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New and Current Evidence on Determinants of Aggregate Federal Personal Income Tax Evasion in the United States

By RICHARD J. CEBULA*

ABSTRACT. Using the most current data available, this study seeks to identify any new as well as traditional determinants of personal income tax evasion. A variety of empirical estimates find that income tax rates, the IRS audit rate and IRS penalty interest rates, and the unemployment rate all influence tax evasion. In addition, rarely investigated variables including the tax-free interest rate, the public's job approval rating of the president, and the public's dissatisfaction with government, along with previously unstudied variables, namely, the real interest rate yield on Moody's Baa-rated long-term corporate bonds and the real interest rate yield on three-year Treasury notes, also affect income tax evasion.

Introduction

Income tax evasion effectively consists of taxable income that is either unreported or underreported to the IRS; it also can consist of spurious or inflated tax deductions. Studies of income tax evasion behavior essentially fall into three categories. First, there are the principally theoretical models of tax evasion behavior, such as Allingham and Sandmo (1972), Falkinger (1988), Klepper, Nagin, and Spurr (1991), Das-Gupta (1994), Pestieau, Possen, and Slutsky (1994), Caballe and Panades (1997), and Gahramanov (2009). Second, there are a number of studies that either (a) use questionnaires or (b) undertake experiments, such as Spicer and Lundsted (1976), Spicer and Thomas (1982), Baldry (1987), Alm, Jackson, and McKee (1992), Thurman (1991), and Alm, McClelland, and Schulze (1999). Third, there are those studies that use what is referred to as "official data," such as Tanzi (1982, 1983), Clotfelter (1983), Carson (1984), Long and Gwartney (1987),

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Pyle (1989), Feinstein (1991), Erard and Feinstein (1994), Feige (1994), Cebula (2001, 2004), Ali, Cecil, and Knoblett (2001), Ledbetter (2004, 2007), Cebula and Coombs (2009), and Alm and Yunus (2009).

In this literature, it is widely believed that the degree of federal personal income tax evasion in the economy as a whole is positively affected by income tax rates (Tanzi 1982; Clotfelter 1983; Feige 1994). This perspective is simple: the higher the income tax rate, the greater the benefit (in terms of a reduced tax liability) from not reporting taxable income, *ceteris paribus*. It is also widely accepted that the *greater* the risk associated with underreporting or not reporting taxable income, the *less* the degree to which economic agents will choose either to not report or to underreport their taxable income (Alm, Jackson, and McKee 1992; Erard and Feinstein 1994; Cebula and Coombs 2009).

This study seeks to add to this rich literature by empirically investigating determinants of aggregate federal personal income tax evasion in the United States using the *most current data available*. To date, the empirical literature has effectively failed to investigate determinants of aggregate personal income tax evasion in the United States for recent years; indeed, except for a *single* somewhat narrowly focused study that investigated tax evasion and government-spending-induced budget deficits through the year 2001 (Cebula and Coombs 2009), the most recent year considered in the tax evasion determinants literature is in fact 1997 (Cebula 2004, 2008; Ali, Cecil, and Knoblett 2001; Alm and Yunus 2009). However, the IRS (2010) has very recently released new time-series data on tax evasion running through the year 2005. Using these new data derived by the IRS (2010), the present study seeks to identify key *personal* income tax evasion determinants in the United States through the year 2005. Aside from investigating the most commonly recognized factors that allegedly influence tax evasion, such as a measure of income tax rates and the IRS audit rate and the IRS penalty interest rate levels, the unemployment rate, and the Tax Reform Act of 1986, a variety of other potential influences on income tax evasion is investigated. These include rarely investigated variables (in the tax evasion literature) such as the tax-free interest rate yield, the public's job approval rating of the president, and the public's dissatisfaction with government *per se*, along with *previously*

unstudied variables, namely, the real interest rate yield on Moody's Baa-rated long-term corporate bonds and the real interest rate yield on three-year Treasury notes. The latter two of these explanatory variables have never before been considered in a time-series analysis involving tax evasion. The basic framework for the empirical analysis is presented in the next section of this study. The formal empirical analysis is provided in the subsequent section of the study. Finally, the closing section provides an overview of the study findings, an interpretation of the results, and certain policy implications thereof.

Basic Framework for the Analysis

In this study, the *relative* probability that the *representative* economic agent will *not* report his/her taxable income to the IRS is treated as positively impacted by (an increasing function of) the expected gross benefits to the agent of not reporting income, *eb*, and as negatively impacted by (a decreasing function of) the expected gross costs to the agent of not reporting income, *ec*. Thus, the ratio of the probability of not reporting income to the IRS, *pnr*, to the probability of reporting income to the IRS, $(1-pnr)$, is described for the representative economic agent by:

$$pnr/(1-pnr) = f(eb, ec), f_{eb} > 0, f_{ec} < 0 \quad (1)$$

Expressing probabilities in *relative* terms such as shown in Equation (1) possesses the virtue that it thereby reflects the form of the available tax evasion data, i.e., data where (as described below) the aggregate degree of federal personal income tax evasion is expressed in relative terms (IRS 2010). This model of tax evasion behavior expands that developed by Cebula and Coombs (2009).

