THE EFFECT OF AUDIT RATES ON THE FEDERAL INDIVIDUAL INCOME TAX, 1977–1986***

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ABSTRACT

This paper analyzes empirically the effects of audit rates and certain other factors on the filing of federal individual income tax returns and the self-reporting of taxes due. Using data drawn from the Annual Report of the Commissioner of Internal Revenue *and the* Statistics of Income *for the years 1977–86, we estimate that self-reported taxes in 1986 would have been greater by approximately fifteen billion dollars had the federal audit rate remained constant at its 1977 level during the intervening period.*

1. Introduction

THE decade 1977–1986 witnessed a dramatic decrease in the Internal Revenue Service ("IRS") audit rate. The audit rate for individuals declined from about two and one-half percent to just over one percent during this period. Audit rates of corporations declined even more precipitously from about nine and one-half percent to around three percent. Although exact comparisons are not possible due to changes in IRS classifications of taxpayers, audit rates of higher income individuals also declined substantially. With the exception of a burst in activity for tax-shelter partnerships in the early 1980s, partnership and small business corporation audit rates reflected a similar downward trend. The declines in audits seem principally due to two factors: first, they were a natural consequence of the budget policies of the period and second, the IRS seemed to adopt a policy of substituting third-party information reporting coupled with IRS document matching and increased taxpayer and tax preparer penalties for an audit-dependent enforcement policy.[1]

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The strengthening in the 1980s of third-party information reporting of tax-related transactions to the IRS and IRS matching of such reports to tax returns means that few additional opportunities for effective third-party reporting remain.[2] Penalties for underreporting tax liabilities also underwent drastic revisions during the past decade and the 1989 penalty revision legislation suggests that further penalty increases are not feasible. The 1989 restructuring of taxpayer penalties seems to reflect agreement that the severity of the penalty structure of the 1980s in combination with a historically low audit rate created some unfairness in the tax enforcement process.[3]

The primary purpose of this paper is to investigate empirically the overall role of audits in the federal revenue collection process. Surprisingly, this has never been done. Although the general deterrence effects of audits have been widely acknowledged, the IRS has never put forth any estimates of the "spillover" benefits of audits (the increase in collections from taxpayers, whether or not they are audited, who report more taxes due in response to an increase in the likelihood of an audit). To date, only the direct revenues obtained from audits (additional taxes and penalties) have been estimated.

The principal innovation in our empirical work is to estimate directly taxes due rather than first attempting to construct a measure of noncompliance, and then extrapolating from noncompliance to revenue. This is consonant with the theoretical literature in which taxpayers typically decide on an optimal level of reported income as opposed to an optimal level of noncompliance. In particular, our empirical analysis is based on two models both of which are estimated using a state level time-series cross-section data set for the years 1977–86. One model specifies reported taxes per return filed as a function of audit rates and a variety of socio-eco-

nomic factors. The other model specifies returns filed per capita as a function of the same variables. This decomposition allows us to separate the effects of underlying explanatory variables into a "reporting effect" and a "filings effect."

The time-series nature of our data also allows us to investigate the overall performance of the federal revenue collection process during the decade 1977–86. Using the results of the estimation described above, we explore the relationship between audit rates and tax collections by asking what would have happened to total reported taxes from individuals had the audit rate remained constant at its 1977 level over the period 1977–86. We estimate that total reported taxes would have been greater by $15.6 billion in 1986, or about four percent of total reported taxes, had the audit rate remained constant at its 1977 level. We further estimate that another $2.6 billion of additional tax and penalty would have been assessed in the extra audits. Although changes in collections during the last decade necessarily reflect a variety of other tax compliance factors—most notably the dramatic increases in third-party information reporting and the IRS's ability to match such information to tax-return submissions as well as the substantial new and increased penalties enacted by Congress in 1981 and 1982—our results confirm the prominence of audit rates in the revenue collection process. These findings have important policy implications for tax administration and generally confirm an economic approach to tax noncompliance: taxpayers do seem to respond rationally, even predictably, to the nature of the tax lottery confronting them.

Finally, we have a number of results regarding taxpayer filing behavior. Most significantly we find that increases in the audit rate decrease returns filed per capita and increases in the percent of the adult population with at least a high school education increase significantly the number of returns filed per capita. These findings shed new light on compliance factors related to nonfilers—a significant tax compliance category—that heretofore has been largely unexplored.

The remainder of this paper is organized as follows: Section 2 describes our data and estimation procedures, Section 3 presents our results on the effect of audit rates on reported taxes as well as on reported taxes plus additional tax and penalty from audits for the years 1977–86, and summarizes other empirical results of general interest, and Section 4 concludes with some comments on the policy implications of our results.

2. Empirical Analysis

Our empirical analysis generates estimates of the effects of federal audit rates on reported taxes per return, reported taxes plus additional tax and penalty from audit per return, and returns filed per capita. We begin by specifying a model in which reported taxes per return depends on the state income tax rate, the audit rate, per-capita income and various other socio-economic variables. We specify a second model which relates federal returns filed per capita to the same variables. We then repeat the analysis using reported tax plus additional tax and penalty from audit per return as a dependent variable in the first model. This allows us to estimate the spillover effects of increases in the audit rate.

2.1 Data

Much of our analysis is based on data reported in the *Annual Report of the Commissioner of Internal Revenue* for the years 1977–86, which covers the government fiscal years, running from October 1 to September 30, 1977–86. These reports include district-level data on Internal Revenue Service collections, number of returns filed, amount and number of refunds, number of examinations, total additional tax and penalties recommended after examination, and budgets. The data is further broken down by "class of tax"—individual, corporate, estate, gift, etc. For most states the entire state is one IRS district. Until 1984 California, Illinois, Ohio, Pennsylvania and Texas all had two districts and New York had four. In 1984 another district was added to Texas

and three were added to California. In all cases of multiple districts within a state we aggregate district-level data from the annual reports to the state level. We also use total reported tax liability aggregated to the state level as given in the *Statistics of Income*.[4]

While, in theory, other data might better facilitate the analysis we have undertaken, a variety of limitations restrict our ability to use less aggregate data sources. Probably the best data base would consist of a sample of individual tax returns over time, but Section 6103 of the Internal Revenue Code limits the IRS's ability to release such individual level data and Section 7216 of the Code similarly prohibits the use of such individual level data collected by tax return preparers. From time to time the IRS has made Taxpayer Compliance Measurement Program ("TCMP") data—a stratified sample of intensive IRS audits—available to researchers, but this data is typically aggregated in some fashion.[5] While we have used such data in other inquiries,[6] that used here—from the Commissioner's annual reports merged with state level data from other sources—permits us to explore a wide variety of questions. In particular we not only derive estimates of the direct effect of audits on revenue, but also extend the methodology to estimate the indirect (or spillover) effects of audits on revenue.

