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Should Taxes Be Based on Lifetime Income?
Vickrey Taxation Revisited

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Most U.S. adults participate during most years of their lives in two different systems of income redistribution: the social security system (OASDI) and the personal income tax system. In determining whom to subsidize and whom to tax, these two systems aggregate income over very different time horizons. The social security system redistributes based upon average earnings in a worker's thirty-five highest years of earnings, a measure that approximates lifetime earnings.[1] In contrast, the tax base for the personal income tax system, including related benefits such as the earned income tax credit (EITC), is annual income.[2]

The existence of these two very different approaches raises several questions. First, how do different types of persons fare under annual systems versus lifetime systems, and in particular under the current U.S. versions of these systems? Second, what can economic theory tell us about the advantages and disadvantages of moving to tax bases that are either longer or shorter than one year? Third, what empirically would be the effects of moving the U.S. personal income tax system to a period of assessment longer than one year? Fourth, are there considerations that would suggest that the length of the assessment period for the retirement benefit system should be different from that of the tax system?

The paper begins in section one by discussing the basic concept of tax averaging and by reviewing the classic Vickrey (1939; 1947) proposal for a cumulative income tax. This section

[1]The annual limit on earnings subject to the OASDI taxes causes the Social Security system to share some features with an annual tax system. I discuss this further below.

[2] There are some minor exceptions to this annual assessment. Various provisions regarding capital income, such as loss-carryforwards and taxation of gains at realization rather than accrural, imply that the period of assessment for the personal income tax is not strictly one year.

also describes the tax averaging formula that was part of the U.S. tax code from 1964 through 1986. Section two briefly discusses the ways in which the paper relates to other work in the tax reform literature. Section three describes the data used for the empirical sections of the paper. Section four uses these data to show the range of average and marginal tax rates paid by workers at a given level of lifetime income, and the reduction in average tax rates that would occur from lifetime tax averaging (in the absence of behavioral responses).

In section five, I define a "distributionally neutral" Vickrey system of cumulative lifetime taxation and derive the theoretical relationship between marginal tax rates in such a system and those in an annual progressive income tax system. Then, in the context of two simple models in which it is optimal to tax equally people with the same lifetime income, I present empirical estimates of the efficiency and equity gains from moving to the Vickrey system.

In section six, I analyze models in which a utilitarian social planner would not want to assess the same level of lifetime taxation on all people with the same level of lifetime income. I discuss models with 1) intertemporal substitution of labor supply; 2) myopic consumers; 3) credit constraints; 4) earnings uncertainty; and 5) non-separable preferences.

The conclusion reviews the main results and discusses several issues that will be the subject of further work.

1. Cumulative Taxation and Tax Averaging

Tax Averaging Basics

The classic argument for determining a person's tax liability based upon a multi-year or even lifetime measure of income is horizontal equity. Under a progressive annual income tax, a taxpayer who spreads his income equally across periods will pay lower total taxes over his lifetime than a taxpayer with the same lifetime income but a more unequal distribution of income across years. This difference in tax payments occurs because the taxpayer with equal earnings takes full advantage of all of the opportunities to have income taxed in low tax rate brackets, whereas the taxpayer with more volatile earnings will have unused space in low brackets in low-income years, while having additional income taxed at high rates in high-income years.

These differences in tax payments can be substantial. Consider a married couple with no children that takes the standard deduction and earns $100,000 over a two-year period. Under the 2000 tax schedules, if that married couple earns all of its income in one year, then it would pay $18,674 in tax. If the couple splits its income equally between the two years, then it would pay $5,558 in each year or $11,115 total over the two years. Thus, the couple with income concentrated in one year pays 68 percent more in tax and faces an average tax rate over this two-year time period that is 7.6 percentage points higher.

The amount a taxpayer receives from the earned income tax credit can similarly vary substantially with the way a taxpayer spreads income across years. A head of household taxpayer with two children and a total of $25,000 of income over two years will pay no income tax and receive a total of $7,800 from the EITC if she splits her income equally across the two years, but will pay $1,522 in non-EITC federal income taxes and receive only $1,380 from the EITC if she earns all of the income in a single year. The $7,942 difference in net tax liability between these two taxpayers represents a 32 percentage point difference in average tax rates for individuals with identical pre-tax total income over the two-year period. The phaseout of the EITC can sometimes make it advantageous to have more volatile income. A head of household taxpayer with two children who has $15,000 of earnings in one period and $45,000 in the next faces an average tax rate net of the EITC of 1 percent, compared with a tax rate of 7.5 percent if she splits her earnings equally across the two periods.

The OASDI payroll tax provides a second case in which it is more advantageous to have volatile income. Consider a taxpayer who earns $169,800 (twice the maximum earnings taxable under OASDI) in one year and nothing in the next year. If this taxpayer instead splits his earnings equally between the two years, he will owe an extra $10,528 in OASDI payroll tax, a 6.2 percent increase in his average tax rate over this two-year period. The incremental Social Security benefits received will offset some of the extra tax payments, but for most high-earners this offset will be far short of 100 percent. While these three examples were carefully crafted to illustrate extreme cases, we will see when we turn to micro data that cases like these do arise and that there is, in fact, a non-trivial spread in average tax rates among individuals at a given level of multi-period income.

The precise formulation of horizontal equity underlying the general sense that two taxpayers with the same present discounted value of lifetime earnings should be taxed identically is that two taxpayers facing the same (pre-tax) lifetime consumption budget constraint should be taxed equally. If taxpayers have perfect foresight and can fully smooth their consumption by borrowing and saving, two taxpayers with the same present discounted value of lifetime earnings but different time paths of earnings face the same budget constraint in allocating consumption across periods. Absent some other information suggesting that they deserve to be treated differently, it therefore violates the principle of horizontal equity to tax them differently.[3] Stated another way, social welfare will increase if each of these two taxpayers pays a tax equal to the average of their respective lifetime tax payments under the current annual tax system, since this would transfer resources from a taxpayer with lower marginal utility (the more lightly taxed individual) to a taxpayer with higher marginal utility (the more heavily taxed individual).[4]

Vickrey's Proposal

William Vickrey (1939; 1947) proposed a cumulative averaging system for personal income taxation that was motivated by principles similar to those described above. Vickrey's scheme aimed to equalize the tax payments of those with fluctuating incomes and those with

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[3] One reason that taxpayers with the same lifetime income may deserve to be treated differently is that they might consume different amounts of leisure. This consideration led Fullerton and Rogers (1993) to develop the concept of potential income – the income an individual would have earned if he or she had worked the maximum possible hours – in their work on the lifetime tax burden. Nonetheless, in part because of data limitations and in part because of concerns that variations in hours worked may reflect things other than preferences for leisure, most of the studies that have examined tax issues from a lifetime perspective have used a consumption or realized measure to rank individuals on lifetime well being (see Poterba (1989) for example). Shaviro (2000) provides a discussion of taxpayer endowments and other related issues.

[4]This principle of "equal taxation for people on identical consumption budget constraints" has motivated some observers to call for consumption taxation rather than income taxation since it seems odd that a taxpayer whose earnings come early in life and who shifts consumption to the future by saving should be taxed more heavily than a taxpayer with the same present discounted value of lifetime earnings whose path of earnings matches his desired consumption path (See Feldstein (1976) and Bradford et al (1984)). In a simple model in which individuals smooth their consumption across periods in an identical fashion, a progressive consumption tax (but not a wage tax) would eliminate the differential treatment of people with different time paths of earnings. However, if persons have different preferences over what fraction of their consumption to allocate to different periods of life, even a progressive consumption tax could lead to differential treatment of people on identical budget constraints.

steady incomes and to eliminate the incentives to shift income, particularly capital income, across time periods.[5] Vickrey's proposals for the taxation of income from capital have led to the important work of Auerbach (1991), Bradford (1995), and Auerbach and Bradford (2001) showing that it is possible to design a capital income tax based on realization accounting that has the desirable properties of an accrual-based tax. In contrast, with the notable exception of Diamond (forthcoming) who applies optimal tax theory in studying redistribution in social security systems, the implications of Vickrey's proposals for the taxation of labor income have been largely ignored by economists.[6]

A cumulative tax system consists of a final tax schedule that specifies total tax payments as a function of total income and of procedures for collecting tax payments along the way so as to assure that a given tax payment is not "too large in relation to the income in the period immediately preceding."[7] Vickrey proposed that the final tax schedule be derived from the existing annual tax schedule by calculating for any total income, the tax that would have been paid under the annual tax schedule if the total income had been earned in equal amounts in each of the years of the averaging period. Thus all taxpayers would be taxed at the same rate as a

[5] Vickrey listed several other criteria, as well, including low administrative burden and ease in adjusting tax rates.

[6] Vickrey's ideas have received some attention in the small literature on the U.S. tax averaging provisions (David, Groves, Miller, & Wiegner, 1970; Ferguson & Hood, 1968; Goldberg, 1965; Klein & Wiegner, ; Schmalbeck, 1984; Smith, 1971; Steuerle, McHugh, & Sunley, 1978).

[7]Vickrey (1939), p. 381.

taxpayer with steady income.[8] Total income was to be calculated as the sum of annual taxable income over the averaging period plus an imputation of accumulated interest on tax payments made throughout the averaging period. In combination with the cumulative tax schedule, the accumulated interest on tax payments removes the incentive to shift the realization of income across periods, since the taxpayer earns interest on tax payments made earlier in life that is equivalent to the extra capital income the taxpayer would earn on the income by postponing realization. Taxes due at the end of the final period are the total tax from the final tax schedule minus the accumulated value of past tax payments.

Under Vickrey's proposal, tax payments in each year are determined by treating that year as the end of the averaging period. The final tax due on the income accumulated to that date is calculated and the payment is the difference between that calculated amount and the accumulated value of past tax payments in previous years. This approach implies that tax payments will be low in years in which income falls below the average of income in past years. Since the previous tax payments implicitly assumed that the taxpayer would continue to earn at the average level experienced so far, the below-average income lowers the cumulative average and effectively entitles the taxpayer to a refund relative to what they would have paid if they had been a steady earner at the level of the revised cumulative average. Indeed, Vickrey shows that the payment in this case will always be below the payment under the annual tax system. Similarly, taxpayers experiencing an above-average year will be required to make a higher payment than under the annual system. Thus annual tax payments are high in years in which a taxpayer can most afford

[8] Vickrey later realized that to make his reform revenue neutral it would be necessary to derive a tax schedule based on some typical pattern of income fluctuations rather than the extreme pattern of a completely steady earner (Vickrey, 1972).

it. Vickrey argues that his scheme would allow entire sections of the tax code concerning allocation of capital income across years to be eliminated and that the only extra complexity would be the necessity of carrying forward two numbers from the previous year's tax return and of having a separate tax table depending on the number of years the taxpayer had been participating in the system.

It is important to note that Vickrey's approach is firmly rooted within the income tax.[9] Taxpayers with the identical present discounted value of lifetime earnings (i.e. who face identical consumption budget constraints) who allocate their consumption differently across years will pay different amounts of taxes.[10] Vickrey's numerical examples all assume that taxpayers with identical lifetime earnings have identical expenditure paths as well. In contrast, in my analysis, I will apply a Vickrey-like cumulative averaging formula to the present accumulated value of lifetime earnings. Thus, taxpayers facing identical lifetime consumption budget constraints will pay the same tax, regardless of how they choose to allocate their consumption across years.

U.S. Tax Averaging 1964 to 1986

Although Vickrey's cumulative averaging system has never been implemented, other tax

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[9] He does, however, acknowledge that a similar cumulative averaging approach could be applied to an expenditure tax.

[10] To see this, consider two taxpayers, A and B, who participate in a Vickrey cumulative averaging system for two years. Assume that the annual interest rate is r and that taxpayer A earns a wage of W_{1a} in period 1, a wage of W_{2a} in period two, and consumes C_{1a} in period one, and similarly for B. Let $t(\bullet)$ be the taxes assessed as a function of income. Adjusted total income for the two periods equals the income in period 1, W_{1a}, plus income in period 2, $W_{2a}+r(W_{1a}-t(W_{1a})-C_{1a})$, plus the accumulated value of period 1 tax payments, $rt(W_{1a})$. So adjusted total income for taxpayer A is $(1+r)W_{1a}+W_{2a}-rC_{1a}$ and for B is $(1+r)W_{1b}+W_{2b}-rC_{1b}$. These will be equal if the PDV of wages is equal *and* if first period consumption is equal.

averaging schemes have been tried.[11] In the U.S., a form of tax averaging was available to all taxpayers from 1964 through 1986, and a similar provision is still available to farmers. Under the U.S. averaging provision, taxpayers who experienced large increases in income could reduce their tax payments by allocating some of the income to the previous four years. Specifically, taxpayers could spread the portion of their taxable income that exceeded 120 percent of their average taxable income in the previous four years over the current year and the previous four years.[12] At its peak in the high-inflation years of the late 1970s, almost seven percent of taxpayers took advantage of these provisions (Schmalbeck, 1984). No averaging provisions were available for taxpayers experiencing falls in income (unless their incomes subsequently rose).[13] Many taxpayers who experienced little or no real income growth were made eligible for this provision by the high inflation rates of the late 1970s and early 1980s, leading its budgetary cost to increase significantly. Budgetary concerns and empirical evidence that the main beneficiaries of the credit were high-income taxpayers with steadily rising incomes (rather than taxpayers with abnormally high or oscillating income) let to restrictions on use of the credit in the Deficit Reduction Act of 1984 and to its elimination in the Tax Reform Act of 1986.