As already observed, the gross expected benefits from *not* reporting income to the IRS are hypothesized to be directly related to the federal personal income tax rate (Cagan 1958; Bawley 1982; Tanzi 1982; Clotfelter 1983; Pyle 1989; Feige 1994). To reflect the federal personal income tax rate, most previous studies using official data for the United States have adopted either of two alternative measures: an average effective federal personal income tax rate (*AEPT*) or the maximum marginal federal personal income tax rate (*MAXT*). In this

study, the *MAXT* measure of the income tax rate is adopted because, as argued in Cebula (2004), Connelly (2004), and Gahramanov (2009), this tax rate is likely to be a more representative measure of the overall degree of progressivity of the personal income tax rate schedule than *AEPT* would be. Accordingly, it is hypothesized, *ceteris paribus*, that:

$$eb = g(\text{MAXT}), g_{\text{MAXT}} > 0 \quad (2)$$

Next, this study endeavors to allow for the potential impact of *legal tax avoidance* on *illegal tax evasion*. To do this, we test the hypothesis by Cebula (2004: 419) that “the higher the tax-free interest rate yield on high grade municipal bonds [*TF*] relative to the taxable interest rate yield on . . . high quality [taxable] bonds or notes such as ten year U.S. Treasury notes [*TEN*], the greater the incentive to engage in legal tax avoidance and the lower the incentive to engage in tax evasion.” Thus, it is expected in the present study that the greater the *TF/TEN* ratio, the lower the aggregate degree of federal personal income tax evasion, *ceteris paribus*. Hence, Equation (2) is now rewritten as:

$$eb = b(\text{MAXT}, \text{TF}/\text{TEN}), b_{\text{MAXT}} > 0, b_{\text{TF}/\text{TEN}} < 0 \quad (3)$$

The Tax Reform Act of 1986 (*TRA*) may have been perceived by at least some portion of the general public as an honest, good-faith effort to reform, that is, to simplify and increase the equity of the Internal Revenue Code. As Musgrave observed (1987: 59): “The Tax Reform Act of 1986 is the most sweeping reform since the early 1940s. . . .” Indeed, the *TRA* did introduce a number of reforms, many of which are outlined in broad terms in Ott and Vegari (2003), Barth (1991), and Sanger, Sirmans, and Turnbull (1990). For example, as observed in Ott and Vegari (2003: 279): “The Act introduced major cuts in the personal tax rate. When fully effective (by January 1, 1988), only two tax brackets, set at 15 and 28 percent, were to replace the 14 bracket tax schedule with rates in the range of 11 to 50 percent . . . while it broadened the tax base by reducing the itemized deduction.” Musgrave (1987: 59) further observes that prior to the *TRA*, a slow erosion of the income tax base had been occurring. Musgrave (1987: 57) was particularly dismayed by the widening of tax loopholes and the emergence of high income tax shelters that had “gained momentum in recent years and undermined the public’s faith in the

income tax.” In this vein, Barth (1991) and Sanger, Sirmans, and Turnbull (1990) describe how the *TRA* decreased depreciation benefits from financial investments in residential as well as commercial real estate, established limitations on the tax deductibility of losses from “passive” investments that affected limited partnerships syndications (including those involving real estate ventures), and terminated favorable capital gains treatment of real estate. Musgrave (1987: 59) also expressed concern that the “compounding of the investment tax credit and accelerated depreciation diluted and distorted the base of the corporate income tax.” Musgrave (1987: 59) asserted that the *TRA* “reversed these trends, a major accomplishment that all reformers will welcome.” Interestingly, Ott and Vegari (2003: 279) observe that, among other things, under the *TRA* “the 10 percent investment tax credit for the purchase of equipment was repealed, and the life of the investment was increased for depreciation purposes.” Based on Musgrave’s (1987) arguments, then, it is expected in the present study that taxpayers might well have favorably regarded the *TRA* and been less resentful of the Internal Revenue Code than before, at least initially. Thus, it is hypothesized here that during the time frame when the *TRA* was enacted and became fully effective (1986–1987) and also received the greatest publicity, reduced taxpayer resentment of the federal income tax system/Internal Revenue Code would, at least temporarily, have resulted in a reduced degree of tax evasion, *ceteris paribus*. The reason this reaction to the *TRA* might be only *temporary* is revealed in the words of Slemrod (1992: 45), who argues that it would take at least some time for taxpayers “to learn about and adjust to the new law [the *TRA*].” Consequently, it is hypothesized here that, for the period when the *TRA* was first implemented, October 1986, through the period when the *TRA* became “fully effective,” January 1, 1987, the aggregate degree of federal personal income tax evasion was reduced. Accordingly, Equation (3) above is replaced by Equation (4):

$$eb = j(MAXT, TF/TEN, TRA), j_{MAXT} > 0, j_{TF/TEN} < 0, j_{TRA} < 0 \quad (4)$$

Next, based on Alm and Yunus (2009), Gahramanov (2009), and Cebula and Coombs (2009), it is expected that the higher the unemployment rate (*UN*), the greater the expected benefits of personal income tax evasion, *ceteris paribus*. This is based on the reasoning

that the higher the unemployment rate, the greater the extent to which the unemployed work in the “underground economy” and hence do not report income. Furthermore, this effect may be reinforced to the extent that a higher unemployment creates an incentive even for still-employed people to avoid taxes to the degree that they try to covet extra funds (by underreporting income) in *anticipation* of a *possible future* lay-off (Alm and Yunus 2009; Gahramanov 2009; Cebula and Coombs 2009). As a result, Equation (4) is expanded to Equation (5):

$$eb = j(\text{MAXT}, \text{TF}/\text{TEN}, \text{TRA}, \text{UN}), \quad j_{\text{MAXT}} > 0, \quad j_{\text{TF}/\text{TEN}} < 0, \quad (5)$$

$$j_{\text{TRA}} < 0, \quad j_{\text{UN}} > 0$$

Finally, there is the issue of the public’s job approval rating of the president (*APPROV*). Following the study of the period *prior to 1998* by Cebula (2008), it is argued here that the higher the public’s job approval rating of the president’s performance in office, the greater the degree to which there is satisfaction with the president’s actions and policies. The latter can be interpreted, at least to some degree, as implying less public resentment towards or greater approval of his various spending and/or tax policies (as well, perhaps, as his other policies). Similarly, the lower the public’s job approval rating of the president, the greater the degree to which the public is likely to be dissatisfied with the president’s actions and policies. In turn, it can be reasonably argued that the latter can be interpreted, to at least some extent, as implying greater resentment of or less public support of his various spending and/or tax policies (as well, perhaps, as his other policies). Stated somewhat differently, the lower the level of *APPROV*, the greater the *subjective benefits* (“secondary gain”) from personal income tax evasion, whereas the higher the level of *APPROV* the lower the *subjective benefits* (secondary gain) of personal income tax evasion. Based on this symmetrical argument, it is hypothesized that the greater the public’s job approval rating of the president, the lower the *eb* and hence the lower the aggregate degree of personal income taxation, *ceteris paribus*. Accordingly, Equation (5) is transformed into Equation (6), as follows:

$$eb = j(\text{MAXT}, \text{TF}/\text{TEN}, \text{TRA}, \text{UN}, \text{APPROV}), \quad (6)$$

$$j_{\text{MAXT}} > 0, \quad j_{\text{TF}/\text{TEN}} < 0, \quad j_{\text{TRA}} < 0, \quad j_{\text{UN}} > 0, \quad j_{\text{APPROV}} < 0$$