We use the following five primary variables from the annual reports: (1) total tax returns filed;[7] (2) number of individual income tax returns filed; (3) number of individual income tax returns examined; (4) additional tax and penalty recommended after examination for individual income tax returns; and (5) costs incurred by the Internal Revenue Service.[8]

Using these five primary variables plus reported taxes as given in the *Statistics of Income* we construct five secondary variables which are used in our analysis:

ALR: reported individual income tax plus additional tax and penalty recommended after examination divided by the number of individual income tax returns filed, in 1972 dollars—assessed liability per return;

RTR: reported individual income tax divided by the number of individual tax returns filed, in 1972 dollars—reported taxes per return;

RCAP: total individual income tax returns filed divided by total population—returns per capita;

AUDIT: total individual income tax returns examined divided by total individual income tax returns filed—the individual audit rate;

BPR: total IRS budget divided by total returns filed in 1972 dollars—budget per return.

We also use a number of socio-economic variables taken from a variety of sources. These are all reported on a calendar year basis:[9]

STAXR: total state individual income tax paid as a percentage of total state personal income—the average state income tax rate;

PERED: percent of the adult population with at least a high school education;

PER65: percent of the adult population over age 65;

UR: the unemployment rate;

INCOME: income per capita, in 1972 dollars;

PMAN: percent of the work force employed in manufacturing;

PSERV: percent of the work force employed in the service industry;

HOUSES: households per capita;

FARMS: farms per capita;

WELFARE: the number of households on welfare divided by the total number of households.

Finally, we have obtained from the IRS regional level data on the number of information returns filed. This allows us to construct one more enforcement variable. This variable takes on a common value for all states within an IRS administrative region:

INFRATE: The number of information returns other than W2 forms filed divided by the number of individual returns filed.

2.2 *Specification*

We pool state level data for the years 1977 to 1986 and estimate ALR and RCAP as functions of PER65, HOUSES, WELFARE, UR, INCOME, STAXR, PERED, PMAN, PSERV, FARMS, AUDIT, and a dummy variable, DUM80, which has a value of zero for all states from 1977–79, and a value of one for all states from 1980–

TABLE 1
VARIABLE DEFINITIONS AND SOURCES[1]

ALR	Assessed tax liability per return—reported individual income tax liability plus additional tax and penalty recommended after examination divided by the number of income tax returns filed, constant (1972) dollars
AUDIT	Individual Audit Rate—number of individual returns examined divided by the number of individual returns filed[2]
BPR	Budget per return—IRS state level budget divided by the total number of individual returns filed[2]
DUM80	Dummy variable, zero from 1977 to 1979 and one from 1980 to 1986
FARMS	Total number of farms divided by total population
HOUSES	Total number of households divided by total population
INCOME	Personal Income per capita in constant (1972) dollars[3]
INFRATE	Number of information returns other than W2 forms filed divided by total number of individual returns filed[4]
ONE	Constant term
PER65	Percentage of the adult population over 65 years of age
PERED	Percentage of the adult population with at least a high school education[5]
PMAN	Percentage of labor force that works in a manufacturing industry
PSERV	Percentage of labor force that works in a service industry
RCAP	Total individual income tax returns filed divided by total population
RTR	Reported tax liability per return—reported individual income tax liability divided by the number of income tax returns filed, constant (1972) dollars[6]
STAXR	Average state income tax rate
UR	Unemployment rate
WELFARE	Total number of households on welfare divided by the total number of households

Notes (1) Unless otherwise noted, data is taken from *Statistical Abstract of the U.S.*, 1977-1986.

(2) Individual returns filed, individual returns examined, IRS state-level budgets, additional taxes and penalities, and total returns filed are taken from *Annual Report of the Commissioner of Internal Revenue*, 1977-1986.

(3) Personal Income is taken from the *Bureau of Economic Analysis* as reported in the *Statistical Abstract of the U.S.*, 1977-1986.

(4) Number of information returns were obtain directly from the Internal Revenue Service for the years 1977-1986.

(5) We get the percent of the adult population with as least a high school education from Census data for 1976 and 1980 and interpolate for 1977, 1978, and 1979. For 1981 through 1985 we combine data on the number of high school graduates with other demographic data to construct projections based on the 1980 values.

(6) Reported individual income tax is taken from *Statistics of Income* as reported in the *Statistical Abstract of the U.S.*, 1977-1986.

