# The Effects of Tax Rates and Enforcement Policies on Taxpayer Compliance: A Study of Self-Employed Taxpayers

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*This paper presents an econometric analysis of taxpayer compliance, exploring its relationship with audit rates, penalties if detected, tax rate schedule, income level, and sources of self-employment income. Using data drawn from the Annual Report of the Commissioner of Internal Revenue Service [IRS, various] and the Data Book [IRS, various] for 1980 to 1995, the audit rate and penalty rate are both effective deterrents to noncompliance. The effectiveness of these two policy instruments depends upon the individual's level of income. It seems the higher the income level, the more effective these instruments are. In general, compliance increases with the level of income but at a decreasing rate. It is also found that individuals tend to comply less as the marginal tax rate rises. Again, such tendency is more pronounced for high-income taxpayers than for low-income taxpayers. (JEL H20, H24, H26)*

## Introduction

Noncompliance is a major problem for federal tax authorities. The Internal Revenue Service (IRS) estimates the federal income tax gap for individual taxpayers at more than $93 billion for 1992 [IRS, 1996]. Further, the IRS estimates that revenue loss as a result of noncompliance increased at an alarming annual rate of 14 percent in the 1973-81 period. While dated, this finding begs research for deterrents. Accordingly, authorities are looking for effective policies to reduce noncompliance. U.S. Congress enacted compliance legislation in 1981, 1982, and 1984 and completely overhauled the federal income tax laws in 1986. Besides the changes in tax laws, these enactments added a wide variety of new penalties for noncompliance. Unfortunately, all this action has taken place in the absence of any solid knowledge about the responsiveness of tax compliance to such policy tools as audit rates, penalty rates, and tax rate schedule [Graetz and Wilde, 1985]. Without such knowledge, it would be difficult to judge the effectiveness of policies instituted during 1980s or to formulate an effective policy in the future.

This paper provides evidence concerning the possible effects of tax enforcement strategies and tax rate schedule for Schedule C and Schedule F filers on tax compliance by analyzing the annual time series data for 1980 to 1995 published in the *Annual Report of the Commissioner of Internal Revenue Service* [IRS, various] and the *Data Book* [IRS,

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various]. The audit rate and penalty rate both serve as effective deterrents to noncompliance. The effectiveness of these two policy instruments depends upon the individual's level of income. It seems the higher the income level, the more effective these instruments are. In general, compliance increases with the level of income but at a decreasing rate. It is also found that individuals tend to comply less as the marginal tax rate rises. Again, such tendency is more pronounced for high-income taxpayers than for low-income taxpayers.

The plan for this study is as follows. The second section reviews the existing theoretical and empirical literature on tax compliance. The third section develops an econometric model for tax compliance. The fourth section reports the estimated model and presents new empirical evidence on how audit rates, penalty rates and tax rates affect compliance. Some concluding remarks are presented in the fifth section.

## Previous Research

The basic theoretical model of tax compliance is an extension of the classic economic analysis of crime by Becker [1968]. The model is a straightforward application of individual choice under uncertainty. The formal analysis was pioneered by Allingham and Sandmo [1972] and Srinivasan [1973]. In this model, the taxpayer's actual income is exogenously given and he chooses a combination of riskless assets (reported income) and risky assets (unreported income). A constant proportional tax is applied to the reported income. With some exogenous and constant probability, the taxpayer is audited. If unreported income is found, the taxpayer pays a penalty proportional to the unreported income at a rate higher than the proportional tax rate. The taxpayer chooses a level of reported income so that his expected utility of net income is maximized. As can be seen, the taxpayer's decision of the level of reported income is determined solely by the level of actual income, the probability of detection, penalty structure, and tax structure, all assumed to be exogeneously determined, and the risk attitude of the taxpayer.

Based on this basic model and consistent with deterrence theory, it was shown that reported income increases as both the probability of detection and the penalty increases [Allingham and Sandmo, 1972; Srinivasan, 1973]. However, the relationship between reported income and actual income or tax rate is not so unambiguous. For example, it was found that for a risk-neutral individual, reported income will tend to decrease with the tax rate, but when risk aversion is allowed, Allingham and Sandmo conclude [1972, p. 330] that "no clear-cut hypothesis emerges as to the connection between the regular tax rate and reported income." If the basic model is modified by assuming that penalties are a function of the unpaid tax rather than the unreported income, Yitzhaki [1974] showed that an increase in the marginal tax rate should result in an increase in reported income. However, Beck and Jung [1989] showed that if the assumption of decreasing risk averse is relaxed, the findings of Yitzhaki [1974] no longer hold.