The expected gross costs of not reporting income to the IRS are hypothesized to be an increasing function of the expected risks/costs thereof (Alm, Jackson, and McKee 1992; Pestieau, Possen, and Slutsky 1994; Erard and Feinstein 1994; Caballe and Panades 1997; Alm and Yunus 2009; Cebula and Coombs 2009). In this study, to the representative economic agent, the expected risks/costs from not reporting or from underreporting taxable income to the IRS are enhanced by an increase in *AUDIT*, the percentage of filed federal personal income tax returns that is formally audited by IRS examiners, *ceteris paribus*. Indeed, the experience of an IRS tax audit could imply nonpecuniary (“psychic”) costs as well as pecuniary costs (including outlays for legal or other representation, along with the value of one’s own lost time) above and beyond any potential added taxes, penalties, and interest assessed by the IRS. In addition to *AUDIT*, it is hypothesized that the expected risks/costs of tax evasion also include the magnitude of the IRS-imposed penalties [*PENALTY*] should one’s tax evasion activities be successfully detected by the IRS. To reflect this penalty, this study adopts the average interest rate charged by the IRS in each year on detected unreported income. Clearly, the greater the value of *PENALTY*, *ceteris paribus*, the greater the *ec* and hence the lower the degree of aggregate personal income taxation that is expected. Thus, we have:

$$ec = j(AUDIT, PENALTY), j_{AUDIT} > 0, j_{PENALTY} < 0 \quad (7)$$

Substituting from Equations (6) and (7) into Equation (1) yields:

$$pnr/(1 - pnr) = b(MAXT, TF/TEN, TRA, UN, APPROV, AUDIT, PENALTY), b_{MAXT} > 0, b_{TF/TEN} < 0, b_{TRA} < 0, b_{UN} > 0, b_{APPROV} < 0, b_{AUDIT} < 0, b_{PENALTY} < 0 \quad (8)$$

Let *AGI* represent the *actual total value of the aggregate federal adjusted gross income* in the economy, that is, $AGI = UAGI + RAGI$, where *UAGI* is the dollar size of the *unreported aggregate federal adjusted gross income* in the economy, and *RAGI* is the dollar size of the *reported aggregate federal adjusted gross income* in the economy. It reasonably follows overall that:

$$UAGI = (pnr) * AGI \quad (9)$$

and

$$RAGI = (1 - pnr) * AGI \quad (10)$$

It then follows that:

$$UAGI/RAGI = (pnr) * AGI / (1 - pnr) * AGI = (pnr) / (1 - pnr) \quad (11)$$

From Equations (8) and (11), substitution for $pnr / (1 - pnr)$ yields the following model of aggregate personal income tax evasion:

$$UAGI/RAGI = b(MAXT, TF/TEN, TRA, UN, APPROV, AUDIT, PENALTY), b_{MAXT} > 0, b_{TF/TEN} < 0, b_{TRA} < 0, b_{UN} > 0, b_{APPROV} < 0, b_{AUDIT} < 0, b_{PENALTY} < 0 \quad (12)$$

Empirical Analysis

This section of the study provides the empirical findings. It is divided into two subsections. In the first subsection, the basic model is estimated and analyzed. The model is estimated in linear form and then, as tests of consistency and robustness, semi-log and log-log estimates are also provided. In the subsequent subsection, the model is expanded with two additional variables, one very rarely considered and the other entirely ignored, in the tax evasion literature to date. In addition, the estimates in this case (the second subsection) are two-stage least squares. It is noted here that an interpretation of the specific estimation results is to be provided both in the first subsection and, from a different perspective, namely, a policy perspective, in the Conclusion.

Estimates of the Basic Model

Based on the framework provided in Equation (12) above, the following reduced-form equation is to be estimated *initially*:

$$(UAGI/RAGI)_t = a_0 + a_1 MAXT_{t-1} + a_2 (TF/TEN)_{t-1} + a_3 TRA_t + a_4 UN_{t-1} + a_5 APPROV_{t-1} + a_6 AUDIT_{t-1} + a_7 PENALTY_{t-1} + u \quad (13)$$

where:

$(UAGI/RAGI)_t$ = the ratio of the aggregate *unreported* federal adjusted gross income in year t to the aggregate *reported* federal adjusted gross income in year t, expressed as a percent;

a_0 = constant term;

$MAXT_{t-1}$ = the maximum federal personal income tax rate in year $t-1$, expressed as a percent;

$(TF/TEN)_{t-1}$ = the ratio for year $t-1$ of the average annual tax-free interest rate yield on high-grade municipal bonds to the average annual taxable interest rate yield on 10-year U.S. Treasury notes, expressed as a percent;

TRA_t = a binary (dummy) variable for the years 1986 through 1987, when the Tax Reform Act of 1986 was initially implemented and became effective: $TRA_t = 1$ for the years 1986 and 1987, and $TRA_t = 0$ otherwise;

UN_{t-1} = the average percentage unemployment rate of the civilian labor force in year $t-1$;

$APPROV_{t-1}$ = the public's average job approval rating of the president in year $t-1$: values for $APPROV_{t-1}$ lie between 0 and 100;

$AUDIT_{t-1}$ = the percentage of filed federal personal income tax returns in year $t-1$ that was subjected to a formal IRS audit involving IRS examiners;

$PENALTY_{t-1}$ = the average percentage interest rate used by the IRS in year $t-1$ to assess interest penalties on detected unreported income; and

u = stochastic error term.