TABLE 2
MEAN VALUES OF VARIABLES BY YEAR
(STANDARD DEVIATIONS IN PARENTHESIS)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
ALR	1.17	1.25	1.27	1.32	1.35	1.26	1.21	1.24	1.24	1.33
	(.250)	(.230)	(.240)	(.246)	(.261)	(.238)	(.228)	(.240)	(.240)	(.266)
AUDIT	1.88	1.77	1.66	1.66	1.53	1.40	1.36	1.23	1.15	1.00
	(.654)	(.590)	(.577)	(.578)	(.455)	(.352)	(.374)	(.376)	(.367)	(.423)
BPR	.005	.005	.005	.004	.004	.004	.005	.005	.004	.004
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
DUMS0	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FARMS	.017	.017	.015	.014	.015	.015	.014	.014	.014	.013
	(.015)	(.015)	(.014)	(.014)	(.013)	(.013)	(.013)	(.012)	(.012)	(.012)
HOUSES	.338	.343	.350	.351	.357	.357	.356	.361	.362	.360
	(.018)	(.019)	(.018)	(.017)	(.017)	(.016)	(.017)	(.016)	(.018)	(.016)
INCOME	4.82	5.03	5.14	5.14	5.24	5.20	5.28	5.53	5.50	5.68
	(.692)	(.664)	(.654)	(.732)	(.726)	(.780)	(.807)	(.800)	(.877)	(.951)
INFRATE	3.18	3.31	3.39	3.61	3.96	4.17	4.36	4.91	5.56	5.44
	(1.60)	(1.66)	(1.56)	(1.68)	(1.73)	(1.89)	(1.76)	(2.20)	(2.38)	(1.60)
PER65	.152	.153	.153	.154	.155	.156	.157	.159	.161	.162
	(.029)	(.028)	(.029)	(.028)	(.028)	(.028)	(.028)	(.028)	(.029)	(.027)
PERED	.673	.674	.674	.675	.674	.674	.672	.672	.671	.675
	(.073)	(.074)	(.074)	(.076)	(.072)	(.070)	(.068)	(.068)	(.071)	(.073)
PMAN	.215	.213	.212	.206	.203	.193	.189	.190	.184	.178
	(.089)	(.087)	(.085)	(.082)	(.082)	(.079)	(.077)	(.077)	(.074)	(.071)
PSERV	.182	.184	.187	.193	.199	.206	.212	.214	.218	.224
	(.042)	(.042)	(.042)	(.042)	(.041)	(.043)	(.043)	(.043)	(.042)	(.042)
RCAP	413.0	420.7	420.0	421.5	423.4	418.3	419.0	426.2	435.9	434.9
	(32.1)	(32.7)	(34.8)	(32.6)	(32.3)	(34.5)	(36.3)	(36.8)	(40.3)	(37.1)
RTR	1.16	1.24	1.25	1.31	1.34	1.24	1.19	1.22	1.22	1.31
	(.245)	(.227)	(.237)	(.242)	(.257)	(.233)	(.221)	(.232)	(.234)	(.264)
STAXR	1.62	1.61	1.61	1.56	1.52	1.57	1.63	1.71	1.78	1.75
	(1.13)	(1.05)	(1.02)	(1.00)	(1.02)	(1.08)	(1.11)	(1.11)	(1.12)	(1.10)
UR	.066	.057	.055	.068	.073	.093	.093	.073	.071	.070
	(.016)	(.015)	(.014)	(.016)	(.019)	(.023)	(.025)	(.022)	(.020)	(.022)
WELFARE	4.21	4.05	3.98	4.11	4.08	3.60	3.69	3.65	3.60	3.68
	(1.40)	(1.40)	(1.43)	(1.46)	(1.48)	(1.37)	(1.37)	(1.36)	(1.31)	(1.29)

86. The inclusion of a dummy variable for the years 1980–86 captures the effects of changes in IRS enforcement strategies and tax law changes which affected all states.[10] The reporting and filing equations are respectively:

$$RTR_{it} = \alpha_0 + \alpha_1 PER65_{it} + \alpha_2 HOUSES_{it} + \alpha_3 WELFARE_{it} + \alpha_4 UR_{it} + \alpha_5 INCOME_{it} + \alpha_6 STAXR_{it} + \alpha_7 PERED_{it} + \alpha_8 PMAN_{it} + \alpha_9 PSERV_{it} + \alpha_{10} FARMS_{it} + \alpha_{11} AUDIT_{it} + \alpha_{12} DUM80_t + \epsilon_{it}^{RTR} \quad (1)$$

$$RCAP_{it} = \beta_0 + \beta_1 PER65_{it} + \beta_2 HOUSES_{it} + \beta_3 WELFARE_{it} + \beta_4 UR_{it} + \beta_5 INCOME_{it} + \beta_6 STAXR_{it} + \beta_7 PERED_{it} + \beta_8 PMAN_{it} + \beta_9 PSERV_{it} + \beta_{10} FARMS_{it} + \beta_{11} AUDIT_{it} + \beta_{12} DUM80_t + \epsilon_{it}^{RCAP} \quad (2)$$

Our choice of independent variables for the "reporting effect" equation is motivated by two considerations, the size of the tax base and the compliance behavior of taxpayers. Variables which are primarily related to the tax base are PER65, HOUSES and WELFARE. Variables which are related to both the tax base and the compliance behavior of taxpayers are UR, INCOME and STAXR. Variables which are primarily related to the compliance behavior of taxpayers are PERED, PMAN, PSERV, FARMS and AUDIT.

Our expectations regarding the effect of these variables on reported taxes per return are based on conventional theoretical considerations.[11] In particular, with respect to variables which are primarily related to the tax base, we expect a negative coefficient on PER65 since taxpayers over 65 years of age are allowed special tax reductions. An increase in the number of households per capita (HOUSES) should increase reported taxes per return since it implies fewer exemptions. Finally, an increase in the percent of households on welfare (WELFARE) should increase reported taxes per return since it effectively eliminates a portion of the lower tail of the distribution of income.[12]

We use three variables which are related both to the tax base and to the compliance behavior of taxpayers. In general, this leads to ambiguous predictions. For example, states with higher unemployment rates may have unsound economies and thus yield lower reported taxes per return. This effect is reinforced if unemployment is associated with the underground economy and thus produces noncompliance. On the other hand, if most unemployed taxpayers have relatively low income, then reported tax per return should rise as a portion of the lower tail of the distribution of income is eliminated. To the extent that the elimination of some low-income filers is dominated by the reduction in reported taxes by the remaining filers, we expect a negative coefficient on UR. Changes in real income per capita also have confounding effects on reported tax per return. In general, higher income taxpayers have increased opportunities to evade, but there is strong direct relationship between real income per capita and reported taxes per return. In fact, the latter effect should be quite large, leading to a positive coefficient on INCOME. Finally, since state income taxes are deductible, an increase in the average state income tax rate should decrease reported taxes per return. On the other hand, if states attempt their own tax enforcement, and share information yielded by their enforcement activities with the IRS, and if states with higher income taxes do more enforcement, then an increase in average state income tax rates should increase reported taxes per return. Since the former is likely to dominate the latter, we expect a negative coefficient on STAXR.