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[11] Vickrey (1939) describes abandoned averaging systems in Australia in the 1920s and Wisconsin between 1928 and 1932. Canada abandoned some averaging provisions in the 1980s around the same time that the U.S. did.

[12] In addition, income in the current year must have exceeded the 120 percent of average income in the previous years by at least $3000.

[13] If taxpayer incomes oscillate, then an appropriately designed system that reduces taxes in high-income years is sufficient to equalize tax payments between taxpayers with steady incomes and those with fluctuating incomes. However, a taxpayer who experienced 20 high-earning years followed by 20 low-earning years would not be treated equivalently to a taxpayer who experienced 40 average years.

2. Some Context for the Current Analysis

Before turning to the main analysis, it is worth pausing to remark on several issues that will help in the interpretation of the results.

Horizontal Equity versus Welfare Maximization

While the case for assessing taxes on a multi-year basis has most often been made using horizontal equity arguments, these discussions have implicitly assumed simple models in which eliminating horizontal inequities simultaneously maximizes social welfare. In Kaplow's (1989; 2000) terminology horizontal equity is being used in these cases as a proxy device, not as an independent normative principle. The analysis in the current paper follows Kaplow in taking social welfare maximization as the goal of tax policy and, therefore, does not give any additional weight to policies that treat people with the identical present discounted value of lifetime resources equally in cases in which such a policy is inconsistent with social welfare maximization.

Optimal Taxation versus Tax Reforms

There are two main strands in the literature on the design of tax systems. One tries to derive the properties of optimal tax systems given some set of information and constraints.[14] The second studies tax reforms and evaluates the impacts of specific changes to existing tax

[14] The classic work by Mirrlees (1971) and the large literature that followed take this approach. See Tuomala (1990) for a survey.

policies.[15] This paper is firmly in the second category. It studies the impact of moving from existing annual progressive income tax systems to a specific type of multi-year system. There may or may not be similar impacts of moving from an optimal annual system to an optimal multi-year system.

Commitment by the Government

An under-appreciated feature of the standard Mirrlees optimal income tax problem is that after the government has set its tax schedule and individuals have chosen their level of effort, every worker's type is revealed to the government. This makes it a strange model of an annual tax system unless the government can commit to forget the information that has been revealed to it.[16] The puzzling ability of the government to commit to ignore the information revealed by taxpayers is similar to the government's apparent ability to commit not to finance all of its operations with a one-time non-distortionary capital levy.[17] Whatever the reason, the U.S. political system does seem to prevent the government from reneging on these two commitments,[18] and I assume in this paper that the government can commit to a lifetime tax

[15] Feldstein (1976) and King (1986) argue for the importance of studying tax reforms. Among the many examples of this approach are Auerbach and Kotlikoff's (1987) analysis of moving from an income to a consumption tax base.

[16] Considerations such as these are part of Diamond's (forthcoming) motivation for reinterpreting the Mirrlees model as a model of lifetime taxation. Diamond implicitly makes a commitment assumption that is analogous to the one I make here.

[17] See Brito et al (1991) for a discussion of these issues.

[18] Indeed, the recent U.S. proposals to rebate to corporations taxes paid in the past suggest that the tendency of the U.S. political system leans in the opposite direction of capital levies. President Ford's 1975 tax cut is an example of a rebate of past taxes that actually was

schedule.[19]

Taxation of Income from Capital

The models and empirical results in this paper mostly assume no taxation of income from capital and are therefore of progressive wage taxes, not of income taxes. This allows me to focus on the issue of how annual and lifetime systems of redistribution affect people with different distributions of labor income without introducing the complications of capital taxation. In addition, this simplification greatly eases data and computational requirements. Moreover, starting from a perspective that people on the same consumption budget constraint deserve to be treated equally, it is difficult to motivate income taxation, though Saez (2000) has recently shown that if high-earners have greater propensity to save, it can be optimal to tax interest income even in the presence of an optimal non-linear earnings tax.[20] While it would be possible to combine an Auerbach-Bradford generalized cash flow capital income tax with a Vickrey-style tax on wage earnings, it is worth emphasizing that the impacts of the two taxes are not separable; in particular, the presence of the capital income tax will raise lifetime marginal tax rates on labor

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implemented.

[19] Roberts (1984) and Dillen and Lundholm (1996) study optimal dynamic taxation in models without government commitment and, due to the rachet effect, are generally pessimistic about the government's ability to use information from early periods of life to accomplish redistribution in later periods of life with lower efficiency cost.

[20] However, Dynan, Skinner, and Zeldes (2000) conclude that the disparate saving behavior of the rich and poor cannot be explained by differences in rates of time preference.

income earned early in life relative to labor income earned later in life.[21]

Which Extra Information to Use?

Lastly, a cumulative tax system in which current and future tax liabilities depend in part on past income levels is one of many ways in which the government could use additional information in assessing taxes beyond the information it currently uses. For example, Kremer (1997) argues that the government could accomplish redistribution at lower efficiency cost by conditioning taxes on the age of the taxpayer.[22] An interesting question that I do not address in the current paper is how the gains from cumulative taxation compare to those from other alternatives for conditioning tax payments on things other than annual income. It is worth noting, however, that whereas some possibilities for improved targeting of tax schedules such as conditioning on race, census tract of birth, or age might be perceived as offensive and/or radical changes from the current approach, cumulative taxation simply involves the government assessing taxes based upon information it already collects on the income tax form.

3. Data

The main data for this paper will ultimately be lifetime Social Security earnings histories from 1951 through 2000 linked to the 1984, 1990, 1991, 1992, 1993, and 1996 panels of the Survey of Income and Program Participation. However, because Census disclosure procedures

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[21] See Auerbach and Bradford (2001) for further discussion of issues that arise when combining labor income taxation and their generalized cash flow tax.

[22] Akerloff (1978) provides a more general discussion of the gains to conditioning transfers on immutable observable characteristics.

currently result in a long lag between when results are produced and when they can be distributed, this version of the paper uses an older, public use, set of Social Security earnings histories from 1951-1980 linked to the Social Security Administration's New Beneficiary Survey (NBS) for a cohort of workers who first claimed Social Security benefits in the early 1980s (and who were therefore typically between the ages of 30 and 60 in the years covered by the earnings data). I select male respondents who have positive earnings in at least 20 of the 30 years, who do not have any other indications of having worked in a sector of the economy not covered by Social Security,[23] and who did not claim disability benefits. With these restrictions, the sample totals 6184. In simulating tax payments, I treat the males as having been married in all years to a non-working spouse and as having no asset income. I assume that the taxpayer claimed the standard deduction in every year and that there were two children present in the household during the first 15 years of the sample and no children present in the last 15 years. Imposing this uniformity on the family circumstances of the taxpayers allows me to focus on the pure impacts of tax averaging without having to worry that the results are contaminated by correlations between family characteristics and earnings volatility. It also eliminates the need for judgements about appropriate equivalence scales for families of different sizes and about whether various tax preferences for children and child-related costs accurately reflect ability to pay.

The Social Security earnings histories are truncated at the maximum level of earnings subject to the Social Security payroll tax. I impute earnings above the taxable maximum using a parametric AR(1) random effects model that is an extension of a Bayesian Gibbs sampling model

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[23] Specifically, people are dropped from the sample if they have income from a public pension or report public sector employment in the retrospective employment history.

used in Hirano (2002). My extension involves treating the unobserved earnings above the taxable maximum as additional parameters to be estimated and adding a step to the Gibbs sampler that draws from the relevant truncated normal distribution (see Appendix A for details). The advantage of my method relative to the approaches used in previous studies that have imputed earnings above the taxable maximum is that my imputation procedure reflects the autocorrelation between earnings in adjacent years that is a well-known feature of panel earnings data. The sensitivity of my results to sample selection choices and imputation procedures will be much more limited when I am able to use the SIPP matched data since that data set contains uncapped earnings for all workers from 1978 to the present regardless of whether the workers were employed in sectors of the economy covered by Social Security.

As a check on the earnings data and to provide better evidence on high income households than is available from the NBS data, I also provide results using the University of Michigan Tax Panel, a twelve-year panel data set of U.S. federal income tax returns covering the years 1979-1990. From that data set, I select married taxpayers who remain married for the entire duration of the panel, who are present in every year in the panel, and who did not claim an age exemption for being over 65. With those restrictions, my total sample size in 2482. These taxpayers should be broadly comparable to the sample from the New Beneficiary Survey in that they should mostly be in their prime earning years, though they are likely to be somewhat younger on average than those from the NBS. To see whether income volatility is substantially different when asset income is included, I use a modified adjusted gross income as the main income measure in my results from the tax panel. The modifications to AGI are designed to make the AGI concept consistent across years despite changes in tax laws. Specifically, I adjust AGI by adding back in IRA and Keough deductions as well as excluded dividends and capital gains in years in which these deductions and exclusions were applicable. On a priori grounds it is hard to know whether to expect the income measure from the tax panel to exhibit greater or lessor volatility than the NBS earnings. On the one hand, the tax panel data set presumably understates lifetime income variability because it covers only 12 years and therefore does not represent the variability that occurs across decades of a person's life. Moreover, individuals who filed tax returns in all 12 years with the same marital status are likely to have less volatile incomes than would the average taxpayer. On the other hand, because I include capital income in the tax panel measure of income as well as earnings from secondary earners, these data should exhibit higher volatility than my NBS sample which is limited to earnings of the primary earner in the household. Both data sets are inflated so that all income measures are in 2000 dollars and so that wages in the last year of each sample are at 2000 levels.

4. Descriptive Results

The analysis in sections 5 and 6 will examine the equity and efficiency implications of adopting Vickrey-style cumulative lifetime taxation using models that incorporate behavioral responses to tax incentives. To motivate that discussion and to provide some results that are not sensitive to the assumptions of the behavioral models, the current section presents descriptive results that show the extent to which taxpayers at a given level of lifetime income vary in their lifetime personal income and payroll tax payments and in the distribution of marginal tax rates they face over their lifetime.

Variations in Lifetime Average Tax Rates

The two panels of Figure 1 show the distribution of lifetime average tax rates from the federal personal income tax (excluding the EITC and child credit) at different levels of discounted multi-period earnings. The lifetime average tax rates are calculated as the present discounted value of taxes divided by the present discounted value of income, discounted at a 3 percent real rate. The simulations assume that taxpayers faced the 2000 tax schedules in all years of their lives. The top panel contains data from the NBS and therefore reflects 30 years of earnings. The bottom figure contains data from the tax panel and reflects 12 years of modified adjusted gross income. To make the data comparable across the two data sets as well as to make the earnings levels easier to interpret, the discounted earnings are annualized by dividing the PDV of earnings by the PDV of earning $1 in each year. Thus, the discounted NBS earnings are divided by 20.19 and the discounted tax panel income is divided by 10.25 to produce annualized earnings and income.

Each panel shows the actual data points for each sample member as well as the fitted value at each income level estimated using a kernel regression. In the top panel we see that the range of lifetime average tax rates at a given lifetime income level is fairly wide. At $15,000 of annualized lifetime income, some taxpayers pay average lifetime tax rates below 1 percent while others pay 8 percent or more. At $50,000, some pay 10 percent while others pay 14 percent. The range of average tax rates in the tax panel data is generally lower than that in the earnings data. Thus any extra variability introduced by including asset income in the income measure appears to be outweighed by the shorter period of observation and the sample requirement that people remain as married tax-filers in all periods. The NBS data contain substantially more observations with very low or zero annual income than the tax data do, explaining the much greater variation in average tax rates at lower income levels in the top panel of figure 1 than in the bottom panel.

Table 1 contains further details about the distribution of average tax rates at different income levels. Specifically, it shows different points in the distribution of deviations of average tax rates from the mean average tax rate for that lifetime income level. These are calculated by subtracting each individual's average tax rate from the kernel regression predicted value for the individual's income level. For the entire NBS sample, the standard deviation of average tax rates relative to the predicted value is 0.8 percent of lifetime income. The deviations range from -5.5 percent of lifetime income to 2.0 percent of lifetime income. Fifty percent of the sample has deviations between -0.5 and 0.4 percent of lifetime income and 80 percent are between -0.8 and 1.0. For the tax panel, the distribution of deviations is tighter. The standard deviation is 0.6 percent of lifetime income. Fifty percent of the sample has deviations between -0.1 and 0.3 percent of lifetime income and 80 percent are between -0.7 and 0.5.

Figure 2 shows lifetime average subsidy rates from the EITC. Recall that I have assumed that all sample members have two children in their household for the first half of the years. Thus the variation in average subsidy rates in these data is not a reflection of variation across households in the number of EITC qualifying children, but instead reflects income variation. Lifetime subsidy rates from the EITC average about 13 percent at $10,000 of annualized lifetime income and fall to about 5 percent at $20,000. In the NBS data, there is a very wide range of subsidy rates at some income levels – for example taxpayers with annualized income of around $10,000 receive lifetime subsidies from the EITC that range from less than 5 percent to greater than 20 percent.[24]

Figure 3 shows comparable tax and subsidy rates for Social Security. Results are shown only for the 30-year NBS sample, since there is insufficient information in the 12-year tax panel to reliably calculate future Social Security benefits. Social Security payroll taxes are 12.4 percent of earnings up to the taxable maximum. For low lifetime-income individuals, the average tax rate is therefore exactly 12.4. At higher earnings levels, the fitted value falls as a greater share of earnings are above the taxable maximum. By $80,000 of annualized earnings, the average OASDI tax rate is below 10 percent. At higher income levels, there is also some noticeable variation in lifetime OASDI tax rates at a given income level since individuals vary in the fraction of lifetime income that is above the taxable maximum.

