Do Taxpayers Bunch at Kink Points ?

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Abstract

This paper uses individual tax returns micro data from 1960 to 1997 to analyze whether taxpayers bunch at the kink points of the U.S. income tax schedule generated by jumps in marginal tax rates. Clear evidence of bunching is found only at the threshold of the first tax bracket where tax liability starts. Evidence for other kink points is weak or null. Evidence of bunching is stronger for itemizers than for non-itemizers. The large jumps in marginal tax rates created by the Earned Income Tax Credit generate very little bunching except for recipients reporting substantial self-employment income. In the standard micro-economic model, the amount of bunching should be proportional to the size of the compensated elasticity of earnings with respect to tax rates. We introduce uncertainty and rigidities in labor supply choices to account for the empirical results. Numerical simulations show that, even in those cases, behavioral elasticities consistent with the empirical results are small.

Keywords: Bunching, Budget set kink points, responses to taxation.

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1 Introduction

The analysis of the behavioral response of earnings to taxes and transfers has generated a very large body of empirical work in the labor and public economics literature. The size of the behavioral response is a critical parameter to assess the efficiency costs of taxes and to determine the optimal structure of taxation and the generosity of transfer programs. Most empirical studies on labor supply responses to income taxation use the classical static micro-economic model in which agents choose to supply hours of work until the marginal disutility of work becomes equal to marginal benefits of consumption.[1] This standard model predicts that, if indifference curves are well behaved and preferences are smoothly distributed, we should observe bunching at convex kink points of the budget set. Taxes and government transfers create kink points in individual budget sets. The progressive structure of the federal individual income tax generates a piece-wise linear budget set with kinks at each point where the marginal tax rate jumps. Most government transfer programs also introduce piecewise-linear constraints because transfer benefits are progressively "taxed" away as income rises. The Earned Income Tax Credit (EITC) also creates two large convex kink points at the point where the subsidy stops, and when the credit starts being taxed away. Looking for bunching evidence around kinks is a simple test of the validity of the standard model used as the conceptual framework in most empirical studies.[2]

A strand of the empirical labor supply literature has explicitly taken into account the predictions of the basic model with kinky budget constraints in order to improve estimation of labor supply behavior. This method, known as the non-linear budget set estimation method, reckons explicitly that maximizing utility agents must be either on a linear part of the budget set or at a convex kink point. This method was first developed by Burtless and Hausman (1978) to study the Negative Income Tax experiments. Hausman (1981) applied this method to study the effect of the federal income tax on labor supply. Since then, this method has then been applied to the analysis of labor supply responses to many government transfer programs.[3]

[1]As shown in Feldstein (1999), this model can be extended to analyze not only the choice of hours of work but more generally the response of overall income to taxes.

[2]Looking at bunching is actually the only fully non-parametric method to obtain evidence of responses to marginal tax rates when only a single cross section of income data is available.

[3]Moffitt (1990) describes the non-linear budget set method and provides a survey of applications.

However and perhaps surprisingly, no study has carefully examined the evidence of bunching at the kink points of the income tax schedule, or transfer programs. This is especially striking because studying bunching is relatively straightforward and only requires micro-economic data on taxable income.[4] Therefore, it is surprising that the proponents of the non-linear budget set method did not try to perform that simple test of the basic model. Heckman (1982) early criticized Hausman's studies of the effect of the income tax on labor supply arguing that no evidence of bunching could be found in the data. As Hausman (1982) replied however, this does not necessarily invalidate that approach because measurement error in earnings is present in the data and can be taken care of in the estimation strategy.[5]

But a few studies document the evidence of bunching of agents at the kink points generated by taxes or transfer programs. Burtless and Moffitt (1984) and Friedberg (1998), using Current Population Survey data, observed bunching behavior in the case of elderly who receive social security benefits but are still working. Social security benefits are taxed away when earned income exceeds an exemption amount. Tax rates vary from 33% to 50% and thus generate substantial kinks in the budget set of the elderly. Liebman (1998) looked at the earnings distribution of families eligible for the EITC in 1992 (before the large expansion of the program) but found no evidence of bunching at the kink points generated by this program.

Therefore, the first goal of the present paper is thus to investigate thoroughly whether there is evidence of bunching at the kink points of the U.S. income tax since 1960. This study uses the large cross-sections of tax returns publicly released by the Internal Revenue Service from 1960 to 1997. These data are perfectly suited because they give information about the precise location of taxpayers on the tax schedule. The data shows surprisingly weak evidence of bunching around the kink points of the income tax schedule. Evidence of clustering is present only around the threshold of the first income tax bracket where tax liability starts. The extent of clustering was larger in the 1960s than in the 1990s, when the rules to compute exemptions and deductions

[4] In the United States, tax return micro data have started becoming available since the 1960s.

[5] The most widely used datasets such as the Current Population Survey (CPS) or the Panel Study of Income Dynamics (PSID) do not provide the precise location of taxpayers on the tax schedule because not all sources of income or deductions are reported, and those reported have substantial measurement error. We suspect that the fact that tax returns data have been rarely been used by labor economists explains why the analysis of bunching has remained under-investigated.

was simpler and perhaps more transparent. However, no evidence of bunching is found around the other kink points of the tax schedule. Even though the tax schedule has remained stable from 1988 to 1997, no evidence of clustering is found around the large jump in marginal rates from 15 to 28%. The highest tax brackets introduced in 1993 have not generated bunching either. Perhaps more surprisingly, the very large kinks created by the expanded EITC since 1994 have generated very little bunching, except for the small group of EITC recipients who are self-employed.

In the basic micro model, the amount of bunching generated by kinks in the budget set depends on the size of the *compensated* elasticity of income with respect to the net-of-tax rate. Unsurprisingly, high elasticities should lead to high levels of clustering. The compensated elasticity is one of the key parameters to devise an optimal income tax policy because the deadweight loss of taxation is directly proportional to that elasticity (see e.g. Feldstein (1999)). There is a controversial debate on the size of this behavioral elasticity.[6] The weak evidence of bunching found in the data suggests that, if the standard model is adequate, this elasticity should be very low.

The basic model is too simple because taxpayers cannot perfectly fine-tune their labor supply nor control perfectly all their sources of income. The second part of this paper develops theoretical models to capture these realistic features. When taxpayers cannot choose their earnings exactly as in the basic model because of random components of income such as risky returns on capital (physical or human) or because employers do not allow employees to choose freely their hours of work, perfect bunching at the kink is smoothed out and becomes a hump in the income distribution around the kink point. Numerical simulations show that even in these extended models, for reasonable values of the parameters, clustering of taxpayers around kink points should still appear unless the elasticity of taxable income is very small.

Finally, we argue that the empirical evidence suggests that standard models cannot account for all the facts, and that taxpayers might be sensitive to the saliency of the kink. For example, the first kink point where tax liability starts is much more visible on tax tables than kink points at higher income levels or even the larger kinks generated by the EITC schedule. This suggests that framing effects in the tax structure have potentially important consequences on

[6] Gruber and Saez (2000) provide a survey of most recent empirical studies.

how taxpayers respond to taxes or transfers.

The remaining of the paper is organized as follows. Section 2 introduces the basic theoretical framework and the data and discusses the estimation methodology. Section 3 presents the empirical results. Section 4 extends the basic model to situations where individuals cannot control perfectly their incomes and proposes calibrated numerical simulations. Section 5 provides a brief conclusion and discusses methodological and policy implications.

2 Model, Data, and Methodology

2.1 Standard Model Framework

Consider the standard model with two goods where individuals' utility functions depend positively on after-tax income (individuals value consumption) and negatively on before-tax income (earning income requires effort). We assume that, with a linear budget set with constant marginal tax rate t, individual incomes z are distributed according to a smooth density distribution $h(z)$.

Suppose that a kink is introduced in the budget set at income level z^* by increasing the marginal tax rate from t to $t + dt$ for incomes above z^* as displayed on Figure 1. Such a kink is going to produce bunching of individuals whose incomes were falling into a segment $[z^*, z^* + dz^*]$ before the kink was introduced. The individual (denoted by L on Figure 1) with earnings z^* before the tax change is not affected and his indifference curve remains tangent to the lower part of the budget set (with slope $1 - t$). Let us denote by H the highest income earner (before the tax change) who is now bunching. Before the tax change, individual H had earnings $z^* + dz^*$ and his indifference curve was tangent to the linear budget with slope $1 - t$ as shown in Figure 1. After the tax change, his indifference curve is exactly tangent to the upper part of the budget set (slope $1 - t - dt$) as depicted on Figure 1. For a small change in the marginal tax rate dt, by definition of the compensated elasticity e of earnings with respect to one minus the tax rate, we have

$$\frac{dz^*}{z^*} = e\frac{dt}{1-t}. \tag{1}$$

Thus the total number of taxpayers bunching at z^* is simply $h(z^*)dz^*$ where $h(z^*)$ is the density of incomes at z^* when there is no kink point and dz^* is given by equation (1). This derivation shows that bunching is proportional to the compensated elasticity e and to the net-of-tax ratio $dt/(1-t)$.[7] Two important points should be noted. First, the larger the behavioral elasticity, the more bunching we should expect. As expected, in the extreme case of no behavioral responses to taxation, there should be no bunching. Thus, within the standard model, this critical elasticity could in principle be estimated by measuring the amount of bunching at kinks of the tax schedule.[8] Second, the size of the jump in marginal tax rates is measured by the change in marginal tax rates relative to the base net-of-tax rate $1-t$. Thus, everything else being equal, a change in marginal tax rates from 0 to 10% should produce the same amount of bunching than a change from 90% to 91%.