Variables which are primarily related to the compliance behavior of taxpayers include several which reflect opportunities to evade and one which reflects IRS enforcement activity. The percent of the adult population with at least a high school education is thought to be positively related to tax noncompliance, presumably because more educated individuals are

better able to play the "tax lottery."[13] Thus, with respect to reported taxes per return, we expect a positive coefficient on PERED. The employment distribution variables directly measure opportunities to evade. In particular, the percent of the work force employed in manufacturing industries (PMAN) should be positively related to reported taxes per return since taxpayers working in manufacturing industries presumably have little income other than that reported on W2 or 1099 forms. The percent of the work force employed in service industries (PSERV), on the other hand, should be negatively related to reported taxes per return since some service sectors are thought to be closely connected with the "underground economy." Farms are known to have low levels of voluntary compliance so we expect a negative coefficient on farms per capita (FARMS).[14] Finally, although we expect increases in the federal audit rate (AUDIT) to increase taxpayer compliance and thus reported taxes per return, audit rates presumably respond to compliance levels, so that we cannot treat the federal audit rate as an exogenous factor. Our treatment of the federal audit rate is discussed in more detail below.[15]

Two further observations need to be made regarding our choice of independent variables for the reporting effect equations. First, all of the above considerations apply to such an equation whether reported taxes per return (RTR) or assessed liability per return (ALR) is used as the dependent variable. In addition, though, any change which increases reported taxes per return because the change reduces taxpayer noncompliance is likely to reduce additional taxes and penalties recommended after examination as well. Thus, changes in variables related to the compliance behavior of taxpayers which reduce taxpayer noncompliance should increase reported taxes per return but decrease additional taxes and penalties per return, leaving the effect on assessed liability per return, in principle, ambiguous. However, given the low audit coverage during the years 1977 to 1986, and the relatively low yield from those audits compared to total reported taxes, we expect the increases in reported tax per return to dominate the decreases in additional taxes and penalties. This means that our expectations regarding the effects of changes in compliance related variables on ALR are the same as our expectation regarding the effects of changes in those variables on RTR.

Second, as noted above, we expect that audit rates affect taxpayer compliance levels, as reflected in either reported taxes per return or assessed liability per return, but consider it fundamental to allow for the possible endogeneity of audit rates in any equation meant to explain either variable. Endogeneity occurs when elements of the taxpayers' income and tax status which are known by the taxpayer and observed by the IRS (but not by us) induce below average compliance and simultaneously induce greater audit rates. In this case, correlation between audit rates and the unobservables will lead to inconsistent estimates of the parameters using ordinary least squares estimation.[16] Consistent estimation requires the use of "instruments" which are correlated with audit rates but not with the unobservables. The IRS budget per return filed, BPR, and the rate of filing of information returns, INFRATE, fill this role in our analysis, as is described in detail in the next section.

Our choice of independent variables for the "filing effect" equation is closely related to our choice of independent variables for the reporting effect equations. Unlike the theoretical literature on underreporting—the failure by taxpayers who have filed returns fully to report all taxes due—there is virtually no theoretical literature on nonfilers. One exception is a model due to Graetz and Wilde (1990) dealing with the decision by nonfilers to participate in tax amnesties. In their model, however, taxpayers who file returns are assumed to report honestly. In other words, we receive no guidance whatsoever from formal theory regarding the specification of a returns filed per capita equation. Consequently, we use the same specification for returns filed per capita that we use for reported taxes per return and assessed liability per return.

With respect to variables which relate to the compliance behavior of taxpayers, there is one principle which applies to nearly all. This principle arises from the observation that taxpayers confront three options, to file a return and report honestly, to file a return and underreport taxes, or not to file a return. Anything which reduces the benefits or increases the costs of filing a return and underreporting taxes will increase the likelihood that a given taxpayer chooses one of the other two options, to file a return and report honestly or not to file a return. We call this the compliance principle. It will generally apply to variables which relate to the compliance behavior of taxpayers, but it may be masked by other more direct effects. As it turns out, it plays a particularly important role in the relationship between the audit rate and the number of returns filed per capita.

With respect to variables which relate to the tax base, there is also a rather clear general principle at work. Any change which increases the tax base will tend to increase returns filed per capita as more taxpayers find themselves with incomes above the minimum required for filing. We call this the tax base principle.

With both of these general principles in mind, consider first the effect on returns filed per capita of variables which relate primarily to the tax base. An increase in the percent of the adult population over 65 years of age should decrease returns filed per capita since more taxpayers in this age group are likely to fall below the minimum requirements for filing.[17] An increase in the number of households per capita should also increase returns filed per capita. Finally, an increase in the percent of households on welfare should reduce returns filed per capita as fewer individuals can be expected to have an income level above the minimum required for filing.

We expect a positive relationship between the percent of the adult population with at least a high school education and returns filed per capita for two reasons. First, the compliance principle suggests that because more educated taxpayers find it easier to exploit opportunities to evade they are also more likely to file returns. Second, more educated taxpayers at the lower end of the income distribution are more easily able to comprehend the federal income tax laws and to comply with them. In particular, they are more likely to be able to read and understand tax forms. With respect to employment distribution variables, the compliance principle suggests that the percent of the work force employed in manufacturing industries should be negatively related to returns filed per capita and the percent of the work force employed in service industries should be positively related to returns filed per capita. On the other hand, the reason why we predicted a positive relationship between the percent of the work force employed in manufacturing industries and reported taxes per return, and thus a negative relationship between the percent of the work force employed in manufacturing industries and returns filed per capita, is that taxpayers employed in manufacturing industries have little income other than that reported on W2 or 1099 forms. Given the extent of withholding of taxes due and information matching for such income, taxpayers employed in manufacturing industries should find it in their advantage both to file returns and report honestly on those returns.[18]

The relationship between farms per capita and returns filed per capita is more difficult to predict. While farms are believed to have low levels of voluntary compliance given that they file, they are not known to be better or worse than other noncorporate businesses with respect to filing. Indeed, we expect farms per capita to have little or no effect, other things equal, on returns filed per capita. Finally, we expect the compliance principle to apply very strongly to the federal audit rate; i.e., because increases in the federal audit rate decrease the benefits and increase the costs of filing a return and underreporting taxes due, we expect an increase in the audit rate to decrease returns filed per capita. Since noncompliance and underreporting are likely to be related and because audit rates respond to underreporting, we must, once again, allow for the endogeneity of the audit rate in the re-

turns filed per capita equation. We do this using, as in the assessed tax per return equation, the IRS budget per return and information reports per return as instruments.[19]