Lifetime Social Security benefits are calculated for each sample member by assuming that all 30 observed years of earnings are among the worker's highest 35 years of earnings and adding in another 5 years at 90 percent of the average of the 30 that are observed. Then the 2000 AIME and PIA formulas are applied in order to determine monthly benefit amounts. All of the sample members are assumed to retire at age 62 with a benefit of 80 percent of their PIA. Expected lifetime benefits are calculated using the cohort lifetable for males born in 1940 and discounting at the same 3 percent real rate used for the tax calculations. Because neither spouse benefits nor differential mortality by socioeconomic status are incorporated into the calculations, the only source of variation in benefit levels at a given level of lifetime earnings comes from differences

[24] I have produced similar results for the child credit, but its impact (under 2000 tax rules) is much smaller than that of the EITC, and its flat per child credit amount (after it phases in) leads to little variation in credit amounts at a given level of lifetime income.

in the timing of income throughout the worker's lifetime.[25]

It is interesting to compare the lifetime average tax rates from Social Security in Figure 3 with those from the personal income tax in Figure 1. At $20,000 of annualized lifetime income, the net average tax rate from Social Security is approximately zero as average taxes and average benefits are roughly the same. By $80,000 of annualized lifetime income, OASDI taxes exceed benefits by almost 5 percent of lifetime earnings. Therefore, the average tax rates rise by 5 percent of lifetime income over this range of incomes. In Figure 1 we saw that lifetime average tax rates from the federal personal income tax rose from around 5 percent at $20,000 of annualized income to around 15 percent at $80,000. This is twice as large an increase in lifetime average tax rates as the increase from Social Security over this range. Taking into account the EITC, the personal income tax schedule appears to be more progressive than the Social Security benefit formula at lower income levels as well.[26]

It is worth emphasizing that the U.S. Social Security system is essentially equivalent to a Vickrey-style cumulative lifetime averaging system, since net lifetime benefits from the system

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[25] Social Security indexes earnings to average wage levels which have grown historically at roughly 1 percent per year. Because the wage growth rate is below the 3 percent rate of return at which I discount, people with earnings concentrated later in life receive higher benefits relative to discounted earnings than do people with the same PDV of earnings but earnings concentrated earlier in life. Liebman (2002) shows the variability of Social Security benefits at a given level of lifetime earnings taking into account differences in expected mortality, spouse earnings levels, and the fraction of income in the highest 35-years, as well as in the timing of income. See also Gustman and Steinmeier (2002)and Corronado, Fullerton, and Glass (2000).

[26] Because Social Security benefits payments occur significantly later than the earnings on which they are based, the choice of a discount rate heavily influences the measured average tax rates from Social Security. Using a discount rate lower than the 3 percent rate used here would increase the measured progressivity.

depend on lifetime indexed earnings.[27] Appendix B shows that for a single male taxpayer who works for exactly 35 years, stops working and claims benefits at age 62, and has average male life expectancy for a person born in 1940, the cumulative lifetime tax schedule implied by Social Security is -4.54 percent of lifetime income (discounted to age 27) between 0 and $150,691, plus 6.4 percent of lifetime income between $150,691 and $915,600, plus 9.6 percent of lifetime income above $915,600.[28]

Gains from Averaging

Figure 4 shows how much the average tax rate of each taxpayer in the sample would fall if the taxpayer maintained the same present discounted value of lifetime income but was able to spread the lifetime income equally (in real undiscounted dollars) across all years.[29] In the top

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[27] There are three ways in which this is not exactly true. First, the cap on earnings subject to the payroll tax means that the timing of earnings can effect benefits and taxes. Second, to the extent that the wage rate used to index earnings in Social Security differs from the rate of return that individuals can receive on their saving, the timing of earnings can matter. Third, if a worker has earnings outside of his 35 highest years of earnings, the allocation of earnings across years will matter.

[28] It would, of course, be possible to have a Social Security system that redistributes based upon annual rather than lifetime income. For example, the payroll tax schedule could remain unchanged and a progressive benefit formula based on annual earnings could determine that year's increment to retirement benefit levels. Smetters (1997) argues that the redistribution that occurs through Social Security could be replaced by a more generous (possibly age-indexed) EITC in which redistribution occurred during working years rather than during retirement. He shows that if individuals are liquidity constrained when young, this could lead to significant welfare gains.

[29] A few taxpayers in these simulations have increases in lifetime average tax rates from averaging. Recall that I assume that taxpayers claim two child exemptions during the first half of the sample and no child exemptions during the last half of the sample. For these few taxpayers, income averaging shifts income from years with kids to years without kids and results in a lower share of lifetime income being taxed in the zero bracket.

panel, using the 30-year NBS earnings data, we see that the largest gains are at roughly $14,000 and $58,000 of annualized earnings. These two points correspond to the kink points between the 0 and 15 percent tax brackets and the 15 and 28 percent brackets. The gains from tax averaging are determined by how close a taxpayer's average income is to a kink point, how large the difference is between marginal tax rates in the two brackets, and the variance of the individual's annual earnings. The tax saving from averaging (measured as a change in average tax rates) is largest at the point where the 0 and 15 percent brackets meet both because the jump in marginal tax rates is larger at this point than at any other point in the tax schedule and, as Figure 5 shows, because earnings are more volatile at the bottom of the income distribution than they are at higher incomes.[30]

These same factors suggest that some potential EITC recipients would have large gains from tax averaging. The top panel of Figure 6 shows that taxpayers with average lifetime income at the EITC maximum would gain around 7 percent of lifetime income on average if they could all concentrate their earnings at the EITC maximum rather than having their earnings fluctuate between higher and lower levels. On the other hand, taxpayers at $30,000 – roughly where eligibility for the EITC ends – would lose EITC payments if they had steady income, rather than having their EITC status fluctuate between eligibility and ineligibility.

The concentration of large potential gains from averaging at the bottom of the earnings distribution has led to proposals for carryforwards and carrybacks of unused exemptions going back to Vickrey (1947) and legislation to this effect was introduced in 1946 but not enacted.

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[30] The second panel of Figure 5 provides some indication that the coefficient of variation in annual income is U-shaped, falling until about $90,000 of annualized income and then rising again.

More recently, Batchelder (2002) has proposed that EITC recipients be given the option of income-averaging in calculating their EITC payments.[31]

An interesting question is the extent to which income averaging over periods of less than a lifetime can achieve most of the gains from lifetime averaging. Figure 7 shows the distribution of remaining gains to moving to 30-year averaging under different shorter averaging periods. I examine averaging periods for all shorter periods that are factors of 30 and therefore allow comparison to full 30-year averaging. The results show that the potential gains from moving to full averaging shrink steadily as the number of averaging periods increases from one (i.e. no averaging) to five. There appears to be little gain from moving from 5 to 10 years for most of the sample.[32] Then there are large gains from moving from 10 to 15 years and, for about 10 percent of the sample, there are significant further potential gains from moving from 15-year to full 30-year averaging.

Variations in Marginal Tax Rates

Just as the annual tax system results in people with the same lifetime income paying different levels of lifetime tax, it also results in people at the same level of lifetime income facing different average incentives and in the same individual facing different incentives at different

[31] While these changes would undoubtedly increase the progressivity of the tax code, their desirability from a tax-averaging perspective is not so clear once one takes TANF and food stamp benefits into account.

[32] Indeed because the ten year averaging causes years with and without children to be included in the same averaging period, gains from further averaging actually rise for some percentiles when moving between 6 and 10 year averaging periods. See the discussion of this issue in footnote 28.

points in time. Figure 8 shows the share of lifetime income that is taxed at each marginal tax rate as a function of annualized lifetime income. The shares are calculated by assigning all of the income in the year to the last dollar marginal tax rate. The figures show that, at a given level of lifetime income, taxpayers often have substantial fractions of income taxed at two or more marginal tax rates. Figure 9 shows the dispersion in average (dollar weighted) lifetime marginal tax rates across individuals as a function of annualized lifetime income. At most levels of income the range in average marginal tax rates is at least 5 percentage points.

5. Efficiency and Equity Gains from Vickrey Taxation

The results in the previous section suggest that, if it were possible to have every individual at a given level of lifetime income pay the same lifetime tax, there could be equity gains from equalizing income levels of otherwise identical people. Moreover, if such a tax system allowed people to face a marginal tax rate on all of their income that was the average of all of the marginal tax rates faced in different periods by people at the same lifetime income level there potentially could be efficiency gains. Since deadweight loss rises with the square of the marginal tax rate, taxing people at the average of existing marginal rates would lower deadweight loss. There are two components to this averaging. First, average marginal tax rates would be equalized across people at the same lifetime income level. Second, because people would face a single lifetime marginal tax rate, intertemporal labor supply decisions would no longer be distorted.[33]

[33] Such a reform could also eliminate the distortions to risk-taking that are created in the current system which taxes volatile income more heavily that steady income. In addition, moving to a lifetime cumulative tax system would likely reduce distortions to human capital

In this section, I define what I call a distributionally neutral Vickrey tax system and derive the marginal tax rate in such a system. Then, in the context of two simple models of lifetime labor supply, I estimate the efficiency gains from moving to such a system. I also show how annual taxes in such a system compare to annual income. In the following section of the paper I turn to models in which there are reasons to tax people with the same lifetime income differently and explore the implications of distributionally neutral Vickrey taxation under those models.

Distributionally Neutral Vickrey Taxation

Vickrey initially proposed deriving the lifetime cumulative tax schedule from the existing annual tax schedule by taxing everyone at the level of lifetime tax they would have paid under the annual tax schedule if they had spread their income equally across years. Because such a system would not raise as much revenue as the existing annual system, he later refined his proposal to tax everyone as if they had experienced an average amount of income volatility. Under both proposals, the gains from adopting cumulative taxation would accrue disproportionately to persons at income levels with above-average income variability. In contrast, the system I study attempts to be distributionally neutral by taxing everyone at a given level of lifetime income at the average of the lifetime tax currently paid by people at that level of lifetime income. My approach obviates the need to make judgements about the desirability of redistribution across lifetime income levels and allows me to focus on the gains from equalizing tax payments and marginal tax rates across individuals at the same level of lifetime income.

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accumulation that occur because an annual tax system taxes people with steep earnings profiles more heavily than it taxes those with flat earnings profiles.

Formally, I define the distributionally-neutral Vickrey tax schedule as a function of lifetime income, Y, (suppressing the discount rate r for notational convenience) as:

$$V(Y) = \sum_{p=1}^{p=P}\Big\{ \int_{0}^{\frac{k_1}{Y}} f(s_p|Y) t_1 s_p Y ds_p + \int_{\frac{k_1}{Y}}^{\frac{k_2}{Y}} f(s_p|Y)(t_1 k_1 + t_2(s_p Y - k_1)) ds_p$$

$$+ \int_{\frac{k_2}{Y}}^{\frac{k_3}{Y}} f(s_p|Y)(t_1 k_1 + t_2(k_2 - k_1) + t_3(s_p Y - k_2)) ds_p + \cdots$$

$$+ \int_{\frac{k_{B-1}}{Y}}^{1} f(s_p|Y)(t_1 k_1 + t_2(k_2 - k_1) + \ldots + t_{B-1}(k_{B-1} - k_{B-2}) + t_B(s_p Y - k_{B-1})) ds_p \Big\}$$

where p=1 to P indexes the years over which the averaging occurs and b=1 to B indexes the number of tax brackets in the annual tax system from which the Vickrey system is derived. The kink points (the income levels at which tax rates change) are k_1 to k_B with the additional definitions $k_0=0$ and $k_b=Y$. The tax rates are t_1 to t_B. Finally, the shares of lifetime income received in each period conditional on Y range from 0 to 1 and are jointly distributed $f(s_1, s_2, s_3, \ldots s_{P-1}|Y)$, with $s_P = 1 - s_1 - s_2 - s_3 - \cdots - s_{P-1}$. Intuitively, this formula simply takes the average of the lifetime tax paid under the annual system by people at income level Y, and, under the distributionally neutral Vickrey tax system, each individual with lifetime income Y will pay the same lifetime tax, V(Y).[34]

The formula can be simplified and rewritten as

[34] I defer discussion of the procedure for collecting intermediate tax payments until a later subsection.

$$V(Y) = \sum_{p=1}^{p=P} \left\{ \sum_{b=1}^{b=B} t_b Y \int_{\frac{k_{b-1}}{Y}}^{\frac{k_b}{Y}} f(s_p|Y) s_p ds_p + \sum_{b=1}^{b=B-1} (t_b - t_{b+1}) k_b \int_{\frac{k_b}{Y}}^{1} f(s_p|Y) ds_p \right\}$$

which is convenient for differentiating with respect to Y so as to derive the lifetime marginal tax rate under this modified Vickrey scheme:

$$V'(Y) = \sum_{p=1}^{p=P} \sum_{b=1}^{b=B} t_b \int_{\frac{k_{b-1}}{Y}}^{\frac{k_b}{Y}} f(s_p|Y) s_p ds_p$$

$$+ \sum_{p=1}^{p=P} \sum_{b=1}^{b=B} t_b Y \int_{\frac{k_{b-1}}{Y}}^{\frac{k_b}{Y}} f_Y(s_p|Y) s_p ds_p + \sum_{p=1}^{p=P} \sum_{b=1}^{b=B-1} (t_b - t_{b+1}) k_b \int_{\frac{k_b}{Y}}^{1} f_Y(s_p|Y) ds_p$$

The first term in this expression is simply the dollar weighted average of marginal tax rates from the annual system. Intuitively, if the distribution of income shares received in each period does not change as lifetime income rises, then receiving one more dollar of lifetime income and allocating it to each period according to the existing share of income received in that period will increase tax payments by the dollar weighted average of annual marginal tax rates. If the distribution of income shares does not change with Y, then the second and third term will be zero (since f_Y will equal zero). In the more general case, the second and third terms adjust the lifetime marginal tax rate for changes in the distribution of lifetime income across years that occur as lifetime income rises.

