elasticity. A narrow interpretation of β following from the model described above is as an average cross-elasticity of a deductible good with income. Under that interpretation, both positive and negative βs are consistent with theory. A broader view of γ is as a measure of attractiveness of tax avoidance opportunities accessible to a given individual. Higher values of γ make it more worthwhile to engage in tax sheltering (F). Therefore, under that view, positive values of β should be expected.

Because γ has never been to my knowledge considered in the literature, it should be pointed out that from both theoretical and econometric points of view this variable can be thought in the same way as the marginal tax rate. This variable is affected by policy and it constitutes a parameter of the individual problem just as the tax rate does. It is clearly endogenous as well, but this is the problem that has to be dealt with in empirical work just like any potential endogeneity of tax rates must be dealt with.

It also should be stressed that the specifications I consider do not include the direct (i.e., not interacted with the tax rate) effect of the tax base. This is because the tax base has any impact only to the extent that the individual is subject to taxation to begin with. The real restrictions imposed in the analysis involves a functional form of the interaction of the rate and the base, and the assumption that the rules can be characterized by the single parameter.

4 Data and Empirical Strategy

4.1 Identification and Implementation

In what follows, I briefly discuss prior approaches to identifying the effect of taxes on taxable income, and propose my modifications including those necessary to simultaneously identify

[7] The dependence of taxable income elasticity on similarly defined γ was the focus of the analysis in Slemrod and Kopczuk (2002).

the effect of the tax base.

The identification problems in this setup have been discussed extensively by Moffitt and Wilhelm (2000). The impact of unobservable demographic characteristics whose effect stays constant over time and that are time invariant can be eliminated by first-differencing the regression specification. Therefore, I specify my model in terms of first-differences as

$$\Delta \ln(B_{is}) = \varepsilon\Delta \ln(\tau_{is}) + \beta\Delta[\gamma_{is} \ln(\tau_{is})] + \eta\Delta \ln(B_{is} - T_{is}) + \Delta\delta^v Z_i^v + \delta^h \Delta Z_s^h + \Delta\theta_{is}\,, \quad (8)$$

where τ is the marginal net-of-tax rate, γ is the share of deductible consumption, T is tax liability and $Z = [Z^h, Z^v]$ is the vector of other relevant characteristics. The objective is to directly estimate the elasticity with respect to the marginal tax rate t. For the reasons discussed before, the tax elasticity depends on deductions and therefore the coefficient on $\ln(1 - t)$ is allowed to depend on γ. This is the minimal extension of the specifications considered in the prior literature that allows for testing the constancy of the elasticity. The parameter ε is the broad income tax elasticity when $\gamma = 0$, that is for the comprehensive tax base. Equivalently, this is the response of broad income motivated by substitution away from items reported on the tax return toward leisure, fringe benefits and other types of income. One can test whether $\beta = 0$, in which case there is a single tax elasticity. In principle, depending on whether deductible goods are substitutes or complements for broad income, both positive and negative β's are consistent with theory. A broader view of γ as a measure of the attractiveness of tax avoidance would point to β being positive. Parameter η is the income effect. Finally, Z^v is the set of time-invariant variables whose effect changes over time and Z^h is the set of time-specific variables whose effect stays constant over time.

All reported regressions include dummies for single marital status, sex (these are Z^v's) and the full set of year effects (Z^h). There is no age information, but observe that linear age effects are controlled for by including year dummies in the first-differenced specification. I assume that the effect of other individual characteristics stays constant over time. The effect of any other variables is not controlled for and they are subsumed in the $\Delta\theta$ term.

4.2 Instruments

As in any econometric analysis of the impact of taxes on income or labor supply, one has to worry about endogeneity of some of the key right-hand side variables. In particular, both the marginal tax rate and the tax base depend on the realization of income. The tax rate is a direct function of total income. The tax base is not a direct function of income, but it may depend on it. Furthermore, given limited demographic information present in the dataset, one has to worry about any systematic relationship of omitted variables that are relevant for income with the tax base. For example, people with temporarily high income may be willing to invest more in tax avoidance. On the other hand, people with temporarily low income due to, e.g., medical conditions will have a lower tax base as they qualify for the medical deduction. The tax base is, similarly as the marginal tax rate, an endogenous time-varying variable, exogenously affected by policy shocks.

The assumption necessary for consistent estimation of ε and γ is the existence of instruments for $\Delta \ln(\tau_{is})$ and $\Delta\{\gamma_{is} \ln(\tau_{is})\}$ that are uncorrelated with $\Delta\theta_{is}$. I rely on the standard approach in this literature and construct predicted changes in values of $\gamma_{i,s+1}$ and $\tau_{i,s+1}$ using information as of time s.[8] This is analogous to the approach used by Auten and Carroll (1999) and Gruber and Saez (2002). Only information as of time t is used to construct a prediction as of time $t+1$. In other words, the predicted tax base and predicted marginal tax rate differ from the original one only to the extent that there were changes in tax law. This eliminates the effect of behavioral response between time t and time $t+1$, although it still leaves the individual-specific component. In constructing the predicted tax base, I account for changes in the medical deduction,[9] deductability of charitable contributions by non-itemizers (present between 1982 and 1986), deductibility of personal debt that was phased out after 1986, changes in IRA limits, elimination of the second-earner deduction by TRA86 and change in the treatment of moving expenses (TRA'86 changed their status from adjustment to an itemized deduction). As a part of the process, the predicted itemization status is determined by comparing predicted deductions with the corresponding standard deduction. Performance of the predicted tax base is illustrated in figure 2 using 1985 data to predict 1988 values (this change is mostly due to the Tax Reform Act of 1986).

The instrument for the marginal tax rate is constructed in a standard way. I adjust all period 1 quantities for inflation and compute the period 2 measure of taxable income accounting for changes in the definition as in construction of the tax base. The new tax schedule is applied to this construct. The instrument for a change in income is constructed as in Gruber and Saez (2002): it is simply $\ln(B - T^P/p_2) - \ln(B - T_1)$ where T_1 is tax liability in period 1, T^P is tax liability predicted for period 2 and p_2 is the inflation factor between periods 1 and 2.[10]

Aside: Validity of Instruments. Are instruments base on time s information likely to be uncorrelated with the error term? Two reasons for the failure of this assumption have received attention in the literature. The first one is the regression to the mean effect.

[8] In general and apart from the orthogonality assumptions, with just two years of data what is required for identification of both parameters is that the effect of at least two of the variables used in computing the marginal tax rate and tax base stayed constant over time so that they don't enter specification (8). With multiple years of data and multiple tax reforms, this assumption can be somewhat weakened: I can still identify the effect if *trends* by at least two characteristics stayed constant over time.

[9] Until 1982, medical expenses above 3% were deductible, until 1986 - above 5%, after 1987 - above 7.5%. There were minor changes regarding how health insurance affects the calculation in 1982 and 1983.

[10] The results are not sensitive to variations in constructing the tax rate instrument that involve using inflated capital gains as a component of predicted income and not adjusting income for changes in the definition.