Finally, we have three variables which are related both to the tax base and to the compliance behavior of taxpayers: the unemployment rate, real income per capita, and the average state income tax rate. Despite a potentially complex relationship between the unemployment rate and the compliance behavior of taxpayers, we expect that an increase in the unemployment rate will decrease returns filed per capita since it decreases the number of taxpayers with incomes above the minimum required for filing. An increase in real income per capita should have a strong positive effect on returns filed per capita since both the compliance effect and tax base effect work in the same direction; that is, taxpayers with higher income have more opportunities to evade and thus should file more often, and they are also more likly to have incomes above the minimum required for filing. Lastly, and perhaps surprisingly, we expect an increase in the average state income tax rate to decrease returns filed per capita. This is because the compliance principle suggests that states with higher average state income tax rates, who are the most likely to have enforcement programs of their own, are also the most likely to have taxpayers who fail to file at both the state and federal level. On the other hand, the tax base effect is relatively neutral with respect to average state income tax rates since state income taxes are deductible at the federal level but do not by themselves affect the minimum requirements for filing.

2.3 *Estimation*

The estimation of equations (1) and (2) is complicated by several statistical considerations. First, as noted above, we expect that the audit rate, $AUDIT_{it}$, is correlated with the unobservable factors that influence reported taxes per return, ϵ_{it}^{RTR}, and with the unobservable factors that influence returns filed per capita, ϵ_{it}^{RCAP}. We employ a single-equation consistent estimation procedure to estimate equations (1) and (2) using budget per return, BPR_{it} and information reports per return, $INFRATE_{it}$, as instruments for $AUDIT_{it}$.[20]

Finally, our estimation procedure accounts for possible correlation of the unobservables ϵ_{it}^{RTR} and ϵ_{it}^{RCAP} over time. Inspection of the fitted residuals obtained using preliminary instrumental variables estimation indicated a correlative pattern consistent with the random effects model (Maddala, 1971).[21] This form of the error distribution implies a specific dependence of the unobservables over time. In particular, the random effects model assumes a random error specific to a given state but nonvarying with time:[22]

$$\epsilon_{it}^{RTR} = \eta_i^{RTR} + \xi_{it}^{RTR} \tag{3}$$

$$\epsilon_{it}^{RCAP} = \eta_i^{RCAP} + \xi_{it}^{RCAP}. \tag{4}$$

The optimal weighting of first stage estimates is calculated by a simple transformation of the estimated standard errors from between- and within-group estimators. Given the potential endogeneity of audit rates, we use instrumental variables to obtain consistent estimates of the error components.[23] GLS estimates were obtained by subtracting a fraction of the mean value of each variable by state from each observation of that variable within that state. This fraction is a function of the error variances of between- and within-group estimators, with adjustments made for degrees of freedom. Transformation of the data into Gauss-Markov form then allows us to test for the presence of endogeneity and to construct consistent and efficient estimates of the parameters, which we refer to below as IV-GLS estimates. The results of the estimation are provided in Table 3.

3. Results

3.1 *Audit Rates*

The audit rate is endogenous in all three models; that is, in the reported tax per return equation, the assessed liability per

TABLE 3
REPORTED TAX PER RETURN, ASSESSED TAX LIABILITY PER RETURN, AND RETURNS FILED PER CAPITA*

	Dependent Variable		
	RTR	ALR	RCAP
AUDIT	.108	.119	-14.25
	(4.59)	(5.05)	(-4.22)
DUM80	.063	.069	-.853
	(4.57)	(5.14)	(-.504)
FARMS	-3.97	-3.98	-270.12
	(-4.55)	(-4.46)	(-1.92)
HOUSES	-.679	-.690	-105.78
	(-1.23)	(-1.26)	(-1.38)
INCOME	.250	.254	15.15
	(16.79)	(16.88)	(6.76)
ONE	.549	.589	303.2
	(2.77)	(2.94)	(10.18)
PER65	-.197	-.274	-129.67
	(-.408)	(-.560)	(-1.76)
PERED	-.088	-.165	143.64
	(-.591)	(-1.08)	(6.11)
PMAN	.106	.081	47.40
	(.658)	(.495)	(1.81)
PSERV	-1.77	-1.72	211.93
	(-6.62)	(-6.32)	(4.90)
STAXR	-.015	-.014	-3.50
	(-1.79)	(-1.72)	(-2.81)
UR	-.967	-.948	-311.01
	(-3.50)	(-3.49)	(-8.67)
WELFARE	.894	-.229	676.56
	(.129)	(.033)	(.692)

* IV-GLS estimates for the years 1977-1986 and for the fifty states. Number of observations is 500. t-statistics in parenthesis.

return equation, and the returns filed per capita equation.[24] Furthermore, inspection of the reduced form audit equation reveals that, as expected, the audit rate is significantly influenced by the IRS budget per return, with respect to which it is increasing, and by information reports per return, with respect to which it is decreasing.[25]

With respect to reported tax per return, the audit rate has a significant positive effect. As Table 3 shows, the effect is even stronger in the case of assessed liability per return. We interpret the positive effect of the audit rate on reported tax per return and assessed liability per return as arising from increased compliance and consider it to be strong evidence of the deterrent effect of audits on taxpayer noncompliance.[26] On the other hand, audits bear a negative relationship to returns filed per capita. This result can be explained, as in Section 2, by the fact that routine IRS audits are not an effective mechanism for locating nonfilers. Thus, historically at least, one way to escape audits has been simply not to file.

Based on our estimation, we have conducted an experiment which examines the intertemporal effects of declining audit rates. Using the estimated RTR and RCAP equations from Table 3, we have calculated for each year the predicted value of total reported tax from individual returns that would have been realized had the audit rate remained constant at its 1977 level. By 1986 we estimate that maintaining the audit rate at its 1977 level would have increased total reported tax by 15.6 billion 1986 dollars, or approximately 4 percent of total reported individual tax in 1986.[27] This value represents the indirect revenue effect—or spillover effect—of the increase in audit rates.