A simple example can provide a useful illustration. Consider the jump in marginal tax rates between the first and second tax bracket from 15% to 28% in the U.S. tax schedule taking place at a gross income level around $60,000 (for a family of four with standard deduction). Suppose that the compensated elasticity is 0.5; this falls in the middle range of the estimates on the responsiveness of taxable income (see Gruber and Saez (2000) for a summary of the literature). Then formula (1) implies that $dz^* = \$4,600$. Given the density of taxpayers around that income level, this would mean that about 2.5 million of taxpayers should be bunching around that kink. Therefore, the basic model predicts that we should observe substantial bunching around kink points even for small behavioral elasticities.[9]

2.2 Data

As discussed in introduction, the large publicly available annual cross-sections of individual tax returns constructed by the Internal Revenue Service (IRS), known as the Individual Public Use Tax Files, are the ideal data to carry out this study. The data are available since 1960 and

[7]In the case of large jumps (when $dt/(1-t)$ is no longer small), income effects should be introduced, the elasticity e would no longer be a pure compensated elasticity but a mix of the compensated elasticity and the uncompensated elasticity. However, as long as $dt/(1-t)$ is relatively small, which is the case with most of the empirical kinks considered in Section 3, these income effects can be safely neglected.

[8]As shown in Feldstein (1999), under very general conditions, the deadweight burden of a tax system is directly proportional to the compensated elasticity of taxable income with respect to (one minus) the tax rate.

[9]For example, even with an elasticity as small as 0.1, half a million taxpayers should be expected to bunch at the kink separating the 15% and the 28% rate brackets.

1997 is the latest year available. The average number of observations per year is slightly above 100,000. The annual cross sections are stratified random samples with high sampling rates for high income taxpayers. Therefore, the data span a large number of different tax schedules. This is of interest because we do not expect taxpayers to adapt immediately to changes in the location of kink points, and repeated cross-sections may allow to study the dynamics of bunching as well.

In the United States, income tax is assessed at the family level (married couple with dependents or a single adult with dependents). Taxable income is defined as Adjusted Gross Income (AGI)[10] less personal exemptions (a fixed amount per person in the tax unit) and deductions. Deductions can take the form of a standard deduction (a fixed amount depending on marital status: single, married, or head of household) or of itemized deductions whichever is larger. Itemized deductions include state income taxes, mortgage interest payments, charitable contributions, and other smaller items. Taxes are computed as a function of taxable income[11] from a piece-wise linear schedule with increasing marginal tax rates. The sizes of the tax brackets depend on marital status. The relevant income measure to study bunching is therefore taxable income.

Before the Tax Reform Act (TRA) of 1986, there was a large number of tax brackets (between 15 and 25 depending on years) and thus jumps in marginal tax rates from bracket to bracket were small (from 1 to 5 percentage points in general), except for the first bracket where tax liability begins. The first bracket had a tax rate between 11% and 20% depending on years. From now on, we call the kink associated to this first tax bracket, the first kink point. Moreover, before the TRA, the tax schedule was not indexed for inflation, and thus the real location of kinks changed substantially from year to year during the inflationary episodes of the 1970s (this phenomenon was called 'bracket creep'). In order to mitigate the 'bracket creep' effect, the exemption and standard deduction amounts were also changed periodically. Thus, we limit our study of bunching in the pre-TRA era only to years 1960 to 1969, when inflation was low and the tax schedule stable, and only to the vicinity of the first kink point.[12] As described in Panel

[10] AGI is equal to the sum of all sources of income minus a few tax exempt items, such as contributions to retirement plans or interest on tax exempt local bonds, and a few minor adjustments.

[11] There are a number of exceptions to that rule, the most important being the favorable treatment of realized capital gains, to which we come back later.

[12] An earlier version of the paper, (Saez, 1999a), analyzes in detail years 1979 to 1986 and finds no evidence of

A of Table 1, the income tax structure has been remarkably stable from 1948 to 1963, with the exemption level fixed at \$600 (in nominal dollars), and the standard deduction defined as 10% of AGI (up to a limit of \$1,000) and the first marginal tax rate equal to 20%. In 1964, a more advantageous standard deduction equal to \$200 plus \$100 times the number of exemptions was introduced. Finally, due to inflationary pressures, the modern standard deduction was introduced in 1970 and the exemption levels increased.

After TRA, the number of tax brackets was drastically reduced and exemptions, standard deductions, and tax brackets have been indexed to the Consumer Price Index. Table 1 (Panel B) describes the tax schedule for years 1988 to 2000 (expressed in dollars of 2000). The tax structure has changed little from 1988 to 2000, with two major kinks left: the first kink where the marginal tax rate jumps from 0 to 15%, and the second kink with a jump from 15 to 28%. Note that top two tax brackets have been introduced in 1993, creating jumps from 31 to 36% and 36% to 39.6% for high income earners.[13]

The Earned Income Tax Credit (EITC) is a subsidy for low income earners that introduces substantial kinks in the budget constraint as described in Table 1 (Panel C). The EITC was introduced in 1975 as a small subsidy equal to 10% of earnings up to around \$10,000 of earnings (in 2000 dollars) and phased out at a 10% rate on the next \$10,000 of earnings. This was originally intended to relieve low income earners from payroll taxes. The EITC was slightly expanded after the TRA, and then very substantially expanded in 1994. As shown in Panel C, in 2000, for a family (or a single parent) with two or more kids, the credit is equal to 40% of the first \$9,700 of earnings, is flat on the next \$3,000 dollars, and is phased out at rate 21% (up to the break-even income level \$31,150). This creates very large jumps in marginal incentives. Moreover the two kinks are close. When earnings increase by just \$3,000, including payroll taxes, the net-of-tax value of \$1 of extra gross earnings decreases from \$1.25 to \$0.64. This is a reduction of almost 50%.

bunching or clustering, except around the first kink point.

[13]It is important to note that long-term realized capital gains are subject to a maximum tax rate of 28%, therefore for capital gains earners, the relevant base to analyze bunching around top kinks is not exactly taxable income, but in general taxable income excluding capital gains. The tax return data do provide the exact income measure upon which the standard tax schedule applies.

2.3 Methodology

The analysis consists primarily in the graphical analysis of taxable income distributions. To detect perfect bunching at kink points, the simplest method consists in producing histograms of the distribution with small bins and check whether spikes appear at kink points.[14]

However, we expect that most taxpayers are unable to control perfectly their incomes (due for example to random components such as year-end bonuses or risky returns on assets), or not be perfectly aware of the precise location of kink points. In those cases, we would expect taxpayers to cluster around the kinks instead of bunching exactly at the kink. We develop, for calibration purposes, explicit models along those lines in Section 4. To discern such clustering or humps around kink points, it is more appropriate to estimate the density using kernel density methods instead of histograms. At each income level z, the kernel density method computes local averages of the number of observations around z, using decreasing weights as the observations get further away from z. The bandwidth h determines how quickly the weights decrease as we move away from z.[15] The bandwidth should not be too large, otherwise small humps would be smoothed out and disappear completely. It should not be too small either because otherwise, the estimated density would be bumpy and random humps might be improperly interpreted as clustering around kink points.

Econometricians (see for example the textbook by Hardle (1990)) have developed cross validation methods to pick the bandwidth in function of the sample size and the kernel function. However, in the present situation, it seems more fruitful to use the repeated cross sections to check whether the patterns look stable over years, as we should not expect random humps to be stable over time. Moreover, because the samples are large, and estimates can be aggregated over several years, the density estimates we obtain are very smooth even when the number of bins is large (with histograms) or when the bandwidth is small. As a result, any clear clustering around kinks could be very safely attributed to behavioral responses to taxation.

[14] A spike should appear in the data as soon as a fraction of taxpayers can control nearly perfectly their incomes and behave according to the basic model described above.

[15] More precisely, the kernel density estimation at income level z is given by $\hat{f}_h(z) = (1/h)\sum_{i=1}^{N} K[(z-z_i)/h]w_i$ where $(z_i, w_i), i = 1..N$ is the set of weighted observations, and $K(x) = (3/4)(1-x^2)1(|x| < 1)$ is the Epanechnikov kernel function. See Hardle (1990) for more details.

3 Empirical Results

3.1 First Kink Point

Estimates of the bottom of the taxable income distribution are displayed on Figure 2 for Married taxpayers filing jointly (Panel A) and for single taxpayers and head of households (Panel B) for years 1988 to 1997.[16] Both panels show that taxable income distributions display evidence of clustering around the first kink point where taxable income crosses zero. There a noticeable spike at the kink, and the density distribution appears stretched at this point.

The TRA increased substantially the size of personal exemptions and of standard deduction from 1986 to 1988. Presumably, it may take time for taxpayers to start clustering to the kink, and we would expect to see less bunching in 1988 than in later years when taxpayers have had time to learn and adapt to the new tax schedule. Indeed, as shown on Figure 3, there much less evidence of clustering in 1988 (Panel A) than in 1995 (Panel B).[17] Looking at the annual time series would show that clustering around the kink appeared as soon as 1991 and changed little from 1991 to 1997 suggesting that low income taxpayers reacted fairly quickly to the new tax regime. This dynamic evidence also strongly suggests that the spike or clustering around the kink point that was observed in Figure 2 for all years 1988 to 1997 bundled together was not accidental but the consequence of behavioral responses.

