NBER WORKING PAPER SERIES

TAX COMPLIANCE: AN INVESTIGATION USING INDIVIDUAL TCMP DATA

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Working Paper No. 3078

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
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August 1989

The work reported in this paper was made possible by a grant from the National Science Foundation. Early work on the development of the administrative and Census data bases was supported by Wellesley College. The support of our work by these institutions in no way indicates support for our approach or conclusions. We would like to thank Dennis Cox, Bill Lefbom, and Rick Judd of the Internal Revenue Service for their help in developing the data base and programs for the project and Tasneem Chipty for research assistance. The ordering of the author's is random. All work was done jointly. This paper is part of NBER's research program in Taxation. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

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ABSTRACT

In this paper, we analyze the tax compliance behavior of US taxpayers by using a 1979 data set that combines information from a random sample of individual tax returns each of which has been thoroughly audited, IRS administrative records, and sociodemographic data from the Census. We find evidence that both audits and tax code provisions affect compliance. However, the effects are significant for only the low and high income groups. Interestingly, previous research has shown that these groups also participate most actively in underground economic activities, the income from which is not reported on any tax returns. Our results for audits suggest that the "ripple" or general deterrent effect of audits may be many times larger than the direct revenue yield of audits for high income taxpayers. Our results for allowable subtractions from income imply that the 1986 Tax Reform Act changes to lower allowable subtractions may have procompliance effects.

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I. Introduction

There has been substantial concern and much speculation about how the continuing declines in audit rates affect tax compliance. In addition, with the recent tax code revisions that eliminated or reduced some tax deductions, there has been some question about how the allowed deductions and other types of subtractions (e.g., adjustments, exemptions, and credits) affect taxpayers' overall compliance strategies. In order to address these issues we estimate a standard model of taxpayer compliance using a 1979 data set that combines information for a random sample of individual returns and the results of intensive audits of those returns, Internal Revenue Service (IRS) administrative records, and sociodemographic data from the Census.

Although the theoretical models of taxpayer compliance are well-developed, restrictions on access to the data have limited the empirical work. Previously available data sets either lack information on audit rates and IRS administration or have limited measures of true income. None of the data sets have information on subtraction items. Further, all of the data sets are twenty years old.

To summarize our most interesting empirical results, we find that audits stimulate compliance for all taxpayer groups considered. However, audits have a significant effect on the compliance behavior of only the highest income groups, taxpayers with income over $50,000. As in previous studies, we find that the compliance effects of audits are relatively small. Specifically, we find that a 10 percent increase in audits would lead to only a 1.4 percent increase in reported income for our high income group. However, the implied increase in revenue as a result of a 10 percent increase in audits is substantial, $1.5 billion. This amount greatly exceeds the direct revenue

effect of audits for the high income group. Our results imply that the indirect, "ripple" or general deterrent effect (as it is variously called) of audits yields $150 for every $1 of direct revenue yield. In the last ten years the audit rates of all nonbusiness income groups have fallen from 2.11 percent to 1.03 percent and the drop in the audit rate of the high income group has been even larger. Such declines in audit rates appear to have significant indirect revenue costs.

As regards the effect of the tax code on compliance, we find that taxpayers who have higher legal adjustments, deductions, exemptions, and credits to subtract from income in computing their tax obligations report less income, other things including income being equal. At first this result may seem surprising. It occurs though because higher allowable subtractions (i.e., adjustments, deductions, exemptions, and credits) lower a taxpayer's audit costs and hence make underreporting income more attractive. The effect is significant for our lowest and highest income groups. The elasticities implied by our results are -.13 for the lowest income group and -.26 for our highest income group. Our results for allowable subtractions suggest that decreases in allowed subtractions such as those incorporated in the Tax Reform Act of 1986 may not only increase revenue directly, but may also increase it indirectly by raising the expected cost of an audit and hence the amount of income reported.

The outline of the paper is as follows. In the next section, we present the theoretical model. In Sections III and IV we describe the data and the empirical model. The section on the empirical model also includes a brief discussion of related work. Sections V and VI contain the results and conclusions respectively.

II. Conceptual Framework

In the now standard model of individual tax compliance, a taxpayer chooses the amount of income, and possibly other items, to report to the tax collection agency in order to maximize expected utility given the tax and penalty structure and given the taxpayer's understanding of how returns are selected for audit (Allingham and Sandmo, 1972). The uncertainty arises because the taxpayers believe there is a nonzero audit probability, possibly dependent on the income and other items reported to the tax agency. In the first part of this section we present a basic model of tax compliance and then at the end of the section explain how the model can be extended to consider time allocation and tax avoidance decisions.

In the basic model we assume that an individual taxpayer chooses the amount of reported income and subtractions to maximize expected utility. We consider the income and subtraction reporting decisions separately since a taxpayer's opportunities for noncompliance are different for the two types of reports and since empirical evidence shows that the compliance rates are markedly different for the two types of reports (Roth, Scholz, and Witte, 1989).

We assume that a taxpayer's utility in each state (i.e., audited or not audited) depends on the individual's consumption expenditure. One complication of introducing subtractions to the model is that subtractions under the tax code include (1) expenses such as casualty losses from which the taxpayer derives no utility and (2) expenses such as business entertainment from which the taxpayer derives utility. Taxpayers with higher allowed subtractions of either type have lower tax obligations than do other taxpayer,

ceteris paribus. Taxpayers with higher casualty losses also have less to spend on goods and services from which they derive utility.