We are also able to isolate and estimate the direct revenue effect of audits. It was with this goal in mind that we added additional taxes and penalties resulting from IRS examinations to reported tax, for each state in each year, and divided by the number of individual returns filed to generate a dependent variable which included the revenue produced by the examination process. We called this variable assessed liability per return. Repeating our revenue experiment using the estimated ALR equation given in Table 3, we calculate a predicted value for the increase in total assessed liability for 1986 that would have resulted from holding audit rates at their 1977 levels. This value, 18.2 billion dollars, is 16.7 percent more than our original estimate, which excluded the additional tax and penalty resulting from

IRS examinations. The difference between the two estimates, 2.6 billion dollars, represents the direct revenue effect of the increase in audit rates. We estimate, therefore, that the spillover effects of audits produce six out of every seven dollars of additional revenue.[28]

3.2 Tax Rates

Forty-three states currently have state income taxes. In all these states there is substantial overlap between the information relevant for federal and state income tax computations. Taxpayers can be expected to coordinate their reports of relevant tax items, including, for example, income and deductions, on their federal and state income tax returns, and they likely will perceive there to be a connection between the probability of audit for state and federal tax underreporting. Moreover, both state and federal returns are filed subject to penalties for perjury as well as for tax fraud. Taxpayers rightly therefore should expect that inconsistencies in reporting on federal and state returns will increase the risks of imposition of these harsher penalties for tax noncompliance that depend on the government's ability to prove that taxpayers' understatements were willful.

There also is a direct linkage among the activities of state and federal tax enforcement agencies. Congress and state legislatures have explicitly provided for exchanges of otherwise confidential tax return and other tax information between the states and the IRS "to increase tax revenues and taxpayer compliance and reduce duplicate resource expenditures."[29] We therefore expect that a strong correlation will exist between taxpayers' underreporting on federal and state returns.

In fact, our results with respect to the average state income tax rate accord quite well with our expectations. The variable STAXR is negative and significant in both the reported tax per return equation and the assessed liability per return equation. This is consistent with the compliance principle described above in Section 2 and with the observation that state income taxes are deductible at the federal level. At the same time, there is a very significant and negative relationship between average state income tax rates and returns filed per capita. This is an important result which, apparently, can only be explained by the compliance principle.[30]

3.3 Variables Related to the Tax Base

The three variables which are related to the tax base, PER65, HOUSES, and WELFARE, are largely insignificant. The only exception is the effect of the percentage of the adult population over 65 on returns filed per capita, which is negative as expected. The effect of the number of households per capita is not significant in any of the models, at least at conventional levels.

3.4 Variables Related to the Tax Base and the Compliance Behavior of Taxpayers

We use three variables which are related to both the compliance behavior of taxpayers and the tax base. One of these, average state income tax rates, we have already discussed. The other two are the unemployment rate and real income per capita. Both of these variables are highly significant in all three equations and have the expected signs; that is, increases in the unemployment rate reduce reported taxes per return, assessed liability per return, and returns filed per capita. Increases in real income per capita, on the other hand, increase all three dependent variables.

3.5 Variables Related to the Compliance Behavior of Taxpayers

We use four variables other than the audit rate which are related exclusively to the compliance behavior of taxpayers, PERED, PMAN, PSERV, and FARMS. The percent of the adult population with at least a high school education has the predicted negative relationship with reported taxes per return and assessed liability per return but is not significant. It is, however, significant in the returns filed per capita equation and has a positive

coefficient; i.e., states with a greater percentage of the adult population having at least a high school education have significantly more returns filed per capita. The employment distribution variables, PMAN and PSERV, perform moderately well. Increases in the percent of the work force employed in manufacturing industries have no effect on reported taxes per return or assessed liability per return, but they increase returns filed per capita, a result which suggests that in this case, at least, the compliance effect is dominated by the third choice open to taxpayers, to file returns and report honestly. Increases in the percent of the work force employed in service industries have a strong negative effect on both reported taxes per return and assessed liability per return as predicted. Also as predicted, PMAN and PSERV have a significant positive effect on returns filed per capita. Finally, increases in the number of farms per capita have a significant negative effect on all three dependent variables.

4. Conclusion

Our results corroborate the central role of audit rates in the revenue collection process. The impact of the decade-long fall in audit rates on tax collections seems to have been serious indeed. A budgetary practice of including IRS audit personnel within a general political philosophy limiting the desired size of government agencies is enormously costly. Additional dollars spent on tax audits appear to have substantial marginal productivity, a fact that might have heretofore been concealed by the aggregate stability of the federal revenue collection process over time. On the other hand, the fall in audit rates may have increased the number of taxpayers who file returns.

With respect to socio-economic factors, the most interesting finding in this study is the strong positive relationship between high school education and returns filed per capita. This finding is significant since it provides the first real empirical insight into the population of nonfilers, about which very little is now known. It also suggests potential opportunities for IRS provision of information to the populace and highlights the significance of simplifying the return filing process.[31]

President Bush's Budget Proposals for fiscal year 1991 include additional IRS enforcement funding and estimate that such funding will produce about $5.5 billion of additional revenue during the next five years. In a somewhat similar vein, the Senate version of the 1986 Tax Reform Act would have created a special Tax Administration Trust Fund to ensure increases in IRS enforcement budgets in future years. This proposal was explicitly intended to address the Senate's concerns that the audit rate had fallen by half during the prior decade. The Senate Finance Committee's Report estimated that this trust fund would have produced $17.6 billion of additional revenues in the five fiscal years 1987–1991. These estimates were greeted skeptically and the proposal was not included in the 1986 act, as finally enacted. Although our results here cannot be regarded as estimates of revenue attributable to increases in audits in the same sense that the IRS constructs such estimates based on TCMP data, they do confirm the view that a long-term decline in audit rates is costly to the federal fisc. The IRS audit capacity deserves protection.