The study period runs from 1976 through 2005. The choice of the year 1976 reflects the limited availability of dependable IRS penalty data; the choice of the year 2005 reflects the most recent availability of the official (*UAGI/RAGD*) data. The data are all annual. The (*UAGI/RAGD*) data were obtained from the IRS (2010: Table 6). The data for the variable *MAXT* were obtained from the IRS (2009: Table 1). The *AUDIT* data were obtained from the Government Accounting Office (1996: Table I.1), and the U.S. Census Bureau (1994: Table 519, 1998: Table 550, 1999: Table 556, 2001: Table 546, 2009: Table 469), and the *PENALTY* data were obtained from the IRS (1976–2009). The *TRA* variable is a dummy variable. The data for the variables *TF/TEN* and *UN* were obtained from the Council of Economic Advisors (2010: Tables B-73, B-35). The data for the variable *APPROV* were obtained from the Gallup Poll (2009). The mean value for variable

(*UAGI/RAGI*) for the study period was 13.42, with a standard deviation of 1.69.

The tax evasion estimates (the estimates of the ratio of the aggregate *unreported* federal adjusted gross income in year *t* to the aggregate *reported* federal adjusted gross income in year *t*) were generated by the IRS using the “AGI-gap approach.” Simply put, this technique for estimating the degree of aggregate federal personal income tax evasion compares the total adjusted gross income (AGI) estimated from the National Income and Product Accounts (NIPA) with the total adjusted gross income reported on tax returns submitted to the IRS (IRS 2010: Table 6). The difference between these two estimates is referred to as the “AGI gap”; the latter effectively represents the aggregate degree to which taxpayers as a whole underreport their adjusted gross income (Ledbetter 2007: 35). Thus, the IRS personal income tax evasion estimates do *not* depend upon any of the variables expressed in the model.

The (*P-P*) Phillips-Perron and *ADF* (Augmented Dickey-Fuller) unit root tests indicate that the variable *MAXT* is stationary in only first differences, whereas the variable *PENALTY* is stationary only in second differences over the study period. Furthermore, the variables *UN*, *TF/TEN*, and *APPROV* are stationary in levels, and the variables (*UAGI/RAGI*) and *AUDIT* are stationary in levels with a trend variable. Accordingly, in the estimations, the variable *PENALTY* is expressed in second differences, and the variable *MAXT* is expressed in first differences. In addition, a linear trend variable (*TREND*) is included in the analysis.

The OLS (ordinary least squares) estimation of Equation (13), adopting the Newey-West heteroskedasticity correction, is given by:

$$\begin{aligned}
 (UAGI/RAGI)_t = & 28.44 + 0.083 \Delta MAXT_{t-1} - 8.97 (TF/TEN)_{t-1} - 0.81 TRA_t \\
 & \quad (+3.11) \quad \quad \quad (-2.52) \quad \quad \quad (-1.86) \\
 & + 1.252 UN_{t-1} + 0.25 TREND - 0.306 APPROV_{t-1} - 1.88 AUDIT_{t-1} \\
 & (+6.66) \quad (+4.28) \quad \quad (-8.92) \quad \quad \quad (-3.83) \quad \quad (14) \\
 & - 0.215 \Delta \Delta PENALTY_{t-1} \\
 & (-2.75)
 \end{aligned}$$

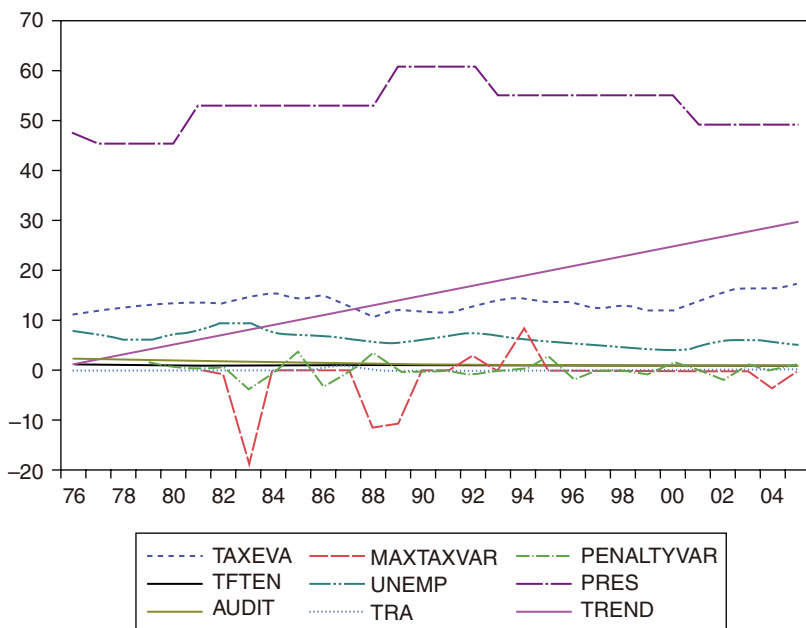
$$R^2 = 0.90, adjR^2 = 0.87, F = 22.52, DW = 1.89, Rbo = 0.05$$

where terms in parentheses are *t*-values, Δ is the first-differences operator, and $\Delta\Delta$ is the second-differences operator.

In Equation (14), the estimated coefficients on all seven of the explanatory variables exhibit the hypothesized signs, with five being statistically significant at the 1 percent level, one being statistically significant at the 2.5 percent level, and one being statistically significant at the 10 percent level. The coefficient of determination is 0.90 and the adjusted coefficient of determination is 0.87, so that the model explains roughly nine-tenths of the variation in the dependent (tax evasion) variable. The F-statistic is significant at the 1 percent level, attesting to the overall strength of the estimate. Finally, there should be no concern regarding autocorrelation. For the interested reader, a plot of the variables in Equation (14), including the *personal* income tax evasion variable, is provided in Figure 1.