We assume that a fraction β of an individual's allowed subtractions are for expenses such as casualty losses that yield no utility. The individual's consumption of goods and services if not audited is

$$C^{na} = I - t(I^r - S^r) - \beta S$$

where I and I^r are the individual's income and reported income respectively, S and S^r are the individual's subtractions allowed by the tax code and reported respectively, and t is the tax rate. An individual's consumption when not audited are the after-tax income minus expenditures on the subtractions items for which the individual receives no utility. If all of the subtractions are for consumption expenditures from which the individual derives utility (i.e., β=0), then the individual's consumption is the after-tax income, as in the standard model with only income reporting.

The individual's consumption if audited is

$$C^a = I - t(I - S) - tf(I - S - (I^r - S^r)) - \beta S$$

where f is the penalty rate. The taxpayer's consumption in this case is the income after taxes and penalties minus subtractions items for which the individual receives no utility.

A taxpayer chooses reported income and subtractions to maximize expected utility which is

$$(1 - P(I^r, S^r))\ U(C^{na} + P(I^r, S^r))\ U(C^a)$$

where P is the audit probability function. Consistent with the way in which the IRS selects returns for audit, we represent a taxpayer's reports as affecting the probability of an audit.[1] The probability of an audit might also depend on other factors such as the amount of income from IRS information reports.

We assume that the audit probability function decreases at a decreasing rate with reported income and increases at an increasing rate with reported subtractions. We do not make any assumptions on the sign of the cross partial of the audit probability function with respect to reported income and subtractions but do assume that the magnitude of the cross partial effect is smaller than the own second partial effects. The assumption that the effects of reported income and subtractions are opposite in sign is required in order to have an internal optimum. Whether the effects must be of the assumed signs for an internal optimum depend on the relative values of (1-P) and Pf. In 1979 the fraction of returns audited was only .0211, and fine rates, even on returns subject to civil penalties, were less than unreported tax obligations (i.e., $f < 1$). Thus, for almost all (and perhaps all) taxpayers, $(1-P) > Pf$ in which case the probability of an audit must be decreasing in reported income and increasing in reported subtractions at an internal optimum. Unless the cross partial effects are very large in magnitude, an internal optimum also requires at least one of the second derivative assumptions made above, namely $P_{11} > 0$ and $P_{22} > 0$.

As in the model with only reported income, the effect of increased income on a taxpayer's reported income (and reported subtractions) depends on the extent of risk aversion. Similarly, the effect of an increase in subtractions depends on the extent of risk aversion. One effect of increased subtractions is to lower the "true" tax obligation and the cost of being audited. With lower audit costs, reported income falls and reported subtractions increase. Indeed, with $\beta = 0$ or with risk neutrality, an increase in subtractions has only an audit cost effect. However, unless $\beta = 0$, increased subtractions also reduce consumption from which the individual derives utility. This second effect of increased subtractions is a wealth type effect. As in the usual tax compliance models, the direction of this effect depends on the individual's preferences. For instance, with a quadratic constant relative risk aversion utility function, the wealth effect of increased subtractions unambiguously increases reported income. However, with other utility functions, even nonquadratic constant relative risk aversion functions, the direction of the wealth effect on reported income depends on the particular parameters of the utility function.

This model can be extended straightforwardly to include an individual's time allocation (Andersen, 1977; Pencavel, 1979) or tax avoidance decisions (Cross and Shaw, 1982). In the time allocation model an individual's utility depends on both consumption and leisure. The individual's income is now endogenous and the individual chooses the number of hours to work and the amount of income and subtractions to report to the tax agency given the wage and any nonlabor income.

In the tax avoidance model, the individual can make decisions that affect the amount of income that is taxable and the amount of allowed

subtractions. Tax avoidance models are intended to reflect a taxpayer's opportunities to transform income into a form that is untaxed or taxed at a lower rate than other types of income and the opportunities to deduct expenditures for consumption items in computing taxable income. Transforming income from a taxable form to a nontaxable (or only partially taxable) form has costs and the costs are generally assumed to increase at an increasing rate with the amount of income or expenditures that become nontaxable. These costs might include transaction, financial liquidity, or information costs.

We could extend our model to incorporate the idea of tax avoidance by allowing the individual to choose the level of legally allowable subtractions but assuming that there is a cost to obtaining the subtractions and that the cost increases at an increasing rate with the amount of the subtractions. The taxpayer then makes the tax compliance and tax avoidance decisions jointly.

III. Data

Our data set combines 1979 Taxpayer Compliance Measurement Program (TCMP) data for individual returns with IRS administrative records for District Offices and 1980 Census data at the five-digit Zip Code level.[2] Merging other data bases with the TCMP data is necessary in order to estimate meaningful compliance models because TCMP data contains only information available from the tax return and the auditor's findings. While the TCMP data includes much of the required information on taxpayer income and transactions, it contains very limited data on sociodemographic characteristics and no administrative or audit data.

Previously, academic researchers have had to work with aggregate data in order to merge administrative and audit information with the TCMP data. By working with IRS personnel in the Research Division, we were able to use the individual TCMP data and to merge these data with other data. Our access to the TCMP data was understandably limited and monitored. We were able to use the data for about six months (June-November, 1988) and we submitted the programs and received the output through IRS employees.