Transitory components of income cannot be differenced out. Because by construction transitory components of income as of the first period may enter instruments, this leads to a violation of the orthogonality assumption. Carroll (1998) provides evidence that this effect is important. The second source, discussed by, e.g. Goolsbee (2000), has to do with trends in inequality. There is extensive evidence that relative incomes of the rich were rising in the 1970s and the 1980s. Failure to control for such non-tax trends will almost certainly lead to a bias in the tax coefficient given that changes in both tax rate and tax base were not independent of income. To motivate the following discussion, suppose that $\Delta\theta$ can be expressed as

$$\Delta\theta_{i,s} \equiv \theta_{i,s+1} - \theta_{i,s} = \xi_{i,s+1} + (a-1)\lambda_{i,s} + \phi_{i,s+1} \,,$$

where $\xi_{i,s+1}$ is the income trend between period s and $s+1$ for individual i, $\lambda_{i,s}$ is the transitory component of income in period s and a is a constant reflecting the degree of its persistence,[11] and $\phi_{i,s+1}$ is an income innovation that is uncorrelated with any of the period s variables. When dealing with the tax rate, the worry is that both $\xi_{i,s+1}$ and $\lambda_{i,s}$ are not independent of time s income, although this is due to two distinct reasons. $\lambda_{i,s}$ is a component of income and its correlation with $\ln(B_{is})$ is mechanical. In the presence of differential trends by income groups, $\xi_{i,s+1}$ is correlated with the permanent income (the group indicator), and through this channel it is correlated with $\ln(B_{is})$. The presence of correlation between the error term and initial income almost certainly invalidates the tax rate instrument that is constructed using income even though it takes the form of first difference.

Moffitt and Wilhelm (2000) discuss including income as of time s to control for the regression to the mean effect. This procedure can be understood by interpreting the transitory income component λ_{is} as an omitted variable. Because time s income is correlated with its transitory component, it can be used as a proxy for it. They point out, however, that because of the direct dependence of the tax rate on income, to avoid reliance on functional form assumptions, identification requires some other variation in tax rates such as due to state, demographic characteristics or (in the case of panel data) time variation. This procedure has been accepted and used in most of the recent work (see e.g., Auten and Carroll, 1999; Sillamaa and Veall, 2001; Gruber and Saez, 2002). Gruber and Saez (2002) appear to suggest that this approach also addresses the inequality trend issue. In general, however, one cannot control for the two omitted variables $\xi_{i,s+1}$ and $\lambda_{i,s}$ using a single control variable unless its relationship to the omitted variable can be reduced to its dependence on their sum $\xi_{i,s+1} + (a-1)\lambda_{i,s}$.

Gruber and Saez (2002) experiment with flexible spline income controls in first-period income and conclude that nonlinearities are important. Allowing for nonlinearities in income

[11] If $a = 1$, the shock is permanent and it is eliminated by first differencing. If $a = 0$ so that shocks die off after one period, the problem is most pronounced.

does not address the issue of the two different sources of correlation though. Nonlinearities in permanent income may be important to appropriately control for an unobservable trend (ξ). On the other hand, controlling for nonlinearities in current income effectively eliminates identification due to the changes in the federal rate structure leaving only state variation.

Carroll (1998) constructs an instrument using a proxy for permanent income. Such an instrument should be uncorrelated with the transitory component $\lambda_{i,s}$,[12] but it is still likely correlated with $\xi_{i,s}$. He does not though control for total income but in some specifications he controls for the initial income from financial assets (the sum of dividend and interest income). The latter is likely to be correlated with both ξ and λ. As a result, this control will partly reflect residual correlations with both of these variables and is unlikely to appropriately control for ξ.

Strategy. The tax rate is a function of taxable income, and some demographic characteristics (such as the state of residence, marital status, number of dependents, or age). Effectively then, the tax rate is a function of broad income, the structure of deductions/adjustments and demographic characteristics. In constructing the predicted tax base I rely on taxable income, deductions and tax adjustments. As the result, the tax base is affected by individual specific and transitory components present in each of them. Examples of such influences are tastes for charity (that affect charitable contributions), health status (affecting medical deduction), home ownership (affecting real estate tax and home mortgage deductions), credit history (affecting personal interest deductions) and unobservable income shocks (affecting state tax liability and through this channel the itemization status). The effect of the tax base on income can be identified to the extent that at least some of these characteristics do not independently affect income or that their effect stays constant over time so that they are not present in equation (8). Much of the dependence that is not differenced out will result in correlation with either the transitory effect (λ) or the group-specific trend (ξ). If it was the only source of the correlation, the consistency of estimates rests on these effects being appropriately controlled for, exactly as it does in the analysis of the tax rate effects. Many individual characteristics can be expected to fall in this category. For example, own health status is likely a determinant of the transitory component of income while home ownership is likely closely related to permanent income and the group-specific trend. The assumption that I make is that the effect of unobservable person-specific determinants of deductions that do not stay constant over time is fully accounted for by λ and ξ.

Because I rely on instruments constructed using information as of time s, I must address their possible correlation with both the group-specific trend (ξ) and the transitory income component (λ). The above discussion suggests that I should include two additional control

[12] His proxy for the permanent income is the average income between 1989 and 1995 and he compares 1989 and 1995 income. This proxy may still be correlated with the transitory component as of 1989.

variables to pacify the impact of ξ and λ. In order to control for ξ, I need a measure of the individual's rank in the income distribution. I will use income as of the first year (1979) of the twelve-year panel.[13] I define the transitory income component as the difference between current and 1979 income and exclude 1979 observations from the sample used for estimation. I use this variable to control for λ. I experiment with a 10-piece spline in logarithms of both 1979 income and the "transitory" component to allow for potential nonlinear effects.[14] Nonlinearity in permanent component allows me to account for trends in income varying across different income classes. In principle, the transitory component can be controlled for in a linear fashion. However, because my proxy for temporary income includes a measurement error, allowing for higher-order effects aids in eliminating residual correlation and the resulting bias.

4.3 Data

I use the Statistics of Income/University of Michigan panel of tax returns that were selected every year between 1979 and 1990, according to the last four digits of the social security number. There are usual pros and cons of relying on the data from tax returns: the dataset contains little demographic information, but it includes detailed information about tax returns. The latter is crucial here, because it allows for constructing a measure of the tax base.[15]

I follow Gruber and Saez (2002) in comparing differences between observations three years apart. In other words, when differencing, I subtract observations for 1979 (1980,

[13] An alternative strategy would be to follow Carroll (1998) and construct a measure of permanent income by averaging income over all years an individual is observed the sample. This is problematic for two reasons. First, such a permanent income measure will reflect any tax response. Second, it is unclear how it should be constructed for the unbalanced panel. For a critique of the approaches based on lags of income such as the one presented here and an alternative approach (in the context of charitable gifts) see Auten et al. (2002).

[14] This strategy does not fully eliminate income differences as a source of identification, contrary to the specification of Gruber and Saez (2002) who allowed for flexible spline specifcation in current income. To see that, note that I allow income to enter as $S_1(y - y_{79}) + S_2(y_{79})$ where y is logarithm of current income, y_{79} is logarithm of 1979 income and S_1, S_2 are 10-piece spline functions (i.e., continuous functions linear within deciles of the distribution of the argument). Only in special cases (such as S_1 being linear) is it possible to disentangle the effect of y and y_{79}. The identification from this source therefore arises to the extent that the distribution of the transitory component of the tax rate (i.e., generated by transitory income shocks) is not independent of permanent income. In absence of an economic argument for including current income explicitly, this is a desirable feature of my specification.