Figure 1

Plot of Variables in Basic Model



The estimated coefficient on the $\Delta MAXT$ variable is positive and statistically significant at beyond the 1 percent level. Thus, the higher the maximum marginal federal personal income tax rate, the greater the degree of federal income tax evasion by households, presumably because a higher income tax rate increases the incentive to evade taxes. This finding is consistent in principle with the conventional wisdom and with several previous empirical studies (Tanzi 1982; Clotfelter 1983; Feige 1994; Alm and Yunus 2009; Cebula and Coombs 2009). The estimated coefficient on the TF/TEN variable is negative and statistically significant at the 2.5 percent level, affirming the hypothesis in Cebula (2004) that this form of *legal tax avoidance* acts to reduce the degree of *illegal tax evasion*. The estimated coefficient on the Tax Reform Act of 1986 dummy variable (TRA) is negative, as hypothesized (Musgrave 1987), and statistically significant at the 8 percent level, providing evidence, albeit modest, that taxpayers may have regarded the Tax Reform Act of 1986 as a genuine, honest effort to reform the inequities of and diminish the complexities (compliance costs) of the existing Internal Revenue Code. Alternatively, as implied by Slemrod (1992: 45), the observed drop in personal federal income tax evasion for this brief period may simply have reflected the time frame required by taxpayers to learn about and adjust to this allegedly “sweepingly reformed” (Musgrave 1987) new version of the Internal Revenue Code. The estimated coefficient on the unemployment rate variable (UN) is positive, as hypothesized, and statistically significant at the 1 percent level. This finding is consistent with the hypothesis that the higher the unemployment rate, the greater the degree to which households enter the underground economy (Alm and Yunus 2009; Gahramanov 2009; Cebula and Coombs 2009). The variable $TREND$ is positive and statistically significant, as one would expect in view of the results of the P - P and ADF tests. Next, there is the issue involving the presidential job approval rating: “Does a lower (higher) job approval rating of the president by the U.S. public act to increase (decrease) the degree of aggregate federal personal income tax evasion?” As shown in Equation (14), the estimated coefficient on variable $APPROV$ is negative (as hypothesized) and statistically significant at the 1 percent level. Thus, this finding in

Equation (14) provides empirical support for this hypothesis (Cebula 2008).

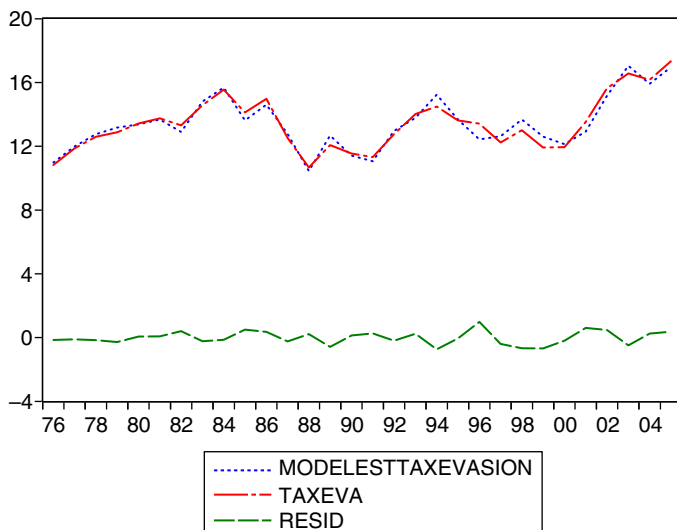
The estimated coefficients on the variables *AUDIT* and *PENALTY* are both negative (as hypothesized); furthermore, the coefficients on the *AUDIT* and *PENALTY* variables are both statistically significant at the 1 percent level. These results are consistent with other studies for the United States, including the recent analyses by Cebula and Coombs (2009) and Alm and Yunus (2009). In any case, these two findings combined would suggest that taxpayers are *discouraged* from tax evasion behavior by increased prospects of detection (as represented by variable *AUDIT*) on the one hand *and* that they are *dissuaded* from engaging in income tax evasion by higher interest rate penalties imposed by the IRS when such *personal* income tax evasion behavior is in fact detected (as reflected in the variable *PENALTY*).

For the interested reader, a plot of the actual IRS estimates of unreported AGI as a percent of reported AGI, the estimates of unreported AGI as a percent of reported AGI obtained from the model in this study, and the residuals is provided in Figure 2. As shown in Figure 2, the residuals are modest in size, reflecting the finding that the actual IRS estimate of unreported income is very close to the estimate based on the model.

In addition, a plot of IRS *estimated revenue losses* from *personal* income tax evasion versus the estimates of IRS *estimated revenue losses* from *personal* income tax evasion as obtained from the model in this study are provided in Figure 3 (in billions of *current* dollars). Clearly, the predicted lost tax revenues from *personal* income tax evasion obtained from the model are very close in magnitude to those derived by the IRS (2010: Table 6, 2005: Table 7). Moreover, as shown in Figure 3, we observe that the trend in these revenues lost to the IRS is upwards, that is, is increasing over time. Furthermore, as shown in Figure 4, even after adjusting for inflation, there is an upward trend over time to these lost revenues even when converted to constant (year 2000) dollars. Also evident from Figure 4, the predicted lost *real* tax revenues from *personal* income tax evasion obtained from the model are very close in magnitude to those derived by the IRS. In any event, before proceeding to the specific empirical results, it is perhaps noteworthy to stress here that

Figure 2

Plot of Actual IRS Estimates of Unreported AGI (*TAXEVA*), Model Estimates of Unreported AGI (*MODELESTTAXEVASION*), and Residuals (*RESID*)