Most of the remainder of theoretical literature [Anderson, 1977; Pencavel, 1979; Sandmo, 1981; Koskella, 1983a, 1983b; Greenberg, 1984; Reinganum and Wilde, 1985, 1986, 1988; Graetz et al., 1986; Alm et al., 1993; Erard and Feinstein, 1994; Yaniv,

1994; Lee, 1995] are extensions or refinements of the basic model by Allingham and Sandmo [1972] and Srinivasan [1973]. These refined models have produced more rather than less ambiguous results regarding the effects of income, audit rates, penalty rates, and tax rates on compliance. For example, even the most intuitively plausible conclusion that increases in the probability of detection increases compliance breaks down when the model is extended by incorporating the labor supply decision along with the decision to report income [Anderson, 1977; Pencavel, 1979; Sandmo, 1981]. Of these refinements, perhaps the most intriguing theoretical innovations [Koskella, 1983a, 1983b; Reinganum and Wilde, 1985, 1986; Graetz et al., 1986; Alm et al., 1993; Erard and Feinstein, 1994] has been to recognize the fact that the IRS does not select tax returns randomly for auditing but instead uses information from the returns to determine whom to audit. Thus, the audit rate is endogenous and determined from the joint decisions of the taxpayer and the IRS.

In short, the major contribution of theoretical literature is that it has provided a framework to analyze the tax compliance problem. Unfortunately, the predictions of these models are plagued by ambiguities and are extremely sensitive to the underlying assumptions. In these circumstances, empirical research is of crucial importance in providing guidance to the appropriate path for future policies.

There have been a number of empirical studies on the determinants of taxpayer compliance. One of the earliest is by Clotfelter [1983] who analyzed a data set collected originally as part of the 1969 IRS Taxpayer Compliance Measurement Program (TCMP). TCMP data are from detailed audits of a stratified random sample of taxpayers. Based on this data, Clotfelter [1983] estimated models for noncompliance for three classes of taxpayers (nonbusiness, nonfarm business, and farm) and examined the effects of marginal tax rates and income levels on noncompliance. He found that both income and tax rates were negatively related to compliance. The finding of a negative relationship between tax rates and compliance is consistent with that found by Crane and Nourzad [1985, 1986, 1987] in their analysis of aggregate time series data for the period 1947 to 1981; Crane and Nourzad [1990] in their analysis of amnesty data for the state of California; Poterba [1987] in the analysis of time series data on capital gains; Alm et al. [1990, 1993] in their analysis of individual-level data for Jamaica; and Pommerehne and Weck-Hannemann [1996] in their analysis of income tax noncompliance in Switzerland. This is in contrast to the findings of no significant relationship by Kamdar [1995] using TCMP individual-level data for 1971 and by Joulfaian and Rider [1996] in their analysis of low-income taxpayers and the findings of a positive relationship by Kamdar [1997] in the investigation of corporate income tax compliance using time series data. However, the findings of Feinstein [1991] are mixed. He finds a negative relationship between tax rates and compliance when the data for 1982 and 1985 are analyzed separately, but the relationship is positive in the pooled data.

Consistent with Clotfelter [1983], Crane and Nourzad [1985, 1986, 1987, 1990], Dubin et al. [1987], Alm et al. [1993], and Feinstein [1991] found a negative relationship between income and compliance. This is contrary to the finding of a positive relationship by Beron et al. [1988], Dubin et al. [1990], and Kamdar [1997].

Following Clotfelter [1983], Witte and Woodbury [1985] analyzed the 1969 TCMP data. Data were aggregated at the level of tax districts and grouped into seven audit classes. Witte and Woodbury estimated compliance equations for the seven audit classes in each of three groups of taxpayers: small proprietors, middle income wage and salary earners, and upper income self-employed persons. They found that the audit rate might have a positive, negative, or no relationship with compliance, depending upon the audit class and the taxpayer group. However, in most of the cases, the audit rate was found to have a positive relationship with compliance, with elasticity being the highest for small proprietors and the lowest for upper income self-employed taxpayers. A positive relationship between the audit rate and compliance was also found by Crane and Nourzad [1985, 1986, 1987, 1990], Dubin et al. [1987, 1990], Beron et al. [1988], Alm et al. [1990], and Kamdar [1997]. Dubin and Wilde [1988] reanalyzed the 1969 TCMP data by aggregating data at the three-digit zip code levels for the same [Witte and Woodbury, 1985] seven audit classes. Consistent with Witte and Woodbury [1985], they found that the audit rate may have a positive, negative, or no relationship with compliance, depending upon the audit class.

In addition to the relationship between audit rate and compliance, Witte and Woodbury [1985], in their analysis of the 1969 TCMP data, investigated the role of penalties on the compliance decision. They found that the probability of civil penalty has a significant negative relationship with compliance for the middle-income wage earners and the upper-income self-employed persons, and the relationship is not significant for small proprietors. These findings are in sharp contrast to the findings of a negative relationship between penalty tax and noncompliance by Crane and Nourzad [1986, 1987] and Alm et al. [1990]. However, studies by Pommerehne and Weck-Hannemann [1996] and Kamdar [1997] found no evidence of a significant relationship between penalty tax and compliance.