The IRS separates the TCMP and audit data into twelve separate audit groups based on the income level, the complexity of the tax return, and on the portion of the income from unincorporated business earnings. Previous work by the IRS and others (Witte and Woodbury, 1985; Dubin and Wilde, 1988) shows that compliance behavior varies substantially across taxpayer groups. Further, the IRS develops separate audit selection formulas for each of the twelve groups. For these reasons we analyze the audit classes separately.

The model developed in the previous section is most appropriate for taxpayers who directly and consciously choose their reported subtractions and who use their subtractions to alter their tax liability in the manner described in the previous section. This is not likely to be the case for taxpayers claiming standard deductions or for taxpayers with substantial unincorporated business income (i.e., income on Schedules C or F). Comparisons of the returns for nonbusiness and business classes with comparable incomes suggest that there may be substantial mixing of some subtractions and unincorporated business expenses. Fewer business group taxpayers itemize than do those with similar incomes in nonbusiness groups. Of those who itemize, the business groups claim larger average deductions for state and local taxes and for health expenditures, both of which might be

difficult or disadvantageous to mix with business expenses, than do the nonbusiness classes of similar incomes. However, the business groups claim less on average for mortgage expenses and real estate tax deductions, where it might be possible to mix business and nonbusiness expenses. A joint model of their business activities and tax compliance together with longer access to the TCMP data would be required to understand the income reporting behavior for business returns.

We estimate our model for the four audit classes that itemize deductions and that have income primarily from sources other than unincorporated businesses. The four groups differ by their total positive income (i.e., sum of all income items with positive entries). Table 1 contains the definitions of the audit classes.

IV. Empirical Model

Based on our theoretical work, we specify a taxpayer's reported income and subtractions as depending on "true" income, the legally allowable subtractions from income, the tax and penalty structure, tastes and preferences, and the probability of an audit (endogenous).[3] We chose audits as the measure of endorsement policy since this is the enforcement action that has been of most interest in the literature on tax compliance and since the IRS believes that audits are its most effective instrument for stimulating accurate taxpayer reports (Comptroller General of the United States, 1976, p. 1). Given the limited time for which we had access to the data and the restrictions imposed by the IRS, we estimated only the income reporting equation. We chose to estimate the equation for reported income rather than

for reported subtractions because most noncompliance takes the from of underreported income rather than overreported subtractions. In 1987, the IRS estimates that 87 percent of the "tax gap" on filed individual returns resulted from underreports of income (IRS, 1988a).

We were not allowed to estimate an audit equation because of IRS fears regarding revelation of its audit selection rules. We account for the fact that the probability of audit is endogenous by estimating the income reporting equation using two stage least squares. Two stage least squares allows for the endogeneity of audits without estimating the audit equation. In this application two-stage least squares may even have some advantage over systems estimation since our information about the form of the audit equation is necessarily limited and two stage least squares does not spread omitted variable bias across equations.

We identify the income reporting equation by excluding from the income reporting equation two IRS variables that affect the probability of audit but do not directly affect reporting behavior. These variables are a measure of crowding at the IRS District Office level and of IRS work load. We measure these variables at the District Office level because most direct IRS contacts, including audits, are carried out by District Office employees. In 1969 there were 58 IRS districts. The boundaries of the districts were coterminous with states in all but the six most populous states (IRS, 1980).

Our measure of crowding reflects restrictions on the IRS's ability to allocate its resources across districts as it would like. Understanding the crowding measure requires some explanation of how the IRS selects most tax returns for audit. For most audited returns, the first step in the selection process is the scoring of all filed returns for audit potential using formulas

developed using TCMP data from three or more years ago. The formulas, referred to as DIF formulas, are based on discriminant analysis designed to differentiate those returns that show large discrepancies (positive or negative) between the taxpayers' reports and the auditors' findings versus those returns that show little or no discrepancy. The DIF formulas assign a numerical value to each return with higher scored returns having higher audit priority. The DIF formulas are done separately for each audit class. The IRS establishes a national DIF cut-off score for each audit class and would like to audit all returns with DIF scores above this national cut-off.

Because of the distribution of its employees across Districts, the IRS cannot carry out such an audit plan. The General Accounting Office and the IRS found that some districts audit returns with relatively low DIF scores while other districts are unable to audit returns with higher scores. As a result, some taxpayers are audited or not audited because they file in districts that are over- or under-staffed in relation to other districts (Comptroller General, 1976 and 1979; Wilt, 1986). The imbalance in staffing results from civil service regulations requiring uniform pay throughout the United States,[4] IRS's policy of no forced transfers, and differential impact across districts of IRS special programs (e.g., the drug program, tax shelter program) on resources for regular DIF-score initiated audits. In order to correct the imbalance in staffing and carry out its desired audit plan the IRS would have needed to transfer employees between districts and hire employees in the under-staffed districts where it had vacancies. However, after examining these options in the late 1970s, the General Accounting Office concluded that "imbalances will never be completely eliminated unless IRS

starts moving personnel from district to district as needs dictate. In our opinion, moving significant number of staff around the country is too expensive in terms of money and staff morale to be considered a viable alternative to staffing imbalances" (Comptroller General, 1979, p. 25).