[15] There is one practical concern: as elaborated on in what follows, the instrument for the tax base that I use is the predicted change in tax base. This is a feasible task when deductions are removed but it is not possible to be done exactly when they are introduced. The ERTA'81 introduced several new deductions, so that predicting post-1981 tax base for pre-reform data exactly is not feasible. Still, an instrument relying only on the pre-existing deductions remains a valid instrumental variable as long as it remains correlated with actual tax base.

1981,...,1987) from the corresponding observations for 1982 (1983, 1984,...,1990). The three year spread was also used by Feldstein (1995). Using a longer spread allows for estimating permanent elasticity, while short-term differences can be significantly affected by income shifting over time. Using a much longer spread would confound the effects of ERTA'81 and TRA'86 that were just five years apart. For example, the four-year window would include the 1982-1986 pair that adjoins both of the major tax reforms.

The panel is not balanced. There are almost $300,000$ observations that translate into close to $100,000$ three-year differences, but not all observations are used in the analysis. Unless otherwise stated, the sample for estimation is selected as follows. For reasons discussed earlier, I use only post-1979 observations of individuals who are observed in 1979 and whose marital status in 1979 and the considered year is identical. There are 54,374 such three-year differences. Additionally, I exclude those who claim an age exemption in either of the two years (9,932), heads of households (2,674), those with non-positive income in 1979 or either year of the pair (540), those whose state of residence is unknown (33) [16] and some tax returns with missing data. This procedure leaves 41,442 observations.

Details of the definitions of variables are given in the appendix. The major issue is the definition of the left-hand side variable. The ideal variable to use would taxable income, but its definition changes with the tax reforms. As a result, researchers have made compromises by accounting only for these components of taxable income that are observed before and after the reforms. Various definitions have been used in practice. The prevailing approach is to use a broad definition of income that includes all components of income that were reported on tax returns under all considered tax regimes.[17,18] This is also the approach employed here. I construct and use as a dependent variable the measure of broad income consisting of all income that had to be reported every year, regardless of whether it was taxable or not.[19]

Marginal tax rates and tax liabilities were computed by applying the NBER TAXSIM[20]

[16]There is a small number of predominantly rich taxpayers whose state of residence is for confidentiality reasons not reported in the dataset. For most of them, I do have information about their state of residence in one of the prior years and this is what I use, implicitly assuming that they didn't relocated during the intervening period.

[17]In practice, capital gains are often excluded.

[18]Auten and Carroll (1999) and Gruber and Saez (2002) also considered stylized definitions of taxable income. They subtracted from broad income some of the itemized deductions using a constant definitions of applicable floors and limits. In the presence of endogenous itemization decisions, for individuals who change their itemization status, deductions are not observed in all years. Consequently, estimated elasticities partly reflect the mechanical effect of disappearing deductions when individual is no longer itemizing (and vice versa).

[19]Reported nontaxable components include exempt dividends and interests (e.g., from municipal bonds) and a part of unemployment insurance.

[20]The calculator is available at `http://www.nber.org/taxsim/` and described in Feenberg and Coutts (1993). It handles various features of the tax code including Earned Income Tax Credit and AMT. It also

calculator to the actual AGI. Both state (t_s) and federal income (t_f) tax rates are used. The effective marginal tax rate is calculated as $t_f(1-t_s)+t_s$ for itemizers who claim state tax deductions and as t_f+t_s for all others.

Spending on deductible commodities is defined to include total adjustments to income, total deductions for itemizers, charitable deductions for non-itemizers between 1982 and 1986 and non-taxable but reported components of income (as in footnote 19). The value of γ is defined as a ratio of such spending to the broad income measure. Note that, consistently with the model described earlier, inelastic exemptions and the standard deduction are not a part of the definition of γ. In order to construct γ, deductions need not be enumerated, because tax base can be almost mechanically constructed by dividing the taxable income observed on the return through a measure of the broad income. The extent and sources of variation in γ will be discussed in what follows.

Table 1 shows basic summary statistics for the sample used in estimation. The average reported income is about \$45,000 dollars, compared to initial 1979 income of about \$40,742 dollars. 32% of the population is single and 86% are males (virtually all tax returns filed by couples list male as a primary taxpayer). Slightly more than a half of the population itemizes. The average marginal tax rate for the whole sample is 26.4% in period 1 and 24.7% in period 2, while the tax base $(1-\gamma)$ in both periods is on average the same at about 0.865.

4.4 Variation in the tax base.

There are two major aspects of the tax system that are responsible for determining broadness of the tax base. First, deductions and adjustments explicitly exclude parts of income from taxation. As they vary, the tax base of an individual varies. Second, tax bases of itemizers and non-itemizers are different. Changes in both standard deduction and availability of itemized deductions affect relative payoffs from being in different itemization regimes and affect individual itemization status even in the absence of behavioral response (other than a change of itemization selection).

Importantly, the effects of such changes vary also in cross-section. Changes in the standard deduction affect the itemization status (and therefore the tax base) only of those individuals whose gains from itemization are small enough. Elimination of charitable deduction for non-itemizers affects the tax base of people making charitable contributions but not the others. Changes in medical deduction affect the tax base of itemizers who have high enough medical expenses. These effects can interact. For example, following the repeal of the pre-1986 non-itemizer deduction for charitable contributions, a non-itemizer who relied on it may (but need not) change his itemization status. If he does not change it, his tax base

allows for computing state tax rates.

will increase. If he changes the itemization status, his tax base will likely fall as deductions available to itemizers are taken advantage of.

Table 2 presents descriptive statistics showing variation of the key variables over the years for the whole sample. The temporal pattern indicates that tax reforms of the 1980's affected the tax base. The tax base was falling before 1986 and was sharply increased by the Tax Reform Act of 1986. Columns 7 and 8 show that identical pattern is present for both itemizers and non-itemizers. The proportion of itemizers sharply fell following the TRA'86. If only standard deduction had changed, the remaining itemizers would be people with relatively low tax base. Nevertheless, the average tax base among itemizers increased sharply indicating that these changes were not simply caused by changes in the standard deduction.

Column 8 of Table 2 show that non-itemizers do not automatically have a value of γ of 0 (the tax base equal to 1), although it is not far from that. The tax base of non-itemizers was on average lower following the ERTA'81 mostly due to the availability of the deduction for charitable contributions for non-itemizers. The cross-sectional changes are illustrated in Figure 1. It shows the distribution of the tax base in 1980, 1982, 1985 and 1988 (only individuals in the sample used for estimation are included). In every year, the distribution is bimodal corresponding to groups of itemizers and non-itemizers. The ERTA'81 shifted the whole distribution to the left, while the TRA'86 shifted it back to the right.

Table 3 shows mean changes and standard deviations of key variables and instruments for the three-year pairs used in estimation.

5 Results — Tax Rate Effect Only

I begin by considering specifications that control only for the marginal tax rate, and not for the interaction of the marginal tax rate and the tax base. By doing so, I am able to identify the source of differences in the results obtained in previous studies and present directly corresponding estimates obtained using my approach. These estimates serve as a reference point for the discussion of the role of tax base in the next section.