An important objection about the irregularity of the density distribution that we found around the first kink point and that we attributed to clustering could be raised. By definition, taxpayers below the kink have negative taxable income and thus do not owe any income taxes while taxpayers above the kink have positive tax liability. As a result, it is conceivable that the shape of the distribution is artificially kinky around the first kink point because non-filers are missing on the left of the kink point. In addition to the dynamic evidence presented in Figure 3, a number of elements tend to prove that this is not the case.

The filing threshold for gross income in the United States is often lower than the sum of exemptions and the standard deduction. Actually, the filing in required for all tax units with

[16] We have removed from the sample taxpayers who can be claimed as dependents by other taxpayers. These are mostly kids with income. This is because they are subject to special rules to compute their standard deduction. This tends to make their taxable income often artificially close to zero.

[17] All taxpayers, except those with that can be claimed as dependents have been included in the estimation.

gross income equal or above to the standard deduction (which depends on marital status) plus the *minimum* amount of exemptions (two for married filing jointly, one for singles or heads of households). As a result, all taxpayers with more than the minimum number of exemptions are required to fill tax returns even though their taxable income is negative. If it is the case that the irregularity around the kink displayed on Figure 2 is due to missing filers just below the kink, we expect this effect to be present for those with the minimum number of exemptions but absent for those with more than the minimum number of exemptions. Panel A in Figure 4 displays the density distributions for taxpayers with more than the minimum number of exemptions. This distribution displays a comparable amount of bunching than the overall income distribution (as displayed on Figures 2 or 3B).

One could further object, however, that taxpayers with no taxable income often fail to file tax returns, even if their gross income requires them to do so because they are not subject to harsh penalties for failing to file in that situation. In the U.S. individual income tax system, most taxes are withheld at source. This is especially true for wages and salaries which form more than three quarters of incomes of taxpayers around the first kink point. In principle, withholding depends on the marital status and the number of exemptions of taxpayers.[18] However, in practice, withholding is often imperfect, and for the vast majority of low income earners, too much income tax is withheld from their wages. As a result, most low income earners have an incentive to file to obtain a refund from the IRS. Actually, in 1997, over three quarters of taxpayers with taxable income between zero and $10,000 expected a refund from the IRS, and only about 4.9% had a absolute balance (owing taxes or expecting a refund) smaller than $30, showing that with-holding cannot be perfect.

Two facts show that many low income earners file to get refunds. First, gross income density distributions do not show a jump at the filing requirement threshold. Second, it is well known that the TRA, by increasing the size of exemptions and the standard deduction, reduced significantly the number of taxpayers (from 1986 to 1988, the number of taxpayers declined from 97.4 million to 90.3 million). However, the actual number of returns filed did increase from 103.1 million in 1986 to 109.7 million in 1988. Taxpayers eligible for the EITC have strong incentives to file, even though their taxable income is often negative. We display on Panel B of Figure

[18] Employees fill a form W9 to indicate to their employer the proper amount of withholding.

4 the density distribution of taxpayers with kids and who report at least 50% of their AGI as wages and salaries. These taxpayers, when their meet the income test, are eligible for the EITC and thus should file returns even if their taxable income falls below zero. However, Panel B of Figure 4 shows that the taxable income distribution of taxpayers eligible for the EITC displays bunching around the first kink point very comparable to the overall taxable income distribution.

Finally, interesting evidence can be obtained by analyzing the earlier period from 1960 to 1969. As discussed in Section 2, during this period, the tax system was perhaps more transparent for low income earners. From 1948 to 1963, the system had been extremely stable, with exemptions fixed at $600 in nominal terms throughout the period (which was a low inflation period). Moreover, the standard deduction was defined as 10% of AGI (up to a $1,000 limit). As a result, income exempted from tax was exactly $600 times the number of exemptions. Moreover the first tax rate was large (20%). In these circumstances, we would expect taxpayers to be fully informed and able to bunch around the kink. Furthermore and until 1969, the filling threshold was very low and equal to $600 for all taxpayers independent of the marital status.[19] Thus most taxpayers with moderately negative taxable income were required to file. Figure 5 displays the density distributions of taxable income (expressed in 2000 dollars) for years 1960 to 1969[20] for four categories of taxpayers: Married filing jointly (Panel A), Singles and Heads of household (Panel B), Itemizers (Panel C), and non-itemizers (Panel D).

Figure 5 shows very strong evidence of bunching for all groups. Married taxpayers for which we expect no special filing threshold effects (as they always claim at least two exemption) display clear evidence of bunching. Furthermore, single taxpayers pile up below the kink and it is clear that missing filers exactly below the kink cannot account for this. The distinction between itemizers and non-itemizers is also instructive. There is a much sharper spike for itemizers but perhaps a large amount of overall clustering for non-itemizers. We expect indeed itemizers to be able to bunch exactly at the spike because some of the itemized deductions such as charitable contributions might be manipulated much more easily than earnings.[21] The fact that bunching

[19]The threshold was higher and equal to $1,200 for taxpayers above 65 automatically entitled to an extra exemption.

[20]Years 1961, 1963, and 1965 are not included because no micro file was created for these years.

[21]Some taxpayers who itemize deductions might bunch exactly at the kink because they may stop reporting deductions once they have reached the threshold of no tax liability.

is present for non-itemizers as well suggests that this phenomenon cannot be explained only by itemized deductions.[22] However, it is important to emphasize that the overall amount of exact bunching for itemizers is very small compared to the prediction of the basic model. Only a very small elasticity (below 0.1) would generate such a small spike in the distribution (see Section 2).

In 1964, a more generous standard deduction was introduced equal to either 10% of AGI (as before) or $200 plus $100 for each exemption (see Panel A in Table 1). The first tax rate was also reduced from 20% to 14%. We would not expect taxpayers to adapt immediately to the new tax situation. Figure 6 displays the density of taxable income for 1964 in Panel A where indeed evidence of bunching is much weaker than in Figure 5: taxpayers seem to pile up below the kink instead of exactly at the kink. However, Panel B shows the distribution of "fictitious" taxable income computed according to the earlier 1963 rule. We see that there is substantial bunching in Panel B, showing that taxpayers were indeed not able to adapt to the new regime immediately. Interestingly, the time series from 1964 to 1969 shows that taxpayers start clustering more and more around the new kink point, and by 1969, bunching is about as large as in 1960 or 1962.

3.2 Middle and High Income Earners

Figure 7 displays taxable income densities around the second kink point (jump in marginal tax rate from 15% to 28%) for Married filing jointly (Panel A) and Singles (Panel B) for years 1988 to 1997. Density distributions look very regular around the kink point, and no spike or even clustering is discernible. We can rule out the explanation that it takes time to taxpayers to learn about the tax regime because there is no more evidence of bunching in later years such as 1996 or 1997, which is almost ten years after the reform. Dividing the data between itemizers and non-itemizers does not reveal any more evidence of bunching.

We would expect that some sources of income are more responsive to taxation than others, or more easily manipulable, or more prone to tax avoidance or evasion. For example, self-employment income might be more elastic because the labor supply of the self-employed might be adjusted more freely than labor supply for employees, or because it is easier to under-report

[22]Distributions by itemizing status after TRA display the same type of evidence but weaker: there is exact bunching for a small group of itemizers at zero and a less sharp but more extensive amount of clustering for non-itemizers.

on tax returns self-employment income than wages and salaries. Individuals can freely choose when to realize capital gains and may or may not choose to do so in order to avoid paying high marginal tax rates.[23] Similarly charitable contributions can be easily manipulated for reasons.[24] As tax return data provide information on most sources of income and deductions, it is possible to analyze separately groups of taxpayers reporting these various forms of income. However, looking specifically at distributions of taxpayers reporting either self employment income, or capital gains, or charitable contributions, around the kink 15 to 28% from 1988 to 1997 does not reveal any robust evidence of bunching.

Two additional tax brackets were introduced in 1993 with tax rates of 36% and 39.6% creating two new kinks in the tax schedule. Panels A and B in Figure 8 report the distributions of taxpayers from 1993 to 1997 around these two kinks.[25] There is no evidence at all of bunching around these kinks. As above, dividing the samples by sources of incomes or deductions does not reveal any bunching evidence.[26]

Our results imply that either low income and middle income earners do not behave in the same way or that the first kink point is perceived differently from the other kink points. At this early stage, we can presume that either middle income earners control less accurately their income or that their elasticity with respect to marginal rates is lower. The argument will be made more precise in the numerical simulation section.

[23]The kink 15 to 28% applies equally to capital gains income.

[24]Actually, there is a large literature in public finance analyzing the response to tax rates of a very wide range of income sources such as self-employment income, business income, capital gains realizations, or charitable contributions. As expected, charitable contributions or capital gains realizations are found to be very tax responsive, at least in the short run.

[25]Income is defined as taxable income less realized long term capital gains. This is the base over which the regular tax schedule applies because of the special treatment of long-term capital gains. The level of the kink 36/39.6% is independent of marital status, but this is not the case for the kink 31/36%. This is why we restrict the sample to married taxpayers for the later kink.

[26]Similarly, a thorough analysis of higher kink points in the earlier period 1960 to 1987 does not reveal any robust evidence of bunching. See Saez (1999) for an empirical analysis of the period 1979 to 1986.