In the applications that follow, I numerically calculate distributionally neutral Vickrey tax schedules from micro data, rather than using these analytic formulas. Nonetheless, some further intuition may be gained by examining a particularly simple case for which analytic tax schedules can be calculated. Consider a two-period, two-bracket system with a single kink point at K.

Further assume that the income shares across the two periods are uniformly distributed. In this case it is easy to show that

$$V(Y) = t_1 Y \quad if\ Y < K$$

$$V(Y) = t_2 Y + (t_2 - t_1)(\frac{K^2}{Y} - 2K) \quad if\ Y >= K$$

$$V'(Y) = t_1 \quad if\ Y < K$$

$$V'(Y) = t_2 - \frac{K^2}{Y^2}(t_2 - t_1) \quad if\ Y >= K$$

Before turning to an empirical application, one further observation is in order. This distributionally neutral Vickrey system is exactly distributionally neutral by lifetime income groups only in the absence of behavioral responses to the new tax system. Moreover, because annual tax systems result in different incentives for people with different distributions of income across periods, people who end up at the same level of lifetime income under the annual tax system are not, in general, people who would have had the same lifetime income in the absence of taxation – in other words they are not people who would have been on the same pre-tax lifetime consumption budget set. If the government knows the model that describes individuals' labor supply behavior as well as the relevant elasticities, it may be possible to determine people's abilities, and solve for the average annual tax paid by people who would be on the same consumption budget constraint in the absence of taxation.[35] Even if it used this alternative "distributionally neutral Vickrey scheme" the system would still be only approximately

[35] The first model in the next subsection is one that would allow the government to average over people on the same pre-tax budget constraint rather than over people with the same post-tax income. However, the simulations I present here average over people with the same post-tax income.

distributionally neutral once behavioral responses are taken into account.

Estimates of Efficiency Gains

In this subsection, I use the NBS micro data to calculate the efficiency gains from switching to distributionally neutral Vickrey taxation in a simple model in which it is optimal to assess the same level of taxation on people with the same level of lifetime income.

Consider a taxpayer who has chosen a career, thereby determining the slope of his or her lifetime wage profile. For example, a taxpayer who decides to become a doctor commits to no wages during medical school, low wages during residency and fellowship, and high wages thereafter. A taxpayer who decides to become a professional football linebacker commits to a wage profile with 4 years of very high wages and then very low wages for the rest of his life. A taxpayer who chooses a career in middle management in a large corporation commits to the wage and promotion path of that corporation. A taxpayer who chooses to be a farmer or a self-employed lawyer commits to a volatile earnings stream in which effort and payments may be separated by a significant period of time. Given this career choice that determines the share of lifetime income received in each period, I assume that the taxpayer chooses a level of lifetime effort so as to maximize the lifetime utility function

$$U = \sum_{p=1}^{p=P} \frac{s_p ew}{(1+r)^{p-1}} - \sum_{p=1}^{p=P} \frac{\tau\left(s_p ew\right)}{(1+r)^{p-1}} - \frac{e^{K+1}}{K+1} .$$

where p= 1 to P indexes the years of the individual's working life, r is the real interest rate, s_p is the fraction of lifetime income earned in period p, e is the lifetime level of effort, w is the individual's wage, $\tau(\bullet)$ is the annual tax schedule as a function of annual income, and K is a parameter equal to $1/\epsilon$,. where ϵ is the elasticity of labor supply. This quasi-linear model, which is similar to models studied by Saez (1999) and Diamond (forthcoming), has the convenient property that there are no income effects of taxation, and therefore that the compensated and uncompensated elasticities are equal.

While it is clearly unrealistic to assume a single lifetime effort choice and infinite substitutability of consumption across periods, it is useful to study the impact of Vickrey taxation in a simple model in which taxing people with identical lifetime incomes is optimal, before moving on to more complicated cases. In addition, there are many cases in which workers have control over their amount of effort but not over the timing of their income, so this model does capture an important aspect of labor supply.[36]

The first order condition from this model is:

$$(e^*)^K = \sum_{p=1}^{p=P} \frac{s_p w(1-\tau'(s_p e^* w))}{(1+r)^{p-1}}.$$

Multiplying both sides by e* and raising both sides to the 1/(K+1) power results in an expression for e* as a function of the labor supply elasticity and the observed earnings and marginal tax rates in each period:

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[36] For related discussions in the labor literature see for example Baker and Holmstrom (1995)on internal labor markets, Hutchens (1989)on seniority and wages, and Rosen (1985)on implicit contracts.

$$e^* = \left[\sum_{p=1}^{p=P} \frac{s_p e^* w(1 - \tau'(s_p e^* w))}{(1+r)^{p-1}} \right]^{\frac{1}{K+1}} .$$

Tthe individual's wage can then be calculated (using the observed marginal tax rates and income shares) as

$$w = \frac{(e^*)^K}{\sum_{p=1}^{p=P} \frac{s_p(1 - \tau'(s_p ew))}{(1+r)^{p-1}}} .$$

With these results I calculate the wage, w, and income shares, $s_{p.}$ for each individual in my NBS sample, and use them to do simulations for other tax schedules. I estimate the distributionally neutral Vickrey tax schedule, using a kernel regression to obtain average taxes at each level of lifetime income (this is simply the fitted regression line in the top panel of figure 1). In these simulations, I assume that a 15 percent payroll tax is also in place. Then I use a grid search to find the optimal effort level for each individual in the sample under the Vickrey tax schedule. For the deadweight loss calculations, I also need to know utility levels with lump sum taxation and it is straightforward to analytically calculate optimal effort levels under such a scenario for each individual in the NBS sample.

Table 2 shows the results of the simulations using a labor supply elasticity of 0.5. Lifetime utility equals the present discounted value of lifetime earnings minus the present discounted value of lifetime taxes minus the disutility of effort. Deadweight loss equals the no-tax utility minus the with-tax utility minus the PDV of lifetime taxes. Under the annual income tax simulation (which also includes a 15 percent payroll tax), earnings are 19 percent lower than they would be in the absence of taxation. Deadweight loss is about 17 percent of total revenue.[37] Under the switch to Vickrey taxation, earnings increase by about 1 percent, as does tax revenue, resulting in a reduction in deadweight loss of almost 7 percent of total deadweight loss from the payroll and income taxes and 8.5 percent of the incremental deadweight loss from the income tax. For comparison, Feldstein (1999) calculates that a 10 percent decrease in all marginal tax rates would reduce the incremental deadweight loss of the income tax by 15 percent. Note that the reform that I study raises revenue while reducing deadweight loss, whereas Feldstein's tax reduction loses revenue.[38] In addition, it is worth emphasizing that these efficiency gains came from a model with no opportunities for intertemporal substitution of labor supply, thus an important source of potential efficiency gains from Vickrey taxation are absent from this model.

Distributional Effects

Figure 10 plots post-tax lifetime utility relative to lifetime utility in the absence of taxation for the annual tax system and the Vickrey tax system. For comparison purposes, the

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[37] This deadweight loss estimate is roughly in line with that of other studies. For example, Feldstein (1999) estimates a deadweight loss of the personal income tax that is 32 percent of personal income tax revenue, using an elasticity of 1.04. Since deadweight loss is proportional to the elasticity, Feldstein's estimate would be 16 percent if he used the same 0.5 percent elasticity that I use. This particular Feldstein estimate does not incorporate the preexisting payroll tax, however, suggesting that his estimate would be somewhat higher than mine if he simulated the combined deadweight loss of both the payroll tax and the income tax.

[38] I have also calculated deadweight loss under the two tax systems using the Harberger-Browning approximation $DWL = \frac{1}{2} Y\varepsilon \frac{t^2}{(1-t)}$. To do this for the Vickrey system, I calculate numerical derivatives of the Vickrey tax schedule at the lifetime earnings levels of each member of the sample. The results are quite similar to the model based results – the 7 percent reduction in deadweight loss becomes an 8 percent reduction.

figure also contains the 90 degree line representing utility in the absence of taxation. The main thing to notice is that utility levels under the Vickrey system are in fact distributionally neutral as intended – they lie right in the middle of the utility levels for the annual tax system. Moreover, the Vickrey system removes the variation in post-tax utility for a given level of no-tax utility that occurs in the annual tax system and eliminates utility reorderings – cases in which a taxpayer with higher no-tax utility than another taxpayer ends up with lower after-tax utility than the other taxpayer.

Annual Tax Payments Under the Vickrey System

The distributionally neutral Vickrey tax schedule specifies only discounted lifetime tax payments as a function of discounted lifetime income, it does not specify a procedure for collecting tax payments along the way. As Vickrey noted, the goal of such a procedure should be to have annual tax payments be reasonable in relationship to annual income and to avoid requiring a large payment by the taxpayer at the end of his career. While there are a number of plausible approaches to collecting taxes along the way, the procedure that seems to work best for the distributionally neutral Vickrey scheme is the following: First, calculate the predicted present discounted value of lifetime earnings under the assumption that earnings continue at the average level to date by inflating the PDV of earnings to date by $\frac{\sum_{1}^{T} 1/(1+r)^{t-1}}{\sum_{1}^{D} 1/(1+r)^{t-1}}$ where T is the total number of years covered by the lifetime averaging and D is the current year. Second, calculate the lifetime tax due on the predicted lifetime earnings and multiply this amount by the inverse of the multiplier above to get total taxes due to date. Third, subtract the present discounted value of taxes paid in previous years from the total taxes due to date to find the discounted value of taxes due in this period. Finally, multiply the taxes due this period by $(1+r)^D$ to express them in current dollars.[39]

Figure 11 displays annual tax payments relative to annual income under the current annual tax system and under the Vickrey system. Specifically, it shows average *annual* tax rates as a function of average *annual* income using the procedure described above to assign annual tax payments under the Vickrey system. The main thing to observe is that, under the Vickrey system, taxpayers with the same annual income make a range of annual tax payments. Nonetheless, annual tax payments under the Vickrey system rarely exceed 20 percent of annual income and are generally quite close to payments under the annual system. Moreover, taxpayers whose earnings are below their previous average levels can receive large rebates.

A Model with Period-by-Period Effort Choices

To get a sense of the magnitude of the additional efficiency gains that occur when we account for the fact that under Vickrey taxation, marginal tax rates are averaged not only across individuals at a given lifetime income but also across years for a given individual, consider a simple variant on the previous model in which individuals maximize their utility period-by-period with no saving. In this case, individuals separately choose effort levels in each of the P periods to maximize:

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[39] To be consistent with all of the other discussions in the paper, I have specified the Vickrey tax schedule as a function of the PDV of earnings where the discounting is back to the first year of earnings. In fact, it would probably be simpler to express the schedule as a function of the accumulated value of earnings at the point of retirement. This would make it possible to calculate the annual tax payment in three steps rather than four.

$$U = \sum_{p=1}^{p=P} \frac{1}{(1+r)^{p-1}} \left\{ e_p w_p - \tau(e_p w_p) - \frac{e_p^{K+1}}{K+1} \right\} .$$

I assume that under the Vickrey tax system, individuals know their lifetime marginal tax rate and solve each period's problem as if they faced that marginal tax rate.

The bottom half of Table 2 shows results from simulations under this model. As in the first model, earnings and tax revenue increase from moving to Vickrey taxation. Moreover, the reduction in deadweight loss is now 11 percent compared with 7 percent in the first model. Thus, to the extent that there are opportunities to adjust annual effort levels in response to variations in annual marginal tax rates, a shift to Vickrey taxation results in additional efficiency gains.

6. Models in Which People with the Same Lifetime Earnings Deserve to Be Treated Differently

This section of the paper discusses the impact of Vickrey taxation in models in which a social planner might want to apply different treatment to people with the same lifetime income. I successively discuss models with intertemporal substitution, myopia, borrowing constraints, uncertainty, and non-separable preferences. In the current version of the paper, I simply discuss a few of the issues raised by these models. I am currently working on implementing multi-period dynamic programming models to study these issues more systematically.

Intertemporal Substitution

Adopting the distributionally neutral Vickrey system would reduce taxes on people whose earnings vary across years and raise taxes on people with the same level of lifetime earnings who have steady earnings. If variations in earnings are largely due to variations in wage rates and if it is possible for individuals to intertemporally substitute labor supply in periods with high wages for labor supply in low-wage periods, then this change may redistribute from lower utility individuals to higher utility individuals. In essence, people with large variation in wage rates can earn a given amount in fewer hours by substituting labor supply into the high wage periods, an opportunity not available to people with constant wage rates. If intertemporal labor supply elasticities are small, however, then equalizing tax payment by people at a given level of lifetime earnings may still be welfare improving.

Myopia

If individuals are myopic or lack the self control to consumption smooth via saving, then individuals with fluctuating incomes will have lower utility than individuals with the same lifetime earnings who are fortunate enough to have income patterns that coincide with a smoother pattern of consumption. Vickrey taxation will therefore redistribute from higher utility to lower utility individuals by reducing taxes on those with more variable earnings relative to those with steady earnings.