Income controls. In order to highlight the importance of the choice of income controls, I present in Table 4 estimates of the tax coefficient using full sample and various means of income controls.[21,22] The first specification excludes income controls and leads to a significant negative coefficient. The following two specifications are as in Gruber and Saez (2002):

[21] As discussed later, these specifications are not directly comparable to the results of Gruber and Saez (2002) and Auten and Carroll (1999) because these papers additionally restrict sample used for estimation.

[22] All reported results come from the IV regressions. I report robust standard errors to correct for a potential autocorrelation of individual error terms. Only post-1979 observations are used.

controlling for current income has a huge impact but allowing for nonlinearities reduces the estimated elasticity to about 0.2. The same result was obtained by Gruber and Saez (2002).

The following four specifications highlight the importance of both permanent and transitory component of income. Controlling for just the transitory or just the permanent component has relatively little impact on the estimated elasticity, which remains significantly negative. This is so regardless of whether nonlinearity is allowed for. The last panel allows for both types of income controls entering in different combinations of linear and nonlinear effects. Allowing for nonlinear effects in each case significantly reduces the estimated elasticity, as in Gruber and Saez (2002). However, even when both income controls are allowed to enter in a nonlinear fashion, the estimated elasticity remains as high as 0.57. The final specification allows for separate nonlinear controls of transitory components by year (deviations from 1979 income may include aggregate trends and life-cycle effects), and it shows that it has virtually no impact.

The second panel of Table 4 shows the results for married individuals only. Qualitatively, the results are as sensitive to the choice of income controls as in the case of the full sample. However, all of the estimated elasticities are smaller although still significant using any permanent-transitory mix of controls. The elasticity when splines in current income are used is 0.12 and insignificant, while the elasticity when splines in 1979 income and deviation from it are used is estimated at 0.26. The sensitivity of the results to restricting the sample to married individuals only is further investigated in what follows.

Sample Selection. As discussed above, it is important to control for the mean reverting components of income. Apart from controlling for current income, some earlier research also restricted their samples by excluding certain individuals with low incomes. Gruber and Saez (2002) exclude "taxpayers whose income is below $10000 in year 1 [in 1992 dollars], to avoid very serious mean reversion at the bottom of the income distribution." Feldstein (1995) excludes taxpayers with tax rates below 22 percent. Similarly, Auten and Carroll (1999) limit their sample to "taxpayers with incomes at or above the threshold for the 22% marginal tax rate in 1985." Carroll (1998) excludes taxpayers with income below $50,000 in 1989 (approximately $56,000 of 1992 dollars).

By relying on the realized tax rate, the selection rule used by Feldstein (1995) and Auten and Carroll (1999) likely excludes higher income individuals with low taxable income. These papers find larger elasticities than the other two papers that base their sample selection on the income directly. That this is not a coincidence is illustrated in Table 5. I use the same dataset (CWHS[23]) as Gruber and Saez (2002). This dataset constitutes about 20% of the dataset used by Auten and Carroll (1999). The rest of their sample oversamples rich individuals and is not publicly available. They state that they obtain very similar

[23] The Continuous Work History Survey, which is the same as the SOI/University of Michigan panel.

results when they limit the sample to CWHS (p. 692, footnote 2). They analyze 1985-1989 difference only. Because the Feldstein (1995) and Auten and Carroll (1999) restriction depends on the tax system in place, I present the results for the 1985-1988 change only, using the logarithm of income in 1985 as a control for mean reversion.[24] Estimates for the full sample are very large, suggesting that the mean reversion problem at the bottom of distribution is important. Using the Auten and Carroll (1999) restriction to taxpayers with taxable income qualifying for at least 22% tax bracket in 1985 brings the elasticity down to about 0.8.[25] The Gruber and Saez (2002) restriction to individuals with current income above \$10K reduces the elasticity to less than 0.4,[26] while the further restriction to those with current income above \$30K makes it essentially zero (with a sample size similar to the A-C specification). Compared to these differences, the effect of excluding older individuals and those subject to the AMT (cf. the first and second panel of Table 5) is minor.[27]

Splitting the sample according to either current income or the marginal tax rate is affected by the transitory and permanent components of income as well as individual effects. Additionally, splitting the sample according to the level of tax rate is affected by the itemization and tax avoidance behavior. If the parameter of interest is constant, the sample selection bias will be present to the extent that factors determining selection are correlated with the error term and separately controlled for. When transitory and permanent components of income are appropriately controlled for, the sample selection bias should not be present. In that case, if the underlying parameter of interest is indeed constant, how the sample is split should not affect the results, contrary to the results in Table 5. The results in that table suggest that the specification considered in the previous work was misspecified.

The decision to split the sample may also be motivated by a belief that the underlying parameters vary in the population. This was likely the implicit motivation of previous research that did not consider the low-income group as a valid control for high-income people who experienced the largest tax changes. Differences in behavior of the rich and the poor can be ascribed to either tastes or technology. In the framework of this paper, taste differences are accounted for by allowing for individual effects and thus should not affect the results. Differences in available technology are allowed for by controlling for the tax base. The case for the elasticity of income to vary across different groups is therefore weaker than in prior research. Therefore, I investigate sensitivity of my estimates to sample selection and view stability of estimates as a testable prediction of my approach.

[24] Auten and Carroll (1999) report results with log income control only.

[25] Auten and Carroll (1999) estimate in a directly comparable specification is 0.67.

[26] Using the full panel using sample restriction and weighting by income to mimic results of Gruber and Saez (2002) (Table 4) yields estimate of 0.29 (with t-statistic of 2.08), somewhat higher than theirs of 0.17. A few small changes in the definition of total income discussed in the appendix are responsible for the difference.

[27] Although not reported here, including current income splines as in the preferred specification of Gruber and Saez (2002) renders tax coefficients in all specifications in Table 5 insignificant.

In Table 6, I report estimates of the specification with the tax rate using my preferred specification (i.e., controlling separately and nonlinearly for the level of and deviation from 1979 income) and alternative ways of sample splittings. The estimated elasticity for the whole sample is .57 while estimates for subsamples are all smaller and usually imprecisely estimated. However, estimates obtained by splitting the sample using 1979 income are consistently larger than those obtained by splitting the sample according to the contemporaneous income level. Clearly, in each case the results remain sensitive to the sample selection still suggesting a possible specification error.

6 Results — Tax Rate vs. Tax Base

The previous section offers a mechanical explanation for the differences in results found in previous papers. Relying on the insights regarding the relevance of sample selection and income controls, I turn now to the main question of this paper: the impact of the tax base on reported income.

Table 7 repeats the exercise reported in Table 4 while allowing for both tax rate and tax base effects. Estimates of the direct tax elasticity are equally sensitive to the choice of income controls as the ones when only tax rate is controlled for. In every specification, the interaction effect is positive and significant, but its value is also sensitive to the choice of controls. I conclude that allowing for flexible income controls is important and, in what follows, I allow for splines in both permanent and transitory components.

The main results are shown in Table 8. Estimates for the whole sample indicate that both direct tax elasticity and tax base effects are important. The direct tax elasticity is 0.441 while the coefficient at $\gamma \ln(\tau)$ is 1.04. Evaluated at the average tax base of 0.913 (i.e., $\gamma = .087$), this corresponds to the tax elasticity of 0.53. In the sample used for estimation, following the Tax Reform Act of 1986 the average tax base increased from 0.880 in 1985 to 0.927 in 1988, so that γ declined from 0.120 to 0.077. Consequently, the point estimates imply that the elasticity of broad income at the average tax base fell from 0.57 to 0.52, or by about 9%.