Some of the confusion about whether the probability of an audit differs across taxpayers is a result of equating the DIF scoring with the probability of an audit. The DIF scoring is done at the national level and is uniform across IRS districts. This does not mean though that the probability of an audit, conditional on a taxpayer's report, is the same in all districts. The lowest DIF scores audited and the probability of an audit differ markedly across districts although the DIF scoring does not. The systematic difference in the probability of an audit across taxpayers is of course essential for being able to determine the effect of audits on compliance.

For each IRS district, our crowding variable is the sum across all twelve audit classes of the number of returns that would have been audited in that district if the IRS had been able to distribute the available resources across districts in order to audit all returns with a score above the nationally set cut-off divided by the total number of returns audited. Districts for which the crowding variable is below (above) one are those where the lowest DIF scores audited in most of the audit classes are below (above) the national cut-offs for the corresponding audit class. Our work load measure is the number of returns filed in the district divided by the number of full-time equivalent employees in the district.

In order to use the IRS crowding and workload measures to identify the income reporting equation, these variables should not affect a taxpayer's reporting decisions, apart from the effect on the probability of an audit, and

should not be correlated with the error term in the income reporting equation. The first of these requirements follows directly from the standard theoretical models of taxpayer compliance, including ours. In these models the only effect of the administrative resources or audit selection process is through the audit probability function. The second requirement follows from the work of the GAO and academic researchers on the allocation of IRS resources. If the error term in the income reporting equation is independently distributed across taxpayers, then neither the work load nor the crowding variable are correlated with the error term. If, however, there are regional differences in tax compliance apart from those that are explained by the sociodemographic and income variables in our model, then we might be concerned that the work load variable was correlated with the error term. This might be the case if the IRS were able to allocate its audit resources across districts in accordance with a consistent policy that allowed it to audit all returns with DIF scores above the nationally set level for that audit class. The sources cited above though show clear evidence that the resources are not distributed in this way. Further, on the basis of data from 1967 to 1980, Long (1985) concludes that the "introduction of TCMP compliance data did not bring about any dramatic restructuring in audit coverage--even when it disclosed regions or return classes with much lower compliance levels which were receiving less attention than more compliant groups" (p. 29).

We obtain the data on reported income and true income and subtractions from the individual, 1979 TCMP and the 1980 Census. For the measure of "true" subtractions we use the auditor's finding on subtraction items from the TCMP. The IRS believes that the TCMP examiners' estimates of subtractions are accurate since the examiners are to request documentation for each subtraction

Our results suggest that raising the audit rate for high income wage and salary workers by one percentage point from the 1979 level of 10.4 percent to 11.4 percent would have increased average reported income for this group by approximately $2200 per return or 1.8 percent. The elasticity of reported income with respect to the probability of an audit is thus .19 . In 1979 the marginal tax rate for the typical return in this audit class was 54 percent. This implies an increase in tax revenue of approximately $1148 million which is almost three times the direct revenue yield from audits of this group.[10]

These results offer some support for the IRS claimed "ripple" effect of audits. The IRS does not distribute its resources across audit classes solely on the basis of revenue yield. It devotes some audit resources to audit classes for which the direct revenue yield is relatively low because of its belief that audit coverage is one of the most significant factors in promoting voluntary compliance. Our results suggest that at least for some audit classes the declines in audit rates over the last twenty years may be partly responsible for the decline in voluntary compliance. The decline in audit rates may have had substantial hidden tax revenue costs.

Given our data, we examine tax compliance separately from time allocation or tax avoidance decisions. As mentioned previously, the theoretical models of tax compliance can be extended in a standard way to include time allocation or tax avoidance decisions. The data for estimating such models are not available. In some cases though we can determine the direction of the potential bias that might result from considering the tax evasion decision separately.

the average of the young and old group ages. As an additional age variable, we use a binary for whether at least one of the individuals filing the return was allowed an over 65 tax exemption. The female-headed household variable is zero if the return is a joint return and is the fraction of women householders in single-parent families and non-family households if the return is not joint.

Being able to merge the Census and IRS administrative and audit data with the 1979 TCMP data meant that we were able to obtain measures for the variables required to estimate a standard model of individual taxpayer compliance and in particular to examine the deterrent effects of audits. As mentioned in the introduction, very little data has been available for estimation of such models. For understandable reasons, the individual TCMP data are not public. None of the data previously used has information on taxpayer's reported subtractions or on true subtractions. In addition, the data sets that contain information on audit rates and IRS enforcement do not have the auditors' estimates of income.

Previous econometric studies of the individual model of tax compliance use individual and aggregate data from 1969.[6] In the only study based on TCMP data,[7] Clotfelter (1983) uses individual TCMP data to estimate the auditors' finding on unreported income, which in our notation is $I-I^r$, as dependent on factors including the auditors' finding on income, the marginal tax rate on that income,[8] characteristics of the return such as the percentage of wage and salary income, age variables, and five regional dummies. The data did not include information on audits or other IRS administrative activities. Clotfelter assumes that all nonbusiness taxpayers face the same audit

probabilities, ceteris paribus, examines in detail other factors related to compliance.