ENDNOTES

***This paper is a substantially revised version of Dubin, Graetz, and Wilde (1987 and 1989). Professor Graetz thanks the National Science Foundation for research support (grant no. SES-870443) as do Professors Dubin and Wilde (grant no. SES-8701027). Professor Graetz is currently serving as Deputy Assistant Secretary (Tax Policy) of the Treasury. This research was conducted before Professor Graetz assumed that office and does not necessarily reflect the views of the Treasury Department. All authors thank Michael Udell for research assistance. Three referees provided extremely useful comments and suggestions.

[1]Both civil and criminal penalties appear to have increased during the decade 1978–88. For a nontechnical analysis of tax enforcement during that period see Dubin, Graetz and Wilde (1990).

[2]Indeed, ignoring W2 forms, the number of information reports per return filed for individuals rose from around 3.5 in 1977 to over 6 in 1986.

[3]See §§7711–7243 of P.L. 101–239 ("The Improved Penalty Administration and Compliance Tax Act of 1989"). See also, e.g., Testimony of Michael J. Saltz-

man, Charles J. Muller and James E. Merrett on behalf of the Penalties Task Force of the section of Taxation of the American Bar Association, before the Subcommittee on Oversight, Committee of Ways and Means, U.S. House of Representatives, July 28, 1988.

[4]The *Annual Report of the Commissioner of Internal Revenue* reports the level of individual income tax collections including employment taxes. We used this data to construct a "collections per return" variable in an earlier version of this paper in an attempt to exclude taxes reported which have not been paid (Dubin, Graetz and Wilde, 1987 and 1989). However, since this measure of collections per return includes employment taxes, it tends to overstate the effects of audits on taxpayer behavior. In particular, using the collections per return variable we estimated that total IRS collections would have been greater by 34.4 billion dollars in 1986 had the audit rate remained constant at its 1977 level. While this is twice as high as our estimate using the reported tax per return variable, the spillover effects are roughly the same.

[5]Individual return data generally is not available. When the IRS does make such data available to non-IRS researchers it tends to be cross-sectional and is seldom matched with socio-economic data. A recent exception is the data set used by Tauchen, Witte, and Baron (1989). Their analysis is based on 1979 TCMP data combined with IRS administrative records and socio-economic data from the 1980 Census matched at the 5-digit zip code level.

[6]For example, Dubin, Graetz, Udell and Wilde (1989) use TCMP data aggregated to the IRS district level to analyze taxpayers' decisions to use tax preparers.

[7]Prior to 1981 virtually all nonprofit organizations filed in Delaware. Starting in 1981 they began filing in the district of primary activity. We have therefore subtracted nonprofit returns filed from total returns filed (the former amounts to less than two percent of the latter). Also, prior to 1981 "declarations of estimated tax" were recorded as one entry per year for any taxpayer filing a declaration of estimated tax in any quarter. Starting in 1981 each quarterly form was counted as one entry increasing the number of declarations of estimated tax by a factor of four. We have adjusted "total returns filed" in 1981–86 to account for this.

[8]We have ignored the approximately one to two percent of "examinations" which take place at seven "regional service centers," each of which covers six to eight states. Thus, "number of returns examined," "additional tax and penalty," and "costs" include only the district level figures from the annual reports.

[9]See Table 1 for complete definitions and sources.

[10]For example, the IRS in the early 80s began the CP2000 program, issuing computer generated notices informing taxpayers that additional taxes are due, principally as a result either of IRS matching of third-party information reports for tax returns or of return consistency checks, such as those for mathematical accuracy. As well, Congress enacted compliance legislation in 1981, 1982, and 1984, and overhauled the federal income tax in 1986. These general regime shifts affected all states and are incorporated in both the reporting and filing equations with the use of a dummy variable.

[11]The decision-theoretic literature is summarized by Witte and Woodbury (1983). A more recent survey which also discusses game-theoretic models is provided by Cowell (1985). On the latter, see also Mookherjee (1989).

[12]An increase in the percent of households on welfare should also decrease returns filed per capita, in principle enough that total reported taxes also decrease.

[13]There is some evidence from survey research which supports this position. See, again, the literature reviews by Witte and Woodbury (1983) and Cowell (1985).

[14]The most recent IRS estimates of the tax gap and levels of voluntary compliance for various types of taxpayers can be found in *Internal Revenue Service Income Tax Compliance Research: Net Tax Gap and Remittance Gap Estimates, 1990*.

[15]A substantial theoretical literature devoted to taxpayer behavior developed in the tradition of Gary Becker's classic 1968 article on the economics of crime, beginning a few years later with the publication of papers by Allingham and Sandmo (1972) and Srinivasan (1973). The consensus of this literature is that increasing the probability of audit or the penalty rate for underreporting tax liabilities will unambiguously reduce noncompliance, but that little else can be said conclusively regarding the effects on noncompliance of other factors such as income or tax rates (see, in particular, Yitzhaki, 1974 or, more generally, reviews by Witte and Woodbury, 1983, and Cowell, 1985).

The problem with models developed in the Becker tradition is that they ignore elements of the revenue collection process that need to be incorporated into any reasonable empirical specification of a compliance model. In particular, if audit rates and punishment levels are included as explanatory variables, some account must be taken of their potential endogeneity. This is a point which the empirical literature on crime, in contexts other than tax law, has taken into account (see, e.g., Pyle, 1986), but in the empirical literature on tax compliance often has been ignored (e.g., Witte and Woodbury, 1985) or inadequately dealt with (e.g., Clotfelter, 1983; Crane and Nourzad, 1986).

In a more recent paper, Alm, Bahl and Murray (1989) analyze a random sample from all Jamaican individual income tax returns, and a subsample of audited returns selected from that sample. They estimate a two-stage Tobit model using a dummy variable for whether a return was audited in the first stage, and in the second stage using the detected reported income as a dependent variable, with a selectivity correction for having been audited. Alm, Bahl and Murray find that the probability of an audit increases with reported tax liability, capital losses and tax credits, while it decreases with dividend and wage income. Unreported taxes increase with the predicted probability of being audited, marginal tax rates, higher levels of post-audit after-tax income (a proxy for true income) and self-employment income, but decrease with higher levels of wage, dividend, or rental income.

[16]Endogeneity affects our model specification in another fundamental way. The *Statistics of Income* reports summary statistics by states for a number of tax return characteristics—wage and salary income, schedule C income, etc. We do not use these as independent variables since they are self-reported and subject to endogeneity.