For each alternative way of slicing the income distribution, the direct tax elasticity is always insignificant though a little sensitive to the choice of subsample, while the effect of interaction is usually large and significant. Comparing these results to those in Table 6 reveals that estimates of the direct tax elasticity are usually smaller than those obtained when tax base effects are ignored. The interaction effect is large and significant in most cases. The implied elasticities evaluated at the average tax base for the whole sample (which is roughly 0.9, i.e., $\gamma \approx 0.1$) are always quite close to estimates that ignore tax base effects. Consequently, the quantitative importance of these results lies not in correcting the bias but rather in pointing to a non-structural character of the estimated parameter that varies systematically with tax policy changes.

The next two panels of Table 8 show results by marital status. While one might argue that marital status variations provide an additional source of identification (see Joulfaian in context of charitable gifts), this is a difficult point to make, because it implies that the same behavioral model applies to both types of households. Furthermore, single individuals are likely to be predominantly young and therefore experiencing large changes in income following completing their education. Such reasoning led Auten and Carroll (1999) to exclude individuals younger than 25 from their sample. In the absence of more detailed demographic information (in particular, having no information about age), I am not able to control for such considerations explicitly. However, splitting the sample by marital status allows to partially address this problem if most of the young individuals is single.

Table 8 reveals that the results for single and married individuals are vastly different. Results for singles are all over the map. While the direct tax elasticity is significant and large for the whole sample, it is not significant and varies between .2 and 1.4 for the subsamples. It is very likely that many individuals in this group are working part-time or entering the labor force while in sample, so that changes in their income are not tax motivated. Given my inability to control for other demographic characteristics of these individuals, I believe that results for single individuals are not meaningful.

Results for married individuals are, however, remarkably stable. The direct tax elasticities are always insignificant and close to zero. At the same time, the effect of the interaction is precisely estimated at 0.94 for the full sample and this point esimate is within one standard error of estimates for each of the considered income groups.

With very few exceptions, income effects are close to zero and insignificant.

In Table 9, I repeat the same exercise for the full sample and separately for the sample of married individuals while controlling for the splines in current income only, as in Gruber and Saez (2002). The results using full sample are sensitive to this change, although the results for married individuals are quite consistent.

I interpret my results as indicating that apart from the difficulty to control for transitory and permanent shocks in income, the previous studies suffered from two additional problems. First, the model was mis-specified due to ignoring the effect of the tax base. Second, the results indicate that mixing individuals with different marital status while identifying the effect of taxes on income is suspect. When these two problems are corrected for, the choice of income controls and sample used in estimation has a relatively minor effect.

7 Implications

Given that I have most trust in the results for the married individuals, I concentrate on this group in developing normative implications of the results. I concentrate on the results for all married individuals, i.e., the first specification in the second panel of Table 8. The estimated direct tax elasticity is 0.086 while the estimated effect of the interaction with the tax base is 0.942. As Table 2 shows, the mean marginal tax rate for my sample fell from 0.212 in 1985 to 0.184 in 1988, while the mean average tax base increased from 0.880 to 0.927. The estimated results suggest therefore that the Tax Reform Act of 1986 reduced the elasticity of reported income to the tax rate at the mean tax base from 0.199 to 0.155.

One simple implication of this result can be developed in terms of the marginal cost of funds (MCF). A simple formula for the MCF of the income tax is

$$MCF_t = \frac{1}{1 - \frac{t}{1-t}\varepsilon},$$

where t is the marginal tax rate and ε is the elasticity of tax base. Evaluating this formula at the mean tax rate yields a 1985 value of MCF_t of 1.057 and a 1988 value of 1.036. Interpreting these numbers, it implies that the social cost of collecting a dollar of revenue fell by 2 cents per dollar. Alternatively, given estimated null income response, it directly translates into a reduction in the marginal excess burden by 36%, from 0.057 cents per dollar to 0.036. Holding the tax base constant at the initial level, the same change in the marginal tax rate would have reduced the MCF to just 1.047, resulting in a 50% smaller excess burden reduction. While these are not definitive calculations, they illustrate the potential quantitative importance of understanding the role of non-tax instruments in evaluating tax policy.

The results also indicate that the elasticity of reported income may well be different for different groups, to the extent that their tax bases are different. The results in table 8 indicate (using the average tax base in each group and the estimates for the whole sample) that the elasticity of income for married individuals below the $30,000 threshold was 0.197 while the corresponding elasticity for people with incomes above $100,000 was 0.285. These differences are much smaller than estimated by Gruber and Saez (2002). Even though they still systematically vary with income, they do not necessarily imply that tax rates at high incomes need to be adjusted to account for stronger behavioral response: the differences in elasticities are themselves a function of policy.

To be sure, there are complicating factors that are in no way addressed in this paper and that may be very relevant. To the extent that the estimated response merely reflects shifting from other tax bases such as the corporate or capital gains tax, the elasticity of reported income should be corrected by losses of revenue from other sources. Accounting for such a response could undermine the calculations performed above.

Additionally, the elasticity of income determines only the cost of taxation, while the complete analysis of policy requires understanding benefits as well. There may be a trade-off involved in the choice of tax base to the extent that deductions from the tax base are socially beneficial on, for example, redistributive grounds. Also, a broader tax base may feature different administrative costs (Yitzhaki, 1979; Wilson, 1989).

The response estimated in this paper reflects the response of broad income rather than its taxable component. Proper estimation of the response of taxable income would require accounting for changes in its definition on the left-hand side of estimated relationship. A more complex econometric framework that models, inter alia, itemization decision is necessary for that. There is, however, evidence that at least some of deductions (e.g., charitable contributions) respond strongly to tax rates. By eliminating such responsive components from the tax base, the elasticity of taxable income can be reduced beyond the effect analyzed in this paper. This should be an interestig area for future research.

The bottom line is that any analysis of the impact of taxes should not ignore the fact that the crucial elasticity of taxable income is endogenous to the size of the tax base and, more generally, to other aspects of tax system. Putting these results in a broader perspective, this papers offers an empirical support for theoretical ideas advanced by e.g., Mayshar (1991); Slemrod (1994); Kopczuk (2001); Slemrod (2001) and Slemrod and Kopczuk (2002). The cost of taxation is not merely a function of marginal tax rates, consumer preferences and technology, but rather it crucially depends on the broader tax environment and the structure of tax policy. Therefore, economic analysis of optimal tax policy has to incorporate tax avoidance and administration.

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A Data.

The dataset used is the panel extract of the SOI Tax Model collection of individual income tax returns available from the University of Michigan Office of Tax Policy Research. Documentation of this dataset can be found online at `http://www.nber.org/~taxsim/iit-docs/`. Broad income definition includes wages, dividends and interest income (with excluded components), unemployment income, pensions, annuities, IRA distributions, alimony received, state tax refunds, partnership and S-corporation income, Schedule C income, farm income, rental income and royalties, and other income. Passive losses are added back because they are not consistently observable before and after TRA'86. Income adjustments and total deductions include all items reported on the tax returns. The marginal tax rates are obtained by applying the TAXSIM calculator to the actual AGI (including capital gains and reduced by non-itemizer deduction for charitable contributions between 1982 and 1986), total itemized deductions and claimed exemptions. The tax base $1 - \gamma$ is computed as the ratio of broad income less total adjustments and total deductions (excluding state and local income tax deduction but including non-itemizer charitable contribution deduction) over broad income. Low income individuals with no tax liability who do not claim any deductions have the tax base of 1.