As can be seen, the empirical work to date presents conflicting evidence as to the relative importance and direction of the effects of audit rates, marginal tax rates, penalty rates, and income on tax compliance. This limits the usefulness and sheds doubt on the reliability of these findings. One possible reason for such conflicts may relate to model specifications in these studies. In most of the cases, it seems that in specifying these models, there was one common problem of omission of some key independent variables. Such a problem would likely result in a misspecified model. For example, the two most important variables, audit rate and penalty, were not included in the models by Clotfelter [1983], Poterba [1987], Feinstein [1991], and Joulfaian and Rider [1996]. While the audit rate was a key variable in the models by Dubin et al. [1987, 1990], Dubin and Wilde [1988], and Beron et al. [1988], these studies omitted both the marginal tax rate and penalty tax rate. Witte and Woodbury [1985] also omitted the marginal tax rate variable and Alm et al. [1993] omitted the penalty tax variable.

With econometric problems aside, limitations to empirical literature arose due to the lack of public accessibility to the rich sets of data collected as part of the TCMP and the inadequate attention that is paid to the publicly available data published in the *Annual Report of the Commissioner of Internal Revenue Service* [IRS, various]. TCMP data are

from detailed audits of a stratified random sample of taxpayers. A limitation of empirical literature also arose due to the cross-sectional nature of TCMP data. For example, as tax rates rise with the level of income, it would be difficult to untangle the influences of these two factors on compliance behavior from observations on a cross section of taxpayers.

Further limitation to empirical literature arises due to its inadequate analysis of the self-employed, the group that exhibits lower rates of voluntary compliance than taxpayers whose primary sources of income are wages and salaries. The importance in understanding the behavior of the self-employed cannot be overemphasized. As noted by the U.S. General Accounting Office (GAO) [1994]:

> "Sole proprietors have a disproportionate share of noncompliance. Although they accounted for an estimated 13 percent of individual taxpayers, sole proprietors accounted for an estimated 40 percent of underreported total income by individuals in the 1988 TCMP.... They also accounted for an estimated 36 percent of the $93 billion individual tax gap for 1992. Further, 1988 TCMP data showed that sole proprietors reported only 75 percent of their net business income while individuals reported almost 98 percent of nonbusiness total income."

In addition to this GAO report, Klepper and Nagin [1989], Feinstein [1991], and Erard [1992], among others, find that Schedule C and Schedule F filers are less compliant than other taxpayers. Not only are the sole proprietors significant contributors to noncompliance, their compliance pattern is also considerably different from that of wage earners, as found by Clotfelter [1983] and Joulfaian and Rider [1998], among others.

## Model Specification and Data

Theoretical analysis of the economics of tax compliance has been inadequate, at least until recently, and the existing empirical literature provides only limited insights concerning the likely effects of such policy changes on tax compliance. With econometric problems aside, the limitations of empirical literature arise, mainly due to:

1) its inadequate analysis of the self-employed, the group that not only contributes a disproportionate share of noncompliance [GAO, 1994], but also shows a compliance pattern that is considerably different from that of wage earners [Clotfelter, 1983; Joulfaian and Rider, 1998];
2) the lack of public accessibility to the rich sets of data collected as part of the TCMP; and
3) the inadequate attention that is paid to the publicly available data published in the *Annual Report of the Commissioner of Internal Revenue Service* [IRS, various].

The analysis in this paper is based on annual time series data for 1980 to 1995, reported in the *Annual Report of the Commissioner of Internal Revenue* [IRS, various] and the accompanying *Data Book* [IRS, various]. The report includes data on the number of returns filed, the number of returns examined, the total additional tax, the penalty recommended after examination, and budgets. Data are broken down by tax class: individual, corporate, estate, gift, and the like. The tax class of individual is further subdivided into categories of filers: 1040A, non-1040A, Schedule C, and Schedule F. For

each category of filers, data are broken down by class of reported income: less than $25,000, $25,000 to $50,000, and so on. Schedule C and Schedule F filers were chosen for analysis in this study. The sample entities are the classes of reported income for these Schedule C and Schedule F filers.

The basic theoretical model of compliance [Allingham and Sandmo, 1972; Srinivasan, 1973] is followed to specify the model for reported income. According to this theory, reported income is a function of actual income and the tax and enforcement structures. Specifically, reported income is a function of actual income, marginal tax rate, probability of detection, penalties for noncompliance, and other socioeconomic characteristics. Assuming that any realistically detectable noncompliance can be detected by the normal auditing procedure employed by the IRS, the audit rate is taken as a proxy for probability of detection. The model is an extension of this basic model by recognizing that probability of detection (audit rate) is endogenous and determined jointly by the taxpayer and the IRS. A reduced-form equation for the audit rate relating it to the (exogenous) determinants of the decision by the taxpayer and the IRS constitutes a part of the model for reported income. Several studies, such as Dubin and Wilde [1988] Beron et al. [1988], among others, have identified the resources of the IRS as major determinants for its auditing decision. Moreover, it is anticipated that the tax agency's audit rule in any year is a revision of the rule from the prior year. This suggests that a yearly trend variable would also be a major determinant for the auditing decision. Thus, the reduced-form equation for the audit rate takes the audit rate as a function of actual income, marginal tax rate, penalties for noncompliance, the IRS operating budget per return, year of audit, and socioeconomic characteristics of the taxpayer.