Borrowing Constraints

The current tax system favors people with flat earnings profiles relative to rising earnings profiles. In the presence of borrowing constraints, individuals with flatter earnings profiles are likely to be closer to their optimal consumption paths and therefore to have higher utility than individuals with a rising earnings profile who are unable to borrow against future wealth. Thus, lowering taxes on those with unequal earnings and raising them on those with constant earnings should, in the presence of borrowing constraints, result in redistribution from those with higher utility to those with lower utility.

Uncertainty

The desire to treat workers with uncertain income streams the same as workers with certain streams was one of the primary motivations for Vickrey's original proposal. Given risk aversion it seems odd to tax more heavily the taxpayer facing greater risk. However, if uncertainty occurs in the form of varying wages and it is possible to intertemporally shift labor supply into high wage periods, then a worker with fluctuating wages could be better off than one with constant wages.

Non-separable Preferences

The basic perspective for most of this paper has been that people with the same lifetime resources have the same level of well-being regardless of the allocation of those resources across time. However, if people form habits or become accustomed to a standard of living then those with steadily rising income may deserve to be more heavily taxed than those with steady or falling income. If people with rising income represent a substantial fraction of individuals with highly unequal distributions of earnings across years, then Vickrey taxation could reduce social welfare by reducing taxes on people with relatively low marginal utility of income.

7. Conclusion

The results in this paper suggest that there could be both equity and efficiency gains from moving to a Vickrey-style cumulative lifetime tax system that taxes everyone with a given level of lifetime income at the average of the lifetime taxes paid at that level of income under the current annual personal income tax system. The potential efficiency gains are large – a reduction in deadweight loss of as much as 11 percent of the combined deadweight loss from the OASDI payroll tax and the personal income tax.

Further analysis could confirm the reliability, and address the generalizability, of the results described in this paper. I plan to investigate the characteristics of workers with unequal earnings across years. Are these workers mostly people who suffer sharp declines in earnings, have steep age-earnings profiles, or experience earnings that oscillate from year to year? Second, I will test the sensitivity of my results to alternative treatments of marital status and family issues. Third, I will further analyze how annual tax payments under a Vickrey scheme would correspond to annual income, particularly for those experiencing sharp increases or decreases in income. Fourth, I plan to construct simulation models to further explore the issues raised in section 6 concerning reasons to treat taxpayers differently who have the same lifetime incomes. These models can help assess whether any of these issues are important enough to significantly strengthen or weaken the case for lifetime taxation. Fifth, I plan to integrate the analysis of lifetime taxation into an analysis of Social Security design, to explore whether the existence of Social Security reduces the need for a system of lifetime taxation.

However, there are several directions in which the current analysis needs to be extended in order to be confident that these results are reliable. First, it would be useful to develop a better understanding of who the workers are with different earnings patterns. Are workers who have unequal earnings across years mostly people who suffer sharp declines in earnings? People with steep age-earnings profiles? People whose earnings oscillate from year to year? Second, it will be important to explore how sensitive the results are to alternative treatments of marital status and family issues. More generally there is a need for careful analysis of how closely the tax system's various allowances, credits, deductions, and exemptions correspond to some notion of ability to pay. Third, there needs to be further analysis of how annual tax payments under a Vickrey scheme would correspond to annual income, particularly for those experiencing sharp increases or decreases in income. Fourth, the general discussion in section 6 of reasons to treat taxpayers differently who have the same lifetime incomes needs to be formalized into simulation models that can help assess whether any of these issues are important enough to significantly strengthen or weaken the case for lifetime taxation. Fifth, the analysis of lifetime taxation needs to be integrated into analysis of Social Security design so as to be able to answer questions such as whether the existence of Social Security reduces the need for a system of lifetime taxation.

Appendix A: Imputing Earnings above the OASDI Taxable Maximum

The main earnings data used in this paper are Social Security earnings histories that are capped at the maximum level of earnings that was subject to the OASDI payroll tax. I impute earnings above the cap for each individual in each year, using an AR(1) random effects model that is an extension of the model in the working paper version of Hirano (2002). Specifically, I extend the model to include an extra step in the Gibbs sampler that treats the capped earnings as additional parameters to be estimated and draws them from a truncated normal distribution.

Consider the parametric random effects model:

$$y_{it} = \gamma_i + \rho \cdot y_{i,t-1} + \varepsilon_{it,}$$

where γ_i and ε_{it} are assumed to be normally distributed and i.i.d:

$$\varepsilon_{it} \sim N(0, \tau^{-1}), \qquad \gamma_i \sim N(\psi, \Omega).$$

Hirano shows that this model can be estimated using a Bayesian Gibbs sampler by successively sampling:

$$p(\tau|\rho,\gamma,\Omega,\psi,y),\ p(\rho|\tau,\gamma,\Omega,\psi,y),\ p(\gamma|\tau,\rho,\Omega,\psi,y),\ p(\Omega|\tau,\rho,\gamma,\psi,y)$$

and

$$p(\psi|\tau,\rho,\gamma,\Omega,y).$$

I add an extra step by treating the topcoded observations, y_m, as additional parameters to be estimated and adding an extra step to the Gibbs sampler: $p(y_m|\tau,\rho,\gamma,\Omega,y_{(-m)})$.

I sequentially sample each topcoded observation conditional on all of the other observations for that individual using the distribution for a missing value in an AR(1) model provided by McCulloch and Tsay (1992):

$$y_h \sim N\left(\frac{\rho(y_{h-1} + y_{h+1})}{1+\rho^2}, \frac{\sigma_\varepsilon^2}{1+\rho^2}\right).$$

My draws from this normal distribution are truncated from below at the taxable maximum since we know that these observations are at or above this level. For the purpose of estimating the dynamic earnings process, I treat years with zero earnings as latent values to be estimated as well (truncated from below at zero). After I have estimated the earnings model and imputed the earnings above the taxable maximum, I restore the zero observations to zero for the empirical analysis. As suggested by Little and Rubin (1987), in conducting my analysis I take 5 draws from the posterior distribution of the latent earnings, form complete data sets from each set of draws, estimate each statistic on each of the data sets, and then combine them to produce my reported estimates.

Because the current earnings data are going to be replaced in subsequent drafts of this paper by data that are top coded to a much lesser extent, I do not provide a detailed discussion of the quality of the resulting imputed earnings here, and simply observe that in my current data the distribution of earnings that results from the imputations seems to match the distribution of untruncated earnings fairly closely up to around $90,000 of earnings, but seems to have too few individuals above that level. I am working on extending the imputation procedure to incorporate more flexible distributions of the error term with the hope that such an extension will allow the model to replicate the thick upper tail of the earnings distribution more accurately.

Appendix B: The Cumulative Lifetime Tax Schedule From Social Security

Consider a single male taxpayer who works for exactly 35 years, stops working and claims benefits at age 62, has average male life expectancy for a person born in 1940, and whose earnings are always below the taxable maximum and grow at a real rate of 1 percent per year (which is also assumed to be the average growth rate of earnings in the economy). For every dollar of earnings discounted to age 27, the individual pays 12.4 percent in OASDI payroll tax and receives additional expected lifetime retirement benefits of :

$$.8 \times \frac{12 \times 1.65 \times B'(AIME)}{12 \times 35} \sum_{age=62}^{age=\max age} \frac{p(alive_{age})}{(1+r)^{age-27}}$$

The term within the summation is simply the discounted lifetime benefit paid per dollar of annual benefit. The 0.8 in front of the term on the left reflects the benefit reduction for early retirement. The 35 x 12 in the denominator reflects the fact that a dollar of indexed annual earnings raises average monthly earnings by 1/420th. B'(AIME) is the change in monthly benefits (PIA) per additional dollar of AIME (it equalls 0.9, 0.32, or 0.15 depending on the PIA bracket). The 12 in the numerator annualizes the monthly benefit. The 1.65 in the numerator reflects the fact that earnings indexing accumulates earnings during one's lifetime at the average wage growth of the economy. Under the assumption that a marginal dollar of lifetime earnings is spread across the 35 years consistent with 1 percent annual real wage growth, a dollar of PDV earnings increases indexed earnings at age 62 by 1.65. Using a real discount rate of 3 percent and the appropriate life table gives a value of the summation term of 4.99.[40] Combining this with the PIA formula

[40] These calculations leave out spouse benefits, survivor benefits, and disability benefits. Thus, the net tax rates are too high and should be interpreted as simply illustrating the principle

yields a lifetime net tax schedule from Social Security that has three brackets, one for each region in the PIA formula. Under the assumptions above, the cumulative tax schedule from Social Security is -4.54 percent of lifetime income (discounted to age 27) between 0 and $150,691, plus 6.4 percent of lifetime income between $150,691 and $915,600 plus 9.6 percent of lifetime income above $915,600.

that Social Security is similar to a cumulative income tax system.

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Table 1, part 1
Distribution of the Deviation of Average Tax Rates from Predicted Values in NBS Earnings Data
(percent of discounted lifetime earnings)

		Percentiles									
	min	1%	5%	10%	25%	median	75%	90%	95%	99%	max
Entire Sample	-3.0	-1.8	-1.1	-0.8	-0.5	-0.1	0.4	1.0	1.5	2.6	5.1
Annualized Income											
$0 to $10,000	-2.1	-2.0	-1.7	-1.6	-1.1	-0.7	0.0	1.4	1.9	3.4	4.8
$10,000 to $20,000	-3.0	-2.4	-1.9	-1.6	-1.0	-0.3	0.6	1.5	1.9	3.1	5.1
$20,000 to $30,000	-1.9	-1.5	-1.1	-0.9	-0.5	-0.1	0.4	1.1	1.6	2.8	4.6
$30,000 to $40,000	-0.8	-0.8	-0.7	-0.6	-0.5	-0.2	0.3	0.9	1.4	2.3	3.4
$40,000 to $50,000	-1.0	-0.9	-0.8	-0.7	-0.5	-0.1	0.4	0.9	1.3	2.2	3.5
$50,000 to $60,000	-1.1	-1.0	-0.8	-0.7	-0.4	-0.0	0.4	0.9	1.3	2.3	4.0
$60,000 to $70,000	-1.0	-0.9	-0.8	-0.6	-0.3	-0.0	0.4	0.9	1.3	1.9	2.4
Above $70,000	-0.7	-0.5	-0.4	-0.4	-0.2	-0.1	0.4	0.7	0.8	1.1	1.2

Table 1, part 2
Distribution of the Deviation of Average Tax Rates from Predicted Values in Tax Panel Data
(percent of discounted 12-year modified AGI)

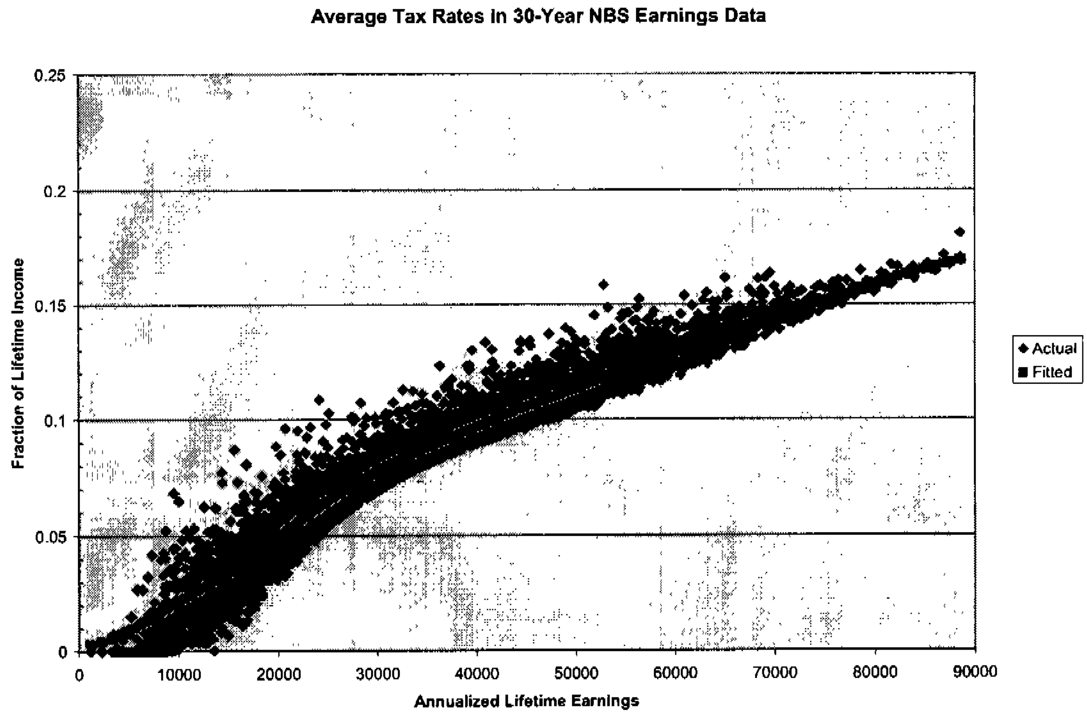
					Percentiles						
	min	1%	5%	10%	25%	median	75%	90%	95%	99%	max
Entire Sample	-5.5	-2.7	-1.2	-0.7	-0.1	0.2	0.3	0.5	0.7	1.0	2.0
Annualized Income											
$0 to $20,000	-3.9	-3.9	-2.1	-0.7	-0.0	0.6	1.1	1.5	1.7	2.0	2.0
$20,000 to $30,000	-3.3	-3.2	-1.0	-0.6	-0.1	0.3	0.4	0.6	0.7	1.0	1.0
$30,000 to $40,000	-3.7	-2.1	-1.2	-0.5	-0.1	0.2	0.3	0.3	0.3	0.4	0.4
$40,000 to $50,000	-3.9	-3.6	-1.3	-0.9	-0.1	0.3	0.4	0.5	0.5	0.5	0.5
$50,000 to $60,000	-3.4	-2.7	-1.5	-1.0	-0.3	0.2	0.6	0.8	0.8	1.0	1.0
$60,000 to $70,000	-2.6	-2.2	-1.2	-0.8	-0.3	0.2	0.4	0.6	0.7	0.9	0.9
$70,000 to $100,000	-49	-2.1	-1.0	-0.5	-0.1	1.5	1.9	2.6	3.1	3.7	3.9
Above $100,000	-5.5	-3.3	-1.0	-0.5	-0.1	0.1	0.2	0.4	0.6	0.9	1.3

Table 2
Impacts of Distributionally-Neutral Vickrey Taxation
(mean utils)

	PDV of Lifetime Earnings	PDV of Lifetime Taxes	Disutility of Effort	Utility	Deadweight Loss
Model with Single Lifetime Effort Choice					
No Taxes	919,280	–	306,430	612,850	0
Annual Income Tax	745,920	187,130	164,300	394,480	31,240
Vickrey Taxation	752,440	188,720	168,740	394,970	29,160
Model with Period by Period Effort Choices					
No Taxes	921,830	--	307,280	614,550	0
Annual Income Tax	745,920	187,130	164,300	394,480	32,940
Vickrey Taxation	754,380	189,940	169,060	395,370	29,230

Note: Annual income tax and Vickrey taxation simulations include 15 percent payroll tax as well.