Not all variables from the tax returns are present for all years. Some effort was undertaken to correct certain missing values. Past state of residence, if known, was used if state of residence is missing. Standard deduction was used to recover age and blindness status if missing. Total Schedule E income is missing in 1981 but can be constructed from its components. Royalty and rental income is not available in 1987 but can be approximated back out from other Schedule E variables.

While constructing instruments, all variables were inflated using three-year CPI change. The predicted marginal tax rate was computed by applying TAXSIM calculator for the second year in the pair to broad income, total adjustments and total deductions recalculated using new definitions, and claimed exemptions. Capital gains were not included. The results are not sensitive to inclusion of capital gains or not adjusting deductions. The predicted tax base was calculated by first recalculating total adjustments and total deductions using new definition and then calculating the ratio as before. Changes in the definitions of rules that were accounted for include changes in the threshold for medical deduction, changes in the deduction for health insurance, changes in the rules governing deductibility of personal interest expenses following TRA'86, changes in the threshold for theft and casualty loss deduction, changes in the treatment of non-itemizer charitable contribution deduction, changes in the IRA deduction and changing status of moving cost income adjustment to a deduction following TRA'86. The computed predicted value of deductions was compared to the new standard deduction to determine predicted itemization status. For individuals before 1984 who were predicted to change their status to non-itemizers, the non-itemizer charitable deduction was instead allowed for. Total and predicted tax liability used in constructing an instrument for income effects was taken from the corresponding TAXSIM results.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	N
Current Income (1992 dollars)	44815	61322	41442
Income in 1979 (1992 dollars)	40742	34665	41442
Single	0.324	0.468	41442
Male	0.859	0.348	41442
Itemizers	0.516	0.5	41442
τ_1	0.264	0.111	41442
τ_2	0.247	0.101	41442
$1-\gamma_1$	0.864	0.164	41442
$1-\gamma_2$	0.866	0.165	41442
$\Delta\ln(B)$	0.038	0.625	41442
$\Delta\ln(\tau)$	0.026	0.122	41442
$\Delta\ln(\tau^P)$	0.032	0.058	41442
$\Delta\gamma\ln(\tau)$	0.005	0.04	41442
$\Delta\gamma^P\ln(\tau^P)$	0.009	0.019	41442
$\Delta\ln(X)$	0.043	0.578	41388
$\Delta\ln(X^P)$	0.011	0.059	41425

τ denotes the marginal tax rate while $1-\gamma$ is the tax base. B is broad income and X is broad income less tax liability. Subscripts $i=1,2$ refer to the first or second year in a three-year difference. Superscript P refers to an instrument (predicted value of the variable) as defined in text. Definitions of other variables are as follows: $\Delta\ln(B)=\ln(B_2/B_1)$, $\Delta\ln(\tau)=\ln(\tau_2/\tau_1)$ $\Delta\ln(\tau^P)=\ln(\tau^P/\tau_1)$, $\Delta\gamma\ln(\tau)=\gamma_2\ln(\tau_2)-\gamma_1\ln(\tau_1)$ and $\Delta\gamma^P\ln(\tau^P)=\gamma_P\ln(\tau^P)-\gamma_1\ln(\tau_1)$, $\Delta\ln(X^P)=\ln(X^P)-\ln(X)$. Sample includes all 3-year differences used for estimation.

Table 2: Means of Selected Variables by Year of Filing

					Share	Tax Base	
Year	**Number**	t	$1-\gamma$	$t(1-\gamma)$	**Item.**	**Item.**	**N-Item.**
1979	45393	0.225	0.926	0.205	0.284	0.762	0.991
1980	45781	0.234	0.920	0.213	0.306	0.760	0.990
1981	46250	0.243	0.913	0.219	0.328	0.756	0.990
1982	9445	0.229	0.897	0.203	0.350	0.735	0.984
1983	18833	0.216	0.891	0.190	0.363	0.731	0.982
1984	9862	0.213	0.884	0.186	0.384	0.729	0.981
1985	19878	0.212	0.880	0.184	0.390	0.724	0.980
1986	10285	0.211	0.874	0.182	0.388	0.720	0.972
1987	21002	0.191	0.919	0.174	0.338	0.776	0.992
1988	21553	0.184	0.927	0.170	0.292	0.770	0.992
1989	22031	0.185	0.928	0.170	0.287	0.767	0.993
1990	21977	0.184	0.922	0.169	0.288	0.756	0.989
Summary	292290	0.215	0.913	0.195	0.325	0.753	0.988

Definitions of variables are as in Table 1. All observations present in the dataset are used.

Table 3: Means of Selected Variables by Year of Filing.

	N	Item.	$\Delta \ln(B)$	$\Delta \ln(\tau)$	$\Delta \ln(\tau^P)$	$\Delta\gamma \ln(\tau)$	$\Delta\gamma^P \ln(\tau^P)$
1979-1982	5277	0.358	0.086	-0.016	-0.016	-0.011	-0.001
		(0.480)	(0.724)	(0.135)	(0.042)	(0.037)	(0.009)
1980-1983	9286	0.413	0.048	0.025	0.024	-0.008	0.004
		(0.492)	(0.679)	(0.128)	(0.042)	(0.037)	(0.013)
1981-1984	4322	0.459	0.034	0.046	0.043	-0.006	0.007
		(0.498)	(0.643)	(0.128)	(0.048)	(0.040)	(0.017)
1982-1985	4057	0.496	0.058	0.019	0.025	-0.004	0.005
		(0.500)	(0.634)	(0.122)	(0.036)	(0.036)	(0.011)
1983-1986	3827	0.521	0.073	-0.003	0.007	-0.008	0.002
		(0.500)	(0.635)	(0.120)	(0.030)	(0.039)	(0.010)
1984-1987	3631	0.563	0.053	0.025	0.047	0.018	0.014
		(0.496)	(0.633)	(0.120)	(0.060)	(0.038)	(0.022)
1985-1988	6867	0.586	0.025	0.041	0.052	0.024	0.019
		(0.493)	(0.610)	(0.118)	(0.076)	(0.040)	(0.024)
1986-1989	3278	0.595	0.014	0.040	0.054	0.028	0.022
		(0.491)	(0.574)	(0.119)	(0.078)	(0.043)	(0.027)
1987-1990	6174	0.573	0.009	0.012	0.013	0.003	0.006
		(0.495)	(0.548)	(0.110)	(0.054)	(0.032)	(0.018)
Summary	46719	0.498	0.044	0.021	0.026	0.003	0.008
		(0.500)	(0.637)	(0.124)	(0.058)	(0.040)	(0.019)

Columns show mean differences of variables. Standard deviations are in parenthesis. Sample includes all 3-year differences used for estimation and 1979-1982 observations selected using the same rule. Definitions of variables are as in Table 1.