3.3 Bunching around EITC kink points

As explained in Section 2, the EITC was significantly expanded in 1994, creating very large jumps in marginal tax rates for low income earners with children. Figure 9 reports the distributions of earnings (defined as wages and salaries plus self-employment income used as the base to compute the credit) for families with two or more kids (Panel A) and families with one kid (Panel B) for years 1994 to 1997.[27] These distributions show little evidence of bunching in spite of the very large changes in marginal tax rates. This result is difficult to reconcile with the evidence of bunching around the first kink point which applies to a population with comparable low incomes. This again suggests that framing effects might be present and that the EITC kink points, even though bigger than the first kink point of the income tax, appears less salient to most taxpayers. Individuals may be less aware of the EITC, and it might be more difficult for them to understand the working of the first kink from a cursory look at the EITC table.

As discussed above, it is conceivable that self-employment income is more sensitive to marginal incentives. Therefore, we report on Figure 10 the same distributions as in Figure 9 but limited to the sample of income earners whose self employment income is at least 20% of earnings (and who also have kids who make them eligible for the EITC). These figures show evidence of very clear spikes exactly at the level of the first kink of the EITC schedule. The fact that the spikes are exactly located at the first kink for each of the two groups is clear evidence of a response to the program.[28] This strongly suggests that the self-employed are able to manipulate their earnings (either through labor supply or tax avoidance mechanisms) in order to take full advantage of the credit. Note however, that, in contrast to theoretical predictions, bunching is absent around the second kink point where the credit starts to be phased out.[29]

Two explanations can account for these facts. First, bunching may reveal pure tax evasion where individuals create businesses with the unique purpose of reporting self-employment and taking advantage of the credit. In that situation, we would not expect these evaders to bunch around the second kink as they already max out the credit. Second and related to the explanation

[27]As described in Table 1, different credit schedules apply in those two cases.

[28]Note again that such a spike is small relative to the prediction of the standard model, with an implied elasticity lower than 0.3.

[29]Similarly, no dip in the distribution appears around the concave kink where the credit is fully phased out.

we gave above, it might be the case that the first EITC kink is more salient on the tax table than the EITC second kink, and taxpayers are reluctant to increase labor supply when the credit stops increasing.

4 Accounting for the facts

4.1 Extensions of the basic model

The standard model presented in Section 2 is too simple because it is unrealistic to assume that taxpayers can perfectly control the level of their earnings. It is more realistic to assume that taxpayers cannot choose their earnings exactly as in the basic model because of random components of income such as risky returns on capital (physical or human) or because employers do not allow employees to choose freely their hours of work, and thus taxpayers may only be able to choose their labor supply from a limited menu of job offers. For example, workers might be able to work either 20 hours a week or full-time, or not at all.

- **Uncertainty in Income Realization**

Let us consider a model where income z is equal to deterministic component y that individuals can choose freely by varying their effort and a random component ϵ (with mean zero) over which taxpayers have no control. Precise economic examples generating uncertainty could be a wage bonus which is received at the end of the year and which is random ex-ante or risky returns on capital assets.

Let us assume for simplicity that utility takes the following simple form $U = z - T(z) - v(y)$ where $z - T(z)$ is after tax realized income and $v(y)$ represents disutility of effort required to earn the certain income y. We assume that taxpayers maximize expected utility EU over the random realization ϵ. We have $EU = \int [z - T(z)]dF(\epsilon) - v(y) = y - \hat{T}(y) - v(y)$ where $\hat{T}(y)$ is the expected tax defined as

$$\hat{T}(y) = \int T(y + \epsilon)dF(\epsilon). \tag{2}$$

Thus, under uncertainty, taxpayers choose their effort as if they were facing the expected tax schedule $\hat{T}(.)$ with no uncertainty instead of the true tax schedule $T(.)$. Taking the derivative of (2), we have

$$\hat{T}'(y) = \int T'(y+\epsilon)dF(\epsilon). \tag{3}$$

So the effective marginal rate is also the expectation of true marginal tax rates. Therefore, a discrete jump in marginal tax rates, as in real tax schedules, will be transformed into a *smooth* increase in the expected marginal rate $\hat{T}'$ at the kink. As a result, and as simulations below will show, the perfect bunching at the kink will be replaced by imperfect clustering around the kink creating a hump in the density distribution around the kink point. We expect that the smaller the variance of the random component, the sharper the clustering around the kink.

The simple model presented assumes that individuals are risk neutral. If risk aversion is introduced, using for example a utility function of the form $U = u(z - T(z)) - v(y)$, with $u(.)$ concave and increasing, we can also define as above an effective tax schedule $\hat{T}$. However, in that case, because of risk aversion, a jump in marginal rates at income level z^* for the true tax function T translates into a smooth increase in marginal rates for the effective tax schedule $\hat{T}'$ *above* income level z^*. As a result, in that case, clustering will appear above the kink point. This case is studied in detail in Saez (1999a) who shows, that for reasonable risk aversion and variance parameters, that shifting effect should be small.

- **Constrained Labor Supply Choices**

The uncertainty model introduced above still assumes that taxpayers can freely choose the mean y of their expected income z. An important feature of the labor supply decision is that most individuals cannot adjust freely the intensity of their effort because they have to choose jobs only among a limited set of possibilities. For example, a Ph.D. graduate in economics can decide to take a post-doc position, or to become assistant professor, or to become a consultant. Employers may not allow employees to choose freely their hours of work and require them to work either 20 hours a week, or full-time with limited possibilities for working overtime or taking unpaid vacation.

Low income earners, who change jobs more frequently and who can work in multiple part-time positions at the same time, may have more flexibility in their labor supply choice than high or middle income earners who work full-time in a single job.[30] If the tax schedule is stable over time as in the 1988 to 1997 period, we would expect that taxpayers are able to get closer over time to their unconstrained optimal labor supply level, as more job options become available.

Constrained labor supply choices can be captured in the basic model by assuming that taxpayers cannot choose freely the earnings level z but have to choose among a limited set of options $z_1, .., z_d$ the one that maximizes their utility. We assume in the model that d is exogenous and fixed, and that the earnings choices $z_1, .., z_d$ are distributed in a wide range around the optimum labor supply choice for each individual. In this model, taxpayers are of course not able to bunch perfectly at the kink point. However, simulations will show that taxpayers will nevertheless tend to cluster around the kink. This clustering grows with the number of job choices d and the "uncontrained" labor supply elasticity.

4.2 Numerical Simulations

The models described above suggest that bunching should be attenuated when taxpayers cannot control perfectly their incomes or face constrained labor supply choices. We now turn to numerical simulations to assess whether, under realistic parameters, we should still expect to observe clustering around the kink points.

The basic model we use is the following. We assume that there is an exogenous distribution of skills $G(w)$. If an individual with skill w supplies labor l, he earns $z = wl$, and consumes $c = z - T(z)$ after taxes. All individuals have the same utility function $U = c - l^{1+1/e}/(1 + 1/e)$ where e is the elasticity of labor supply with respect to the net-of-tax rate. This specification implies no income effects, and thus both uncompensated and compensated elasticities are equal to e. In the standard model, individuals would choose l so as to maximize utility given the tax schedule. In that case, and as described in Section 2.1, we should observe atoms of taxpayers bunching at each kink of the tax schedule.

- **Uncertainty in Income Realization**

We assume that the random component ϵ is normally distributed with mean zero and variance

[30] However, many upper income earners are certainly able to adjust their labor supply at the margin with flexible consulting activities.

σ^2. Individual income is $z = wl + \epsilon$ where wl is the non-random component y described above. The smaller σ, the better individuals can control their incomes. In the simulations, we posit an exogenous skill distribution $G(w)$, and a simple two bracket tax schedule with a single kink. We compute the effective tax schedule $\hat{T}$ using equation (2). We then solve for the optimal labor supply choice l given $\hat{T}$ for each skill level w. We then obtain incomes $z = wl + \epsilon$ by taking a random draw of ϵ for each individual. Finally, we use the kernel density method to plot the distribution. In the simulations, we can make the sample size as large as we want, hence, no issues about bandwidth choices arise. The key parameters are the standard deviation σ and the elasticity e.

We consider two cases corresponding respectively to the jumps in marginal tax rates from 0 to 15% (at income level $10,000) and from 15 to 28% (at income level $50,000) in order to replicate the empirical situation. Panel A in Figure 11 displays simulations for the jump from 15 to 28%. In that case, we choose a uniform distribution for $G(w)$ which produces a declining income density distribution comparable to the empirical one around the second kink point. We consider two values for the elasticity e, 0.5 and 1, and two values for the standard deviation σ, $2,000 and $5,000. As expected, the smaller σ and the larger the elasticity, the sharper the humps. In particular, even with a medium size elasticity $e = 0.5$, the large value of $\sigma = \$5,000$ is not enough to make the hump disappear. Many middle income taxpayers show little variation in taxable income from year to year (see Saez 1999a for such an analysis using the tax return panel data available from 1979 to 1990). Therefore for a large fraction of taxpayers, σ should be small, perhaps in the vicinity of $2,000 and definitely smaller than $5,000. In that case, the simulations suggest that the elasticity for middle income earners compatible with the empirical results where no clustering at all is visible should be less than 0.2-0.3.

Panel B in Figure 11 displays the simulation results for the jump from 0 to 15% at income level $10,000. The distribution of skills is taken as normally distributed so as to produce a single mode density distribution. We consider the case where $e = 0.5$ and $\sigma = \$2,000$. In order to see how taxes affect the distribution, we plot the distributions in the case with no kink (a flat marginal tax rate of 15%) and with a kink (zero marginal rate below the kink and 15% rate above). Introducing a kink produces a deformation in the distribution of incomes which is very similar to what is observed in the actual empirical distributions. Many low income earners probably can control their incomes pretty accurately, therefore the assumption $\sigma = \$2,000$ is conservative. Lower values of σ or higher elasticities would produce humps bigger than in the empirical distribution in the 1988 to 1997 period.[31] Therefore, these simulations suggest that an elasticity equal to 0.5 is a reasonable upper bound for low income earners.