For the choice of functional forms for this model's equations (structural equation for reported income and reduced-form equation for audit rate), there is no theoretical guidance, so personal judgment must be made. It is often argued that simplicity is a virtue of model specification, thus resulting in possibly choosing the simplest functional form that is linear in the determining variables. However, some guidance can be derived from the findings in literature. Clotfelter [1983], Witte and Woodbury [1985], and Feinstein [1991], among others, found that the compliance (or noncompliance) decision behavior varies across income groups as well as across taxpayer classes such as Schedule C and Schedule F filers. This suggests that the relationship to reported income is likely to be nonlinear in income and that there may be some interactions of the variables, such as tax rate, penalty rate, and audit rate with income as well as with taxpayer classes. Considering such possibilities, the structural equation for reported income and the reduced-form equation for the audit rate are specified as:

$$\begin{aligned} REPORTED\ INCOME &= \beta_0 + \beta_1 SCHEDULE\ C \\ &+ \beta_2 ACTUAL\ INCOME + \beta_3 (ACTUAL\ INCOME)^2 \\ &+ \beta_4 AUDIT\ RATE + \beta_5 (AUDIT\ RATE)(ACTUAL\ INCOME) \\ &+ \beta_6 (AUDIT\ RATE)(SCHEDULE\ C) + \beta_7 TAX\ RATE \\ &+ \beta_8 (TAX\ RATE)(ACTUAL\ INCOME) + \beta_9 (TAX\ RATE)(SCHEDULE\ C) \\ &+ \beta_{10} PENALTY\ RATE + \beta_{11} (PENALTY\ RATE)(ACTUAL\ INCOME) \\ &+ \beta_{12} (PENALTY\ RATE)(SCHEDULE\ C) + \varepsilon_r \ , \end{aligned} \tag{1}$$

and

$$\begin{aligned} AUDIT\ RATE &= \delta_0 + \delta_1 SCHEDULE\ C \\ &+ \delta_2 ACTUAL\ INCOME + \delta_3 (ACTUAL\ INCOME)^2 \\ &+ \delta_4 TAX\ RATE + \delta_5 (TAX\ RATE)(ACTUAL\ INCOME) \\ &+ \delta_6 (TAX\ RATE)(SCHEDULE\ C) + \delta_7 PENALTY\ RATE \\ &+ \delta_8 (PENALTY\ RATE)(ACTUAL\ INCOME) \\ &+ \delta_9 (PENALTY\ RATE)(SCHEDULE\ C) \\ &+ \delta_{10} OPERATING\ COST\ PER\ RETURN \\ &+ \delta_{11} YEAR + \varepsilon_a \ , \end{aligned} \tag{2}$$

The Appendix lists the variables, their definitions, and summary statistics (in Table A1) and illustrates the data construction for some of these variables.

## Model Estimation and Analysis

Equation (1) is estimated by the ordinary least squares (OLS) as well as by the two-stage least squares (TSLS) method. These estimated equations for reported income, along with the estimated reduced-form in (2), are presented in Table 1. All of the equations are statistically significant. In particular, the estimated (OLS or TSLS) equation for reported income is highly significant (F-statistic with degrees of freedom = (12, 74) is larger than 4,845), with adjusted $R^2$ exceeding 0.99. Theoretically, perceived audit rates should be between zero and 100 percent. Interestingly, from this equation, predicted audit rates for the sample vary from 1.18 percent to 6.39 percent, which are well within the range of possible detection probabilities. In the following, the analysis and findings are based on the TSLS estimated equation explaining reported income.

The results show that income is a major determinant of reported income. The amount of income reported, at low levels of income, rises with a rise in income but at a decreasing rate, and it declines at higher levels of income. This may be interpreted to mean that compliance declines with a rise in income, that is, high-income taxpayers are likely to be less compliant than low-income taxpayers.