Figure 1


Average Tax Rates in 30-Year NBS Earnings Data
Fraction of Lifetime Income
0.25
0.2
0.15
0.1
0.05
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Annualized Lifetime Earnings
Actual
Fitted

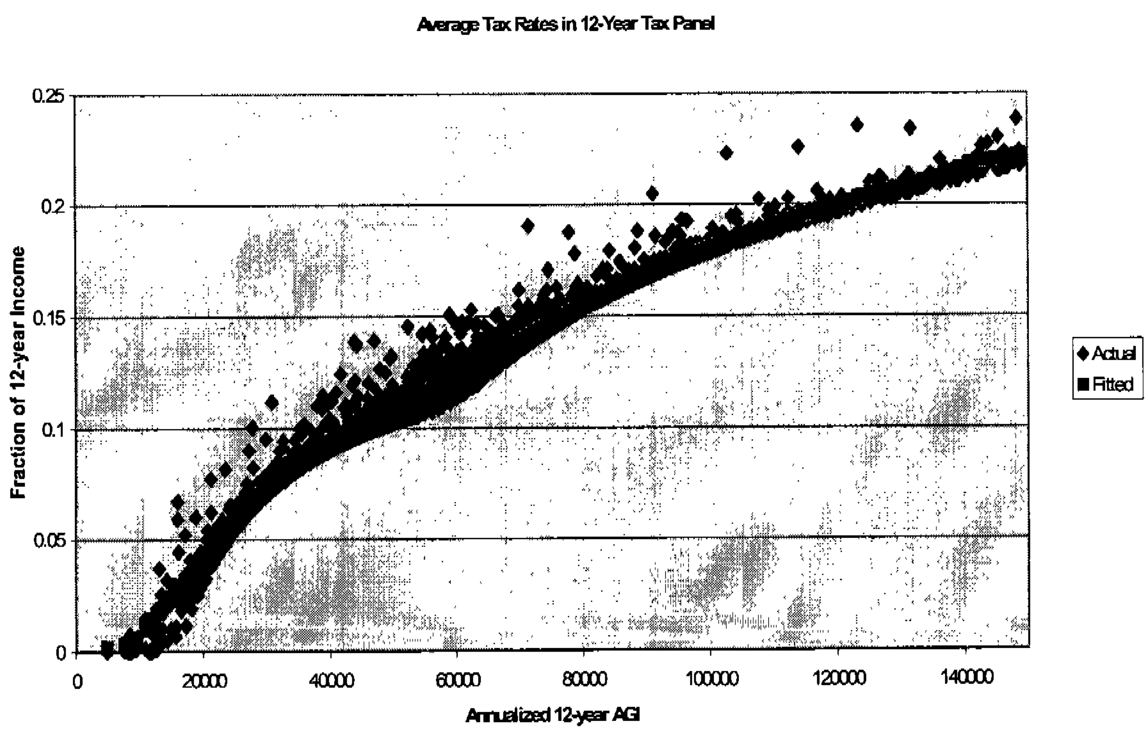
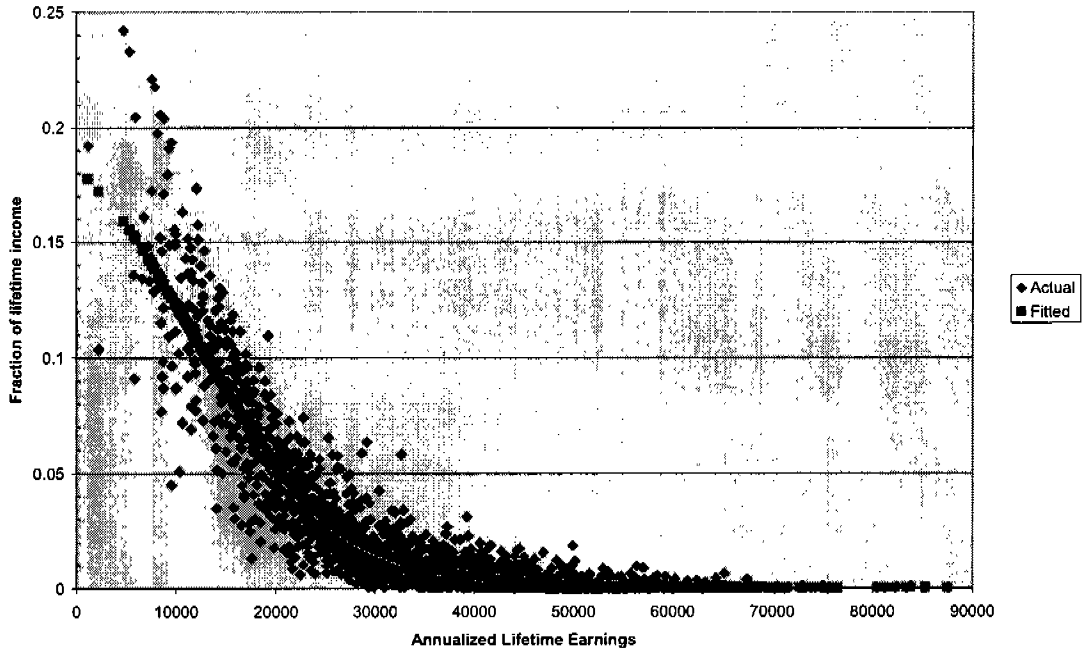

Average Tax Rates in 12-Year Tax Panel
Fraction of 12-year Income
0.25
0.2
0.15
0.1
0.05
0
0
20000
40000
60000
80000
100000
120000
140000
Annualized 12-year AGI
Actual
Fitted

Figure 2

Average EITC Subsidy Rate for Married Taxpayers in 30-Year NBS Earnings Data



Average EITC Subsidy Rate for Married Taxpayers in 12-Year Tax Panel Data

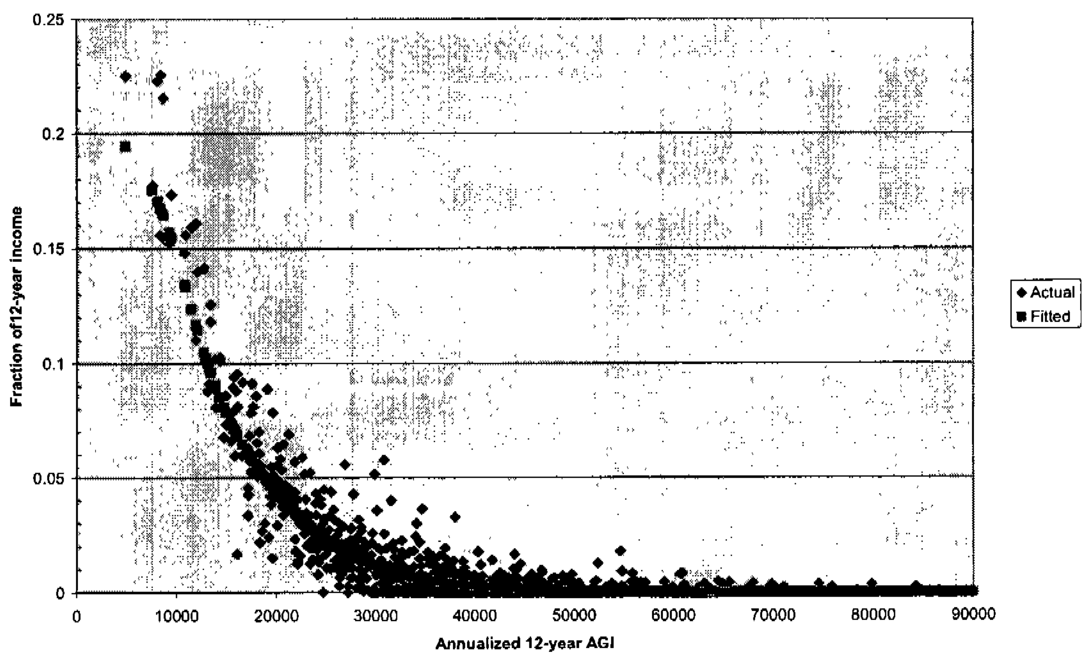
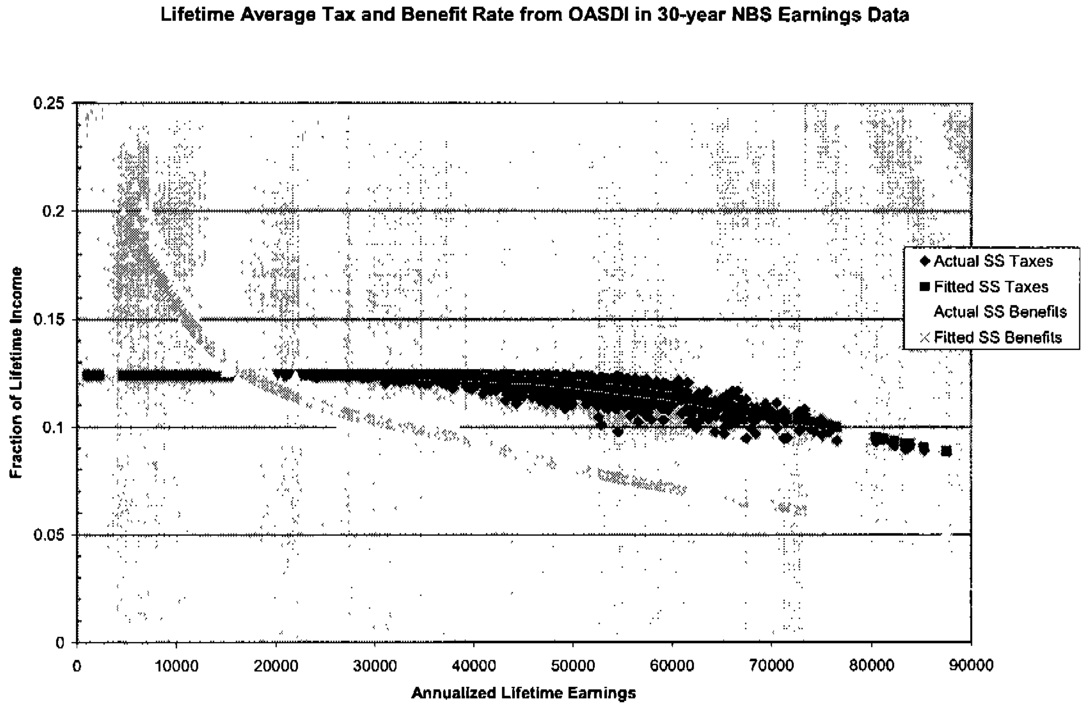


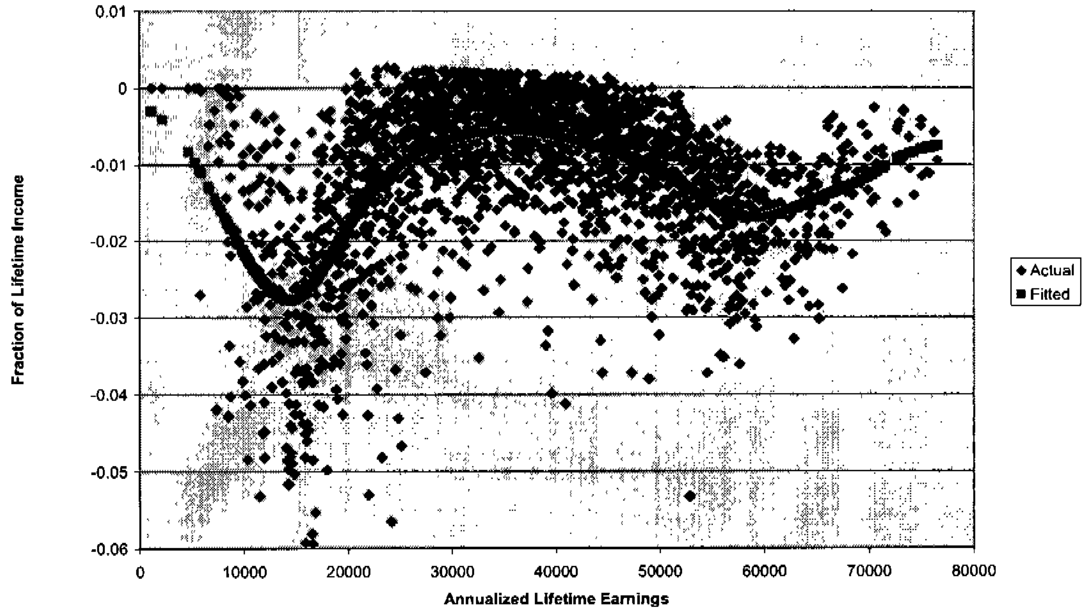
Figure 3



Lifetime Average Tax and Benefit Rate from OASDI in 30-year NBS Earnings Data
Fraction of Lifetime Income
0.25
0.2
0.15
0.1
0.05
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Annualized Lifetime Earnings
Actual SS Taxes
Fitted SS Taxes
Actual SS Benefits
Fitted SS Benefits