- **Constrained Labor Supply Choices**

We assume that individuals are constrained to choose their labor supply l among a limited set of choices $(l_1, .., l_d)$. In the simulation, the l_i are randomly drawn and independent. I assume that each l_i is distributed uniformly around a fairly broad interval centered around the optimal labor supply level.[32] The key parameters are the number of choices d and the elasticity e.[33]

We consider the case of a single jump from 15 to 28% occurring at income level $50,000. Simulation results are presented on Figure 12, for two values of the elasticity: $e = 1$ in Panel A and $e = 0.5$ in Panel B. In each Panel, simulations are presented for four different values for d, namely $d = 2, 4, 6, 8$. As expected, bunching increases with d and the elasticity e. For $d = 2$ bunching is hardly discernible (even for $e = 1$), however bunching clearly appears once $d \geq 4$. Bunching is very sharp for $d = 8$.

As discussed above, when the tax schedule is stable, as time evolves, it is plausible to assume that taxpayers should be able to choose their labor supply closer and closer to the optimal level. In terms of the model, the number d should increase over time from 1988 on, as taxpayers adapt slowly to the post TRA tax schedule. Therefore, in the 1990s, values for d less than four sound implausible. Thus, the constrained labor supply model is compatible with the absence of clustering found in empirical observations for middle income earners only if the elasticity of income is small (lower than 0.2-0.3).

The real world situation is probably a mix of the two models presented so far. However, even in this mixed case, it would be difficult to reconcile the complete absence of clustering around middle and high income kinks with elasticities much larger than 0.5 such as those estimated

[31]Note however, that bunching was more important in the 1960 to 1969 period.

[32]This interval is defined as $[0.5w^e, 1.7w^e]$. The optimal labor supply level of individual w is equal to $(1-\tau)^e w^e$ when the marginal tax rate is equal to τ.

[33]When labor supply is constrained, the actual labor supply elasticity in the aggregate is actually very close to the unconstrained elasticity e.

in the influential studies of Lindsey (1987) and Feldstein (1995). The present results, however, would be consistent with the smaller elasticity results found in later studies (see Gruber and Saez, 2000 for survey).

5 Conclusion

This study has revealed clear evidence of bunching only at the first kink point where tax liability starts. The evidence for higher kink points is either weak or null. The amount of bunching around the very large kinks generated by the EITC is very small and concentrated among the small group of self employed taxpayers. These results can be accounted for in two ways. First, if we believe that the standard model where individuals trade-off effort and consumption optimally at the margin is correct, then the results presented here imply that the behavioral compensated elasticities of taxable income or earnings with respect to marginal tax rates are very small. Second, if we think that behavioral elasticities are sizeable, as some recent studies have forcefully but controversially argued (Lindsey 1987, Feldstein, 1995), then it must be the case that individuals do not behave according to the simple standard model. We have proposed two simple and realistic departures from the standard model to reconcile theory with evidence: incomes may be in part random or individuals may not be able to choose freely their labor supply due to institutional constraints. Numerical simulations show, however, that such departures should not eliminate clustering around kink points, unless behavioral elasticities fall within the lower end range of the estimates from the literature on the behavioral responses to taxation.

However, the empirical patterns we find suggest that standard models cannot fully account for the empirical facts. We find evidence of bunching around the first kink point but not around the larger kinks created by the EITC even though they affect populations with similar income levels. This suggests that, in contrast to the standard models, a jump in marginal rates from zero to a positive value has a larger impact on taxpayers than an increase of the same size starting from a positive value. Obviously, in the U.S. income tax schedule, the jump from 0 to 15% is far more salient than other jumps because taxpayers can see directly from the tax table where income tax liability starts, whereas it is much more difficult to read from the tax table where the jump from 15 to 28% is located. Similarly, the fact that bunching around the first kink point is more important in the 1960 to 1969 period than after TRA might be explained by the fact that the deduction rules were simpler and perhaps more transparent to taxpayers. There is a growing literature in behavioral economics that has shown that such framing effects appear in a wide set of circumstances.[34] In the present context, the fact that framing effects matter has intriguing consequences. For example, it is possible that taxpayers are even less aware of the state income tax brackets than the federal tax brackets. As a result, state income taxes might generate relatively less deadweight burden than the federal tax.

The almost null evidence of bunching around the EITC kink points strongly suggests that the standard intensive model of labor supply is not an accurate description of labor supply for low incomes. The empirical literature has showed (see e.g., Heckman, 1993) that most of the labor supply response to taxes and transfers of low income earners is concentrated along the extensive margin (choosing whether to work or not) and has not been able to show convincing evidence of labor supply responses along the intensive margin as predicted by the standard model (see Meyer and Rosenbaum (2001) for a recent empirical study in the United States). Our bunching evidence around the EITC kink points is consistent with these findings, and has important policy implications for the design of optimal transfer programs. As shown in Saez (2000), when labor supply responses are concentrated along the extensive margin, subsidies for low income earners such as the EITC that encourage labor force participation become much more desirable than traditional welfare programs with high implicit taxation rates discouraging participation. It also suggests that simulations of costs and revenue effects of changes in taxes and transfers might be seriously biased if they are based on the standard model with responses concentrated along the intensive margin.

This study also casts some doubts on the relevance of the approach of non-linear budget sets to estimate the effects of taxes on labor supply (Hausman (1981)). This paper shows that individuals are either not aware or not able to control their precise location on the tax schedule. The model developed here shows that uncertainty smoothes kinky budget sets. Therefore it does not seem sufficient to add an error term in the labor supply equation without modifying the shape of the budget set. It would be very interesting to reconsider the non-linear budget

[34] Give examples from literature.

set methodology with a smoothed budget set and see whether this affects the results.[35] More generally, the results of this paper suggest that empirical strategies using local variation in marginal tax rates (such as Saez 1999b or Gruber and Saez 2000) due to the bracket structure of the income tax might be fragile.

The results of this paper suggest other directions for future research. First, it would be interesting to replicate the empirical estimations presented here to other countries. Some countries have progressive tax schedules with few brackets generating large jumps in marginal rates. The United Kingdom, for example, has a simple income tax structure, with only three brackets since 1989, and a higher first tax rate than the United States.[36] Therefore looking at taxable income distributions for other countries may bring additional evidence about bunching behavior. Second, in most countries, welfare programs generate large kinks in the budget set.[37] The beneficiaries are mostly low income earners. Therefore it would be interesting to estimate the distribution of incomes of recipients of these programs and see whether there is evidence of bunching at kink points.[38] These programs sometimes introduce even discontinuities in the budget set (known as notches) which should generate even more clustering.

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[35]MaCurdy, Green and Paarsch (1990) already used a smoothed budget set in this type of study but mainly to simplify calculations.

[36]The basic income tax rate has fluctuated between 20% and 35% from 1975 to 1999, and is now reduced down to 10%.

[37]Usually the benefits are taxed away at very high rates above an exemption level.

[38]Kane (1998) has looked for evidence of bunching in the case of means tested financial aid for higher education. This financial aid program creates a large kink in the budget set of recipients. However, Kane was not able to find any evidence of bunching.

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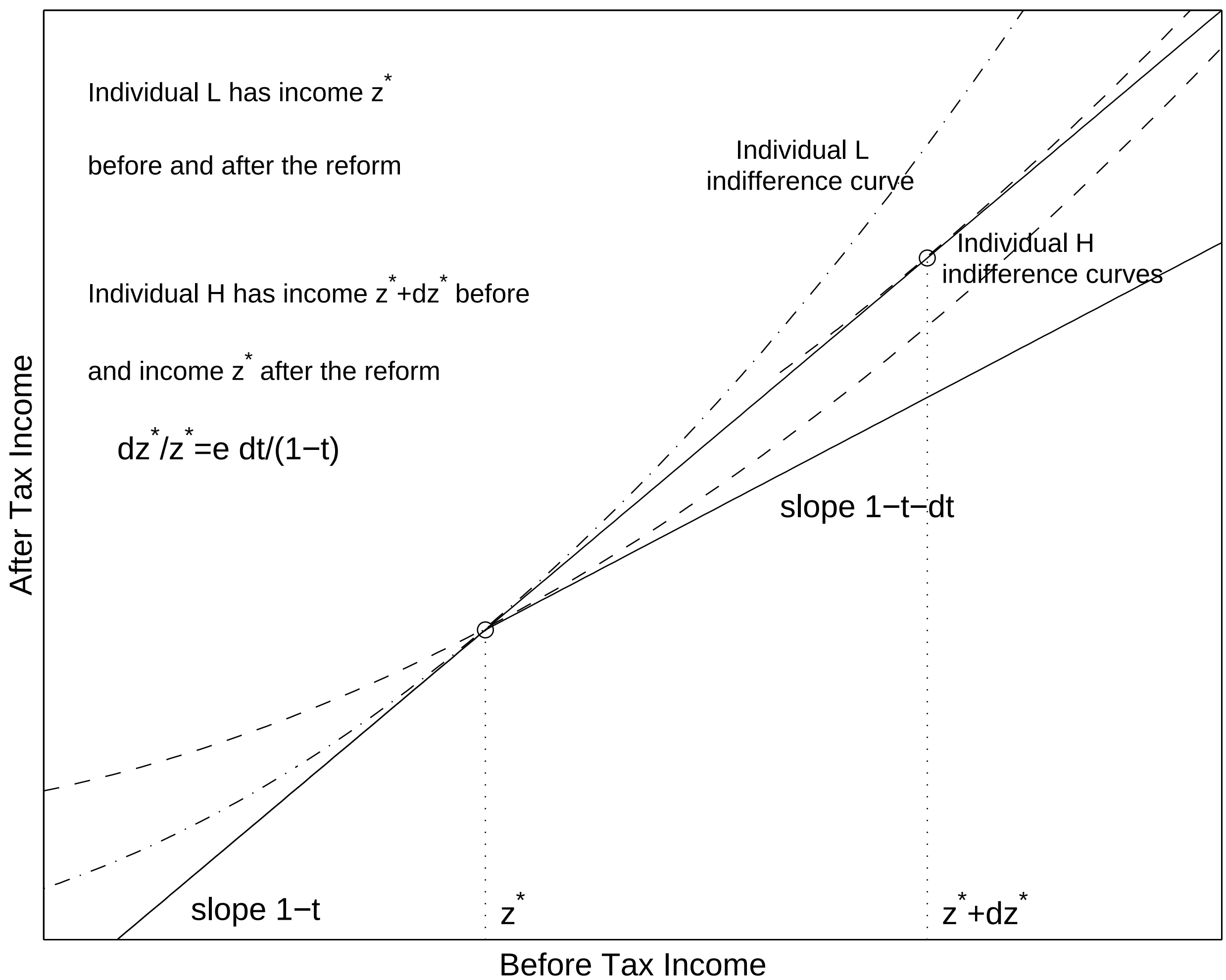
Fig. 1. Bunching in the Standard Model