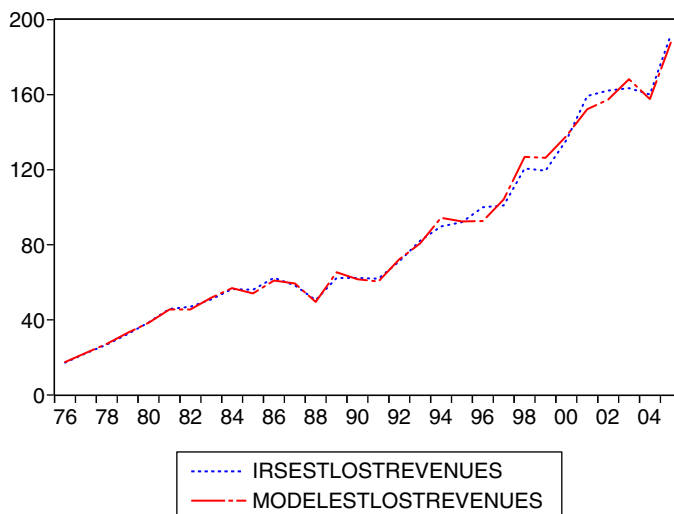


corporate evasion of federal income taxation and IRS revenue losses resulting from same are excluded from the present study; the focus here in other words is solely on *personal* income tax evasion. Although corporate evasion of federal income taxation is excluded from this study, it is noted that researchers have found this category of income tax evasion to be widespread and substantial (Kamdar 1997; Joulfaian 2000; Burman 2003).

In order to test the robustness and consistency of the model in Equation (13), the model is now estimated in both semi-log form and then in log-log form. The results of the semi-log estimates are shown in columns (a) and (b) of Table 1. In column (a) of Table 1, the estimate of Equation (13) in semi-log form is presented, whereas in column (b) the estimate of Equation (13) in semi-log form, with the statistically insignificant *TRA* variable *omitted*, is provided. In column (a) of Table 2, the estimate of Equation (13) in log-log form is provided, while in

Figure 3

IRS Estimates of *Lost Tax Revenue* (*IRSESTLOSTREVENUES*) Versus
Model Estimates of Lost Tax Revenue (*MODELESTLOSTREVENUES*)

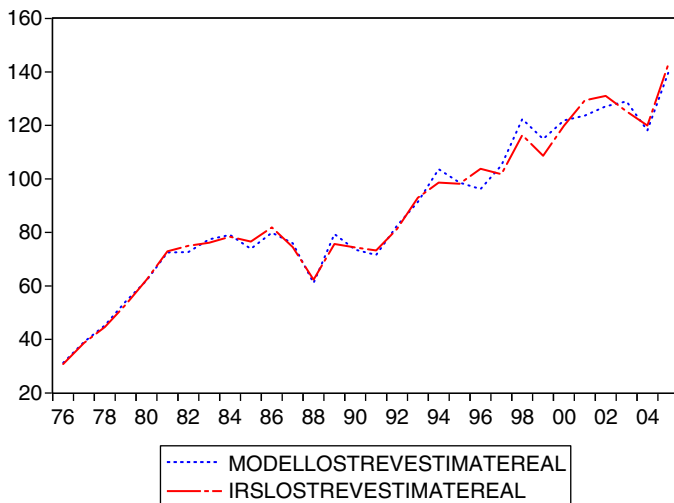


column (b) of Table 2 the log-log estimation is provided with the once-again statistically insignificant *TRA* variable *omitted*.

In Table 1, the coefficients on the *MAXT* variable in columns (a) and (b) are both positive and statistically significant at the 1 percent level, implying that tax evasion is an increasing function of the maximum marginal personal income tax rate. The coefficients on the (*TF/TEN*) variable are negative, as expected, and statistically significant at the 2.5 percent level in one case (column (a)) and at the 1 percent level in the second case (column (b), where the *TRA* variable is omitted), implying that the greater the ratio of the tax-free interest rate yield to the taxable interest rate yield, the less the aggregate degree of personal income tax evasion. In column (a), the *TRA* variable is actually positive, although not statistically significant. The coefficients on the *UN* variable in columns (a) and (b) both are positive, as expected, and statistically significant at the 1 percent level, implying that personal income tax evasion is an increasing function of the

Figure 4

IRS Estimates of *Real Lost Tax Revenue* (*IRSLISTREVESTIMATEREAL*)
 y Versus Model Estimates of *Real Lost Tax Revenue*
 (*MODELLOSTREVESTIMATEREAL*)



unemployment rate. The coefficients on variable *APPROV* in columns (a) and (b) of Table 1 both are negative and statistically significant at the 1 percent level, implying that tax evasion is a decreasing function of the presidential approval rating. In addition, in columns (a) and (b), the coefficients on both the *AUDIT* and *PENALTY* variables are all negative and statistically significant at the 1 percent level. The latter findings imply that tax evasion is a decreasing function of both the IRS audit rate and the IRS penalty interest rate assessment on detected unreported income. The R^2 is 0.88 in both estimates, whereas the adjusted R^2 is 0.83 in column (a) and 0.84 in column (b), so that this log-log model explains approximately five-sixths of the variation in the dependent variable. Once again, the F-statistic in both estimates is statistically significant at beyond the 1 percent level.