Figure 4

Change in Lifetime Average Tax Rate from Complete Averaging in 30-year NBS Earnings Data



Change in Average Tax Rate from Complete Averaging in 12-year Tax Panel

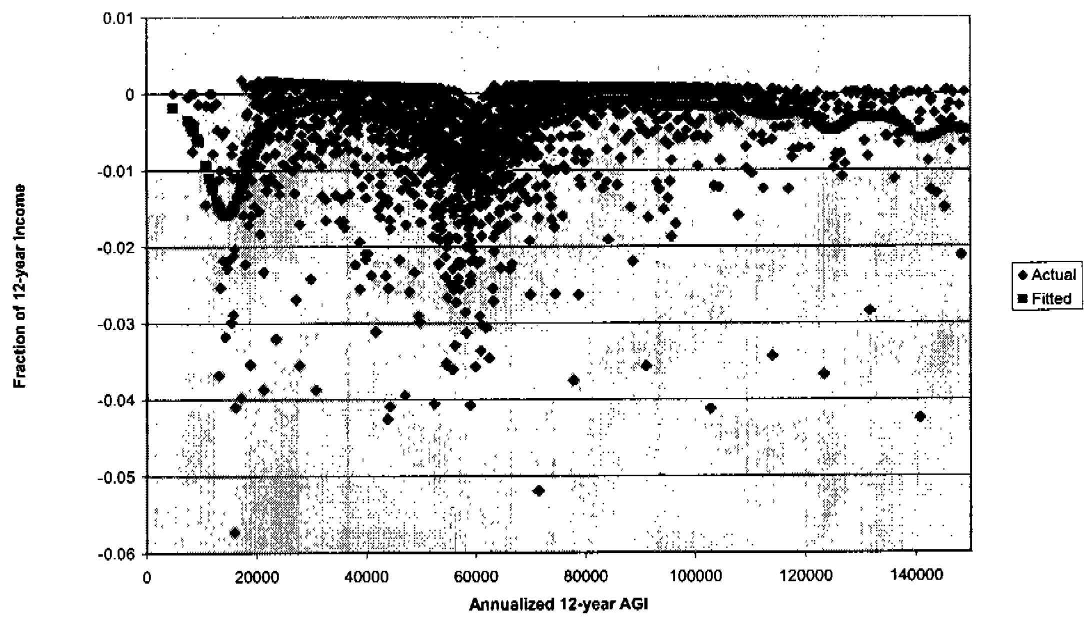


Figure 5

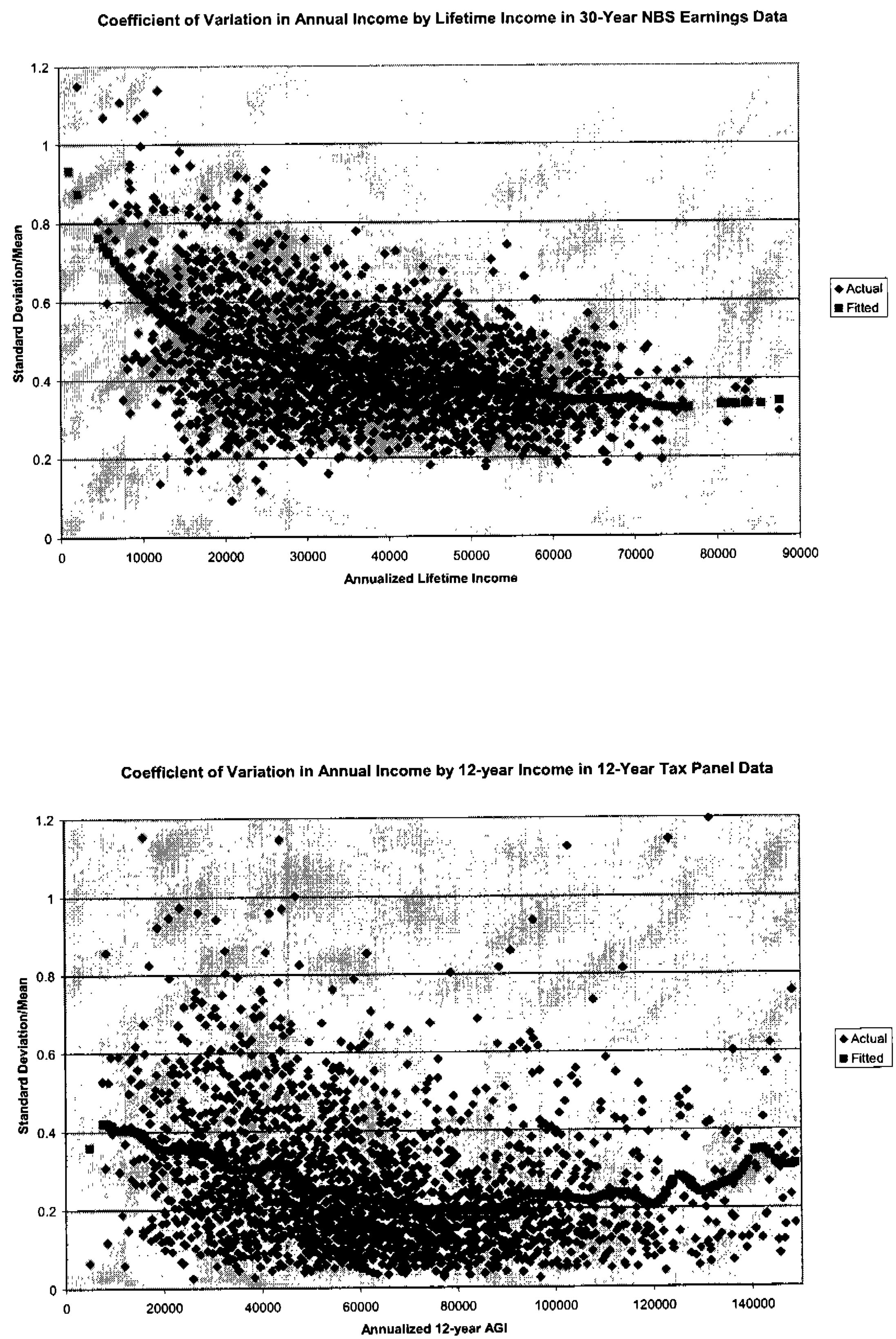
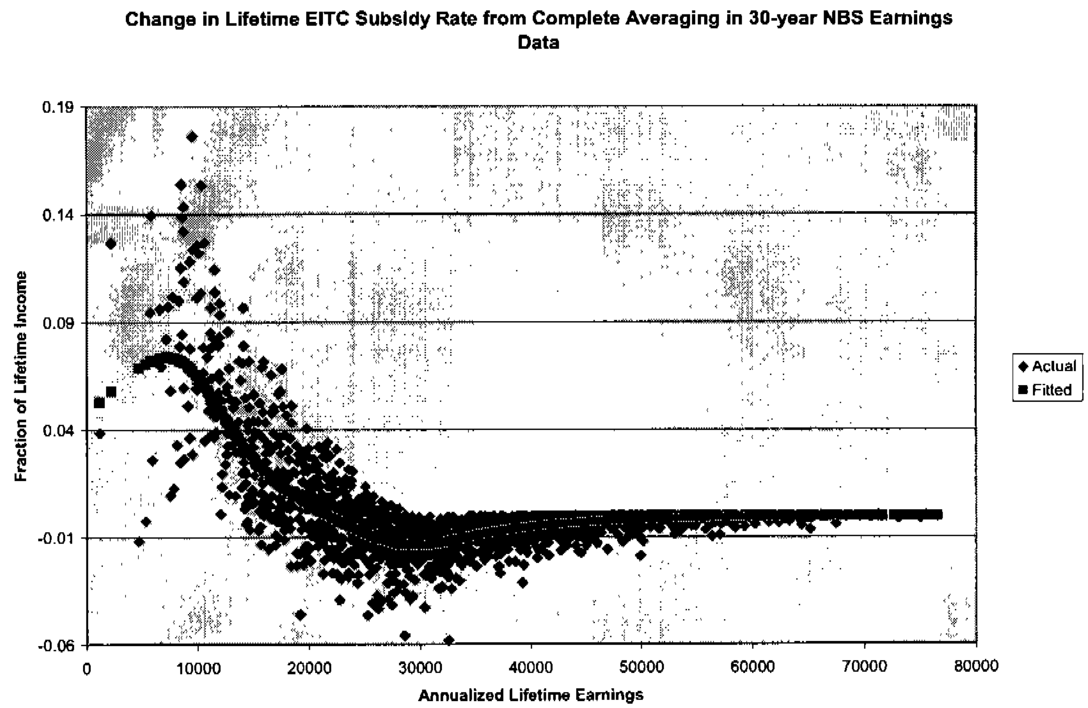

Coefficient of Variation in Annual Income by Lifetime Income in 30-Year NBS Earnings Data
Standard Deviation/Mean
1.2
1
0.8
0.6
0.4
0.2
0
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Annualized Lifetime Income
Actual
Fitted
Coefficient of Variation in Annual Income by 12-year Income in 12-Year Tax Panel Data
Standard Deviation/Mean
1.2
1
0.8
0.6
0.4
0.2
0
0
20000
40000
60000
80000
100000
120000
140000
Annualized 12-year AGI
Actual
Fitted

Figure 6


Change in Lifetime EITC Subsidy Rate from Complete Averaging in 30-year NBS Earnings Data
0.19
0.14
0.09
0.04
-0.01
-0.06
Fraction of Lifetime Income
0
10000
20000
30000
40000
50000
60000
70000
80000
Annualized Lifetime Earnings
Actual
Fitted

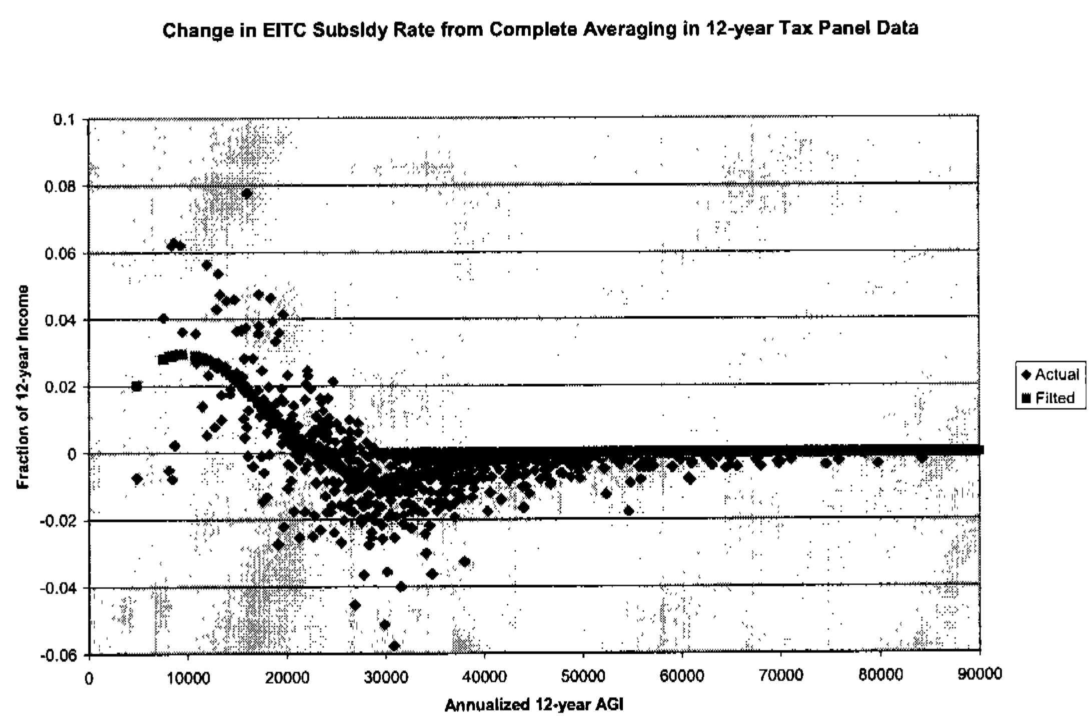

Change in EITC Subsidy Rate from Complete Averaging in 12-year Tax Panel Data
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
Fraction of 12-year Income
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
Annualized 12-year AGI
Actual
Fitted

Figure 7

Change in Lifetime Income Relative to Full Averaging by Length of Averaging Periods, 30-Year NBS Earnings Data