## TABLE 1
## Equations for Reported Income and Audit Rates

| Independent Variables | *REPORTED INCOME* (OLS Estimated) | | *REPORTED INCOME* (TSLS Estimated) | | *AUDIT RATE* (OLS Estimated) | |
|---|---|---|---|---|---|---|
| *SCHEDULE C* | -6,999.250 | (7,520.8; -0.93) | -408.440 | (9,854.00; -0.04) | -0.950 | (1.42; -0.67) |
| *ACTUAL INCOME* | 1.040* | (0.04; 26.07) | 1.090* | (0.066; 16.56) | 9.98E-06 | (7.44E-06; 1.34) |
| *ACTUAL INCOME*$^2$ | -5.12E-07* | (9.09E-08; -5.63) | -8.15E-07* | (1.66E-07; -4.91) | -1.78E-11 | (1.70E-11; -1.05) |
| *AUDIT RATE* | 2,489.540* | (930.62; 2.68) | 2,981.440 | (4,086.3; 0.73) | | |
| (*AUDIT RATE*) (*ACTUAL INCOME*) | 0.017* | (0.0032; 5.24) | 0.055* | (0.015; 3.71) | | |
| (*AUDIT RATE*) (*SCHEDULE C*) | -3,740.990* | (828.34; -4.52) | -9,797.930* | (2,768.32; -3.54) | | |
| *TAX RATE* | 6.240 | (144.38; 0.04) | 75.500 | (184.54; 0.41) | 0.0077 | (0.026; 0.29) |
| (*TAX RATE*) (*ACTUAL INCOME*) | -3.16E-04 | (5.35E-04; -0.59) | -0.0024** | (0.0011; -2.24) | 9.21E-08 | (9.44E-08; 0.97) |
| (*TAX RATE*) (*SCHEDULE C*) | 278.250** | (137.25; 2.03) | 446.730*** | (257.59; 1.73) | 0.033 | (0.024; 1.42) |
| *PENALTY RATE* | 43.230 | (140.42; 0.31) | 102.000 | (177.77; 0.57) | -0.011 | (0.030; -0.35) |
| (*PENALTY RATE*) (*ACTUAL INCOME*) | 9.40E-04 | (6.62E-04; 1.42) | 0.0013*** | (7.94E-04; 1.63) | -3.35E-08 | (1.30E-07; -0.26) |
| (*PENALTY RATE*) (*SCHEDULE C*) | -91.380 | (161.92; -0.56) | -133.618 | (257.37; -0.52) | 0.039 | (0.030; 1.32) |
| *OPERATING COST PER RETURN* | | | | | 0.140 | (0.086; 1.57) |
| *YEAR* | | | | | -0.280 | (0.19; -1.49) |
| Constant | -11,336.40 | (7,236.98; -1.57) | -16,266.70 | (9,380.95; -1.73) | 563.72 | (378.33; 1.49) |
| Sample Size | 87 | | 87 | | 87 | |
| F-statistic | 6,999.000 | | 4,846.000 | | 17.960 | |
| Adjusted $R^2$ | 0.9990 | | 0.9985 | | 0.6845 | |
| Standard Error of Estimate | 4,312.120 | | 5,181.370 | | 0.08057 | |

Notes: *, **, and *** denote significance at the 1, 5, and 10 percent significance levels, respectively. Standard errors and t-ratios are in parentheses.

The audit rate is found to be a significant deterrent to noncompliance. However, the effectiveness of this policy variable is dependent upon the class of the taxpayer—Schedule C or Schedule F filers—as well as the income level of the taxpayer. The significant negative coefficient for the interaction variable (*AUDIT RATE*)(*SCHEDULE C*) indicates that audit activity has a greater deterrent effect on Schedule F filers than on Schedule C filers. A significant positive coefficient for the interaction variable (*AUDIT RATE*)(*ACTUAL INCOME*) indicates that audit activity has a greater deterrent effect on high-income taxpayers than on low-income taxpayers.

The tax rate is found to be a significant determinant of compliance. However, the effect of this variable is dependent upon the taxpayer class—Schedule C or Schedule F filers—as well as the income level of the filer. A significant negative coefficient for the interaction variable (*TAX RATE*)(*ACTUAL INCOME*) along with a insignificant coefficient for *TAX RATE* suggests that higher tax rates discourage compliance, and the discouragement is more severe for high-income taxpayers. A significant (at the 10 percent significance level) positive coefficient for the interaction variable (*TAX RATE*)(*SCHEDULE C*) suggests that higher tax rates discourage compliance more for Schedule F filers than for Schedule C filers.

The coefficient of *PENALTY RATE* and that of the interaction variable (*PENALTY RATE*)(*SCHEDULE C*) are insignificant, but the coefficient of the interaction variable (*PENALTY RATE*)(*ACTUAL INCOME*) is significant (approximately at the 10 percent significance level) and positive. This suggests that the penalty rate is a significant factor for compliance. There is no significant difference in responsiveness between the Schedule C and Schedule F filers, but the effectiveness of this policy depends on the income level of the taxpayer. It seems the policy is more effective for high-income taxpayers than for low-income taxpayers.

To judge the relative strength of sensitivity of reported income to changes in the audit rate, penalty rate, and marginal tax rate, the elasticity of reported income is estimated with respect to the audit rate (*AUDIT RATE*), marginal tax rate (*TAX RATE*), and penalty rate (*PENALTY RATE*) (shown in Table 2). These elasticities were computed for taxpayers at the low and high level of income in 1995, the last year of the sample period, and for both Schedule C and Schedule F filers.