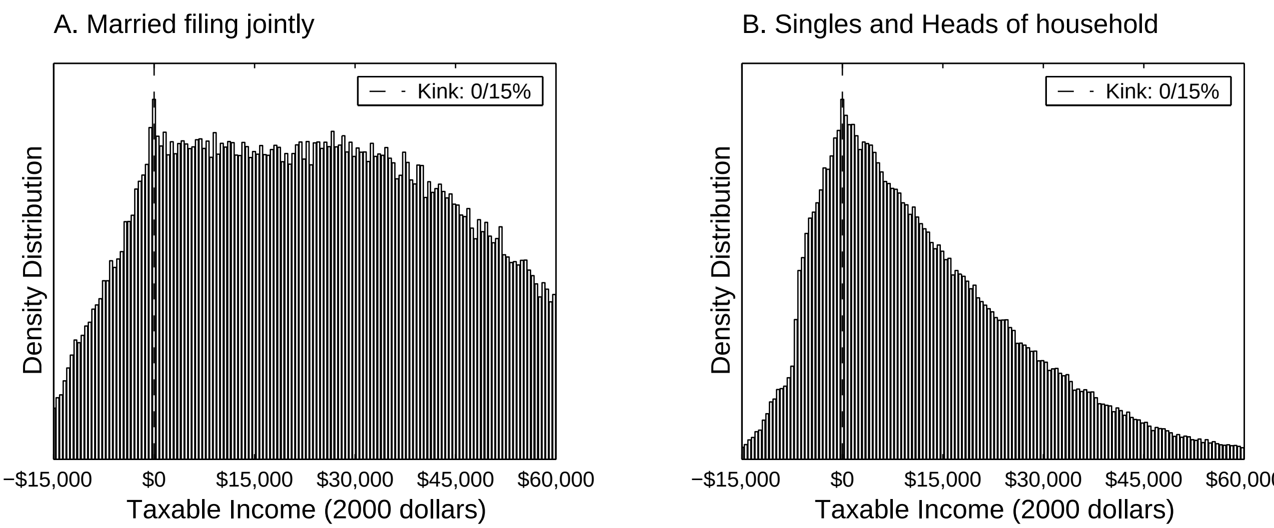


Fig. 2. Distributions around the first kink point, 1988−1997

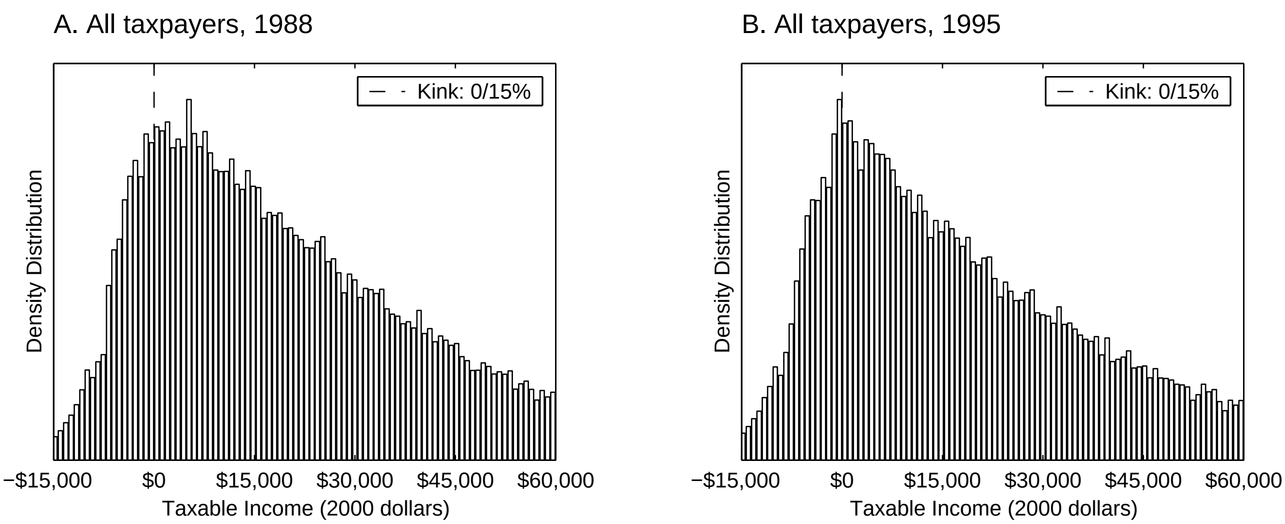


Fig. 3. Dynamics of Bunching, 1988 vs. 1995

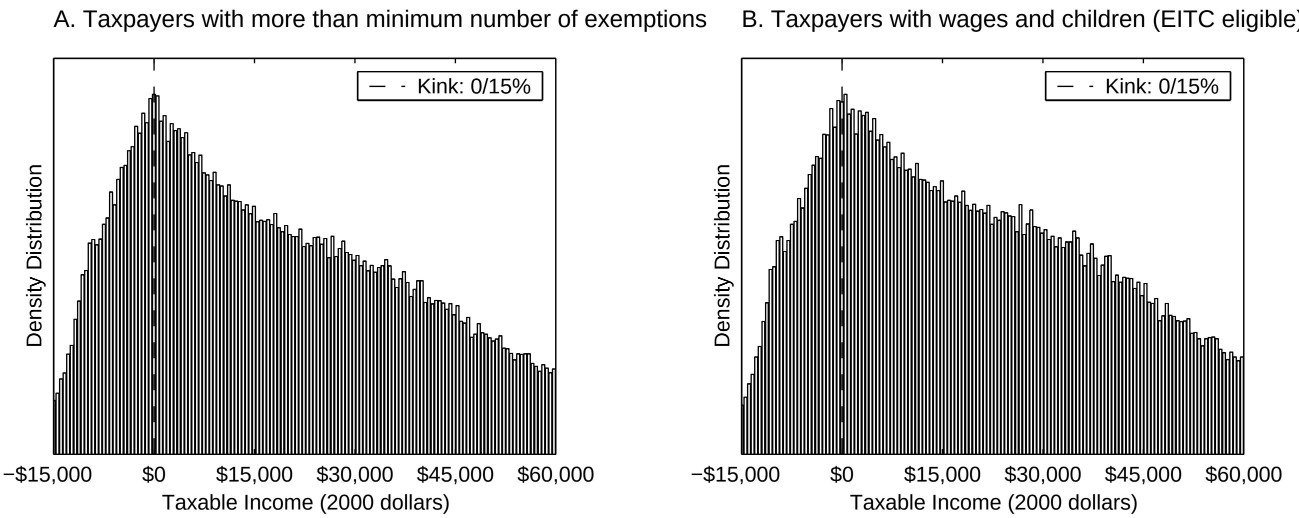
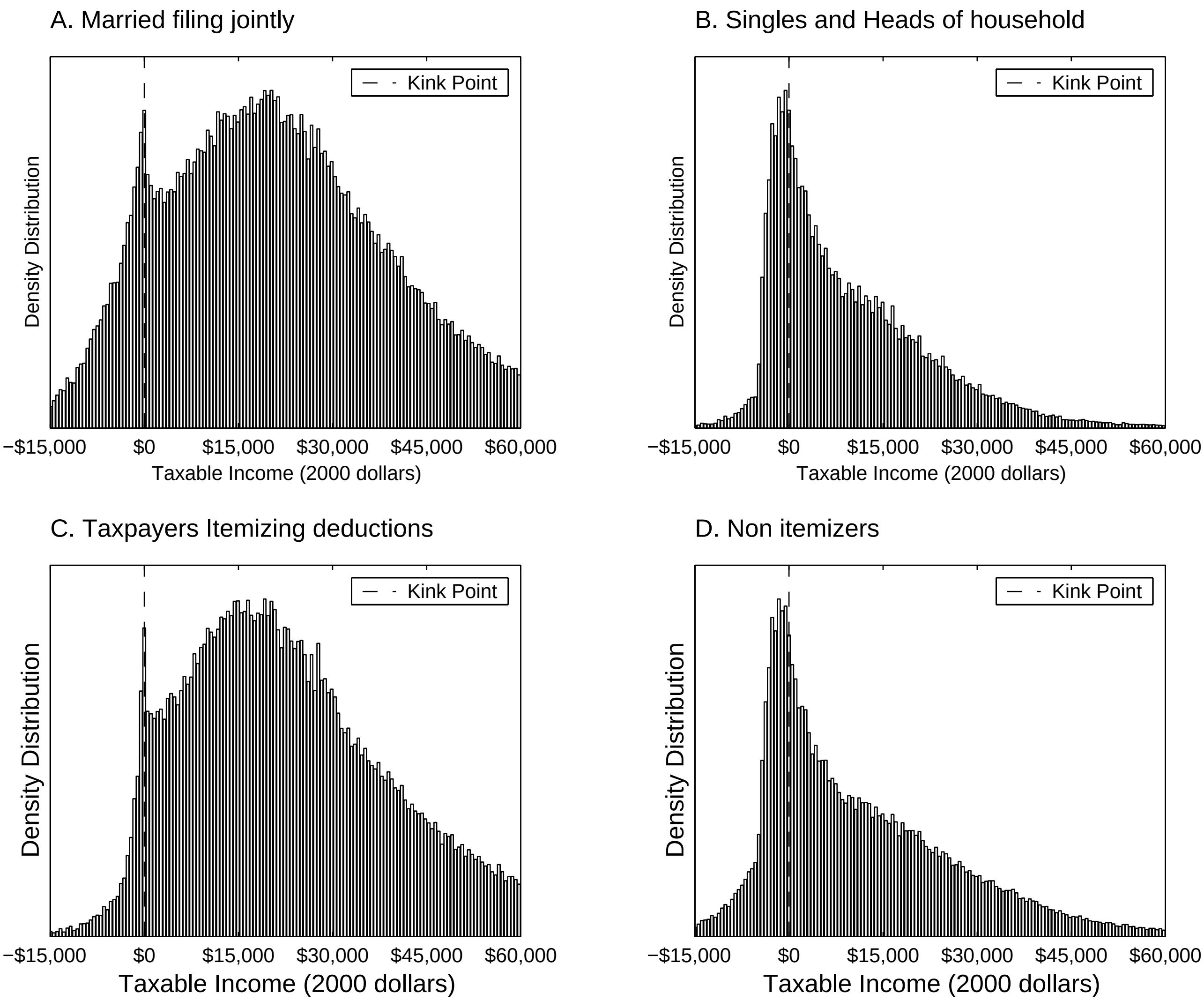