[17]While it is true that the percent of families below

the poverty level is lowest for families in which the head of household is over 65, we have controlled for effects related to the distribution of income with the inclusion of such variables as INCOME, UR, and WELFARE. Thus, other things equal, the preferential tax treatment of individuals over 65 could lead to lower filing rates.

[13]The compliance principle says that anything which reduces the benefits or increases the costs of filing a return and underreporting taxes due will increase the likelihood that a given taxpayer chooses *either* to file a return and report honestly or not to file a return. In the case of taxpayers employed in manufacturing industries, it is the option of filing a return which is generally more desirable.

[19]As emphasized by one of the referees, the audit or examination function of the IRS is not primarily intended to locate nonfilers. The IRS's principal program for locating nonfilers is called the Tax Delinquency Investigation program. Unfortunately, district level data on the number of successful tax delinquency investigations has not been published nor is any information on this program available prior to 1980. In this study, we recognize that noncompliance and underreporting are likely to be related, and therefore specify our filings equation to include the same compliance related variables as used in our equations for reported tax and assessed liability.

[20]The use of budget per return to identify the audit effect is justified by the fact that IRS district level budgets are based on overall workload rather than individual taxpayer noncompliance (Dubin and Wilde, 1988). The use of information reports per return to identify the audit effect is justified by the fact that such third party reports are mandated by the IRS's Information Returns Program, and are therefore out of the control of individual taxpayers. For an extensive discussion of the Information Returns Program and its relationship to IRS audit activity over the last decade, see Dubin, Graetz, and Wilde (1990).

[21]An elementary exposition on the random effects model is provided in most econometric texts. See e.g. Greene (1990, pp. 485–494).

[22]To account for the dependence in the unobservables, we form the optimally weighted average of between- and within-group estimates to obtain the generalized least squares (GLS) estimator. GLS estimation of this type provides more than a gain in efficiency. Not adjusting for random effects may lead to incorrect inferences regarding endogeneity and the apparent insignificance of some structural effects. The use of ordinary least squares (OLS) can seriously bias the standard errors and test statistics when random effects are present. In the estimation of equations (1) and (2) we have found that the F-statistic which compares the null hypothesis of homoscedasticity against the alternative of random effects well exceeds the critical level under which one would accept the simpler specification (see e.g. Moulton and Randolph, 1989).

[23]Within-group estimation, or equivalently fixed-effects, does not account for variation across states and is therefore not fully efficient. This last point notwithstanding, we have performed specification tests on the fixed-effects models and have detected the continued presence of endogenous enforcement variables. This suggests that at least some portion of the endogeneity of the audit rate is due to correlation with the unobserved non-individual specific error. This precludes the use of other estimation methods which seemingly are appropriate in this context, including, for example, that suggested by Hausman and Taylor (1981).

[24]Our specification test for endogeneity is based on Hausman (1978). In effect the test looks for statistically significant differences between the ordinary least squares and instrumental variables estimates. For a more detailed discussion and an example see Dubin and Wilde (1988).

[25]The reduced form audit equation is not a structural equation, as emphasized by a referee. Thus we neither report it nor succumb to the temptation to discuss it further.

[26]It is widely accepted that higher income taxpayers face higher audit rates. Therefore, one might expect the effect of audits on reported tax to vary systematically with income. We included the appropriate audit-income interaction variable in all three of our models but found it insignificant in each.

[27]During the period between 1977 and 1986, the audit rate decreased from approximately two percent to approximately one percent. Thus, for 1986 our experiment incorporates a substantial increase in the audit rate compared to 1977. This results in a correspondingly significant decrease in returns filed per capita and increase in reported tax per return. The combination of these effects yields a net increase in total reported tax of 15.6 billion dollars.

[28]Tauchen, Witte, and Beron (1989) also find a significant spillover effect of audits. However, their estimates yield indirect revenue effects approximately equal to direct revenue effects.

[29]Internal Revenue Service, Manual, *Disclosure of Information Handbook*, §(33) 00. A recent cross-sectional study due to Cox (1986) also raises the issue of the effect of state income taxes on federal income tax compliance. Using 1979 TCMP data, but controlling only for income, he finds no systematic evidence of an effect of state tax rates on compliance.

[30]Average marginal federal tax rates are not available at the state level. Therefore we have not included them in our final specifications.

Using individual return data and the results of actual IRS audits conducted as part of the 1979 IRS Taxpayer Compliance Measurement Program (TCMP), Clotfelter (1983) models underreported income as a function of effective marginal tax rates, after-tax income, wages as a proportion of adjusted gross income, interest and dividends as a proportion of adjusted gross income, and several socio-economic variables. Even though Clotfelter finds a negative relationship between his measure of the effective marginal tax rate and compliance, his analysis omits the audit rate because of potential simultaneity problems.

Crane and Nourzad (1986) analyze the effect of inflation on aggregate tax evasion over the period 1947–81, concluding that increases in the inflation rate or the marginal tax rate increase tax evasion. Their measure of tax evasion is based on the difference between the Adjusted Gross Income estimate derived by the Bureau of Economic Analysis and that reported by the IRS, their measure of the fine rate is the ratio of additional taxes and penalties assessed by the IRS to the amount of tax evaded. and their measure of

true income is the same BEA estimate of adjusted gross income used to construct their measure of tax evasion. Their estimation allows for the simultaneity introduced by the construction of the latter, but not audit rates, fines, or marginal tax rates, the last of which are constructed using a technique similar to that of Clotfelter.

Alexander and Feinstein (1986), using 1982 TCMP data, find negative effects of marginal tax rates on compliance. Tax rates enter in their model through the probability of detection. Their equation for the probability of detection is assumed to be independent of their compliance equation, which leads them to estimate a recursive rather than simultaneous system. Their approach therefore is analogous to treating audit rates exogenously.

[31]In contrast, other studies have recommended tax simplification and increased information and taxpayer assistance without either specifying targets for such information or detailing why such efforts are likely to stimulate compliance. See, e.g., American Bar Association Commission on Tax Compliance, Report and Recommendations, July 1987.

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