**TABLE 2**
**Elasticity of Reported Income: 1995**

| | Low Income | | High Income | |
|---|---|---|---|---|
| | Schedule C | Schedule F | Schedule C | Schedule F |
| *AUDIT RATE* | 7.3758 | 0.2417 | 0.1594 | 0.2438 |
| *TAX RATE* | -6.0317 | -0.0151 | -0.0411 | -0.0970 |
| *PENALTY RATE* | 0.0599 | 0.0910 | 0.0267 | 0.0338 |

As shown in Table 2, for all four groups, elasticity with respect to audit rate and penalty rate are positive and elasticity with respect to marginal tax rate is negative. This suggests that compliance can be increased by reducing the tax rate or by increasing the audit rate or penalty rate. For example, for the high-income Schedule F filer, an increase of 1 percent in the audit rate, a decrease of 1 percent in the tax rate, and an increase of 1 percent in the penalty rate from that in 1995 is estimated to result in an increase of .2438 percent, 0.0970 percent, and 0.0338 percent, respectively, in the reported income. Almost invariably, elasticity with respect to the audit rate was found to be the largest in magnitude and elasticity with respect to the penalty rate was the smallest. Thus, in terms of the effectiveness of policy to change the compliance, the instruments can be rank ordered as: audit rate, marginal tax rate, and penalty rate.

## Concluding Remarks

The basic contribution of this paper is to avoid some of the methodological shortcomings of previous studies in providing evidence on the determinants of compliance behavior for Schedule C and Schedule F filers, the groups that have a disproportionate share of noncompliance by analyzing publicly accessible annual time series data from the IRS. The major methodological shortcomings of previous studies were avoided by including the key independent variables: audit rate, tax rate, penalty rate, and taxpayer income level. Based on this analysis, the paper provides empirical evidence suggesting that taxpayer compliance is sensitive to the audit rate, marginal tax rate, and penalty rate and that the compliance behavior of the taxpayer varies across income levels as well as taxpayer class (Schedule C or Schedule F filer). In general, it is found that compliance increases with a decrease in the marginal tax rate and with an increase in the audit rate or penalty rate.

This study is one of the first that takes a focused look at the unique compliance behavior of self-employed taxpayers and, as such, provides a basis for additional research. For example, the present model (as most models) is not completely free of defects and may not describe compliance behavior adequately. One of the problems that arises is due to the difficulty in measuring some of these variables. In particular, there can be measurement error in estimating the actual income of the representative (average) taxpayer. As this is estimated from a sample of audited returns rather than from a random sample of returns and the audited returns are likely to have relatively more noncompliance, the estimated actual income for the representative (average) taxpayer is likely to be an overestimate. Fortunately, such overestimates (even though they can be related to audit rate levels) are systematic in nature and, thus hopefully, would not cause bias in the coefficient estimates. However, it is likely that compliance behavior is influenced by the opportunities to evade taxes, uncertainty of tax policy changes, demographic characteristics of the average taxpayer, complexity of tax filing, and numerous other factors. If these factors change throughout the years of the sample period, the model could be improved by the inclusion of these variables. Omission of these variables could cause the coefficient estimates to be biased. Thus, the conclusions reached

in this paper may not be reliable. However, the results do suggest that in formulating a policy to influence compliance, the audit rate, tax rate, and penalty rate should be considered as valid instruments.

## APPENDIX
## Variable Definitions

| Variables | Definitions |
|---|---|
| *REPORTED INCOME* | Reported income (real dollars) of an average taxpayer in a reported income class. This is taken to be the midpoint of the income class of the reported income deflated by the consumer price index (CPI) (base = 1983-84). |
| *SCHEDULE C* | This is 1 if the taxpayers in the reported income class are Schedule C filers, zero otherwise. |
| *ACTUAL INCOME* | Actual income (real dollars) of the average taxpayer in the reported income class. This is estimated from the information on reported income (which is the midpoint of the income class of the reported income), the average additional tax and penalty per audited return in that reported income class, the penalty schedule, and the tax schedule. |
| *AUDIT RATE* | Audit rate for the taxpayers in the reported income class. This is the percentage of returns audited. |
| *TAX RATE* | Marginal tax rate of the average taxpayer in the reported income class. This is derived from the information on reported income in nominal dollars and the tax schedule. |
| *PENALTY RATE* | Statutory rate of penalty applied to unreported taxes. This is derived from the information given in Sherman [1990]. |
| *OPERATING COST PER RETURN* | Operating budget (real dollars) of the IRS per return filed in the year. |
| *YEAR* | Year of the data. |

Illustrated here is the construction of the variables. *PENALTY RATE* denotes statutory rate of penalty applied to unreported taxes, *ACTUAL INCOME*, and *TAX RATE* denotes marginal tax rate for the average taxpayer in a reported income class. To construct