Witte and Woodbury (1985) and Dubin and Wilde (1988) use data aggregated to the three-digit ZIP Code level in order to examine the determinants of an estimate of voluntary compliance, $T^r/(T^r + T^e)$, where T^r is the reported tax obligation and T^e is the an estimate of the absolute value of the error that would be accessed by a tax examiner. (If all errors were underreports, then T^e would be unreported tax obligations and this would be a standard compliance measure.) The estimates of voluntary compliance are for a sample of unaudited returns for which the IRS can, of course, observe the reported tax obligations but not the error in reported tax obligations. Estimates of the absolute value of the error were obtained as follows. First, the IRS went back to the 1966 TCMP sample from which the DIF formulas were developed. The IRS used the DIF scores of the returns in the 1966 TCMP sample and then estimated the relationship between the DIF scores and the absolute value of the tax error (the difference between what the taxpayer had reported and what the TCMP auditor had found). For each audit class they regressed the absolute value of the tax errors on the DIF score. For example, for the low income, nonbusiness, itemized returns[9] they found that

$$T^e = 49.4077759 + .2348477 \text{ DIF-score} + .0002691 (\text{DIF-score})^2 .$$

Second, the IRS used this estimated relationship in order to predict the absolute value of the error in reported tax obligations for DIF-scored, but unaudited returns. Since all returns on the IRS Master File of individual tax returns are DIF-scored, they could estimate the voluntary compliance rates for unaudited returns.

Both studies based on these 1969 tax compliance estimates consider the estimated voluntary compliance rate as dependent on sociodemographic factors and audit probabilities. Witte and Woodbury also include measures of IRS administrative and educational activities other than audits and Census income as a measure of true income. To examine the effects of audits on compliance, Witte and Woodbury included lagged audit rates. As in this paper, Dubin and Wilde used an instrumental variables approach in order to avoid the simultaneity bias of including the actual audit rates. They identified the compliance equation by using IRS expenditures at the district level. The sociodemographic variables in both studies are from the 1970 Census.

Beron, Tauchen, and Witte (1988) use a model similar to the one in this paper in order to estimate equations for reported income and reported tax obligations as dependent on Census income, sociodemographic variables, and audits. They also use 1969 data aggregated to the three digit ZIP code level.

V. Results

Table 2 contains the results of estimating the income reporting equations by two stage least squares for four audit groups. We find that audits stimulate higher income reports for all four groups but that the effect is statistically significant for only the highest income group. These results are similar to previous results based on 1969 data in that audits generally increase compliance but not necessarily significantly. Part of the reason for the somewhat weak deterrence results in this and other work may be related to the extent of aggregation of the audit coverage data. For this paper we were able to obtain the audit data only at the IRS district level.

Our results suggest that raising the audit rate for high income wage and salary workers by one percentage point from the 1979 level of 10.4 percent to 11.4 percent would have increased average reported income for this group by approximately $2200 per return or 1.8 percent. The elasticity of reported income with respect to the probability of an audit is thus .19 . In 1979 the marginal tax rate for the typical return in this audit class was 54 percent. This implies an increase in tax revenue of approximately $1148 million which is almost three times the direct revenue yield from audits of this group.[10]

These results offer some support for the IRS claimed "ripple" effect of audits. The IRS does not distribute its resources across audit classes solely on the basis of revenue yield. It devotes some audit resources to audit classes for which the direct revenue yield is relatively low because of its belief that audit coverage is one of the most significant factors in promoting voluntary compliance. Our results suggest that at least for some audit classes the declines in audit rates over the last twenty years may be partly responsible for the decline in voluntary compliance. The decline in audit rates may have had substantial hidden tax revenue costs.

Given our data, we examine tax compliance separately from time allocation or tax avoidance decisions. As mentioned previously, the theoretical models of tax compliance can be extended in a standard way to include time allocation or tax avoidance decisions. The data for estimating such models are not available. In some cases though we can determine the direction of the potential bias that might result from considering the tax evasion decision separately.

As in previous theoretical work on the joint tax avoidance, time allocation, and tax evasion decisions, we assume that the utility function is separable in income and leisure and that preferences exhibit decreasing absolute risk aversion. We also assume that in the population distribution there is no correlation among the explanatory variables. For the time allocation decision, the potential bias in the estimated effect of audits on reported income results because our explanatory variables include taxable income which might be affected by the wage rate (through the choice of the number of hours worked) and the probability of an audit. In a linear model the resulting bias from just this source has the same sign as the term

$$- dH/dp \; dH/dw \; dIr/dw$$

where H denotes the hours worked, p denotes the log odds of an audit, and w denotes the wage rate.

The potential bias solely from this source may be small or nonexistent for some groups. There is considerable evidence that wage rates have very little, if any, effect on the hours worked by prime age males and unmarried women without dependents. In addition, the effects of wages on hours worked by married women appears to be smaller than once thought. Since prime age males and married couples have higher incomes than others, we would expect our higher income audit classes to be comprised disproportionately of prime age men and married couples and would expect little bias for these groups.

For other groups the direction of the potential bias depends on how wages affect reported income and how the probability of audit affects hours worked. As in the usual time allocation model without tax compliance, the substitution effect of an increase in the wage rate is to increase the hours

worked. Also, the substitution effect of an increase in the wage rate is to increase reported income. Assuming that the substitution effect dominates so that hours worked increase with the wage rate, then the direction of the bias depends just on dH/dp. If hours of work increase with the probability of an audit, then the bias is negative and our estimated coefficient on the probability of an audit understates the total effect allowing for how audit coverage affects hours of work. Sufficient conditions that the hours of work increase with the probability of an audit are that the relative risk aversion be increasing and greater than one (Andersen, 1977).