In the log-log estimates shown in Table 2, the estimated values are actually elasticities rather than coefficients *per se*. Aside from the case of the *TRA* variable, the elasticities shown in Table 2 all exhibit the

Table 1
Semi-Log Estimates: $\text{Log}(UAGI/RAGI)$

Variable\Estimation	(a)	(b)
Constant	3.767	3.846
$\Delta MAXT_{t-1}$	0.0063*** (3.37)	0.0056*** (4.85)
$(TF/TEN)_{t-1}$	-0.761** (-2.65)	-0.906*** (-3.03)
TRA_t	-0.048 (-1.57)	—
UN_{t-1}	0.094*** (6.89)	0.099*** (7.36)
$TREND$	0.019*** (4.68)	0.022*** (5.45)
$APPROV_{t-1}$	-0.022*** (-9.50)	-0.023*** (-9.43)
$AUDIT_{t-1}$	-0.138*** (-3.61)	-0.142*** (-3.52)
$\Delta \Delta PENALTY_{t-1}$	-0.017*** (-2.87)	-0.016*** (-2.94)
R^2	0.88	0.88
$AdjR^2$	0.83	0.84
F	17.3***	20.27***
DW	2.06	2.10
Rho	-0.03	-0.05

***Indicates statistically significant at the 1 percent level; **indicates statistically significant at the 2.5 percent level; and *indicates statistically significant at the 5 percent level.

expected signs and all (with one exception) are statistically significant at the 1 percent level. In this set of estimates, as in Table 1 and in Equation (14), only the TRA variable fails to yield a statistically significant (at the generally more acceptable 5 percent level) outcome; hence, it is omitted from the remainder of the estimates. In any case, based on the other results in this table, aggregate income tax evasion

Table 2

Log-Log Estimates: *Log (UAGI/RAGI)*

Variable\Estimation	(a)	(b)
Constant	2.82	2.75
<i>Log MAXT</i> _{<i>t</i>-1}	0.115*** (3.09)	0.127*** (2.89)
<i>Log (TF/TEN)</i> _{<i>t</i>-1}	-0.89*** (-2.72)	-0.79*** (-3.17)
<i>TRA</i> _{<i>t</i>}	0.043 (0.97)	—
<i>Log UN</i> _{<i>t</i>-1}	0.746*** (6.40)	0.72*** (8.39)
<i>TREND</i>	0.021*** (4.04)	0.02*** (5.16)
<i>Log APPROV</i> _{<i>t</i>-1}	-0.57*** (-4.81)	-0.547*** (-4.33)
<i>Log AUDIT</i> _{<i>t</i>-1}	-0.206*** (-4.57)	-0.20*** (-5.06)
<i>Log PENALTY</i> _{<i>t</i>-1}	-0.233*** (-2.91)	-0.218*** (-2.98)
<i>R</i> ²	0.91	0.91
<i>AdjR</i> ²	0.87	0.87
<i>F</i>	51.74***	51.21***
<i>DW</i>	2.07	1.96
<i>Rbo</i>	-0.04	0.02

***Indicates statistically significant at the 1 percent level; **indicates statistically significant at the 2.5 percent level; and *indicates statistically significant at the 5 percent level.

is an increasing function of the maximum marginal personal income tax rate and the civilian unemployment rate, while being a decreasing function of the ratio of the tax-free interest rate yield to the taxable interest rate yield and the presidential approval rating. Finally, the results in Table 2 also imply that income tax evasion is a decreasing function of both the IRS audit rate and the IRS penalty interest rate

assessment on detected unreported income. All of these results are consistent with the findings in Equation (14) and in Table 1, attesting to the overall strength and consistency of the basic model. The R^2 is 0.91, whereas the adjusted R^2 is 0.87, so that this log-log model explains roughly nine-tenths of the variation in the dependent variable. Once again, the F-statistic is statistically significant at beyond the 1 percent level.

Arguably, to the extent that log-log estimation results (since they deal in comparisons involving percentage changes) may be more easily explained both to policymakers and to the general public than either linear or semi-log estimation results (Murray 2006), an interpretation of the elasticities provided in Table 2 would seem reasonable and appropriate. Moreover, given that the R^2 and adjusted R^2 values, as well as the F-statistics, are higher in the log-log estimations than in the linear and semi-log estimations, it seems all the more reasonable to use the results in Table 2 to elaborate on the size of the impacts of each of the explanatory variables on income tax evasion.

Focusing for simplicity of exposition on column (b) of Table 2, a 1 percent increase in the maximum marginal federal personal income tax rate would be expected to elevate aggregate personal income tax evasion by roughly 0.127 percent. A 1 percent increase in the ratio of the tax-free interest rate yield to the taxable 10-year Treasury note yield would reduce tax evasion by about 0.79 percent. A 1 percent increase in the unemployment rate would elicit a 0.72 percent increase in tax evasion. A 1 percent rise in the presidential approval rating would be expected to reduce tax evasion by about 0.55 percent. Next, a 1 percent rise in the formal audit rate of filed personal income tax returns by IRS examiners would act to reduce tax evasion by about 0.2 percent; this finding confirms claims to this effect by Burman (2003). Finally, a 1 percent increase in the IRS penalty interest rate assessment on detected unreported income would be expected to reduce aggregate personal income tax evasion by roughly 0.22 percent. Thus, there appears to be strong evidence that, over the study period, increased IRS audit rates and penalty interest rate assessments could have effectively increased federal personal income tax compliance (reduced personal income tax evasion).

Additional Estimates and Variables

In this subsection of the study, in order to further test the robustness of the model and analysis and to extend the model, two additional variables to the basic model are considered. The first of these variables has been entirely overlooked in the existing published literature on income tax evasion in the United States. The second variable has received very little attention in the literature.

The first extension is to introduce into the model a measure of the *real rate of interest*, to be used as a measure of the opportunity cost of tax compliance. In the interest of thoroughness, two alternative real interest rates are considered. The first of these is the *ex post real* interest rate yield on Moody's Baa-rated long-term corporate bonds, *RBaa*, where *RBaa* is the nominal average interest rate yield on Moody's long-term corporate bonds in a given year *minus* the actual inflation rate during that year (Council of Economic Advisors 2010: Tables B-73, B-64). This is a variable altogether overlooked in previous related empirical studies. It is argued here that the higher the *RBaa*, the greater the expected benefits (*eb*) from engaging in income tax evasion since the dollars gained from that tax evasion can be invested in higher yielding securities (even after having adjusted for inflation). Alternatively stated, the higher the level of *RBaa*, the greater the *opportunity costs of tax compliance*. Accordingly, it is hypothesized that the higher the *RBaa*, the higher the *eb* associated with income tax evasion and hence the higher the aggregate degree of federal personal income taxation, *ceteris paribus*.