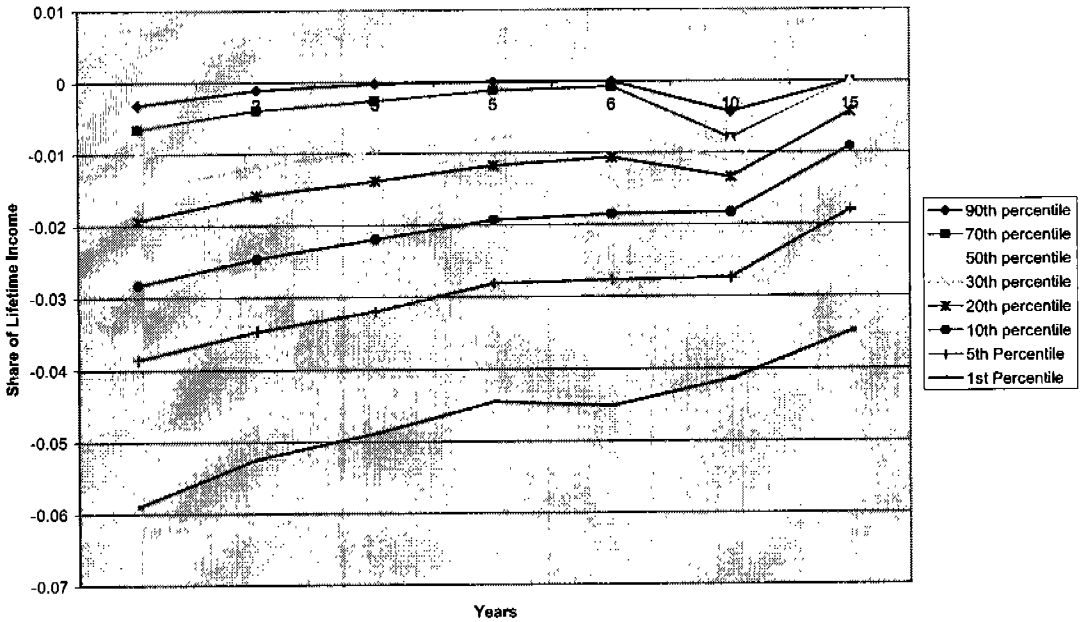
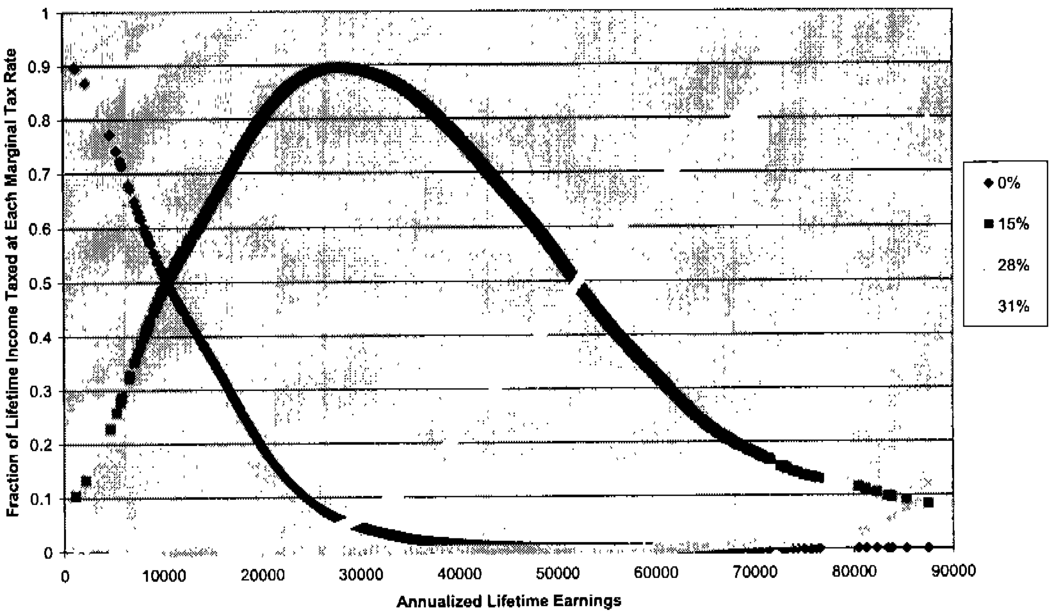


Figure 8

Marginal Tax Rates by Lifetime Income in 30-year NBS Earnings Data



Marginal Tax Rates by 12-year Income in 12-year Tax Panel Data

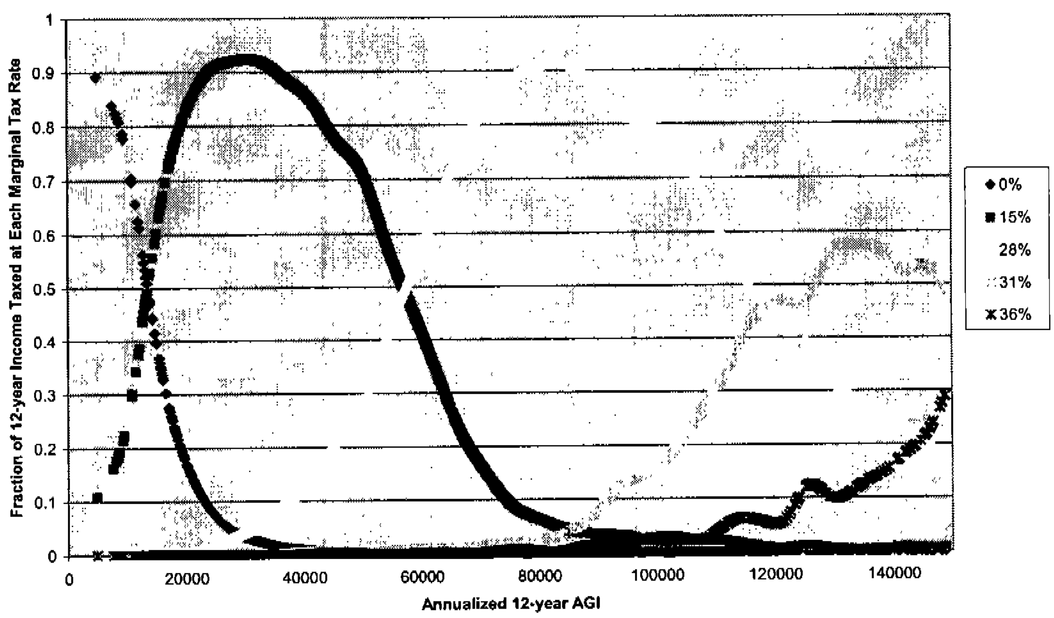
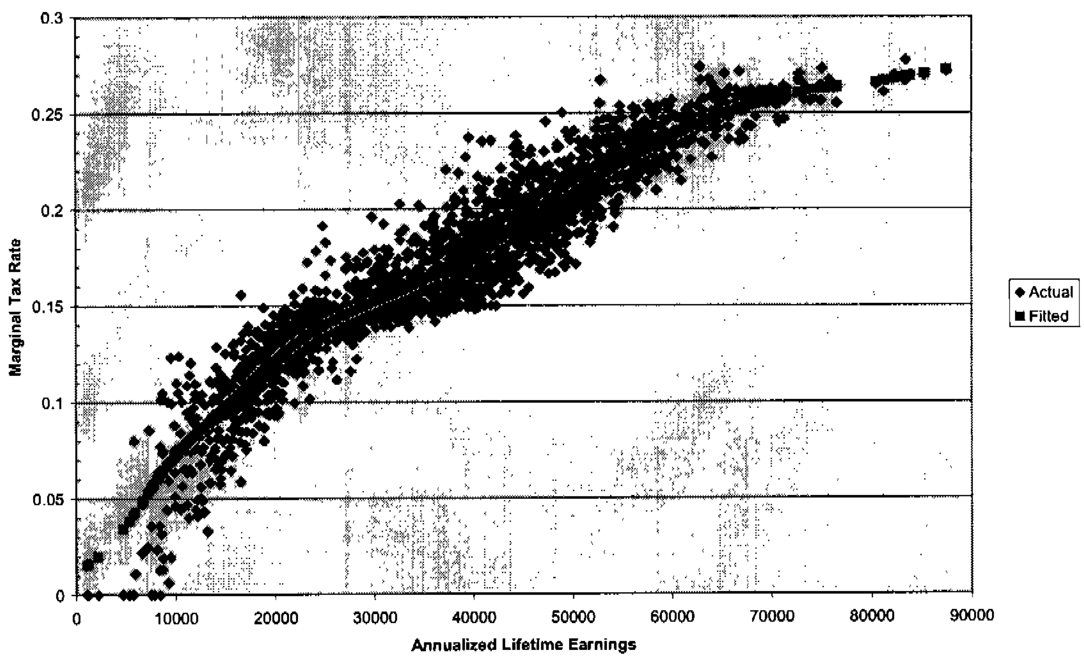


Figure 9

Dollar Weighted Average Marginal Tax Rates in 30-Year NBS Earnings Data



Dollar Weighted Average Marginal Tax Rates in 12-year Tax Panel

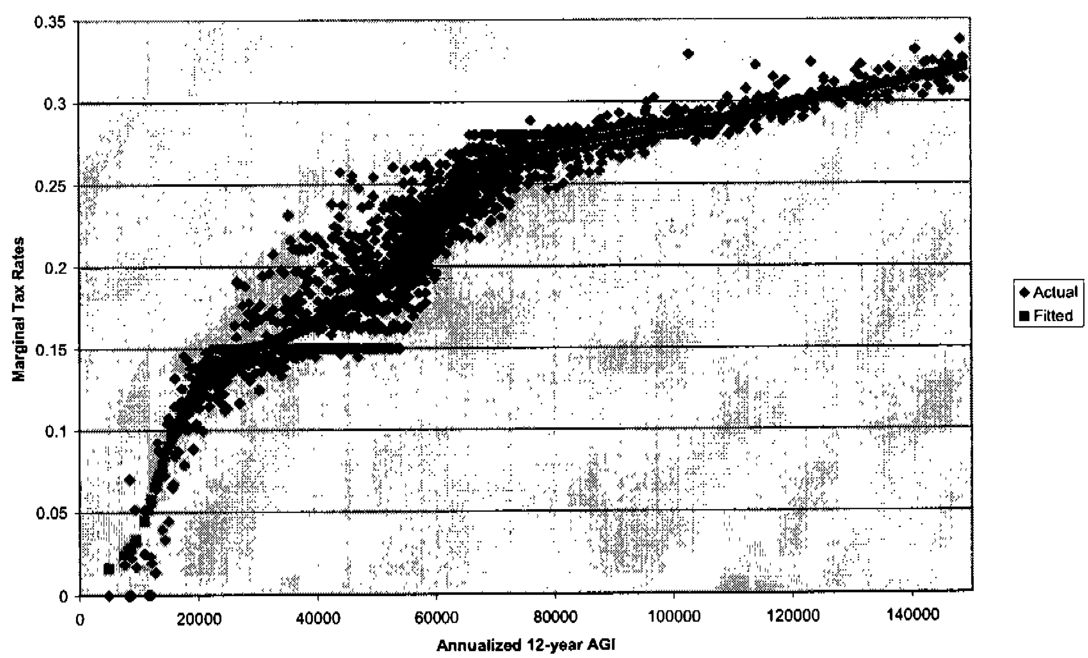


Figure 10

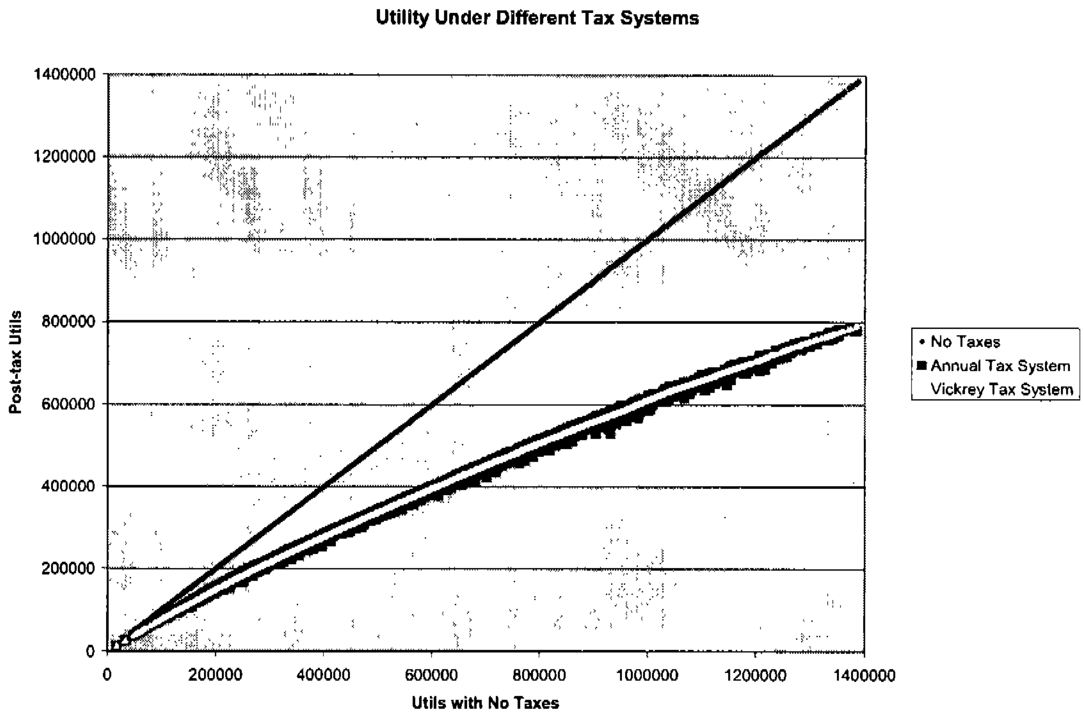


Figure 11