Fig. 4. Testing the non−filers hypothessis, 1988−1997

Fig. 5. Distributions around first kink point, 1960−1969



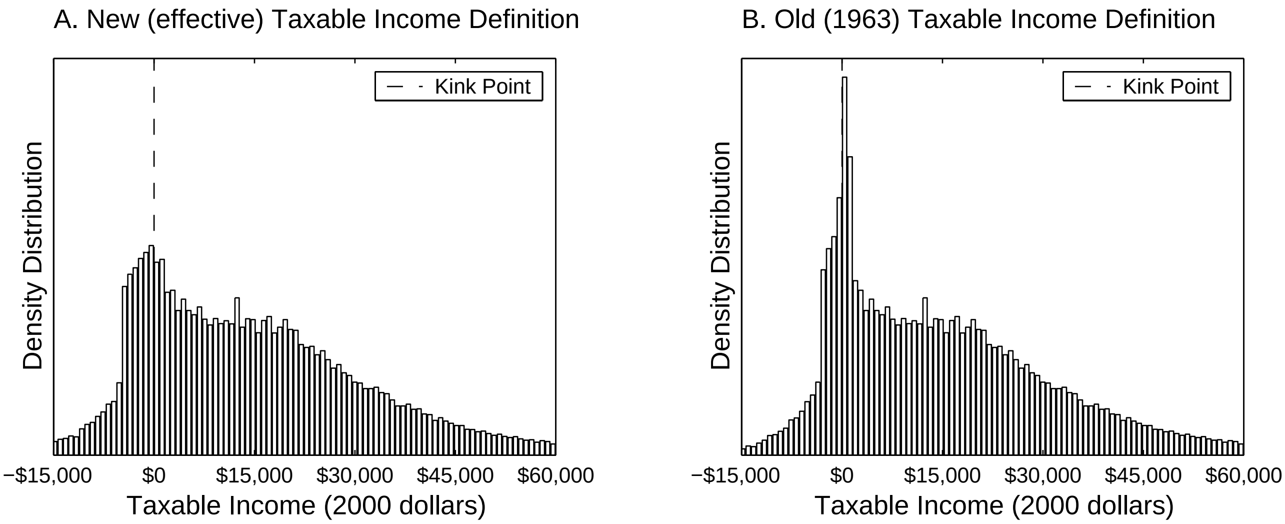


Fig. 6. Dynamics of Bunching after tax change in 1964

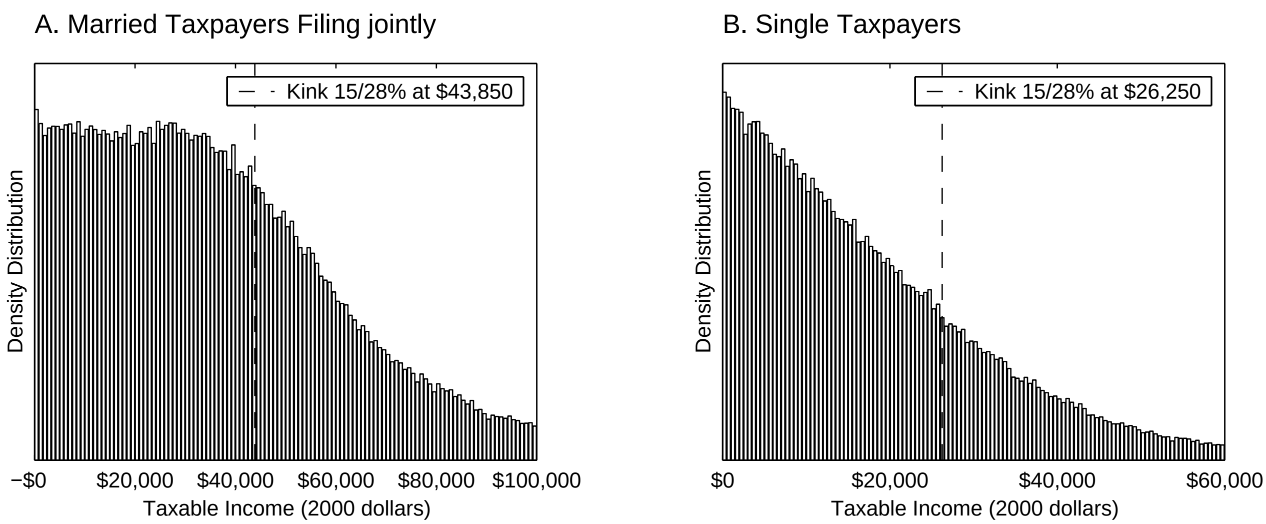


Fig. 7. Density distribution around kink 15 to 28%, 1988−1997

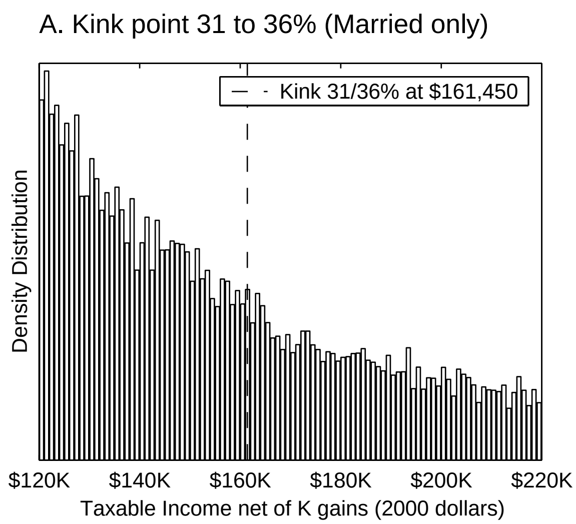


Fig. 8. Density distributions around top kink points, 1993−1997

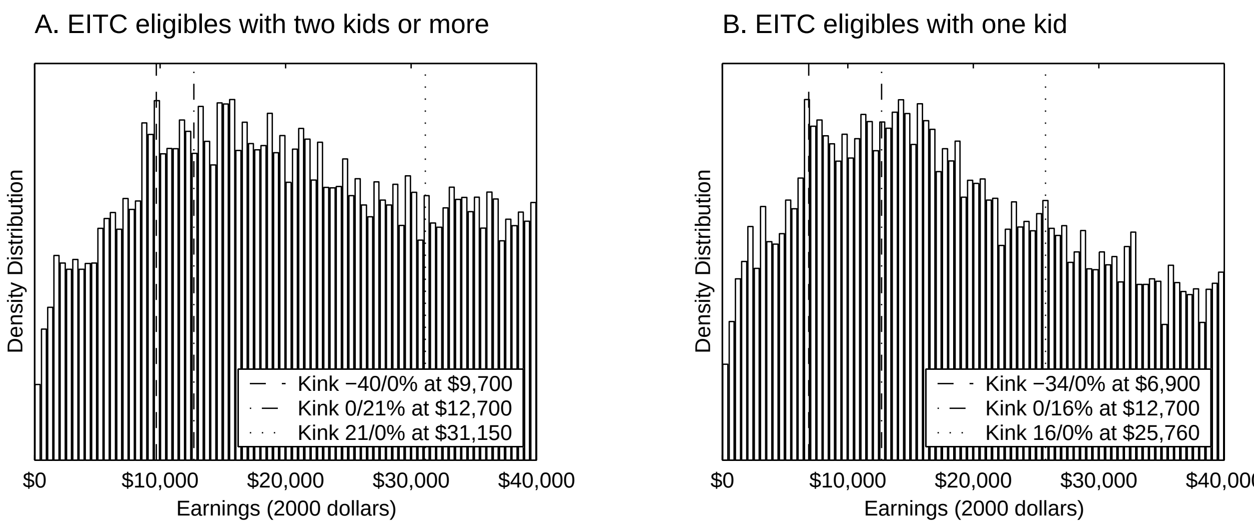


Fig. 9. Earnings distributions after EITC expansion, 1994−1997

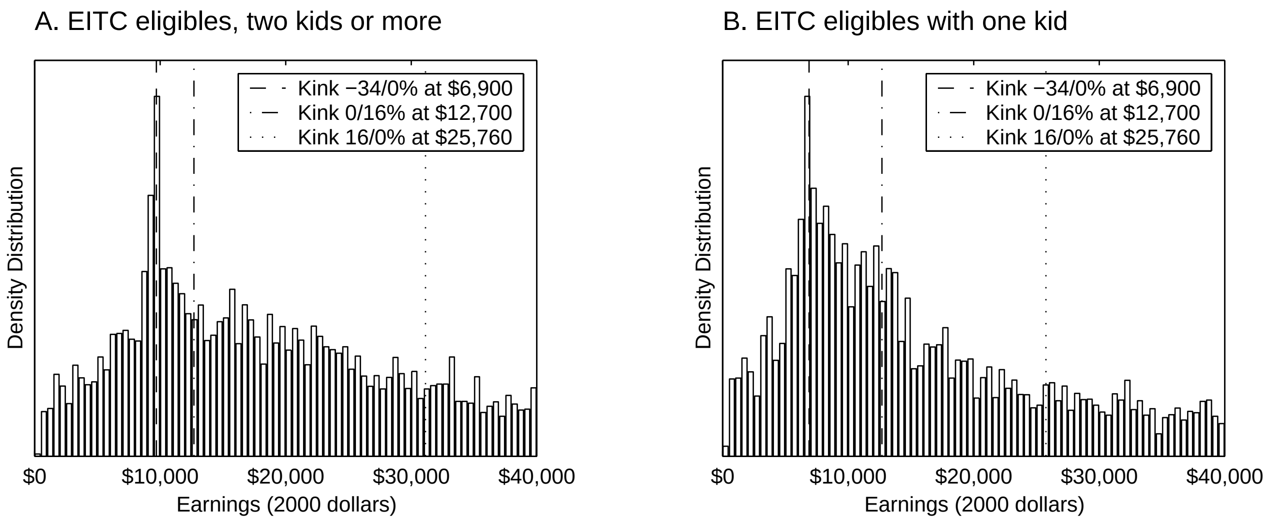


Fig. 10. Self−employed earnings distributions, 1994−1997

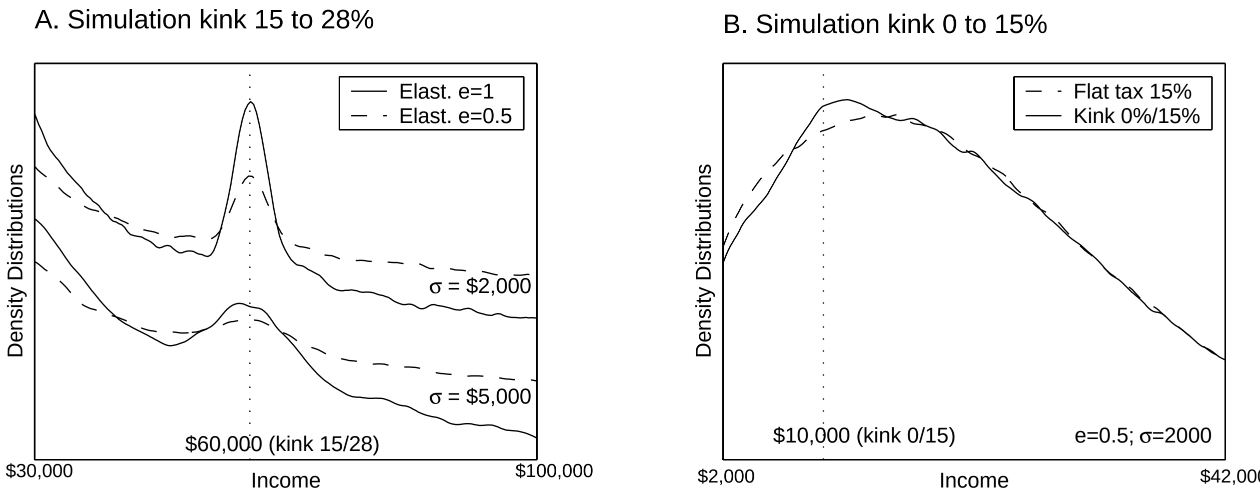


Fig. 11. Numerical simulations with random incomes

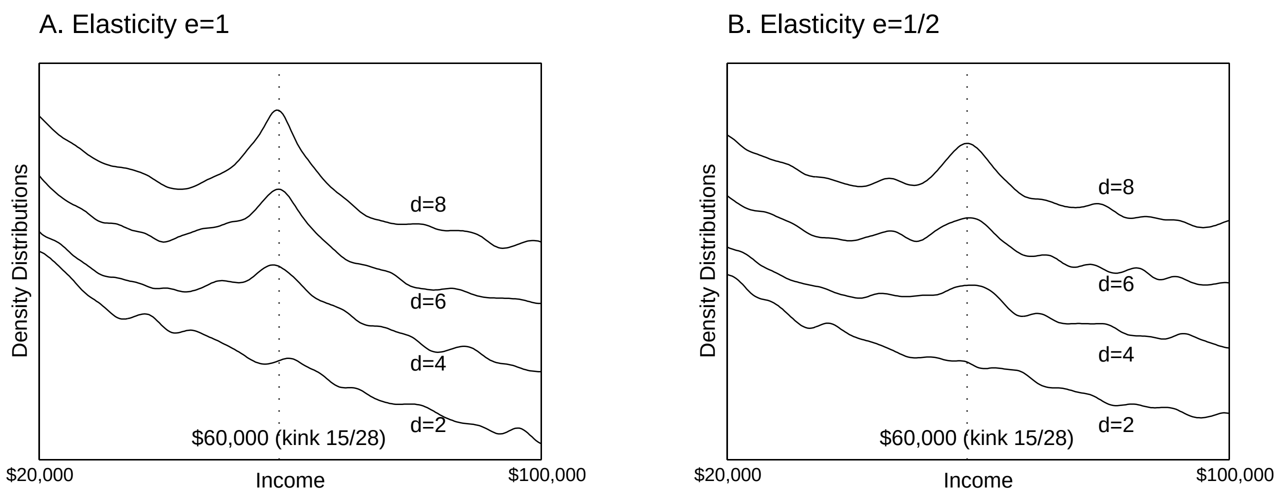


Fig. 12. Numerical Simulations with Constrained Labor Supply

Table 1: Tax Structure and Schedules

A. Tax Structure

	Exemption level (per person)	Standard Deduction	Filing Threshold	First Tax Rate	Top Marginal Tax Rate
1948-1963	$600 ($3,500 in 2000 dollars)	10% of AGI up to $1,000	All Taxpayers: $600 ($3,500 in 2000 dollars)	20%	91%