For the tax avoidance decision, the potential bias in the estimated effect of audits on reported income arises because our explanatory variables include subtractions and taxable income. Taxpayers could affect the amount of their subtractions and taxable income through their tax avoidance decisions. If so, both the subtractions and the taxable income might be affected by the costs of tax avoidance and by the probability of an audit. The separate biases from including subtractions and taxable income given that either might be affected by the cost of tax avoidance have the same signs as

$$-\,dS/dp \;\; dS/dc \;\; dIr/dc \quad \text{and} \quad -\,dI/dp \;\; dI/dc \;\; dIr/dc$$

respectively where c is a parameter that reflects the cost of transferring expenditures into a tax deductible item or the cost of transforming income into a nontaxable form. An increase in the cost of tax avoidance (c) would decrease subtractions (S) and increase taxable income (I). If, as is often claimed, tax avoidance and evasion are substitutes, then an increase in the cost of avoidance would result in more evasion which would decrease reported income. Also, an increase in the probability of an audit would cause more tax avoidance which would increase subtractions and lower the amount of income

that is taxable, ceteris paribus. Both of the above terms are therefore negative which means that, if anything, our estimated coefficients on the probability of an audit understate the effects of audits on reported income.

As do Witte and Woodbury (1985), we find that reported income increases with true income, as measured by the auditors' findings and by Census income but generally at a decreasing or linear rate.[11] Auditors' estimates of true income are for the specific tax return and are far more strongly related to reporting behavior than is Census income although the Census income variables are jointly significant for two of the four audit classes.

We also find that taxpayers with higher allowable subtractions, ceteris paribus, report less income. This effect is significant for the highest and lowest income groups described in Table 1. These two are also the least compliant of our four groups. The lowest and highest income groups fail to report 7 and 4 percent of their incomes respectively whereas the two middle income groups fail to report 3 and 2 percent of their incomes respectively. Recall that the effect of subtractions on reported income depends on the relative magnitudes of an audit cost and wealth effects. The audit cost effect decreases reported income whereas the wealth effect may increase reported income. We find that, if subtractions have any effect on reported income, then the negative audit cost effect dominates any positive wealth effect.

The finding that the allowed subtractions affect reported income supports the strategic audit lottery models such as ours. Simple ad hoc rule in which taxpayers underreport some fraction of their incomes or omit the income not subject to information results would not produce the result that

allowed subtractions affect reported income. Also, ad hoc rules under which taxpayers try to avoid audits by keeping the ratio of their reported subtractions to reported income within some rumored bounds should not produce these findings.

Our results regarding subtractions may give some indication of the effect of tax reform and simplification on compliance. The Tax Reform Act of 1986 curtailed allowable subtractions. We find that, if anything, a reduction in allowable subtractions should increase reported income holding other factors including "true" taxable income constant. Limitations on allowable subtractions were justified on the basis of increasing the perceived fairness of the tax system and, thus, encouraging compliance. Our results suggest that taxpayers' strategic playing of the audit lottery might also lead to greater compliance as subtractions are reduced.

In comparison with previous research based on 1969 IRS data, we find less pronounced sociodemographic effects. Our results provide no evidence that education, race, joint filing status, or gender affect compliance. Results for other sociodemographics are mixed. The coefficients on the age variables are significant only for one taxpayer group, namely taxpayers with total positive income between $25,000 and $50,000. For this group, we find the usual procompliance effect of being older. However, with average age held constant, the over 65 variable is associated with lower not higher levels of compliance.[12] Although there is a common perception that older taxpayers are more compliant than younger taxpayers, other researchers including those doing survey and experimental studies have sometimes found weak or negative effects of audits on compliance (Jackson and Milliron, 1986). We also find that the

fraction of the population unemployed has a significant and positive effect on compliance for the two lower income groups. This result is perhaps surprising but has also appeared in compliance work with 1969 data (Beron, et al., 1988). Possibly, the unemployment effect is attributable to workers who were unemployed for only part of the year filing simple tax returns to get a refund from the withholding during the part of the year when they worked. In order to obtain the refund the workers must report the income received when working.

Part of the reason that previous studies may have found stronger sociodemographic effects is that they had no direct measures of allowable subtractions. The sociodemographic variables in these studies may proxy for the omitted subtraction variables such as the exclusion of Social Security income and the additional exemption for those over 65 years old.

VI. Conclusions

The IRS believes that audits have both direct and indirect revenue effects and allocates its audit resources accordingly. The direct revenue effects are from the penalties and additional taxes assessed on audited returns. The indirect effects arise from the potential specific and general deterrent effects of audits. Specific deterrence occurs if taxpayers who are audited become more compliant. General deterrence occurs if audits promote compliance by other taxpayers.

The work reported in this paper relates to the general deterrent effect (in IRS terminology the "ripple" effect) of audits. We find deterrent effects for all four groups considered but the effects are significant only for the high income, nonbusiness group. Direct revenue yields of audits are also larger for this group than for any other group of taxpayers. In 1979, the

year from which we obtain our data, 28 percent of the additional tax and penalty assessments from audits were from this group although it comprised only 1.1 percent of all individual tax returns filed. By 1988, the most recent year for which the data is available, the high income, nonbusiness group had grown to 9.8 percent of all individual returns and had 49 percent of the additional tax and penalty assessments.