*PENALTY RATE*, note that major determinants of penalty are the ones arising from negligence (*NEGP*) and substantial understatement of taxes (*SUBP*) (see GAO [1991, p. 9]). These penalties were imposed with no regard to the taxpayer's income or filing class. The negligence penalty was imposed if there was "intentional disregard of the rules and regulations relating to taxation" [Sherman, 1990, p. 25]. The negligence penalty was 5 percent on the total understated tax for 1980 to 1989 and 20 percent on the targeted amount of the understated tax for 1990 to 1995 [Sherman, 1990, p. 29, Exhibit 1].[1] "Targeted" is interpreted as relating to the income that arose due to negligence. The substantial understatement penalty was zero percent for 1980 to 1982, 10 percent targeted for 1983 to 1986, 25 percent targeted for 1987 to 1989, and 20 percent targeted for 1990 to 1995 [Sherman, 1990, p. 29, Exhibit 1]. Moreover, a substantial understatement penalty was stacked onto the negligence penalty for 1980 to 1989. Thus, the total penalty rate (*PENALTY RATE*) was 5 percent for 1980 to 1982, 15 percent for 1983 to 1986, 30 percent for 1987 to 1989, and 20 percent for 1990 to 1995.[2]

To construct the variables, *ACTUAL INCOME* and *TAX RATE* (marginal tax rate for an average taxpayer), start with the assessment of additional tax and penalty (*ATAXPEN*) for this taxpayer. In the next step, extract the component of additional tax (*ATAX*) from *ATAXPEN* and determine the reported tax (*RTAX*) as tax due on the reported income (*RINC*) based on the tax rate schedule and apply the appropriate self-employment tax. *RINC* is the midpoint of the income class of the reported income. The total tax (*TTAX*) liability is then determined as *ATAX* + *RTAX*. In the final step, use the tax rate schedule and apply the appropriate self-employment tax to determine the actual income (*AINC*) to be the income that would be consistent with the tax liability of *TTAX*. At this final step, *TAX RATE* is determined as the total of the marginal rate in the tax rate schedule, and that in the self-employment tax table is applicable for the income, *AINC*. *ACTUAL INCOME* is the *AINC* deflated by the CPI.

*ATAXPEN* is taken to be the recommended additional tax and penalty per audited return for the reported income class and filing status (Schedule C or Schedule F) of the taxpayer. To extract the component of additional tax (*ATAX*) from *ATAXPEN*, note that a penalty arises mainly from negligence and substantial understatement of taxes (see GAO [1991, p. 9]) and that substantial understatement tax penalty was imposed "in situations in which the amount of the understatement, defined as the excess of the correct tax over the tax shown on the return, exceeded the greater of 10 percent of the correct tax or $5,000" [Sherman, 1990, p. 27]. Let *NEGP*, *SUBP*, and *OTHP* be the percentages[3] of *ATAX* that are assessed as penalty for negligence, substantial understatement of taxes, and other remaining reasons, respectively. *OTHP* is expected to be small and possibly negligible in almost all cases. It then follows that:

$$ATAX = ATAXPEN - NEGP * ATAX - SUBP * ATAX * D - OTHP * ATAX \quad , \quad \text{(A1)}$$

where $D = 1$ if $ATAX >$ max [5000, 10 percent of ($ATAX + RTAX$)], that is, if *ATAX*

> max (5000, *RTAX* / 9), *D* = 0 otherwise. Here, *RTAX* is the amount of tax due on the reported income, *RINC*. From (A1):

$$\begin{aligned} ATAX &= ATAXPEN / (1 + NEGP + OTHP) \\ &\quad \text{if } \max(5000, RTAX/9) \geq ATAX \\ &= ATAXPEN / (1 + NEGP + OTHP + SUBP) \\ &\quad \text{if } \max(5000, RTAX/9) < ATAX \quad . \end{aligned} \tag{A2}$$

Define $ATAXMAX = ATAXPEN / (1 + NEGP)$ to be the *ATAX* that would result if *SUBP* is not assessed and *OTHP* is negligible and $ATAXMIN = ATAXPEN / (1 + NEGP + SUBP)$ to be the *ATAX* that would result if both *NEGP* and *SUBP* are assessed and *OTHP* is negligible. Consider, then, the following three mutually exclusive and exhaustive possibilities:

$$\max(5000, RTAX/9) \geq ATAXMAX \quad , \tag{A3}$$

$$\max(5000, RTAX/9) < ATAXMIN \quad , \tag{A4}$$

and

$$ATAXMIN \leq \max(5000, RTAX/9) < ATAXMAX \quad . \tag{A5}$$

In the case of (A3), as $ATAX \leq ATAXMAX$, there must be $ATAX \leq$ max (5000, *RTAX* / 9), hence, *SUBP* would not be assessed. Therefore, assuming *OTHP* is negligible, *ATAX* would be *ATAXMAX*. In the case of (A4), assuming *OTHP* is negligible, $ATAX \geq ATAXMIN$ so that *ATAX* > max (5000, *RTAX* / 9), hence, *SUBP* would be assessed. Therefore, *ATAX* would be *ATAXMIN*. In the case of (A5), *SUBP* could not have been assessed because if it had been assessed, $ATAX \leq ATAXMIN \leq$ max (5000, *RTAX* / 9), which would contradict the condition that *ATAX* > max (5000, *RTAX* / 9). Thus, $ATAX \leq$ max (5000, *RTAX* / 9) < *ATAXMAX*. Also note that *OTHP* could not have been negligible because if it had been negligible, $ATAX = ATAXMAX$, which would contradict the finding that $ATAX \leq$ max (5000, *RTAX* / 9) < *ATAXMAX*. Note also that as $ATAX = TAXPEN / (1 + NEGP + OTHP)$, *ATAX* is a decreasing function of *OTHP*. Thus, as $ATAX \leq$ max (5000, *RTAX* / 9), there must be $OTHP \geq [(TAXPEN /$ max (5000, *RTAX* / 9)) - 1 - *NEGP*]. In general, as *OTHP* is expected to be small, set *OTHP* to its minimum possible value of [(*TAXPEN* / max (5000, *RTAX* / 9)) - 1 - *NEGP*] and obtain *ATAX* = max (5000, *RTAX* / 9). Thus, the following results:

$$ATAX = ATAXMAX, \text{ if } \max(5000, RTAX/9) \geq ATAXMAX \quad , \tag{A6}$$

$$ATAX = ATAXMIN, \text{ if } \max(5000, RTAX/9) < ATAXMIN \ , \tag{A7}$$

and

$$ATAX = \max(5000, RTAX/9) \text{ if } ATAXMIN \leq \max(5000, RTAX/9) < ATAXMAX \ . \tag{A8}$$

The following illustrates the computation of *ACTUAL INCOME* and *TAX RATE*. For this illustration, take the case of the average Schedule C filer in the reported income class of $100,000 and up in 1995. For this taxpayer, *ATAXPEN* was $16,166 (see *Data Book* [IRS, various]) and the reported income (*RINC*) was $483,920.[4] Assuming the status of the taxpayer to be single, *RTAX*, using the 1995 tax rate schedule and applying the appropriate self-employment tax, was found to be $188,249. Given that *ATAXPEN* = 16,166, *RINC* = 483,920, and *RTAX* = 188,249, then max (5000, RTAX/9) = 20,917. For this taxpayer, *NEGP* = 5 percent of *ATAX*, *SUBP* = 15 percent of *ATAX* so that *ATAXMIN* = 13,472, and *ATAXMAX* = 15,396, hence, max (5000, *RTAX*/9) > *ATAXMAX*, *ATAX* = 15,396, and *TTAX* = 203,645. Using the tax rate schedule and applying the appropriate self-employment tax, the actual income, *AINC*, for this taxpayer, which would be consistent with the tax liability of $203,645, was found to be $520,798. Deflating *AINC* by the CPI, *ACTUAL INCOME* was found to be $341,731. The marginal tax rate and the marginal self-employment tax rate were found to be 39.6 percent and 2.68 percent, respectively, hence, the *TAX RATE* was 42.28 percent.

**TABLE A1**
**Summary Statistics**

| Variable | Sample Size | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| *REPORTED INCOME* | 87 | 136,100 | 134,800 | 8,202 | 328,100 |
| *AUDIT RATE* | 87 | 2.83 | 1.43 | 0.91 | 7.12 |
| *SCHEDULE C* | 87 | 0.55 | 0.50 | 0.00 | 1.00 |
| *ACTUAL INCOME* | 87 | 150,700 | 145,100 | 15,300 | 389,900 |
| *TAX RATE* | 87 | 42.77 | 10.07 | 28.00 | 70.00 |
| *PENALTY RATE* | 87 | 17.24 | 7.99 | 5.00 | 30.00 |
| *OPERATION COST PER RETURN* | 87 | 31.89 | 10.05 | 18.02 | 48.30 |

## Footnotes

1. In Sherman [1990], the last column of Exhibit 1 is likely to be mislabeled and should be labeled as "1/1/90 to present." The negligence penalty for "1990 to present" was reported in the body of the paper as being 20 percent targeted [1990, p. 26]. This present paper takes this figure instead of 5 percent on total, as reported in Exhibit 1.
2. For 1990 to 1995, it is assumed that when the substantial understatement penalty was not stacked on the negligence penalty, the part of unreported tax that was not targeted under the negligence penalty was targeted under the substantial understatement penalty.
3. For all years through 1989, *NEGP* was 5 percent on *ATAX*, and it was changed to 20 percent on targeted *ATAX* for 1990 to 1995. It is assumed that 20 percent on targeted *ATAX* = 5 percent on *ATAX*. As the total penalty rate (negligence and substantial understatement penalty) for 1990 to 1995 was 20 percent on *ATAX*, it then follows that *SUBP* was 15 percent on *ATAX*, that is, *SUBP* of 20 percent on targeted = *SUBP* of 15 percent on *ATAX*.
4. Reported income for an average taxpayer in a reported income class is taken to be the midpoint of this class. However, for the reported income class of $100,000 and up, for which there is no upper limit, the midpoint is arbitrarily set at $250,000 in 1980 and is adjusted by (multiplying by) the growth rate of median income for the entire population for other years. Thus, for year *X*, reported income of the average taxpayer in this reported income class was $250,000 × (median income in year *X* / median income in 1980). For the median income for the entire population, see U.S. Department of Commerce [1996, p. 466].

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