1964-1969	$600 ($3,200 in 2000 dollars)	10% of AGI or 200+$100*exemptions whichever is larger up to $1,000	All Taxpayers: $600 ($3,200 in 2000 dollars)	14% (16% in 1964)	70% (77% in '64)
1988-2000 (indexed for inflation all values expressed in 2000 dollars)	$2,750	Married: $7,350 Singles: $4,400 Heads: $6,450	Married: $12,950 Singles: $7,200 Heads: $9,250	15%	See Panel B

B. Tax Schedules from 1988 to 2000 (in 2000 dollars)

1988-1990

Tax Rate	Bracket starts at: Married	Singles
15%	$0	$0
28%	$43,850	$26,250
33%	$105,950	$63,550
28%	$215,870	$129,450

1991-1992

Tax Rate	Bracket starts at: Married	Singles
15%	$0	$0
28%	$43,850	$26,250
31%	$105,950	$63,550

1993-2000

Tax Rate	Bracket starts at: Married	Singles
15%	$0	$0
28%	$43,850	$26,250
31%	$105,950	$63,550
36%	$161,450	$132,600
39.6%	$288,350	$288,350

C. Earned Income Tax Credit Schedule (in 2000 dollars)

1988-1993

One kid or more

Tax rate	Starts at:
-14%	$0
0%	$9,250
16%	$14,550
0%	$27,500

1994-2000

Two Kids or more

Tax rate	Starts at:
-40%	$0
0%	$9,700
21%	$12,700
0%	$31,150

One Kid

Tax rate	Starts at:
-34%	$0
0%	$6,900
16%	$12,700
0%	$27,400