The IRS allocates audit resources to some low and middle income groups, particularly groups that file relatively simple returns, even though it knows that the direct revenue yield is low and less than could be obtained from other groups. The IRS rationale for this policy is the assumption that there are trade-offs between direct revenue and general deterrence in the allocation of audit resources. The IRS wants to maintain an audit "presence" in each audit group in order generate general deterrence effects. Our results caution against this approach. Reallocating audit resources to the high income, nonbusiness group may increase direct revenue yield and generate additional general deterrent effects.

Before recommending such a policy several additional issues need to be examined thoroughly. First, the results we obtain here need to be replicated. In doing so, it would be useful if less aggregated audit coverage data were available. Second, we need to know more about the specific deterrent effects of audits. The work that has been done does not provide much evidence about the magnitude of the specific deterrent effect or even necessarily if it exists (Roth, et al., pp 93-96). If specific deterrent effects are high for some income groups, then allocating audit resources to them might be justified even if the direct revenue and general deterrent effects were quite small.

Finally, we need to know how the general deterrent threat of audits is transmitted. The existing literature suggests that taxpayers form their perceptions of the probability of being audited mainly from their own experiences, from friends and associates, and from tax professionals. It is not clear though whether taxpayers necessarily make a clear distinction between audits and other IRS contacts. Indeed, taxpayers may equate any IRS contact regarding a tax return as equivalent to an audit. In recent years, substantially more contacts with the IRS have resulted from IRS activities other than formal tax return audits. Most IRS contacts come as a result of computerized checking of returns and matching of returns against other information documents. For example, in 1988, 18 million returns were corrected through correspondence with Service Centers while only while only 1 million returns were audited. It may be that Service Center contacts can serve, by and large, to establish IRS presence for low and middle income groups that file simple returns and that at least some audit resources can be reallocated to higher income groups. In this way the IRS might be able to reverse the marked declines in audit rates for high income taxpayers including the non-business, high income taxpayers for whom the audit rate fell from 10.55 percent in 1979 to 2.32 percent in 1988.

During the debates about the Tax Reform Act of 1986, there was much discussion of the perceptual benefits of reducing allowable subtractions from income (i.e., itemized deduction, credits and adjustments). It was thought that such reductions would increase the perceived fairness of the tax code and, thus, indirectly promote compliance. There was little discussion of the potential direct benefits of such reforms. Indeed, at the time of the debates, there was, as far as we are aware, no work that examined the direct

effect of such tax code provisions. As shown in Section II, theory provides no unambiguous predictions regrading these direct effects. However, our empirical work provides quite strong support for direct procompliance benefits flowing from such tax code changes. These procompliance effects are significant for our highest and lowest income groups.

Our findings regarding subtractions are consistent with additional information. As reported above, the direct revenue yield of audits is highest for the highest income group. The direct revenue yield is also surprisingly high for our lowest income group. For example, in 1988, Revenue Agents, on average, obtained $5,778 in taxes and penalties for audits of our lowest income group. Considering that individuals in the group had relatively complex returns but income below $10,000, it appears that the audit lottery is a game of choice for this group. The underground economy literature also suggests that high and some low income groups are least compliant with tax laws. See Simon and Witte (1982) and Roth, Scholz and Witte (1989) for surveys. As noted previously, these two groups are also the least compliant of the groups we consider.

From a policy perspective, the magnitude of the effect of changes in legal subtractions on compliance is also of interest. As for audits, the effects of legal subtractions on reported income are moderate. For our lowest income group the elasticity of income report with respect to a change in legal subtractions is only -.13. For our highest income group, this elasticity is twice as large, -.26, but still quite modest. Clearly, there are limits to the additional compliance that can be obtained from simplification of the tax code.

Our results and other literature suggest that both audits and tax code provisions can affect the compliance behavior of taxpayers. However, the magnitude of the effects of such governmental changes is limited. The implication is that nongovernmental (e.g., changes in attitudes, transactions, etc.) play a large role in compliance.

Footnotes

[1]Although the audit selection rules are not publicly released, the IRS provides information on how it develops the rules. See Comptroller General of the United States (1976), Weddick (1982) and Hiniker (1987) for discussions of how the discriminant formulas are developed and Wilt (1986) for a discussion of the trends in audit selection using this method.

[2]The TCMP data is a stratified random sample of individual tax returns each of which has been audited line-by-line by experienced IRS examiners. For a more complete description of the data and its limitations see Roth, Scholz, and Witte (1989, p. 65-69) and IRS (1988b, A 3-7).

[3]See also Beron, Tauchen and Witte (1988). Note that if a taxpayer's reports affect the probability of an audit, then it is the parameters of the audit probability function rather than just the probability of an audit that affects taxpayer compliance. With our approach we are examining the effect of a parallel shift in the log odds of an audit when evaluated at the optimum reported income and reported subtractions for a taxpayer who makes his or her reporting decisions to maximize expected utility. See Tauchen and Witte (1986) for further details.

[4]Because of difficulty in hiring and retaining auditors in high-wage Districts such as Manhattan, the IRS has recently been granted an exemption from the uniform pay scale requirements.

[5]If taxpayers are risk neutral, then only a taxpayer's estimates of the income that the tax auditors could find affects compliance. An assumption of risk neutrality might justify using only the auditor's finding of income as the measure of true income.

[6]For comprehensive surveys of the literature on tax compliance see Witte and Woodbury (1983), Kinsey (1986), Jackson and Milliron (1986), Tauchen and Witte (1986), American Bar Foundation (1988), Roth, Scholz, and Witte (1989).