Table 4: Tax Rate IV Regressions Using Different Approaches to Controlling for Permanent and Transitory Components of Income

	Δ ln(τ)	**T-value**
Full Sample		
No income controls	-0.80	-10.99
Logarithm of current income	1.44	10.19
Splines of log current income	0.21	1.89
Logarithm of 1979 income	-0.32	-3.71
Splines of log of 1979 income	-0.59	-7.14
Deviation of log current income from log 1979 income	-0.52	-6.47
Splines of the above	-0.45	-5.75
Log of 1979 income and log of deviation from it	1.37	9.90
Log of 1979 income and splines of deviations	0.93	7.46
Splines of log of 1979 income and log of deviation	0.89	7.24
Splines of log of 1979 income and splines of log-deviations	0.57	4.89
Splines of log of 1979 income and yearly splines of log-deviations	0.55	4.78
Married individuals only		
No income controls	-0.34	-4.10
Logarithm of current income	0.90	6.34
Splines of log current income	0.12	1.07
Logarithm of 1979 income	-0.25	-2.66
Splines of log of 1979 income	-0.32	-3.41
Deviation of log current income from log 1979 income	0.03	0.36
Splines of the above	-0.06	-0.66
Log of 1979 income and log of deviation from it	0.76	5.76
Log of 1979 income and splines of deviations	0.32	2.75
Splines of log of 1979 income and log of deviation	0.62	4.86
Splines of log of 1979 income and splines of log-deviations	0.26	2.26
Splines of log of 1979 income and yearly splines of log-deviations	0.26	2.26

Sample size is 41,442 for the full sample and 28,025 for the sample of married individuals (1979-1982 pair is excluded). All regressions include gender and marital status (where applicable), as well as the full set of year dummies. "Splines" refer to a flexible piecewise linear functional form (10 components). The tax rate instrument is described in the text.

Table 5: Tax Rate IV Regressions — Sensitivity to Sample Selection Using 1985-1988 Data and Previous Methodology

	Restricted Sample (A+C)				Full Sample (G+S)			
	All	A+C	G+S	G+S 30K	All	A+C	G+S	G+S 30K
				1985-1988 Only				
$\Delta \ln(\tau)$	2.343	.882	.387	.011	2.721	.845	.347	.0008
	(.263)**	(.237)**	(.199)	(.191)	(.237)**	(.205)**	(.167)*	(.161)
$\ln(B)$	-.503	-.115	-.127	.009	-.488	-.108	-.081	.014
	(.022)**	(.027)**	(.02)**	(.025)	(.021)**	(.025)**	(.017)**	(.024)
N	11280	5203	9052	5659	13621	5982	11073	6513

The restricted sample excludes couples with at least one age or blindness exemption and subject to the AMT (for comparability with Auten and Carroll (1999) and Gruber and Saez (2002)). Compared to the other specifications in this paper, this sample does not exclude individuals who are not observed in 1979, heads of households or those with non-positive 1979 income. Specification marked: (1) "all" does not impose additional restrictions; (2) A+C removes taxpayers with federal tax rate below 22%; (3) G+S eliminates taxpayers with total income below 10,000 (1992 dollars) (4) G+S 30K eliminates taxpayers with total income below 30,000 (1992 dollars). All regressions include gender and marital status (where applicable), as well as the full set of year dummies.

Table 6: Tax Rate IV Regressions — Sensitivity to Sample Selection Using Controls for Permanent and Transitory Income Components

		Current income		1979 income				
	NR	$> 10K$	$> 30K$	$< 30K$	$> 10K$	$> 30K$	$> 50K$	$> 100K$
				Full Sample				
$\Delta \ln(\tau)$	.568	.195	.083	.434	.306	.244	.376	.258
	(.116)**	(.101)	(.107)	(.237)	(.11)**	(.119)*	(.147)*	(.265)
N	41442	37295	25180	17158	35627	24284	12602	1529
				Married Individuals				
$\Delta \ln(\tau)$	.259	.157	.035	-.088	.205	.165	.254	.254
	(.115)*	(.108)	(.113)	(.249)	(.113)	(.121)	(.141)	(.262)
N	28025	27361	21954	6066	27509	21959	12078	1448
				Single Individuals				
$\Delta \ln(\tau)$	1.113	.244	.121	1.046	.634	.410	1.031	1.522
	(.335)**	(.275)	(.369)	(.456)*	(.355)	(.442)	(.791)	(2.309)
N	13417	9934	3226	11092	8118	2325	524	81

All regressions include gender and marital status (where applicable), as well as the full set of year dummies. 10-piece linear splines in 1979 income and in deviation of the current income for 1979 income are used. Instruments as described in text.

Table 7: Tax Rate and Tax Base IV Regressions — Sensitivity to Sample Selection Using Controls for Permanent and Transitory Income Components

	$\boldsymbol{\Delta}\ln(\tau)$	**T-val**	$\boldsymbol{\Delta}\gamma\ln(\tau)$	**T-val**	$\boldsymbol{\Delta}\ln(X)$	**T-val**
Full Sample						
No income controls	-0.86	-9.06	0.53	2.19	0.08	0.54
Logarithm of current income	1.18	4.53	2.02	5.58	-0.02	-0.14
Splines of log current income	0.04	0.40	0.70	3.11	0.10	1.47
Logarithm of 1979 income	-0.47	-5.96	0.94	3.43	0.08	0.54
Splines of log of 1979 income	-0.68	-8.07	0.65	2.55	0.07	0.52
Deviation of log current income from log 1979 income	-0.60	-7.24	0.51	2.09	0.03	0.25
Splines of the above	-0.54	-6.93	0.65	2.97	0.04	0.59
Log of 1979 income and log of deviation from it	1.17	4.73	1.89	5.48	-0.04	-0.29
Log of 1979 income and splines of deviation	0.70	4.13	1.61	5.71	0.01	0.05
Splines of log of 1979 income and log of deviation	0.81	4.30	1.30	4.25	-0.06	-0.51
Splines of log of 1979 income and splines of log-deviations	0.44	3.15	1.06	4.08	0.01	0.13
Splines of log 1979 income and yearly splines of log-deviations	0.41	3.04	0.97	3.73	0.04	0.49
Married Individuals Only						
No income controls	-0.42	-5.28	0.42	1.51	0.10	0.52
Logarithm of current income	0.59	2.77	1.45	3.81	0.08	0.53
Splines of log current income	-0.10	-1.09	0.92	4.02	0.19	3.06
Logarithm of 1979 income	-0.35	-4.08	0.50	1.75	0.10	0.53
Splines of log of 1979 income	-0.41	-4.75	0.51	1.76	0.09	0.44
Deviation of log current income from log 1979 income	-0.09	-0.83	0.65	2.26	0.05	0.36
Splines of the above	-0.18	-2.07	0.62	2.61	0.11	1.80
Log of 1979 income and log of deviation from it	0.53	2.91	1.31	3.81	0.05	0.38
Log of 1979 income and splines of deviation	0.13	1.16	0.94	3.70	0.11	1.75
Splines of log of 1979 income and log of deviation	0.45	2.55	1.28	3.70	0.01	0.07
Splines of log of 1979 income and splines of log-deviations	0.09	0.78	0.94	3.67	0.10	1.55
Splines of log 1979 income and yearly splines of log-deviations	0.08	0.75	0.89	3.45	0.12	1.87

Table 8: Tax Rate and Tax Base IV Regressions Using Controls for Permanent and Transitory Income Components