[7]Klepper and Nagin (1988) do not directly estimate a model of individual tax compliance but have devised a way to use 1982 TCMP data aggregated to the national level for each audit class in order to examine the relationship among the line item voluntary compliance ratios for about 30 separate line items.

[8]Clotfelter includes a marginal tax rate variable for the combined federal and state rates. Even when using both state and federal taxes, we were not able to obtain sufficient independent variation in the marginal tax rates and income in order to identify separate tax and income effects. Our results thus show how reported income varies with true income and the accompanying change in taxes due.

[9]The IRS experimented with functional forms and for other audit classes used semi-logarithmic functions.

[10]The tax increase estimate might be an overstatement since some subtractions including the deduction for sales tax would increase with higher reported income. However, the medical deductions would fall since for 1979 taxpayers could deduct medicine and drugs only in excess of one percent of income net of expenses and other medical expenses only in excess of three percent of income net of adjustments.

[11]For audit class six, the findings are consistent with a linear income effect in that the coefficient on the squared income term is positive but insignificant. In addition, the coefficient is very small in magnitude. The

derivative of reported income with respect to the auditor's assessment of income is 1.0004 times larger with than without the squared term.

[12]The sociodemographic variables might also be a partial measure of the fraction of the subtractions that are for items that do and do not provide utility. Relatively more of the subtractions for older individuals might be for medical expenditures which reduce the available funds for expenditure on other goods and services. The reduction funds for these expenditures might affect compliance decisions.

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Table 1: Definition of Non-business Audit Classes

Audit Class	Acronym	Definition
Low Income-Complex	LI-C	Non-business return[1]; Total Positive Income[2] under $10,000; At least one of following: (1) itemized deductions (2) interest or dividend income above $400 (3) income other than wages and salary, interest, dividends, taxable unemployment benefits (4) credits other than political donations and earned income (5) Schedule C or F (6) excess FICA (7) taxes other than from tax tables
Middle Income 1 -Complex	MI1-C	Non-business return; Total Positive Income of at least $10,000 and less than $25,000; At least one of the following: (1) itemized deductions (2) income or losses from partnerships, estates or trusts, or small business corporations (3) Schedule C or F
Middle Income 2	MI2	Non-business return; Total Positive Income is at least $25,000 and less than $50,000
High Income	HI	Non-business return; Total Positive Income greater than $50,000

[1]A non-business return is defined as a return that does not meet the conditions for a business return. A business return is a return that meets one of the following conditions:

(1) Total gross receipts from Schedule C and F are at least $100,000
(2) Total gross receipts are at least $25,000 and less than $100,000; Total positive income[2] from sources other than Schedule C and F is less than $50,000
(3) Total gross receipts are less than $25,000; Total Positive Income from sources other than Schedule C and F is less than Total Gross Receipts

[2]Total Positive Income is the sum of the positive income items.

Table 2: Empirical Results for Reported Income
(t-values in Parentheses)

Variable	Audit Class LI-ID	MII-ID	MI2	HI
Log Odds of an audit -- endogenous	71.16 (0.33)	26.05 (0.10)	55.05 (0.20)	16916.81* (1.86)
True Income				
Auditor's Assessment	0.72** (72.60)	1.30** (74.65)	1.77** (32.74)	7.02** (97.64)
Auditor's Assessment Squared (in $1,000,000,000)	-0.67** (-24.23)	-1.19** (-32.90)	-1.17** (-15.57)	2.28 (1.01)
Census Income	0.65 (0.78)	0.47 (0.43)	0.24 (0.27)	5.46 (0.35)
Census Income Squared (in $100,000)	-7.44 (-0.99)	-1.07 (-0.33)	-0.31 (-0.24)	-7.23 (-0.32)
Tax Code Variables				
Subtraction per Exam	-0.14** (-5.52)	-0.02 (-1.24)	-0.02 (-1.52)	-1.02** (-28.40)
Fraction over 65	130.88 (0.66)	-199.18 (-0.46)	-1327.02** (-2.11)	15679.57 (1.60)
Fraction Unemployed	3179.86** (2.92)	2230.75** (1.96)	-626.51 (-0.36)	30228.63 (0.81)
Sociodemographics				
Fraction Holding High School DIPL.	388.66 (1.13)	245.98 (0.74)	-286.60 (-0.52)	-7732.49 (-0.71)
Fraction White	-166.69 (-0.54)	-320.69 (-1.00)	327.62 (0.75)	7311.37 (0.88)
Fraction Reporting Jointly	137.66 (0.37)	-222.45 (-0.36)	1018.10 (0.75)	-1513.95 (-0.05)
Fraction Female Householder	-223.15 (-0.41)	-371.96 (-0.40)	1458.24 (0.70)	2176.54 (0.05)
Average Age	9.84 (1.57)	-3.38 (-0.28)	35.27** (1.96)	-340.27 (-1.27)

Table 2 - continued

Variable	LI-ID	MI1-ID	MI2	HI
Fraction Foreign Born	-379.43 (-0.49)	-530.12 (-0.58)	797.84 (0.61)	44790.31* (1.85)
Constant	568.79 (0.23)	-5538.97 (-0.60)	-18663.83 (-1.31)	-26829.09 (-0.10)
F-Value	491.80	747.34	975.91	1549.02
Adj R-Square	0.70	0.80	0.87	0.88
N	2923	2557	2022	2858