		Current income		1979 income				
	NR	$> 10K$	$> 30K$	$< 30K$	$> 10K$	$> 30K$	$> 50K$	$> 100K$
$\Delta \ln(\tau)$	.441	.150	.091	.410	.219	.109	.162	-.028
	(.139)**	(.115)	(.123)	(.293)	(.124)	(.117)	(.133)	(.214)
$\Delta\gamma \ln(\tau)$	1.045	.528	.613	.997	.771	.890	.902	.712
	(.26)**	(.231)*	(.279)*	(.664)	(.26)**	(.255)**	(.313)**	(.411)
$\Delta \ln(X)$	.010	.014	-.067	-.036	.003	.061	.114	.255
	(.082)	(.084)	(.104)	(.154)	(.084)	(.079)	(.078)	(.075)**
N	41388	37248	25143	17147	35578	24241	12574	1517
$\bar{\gamma}$	.128	.139	.167	.076	.143	.174	.194	.211
Married Individuals								
$\Delta \ln(\tau)$	.086	.046	-.020	-.232	.049	.044	.096	.022
	(.11)	(.106)	(.115)	(.192)	(.108)	(.119)	(.132)	(.226)
$\Delta\gamma \ln(\tau)$	.942	.713	.793	.896	.867	.889	.889	.670
	(.257)**	(.234)**	(.267)**	(.616)	(.26)**	(.27)**	(.329)**	(.452)
$\Delta \ln(X)$	.099	.098	.015	.282	.094	.043	.077	.191
	(.064)	(.068)	(.092)	(.103)**	(.066)	(.085)	(.088)	(.094)*
N	27978	27319	21919	6058	27464	21920	12051	1436
$\bar{\gamma}$	.164	.167	.175	.118	.165	.179	.194	.212
Single Individuals								
$\Delta \ln(\tau)$	1.364	.414	.384	1.43	1.126	.171	.184	-.530
	(.573)*	(.388)	(.483)	(.806)	(.656)	(.384)	(.622)	(.975)
$\Delta\gamma \ln(\tau)$	.811	-.171	-.682	.704	.042	.855	1.321	2.730
	(.837)	(.634)	(.723)	(1.165)	(.819)	(.767)	(1.13)	(1.983)
$\Delta \ln(X)$	-.153	-.148	-.172	-.22	-.313	.213	.31	.633
	(.208)	(.171)	(.175)	(.248)	(.247)	(.155)	(.136)*	(.079)**
N	13410	9929	3224	11089	8114	2321	523	81
$\bar{\gamma}$	.07	.084	.127	.054	.091	.141	.183	.197

All regressions include gender and marital status (where applicable), as well as the full set of year dummies. 10-piece linear splines in 1979 income and in deviation of the current income for 1979 income are used. Instruments as described in text.

Table 9: Tax Rate and Tax Base IV Regressions Using Splines in Current Income

		Current income		1979 income				
	NR	$> 10K$	$> 30K$	$< 30K$	$> 10K$	$> 30K$	$> 50K$	$> 100K$
$\Delta\ln(\tau)$	.044	.026	.034	.047	.003	.022	.066	-.099
	(.106)	(.105)	(.118)	(.241)	(.105)	(.108)	(.125)	(.207)
$\Delta\gamma\ln(\tau)$	.692	.522	.626	.194	.719	.884	.845	.711
	(.227)**	(.217)*	(.271)*	(.565)	(.237)**	(.239)**	(.295)**	(.392)
$\Delta\ln(X)$	.104	.065	-.047	.03	.095	.132	.143	.272
	(.072)	(.08)	(.106)	(.118)	(.078)	(.076)	(.071)*	(.07)**
N	41388	37248	25143	17147	35578	24241	12574	1517
Married Individuals								
$\Delta\ln(\tau)$	-.101	-.079	-.09	-.263	-.141	-.048	-.004	-.062
	(.094)	(.097)	(.107)	(.191)	(.093)	(.109)	(.121)	(.216)
$\Delta\gamma\ln(\tau)$	.918	.730	.812	.935	.877	.883	.826	.658
	(.229)**	(.215)**	(.247)**	(.572)	(.233)**	(.25)**	(.303)**	(.429)
$\Delta\ln(X)$	.189	.152	.064	.317	.177	.125	.131	.214
	(.062)**	(.062)*	(.087)	(.104)**	(.065)**	(.086)	(.077)	(.092)*
N	27978	27319	21919	6058	27464	21920	12051	1436

All regressions include gender and marital status (where applicable), as well as the full set of year dummies. 10-piece linear splines in current income is used. Instruments as described in text.

Figure 1: Distribution of the Average Tax Base in 1980, 1982, 1985 and 1988

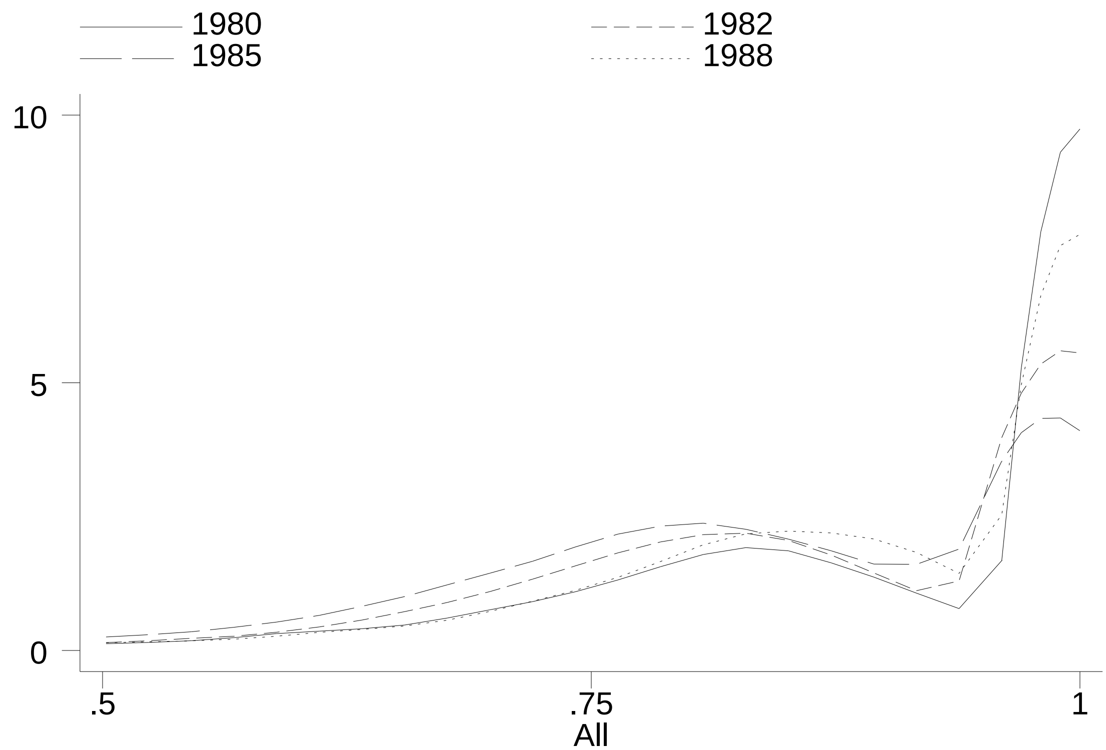

Figure 2: Distribution of the Actual and Predicted Tax Bases in 1985 and 1988