As an *alternative* to *RBaa*, this study examines the adoption of the *ex post real* average annual interest rate yield on three-year U.S. Treasury notes, *RTHREE*. Paralleling the computation of *RBaa*, *RTHREE* equals the nominal interest rate yield on three-year Treasury notes in a given year *minus* the actual inflation rate in that year (Council of Economic Advisors 2010: Tables B-73, B-64). Consideration of this *alternative measure of the opportunity cost of tax compliance* is a reflection of the fact that the ratings assigned by ratings agencies have become suspect in recent years. For example, Liebowitz (2009), Barth (2009), and others have questioned the dependability of bond ratings and related activities by Moody's, Standard and Poor's,

and Fitch, arguing in part that these rating agencies incorrectly rated (overrated) many financial instruments and companies, particularly in the period leading up to and during the financial crisis of recent years. In any case, the higher the level of *RTHREE*, the greater the opportunity costs of tax compliance and thus the greater the degree of personal income tax evasion, *ceteris paribus*.

In seeking to explain aggregate federal personal income tax evasion for the heretofore unstudied period for the United States running through 2005, the second extension of the model introduces the variable *DIS*. The variable *DIS* is the so-called public dissatisfaction with government index (University of Michigan Institute for Social Research 2007). This variable measures (a) the degree to which the public distrusts public officials (other than the president) to fulfill their job obligations; (b) the degree to which the public regards government officials as dishonest; and (c) the degree to which the public believes that government officials waste tax dollars. The value of the index ranges from -1.5 to $+1.5$, with a higher index value signifying a greater degree of dissatisfaction with government. Interestingly, as observed in Cebula (2008), the variables *DIS* and *APPROV* are almost entirely unrelated statistically; indeed, they have a correlation coefficient of only $+0.139$. In any event, the impact of this variable on tax evasion has been studied only twice before (Feige 1994; Cebula 2001). Following Feige (1994) and Cebula (2001), it can be argued that the greater the public's dissatisfaction with government, the greater the *secondary gain* from not reporting or from underreporting taxable income, *ceteris paribus*. Accordingly, since a higher level of *DIS* implies a higher level of *eb* (through these secondary gains), it is hypothesized that the aggregate degree of federal personal income taxation is positively impacted by *DIS*, *ceteris paribus*.

The equations to be estimated are now given by the following:

$$\begin{aligned} (UAGI/RAGI)_t = & a_0 + a_1 MAXT_{t-1} + a_2 (TF/TEN)_{t-1} + a_3 TRA_t \\ & + a_4 UN_{t-1} + a_5 APPROV_{t-1} + a_6 AUDIT_{t-1} \\ & + a_7 PENALTY_{t-1} + a_8 RBaa_{t-1} + a_9 DIS_t + u \end{aligned} \quad (15)$$

$$\begin{aligned} (UAGI/RAGI)_t = & a_0 + a_1 MAXT_{t-1} + a_2 (TF/TEN)_{t-1} + a_3 TRA_t \\ & + a_4 UN_{t-1} + a_5 APPROV_{t-1} + a_6 AUDIT_{t-1} \\ & + a_7 PENALTY_{t-1} + a_8 RTHREE_{t-1} + a_9 DIS_t + u \end{aligned} \quad (16)$$

where:

$RBaa_{t-1}$ = the *ex post* real average interest rate yield on Moody's long-term corporate bonds in year $t-1$, expressed as a percentage;
 $RTHREE_{t-1}$ = the *ex post* real average interest rate yield on three-year U.S. Treasury notes in the year $t-1$, expressed as a percentage; and
 DIS_t = the public dissatisfaction with government index in year t .

Observe that the variable DIS is un-lagged. This reflects the finding in Cebula (2001), albeit for the earlier period 1973–1997, that the decision as to whether or not to evade taxes was contemporaneous with the public's dissatisfaction with government. Furthermore, as in the earlier period studied by Cebula (2001), the *P-P* and *ADF* tests both reveal that the variable DIS is stationary only in first differences; therefore, DIS must be expressed only in first-differences form in any estimation, that is, in the form ΔDIS . Similarly, the *P-P* and *ADF* tests reveal that both real interest rates are stationary only in first differences; hence, both $RBaa$ and $RTHREE$ are expressed in first-differences forms in these TSLS estimates, as $\Delta RBaa$ and $\Delta RTHREE$, respectively.

Given that the variables $(UAGI/RAGD)_t$ and DIS_t are contemporaneous, the possibility of simultaneity bias exists. This was verified using the Hausman (1982) specification test. Accordingly, the models in Equations (15) and (16) are estimated by TSLS (two-stage least squares), with the instrumental variable being the two-year lag of the average effective federal personal income tax rate, ATR_{t-2} . The choice of this instrument is based on two findings: (1) that variables ATR_{t-2} and ΔDIS_t are highly correlated and (2) that the instrument is not correlated with the error terms in the system.

The TSLS estimates of Equations (15) and (16) are provided in columns (a) and (b), respectively, of Table 3. In the estimate in column (a), all eight of the coefficients on the explanatory variables exhibit the expected signs. Of these eight "correctly signed" estimated coefficients, five are statistically significant at the 1 percent level, two are statistically significant at the 2.5 percent level [(TF/TEN) and ΔDIS], and one is statistically significant at the 5 percent level [$\Delta RBaal$]. The F-statistic in this TSLS estimate is statistically significant at the 1 percent level, attesting once again to the overall strength of

Table 3
Two-Stage Least Squares Estimates: (*UAGI/RAGI*)

Variable\ Estimation	(a)	(b)
Constant	33.69	33.96
$\Delta MAXT_{t-1}$	0.071** (2.57)	0.071*** (2.89)
$(TF/TEN)_{t-1}$	-15.96*** (-4.77)	-15.6*** (-5.34)
UN_{t-1}	1.34*** (9.12)	1.35*** (10.55)
<i>TREND</i>	0.35*** (7.43)	0.344*** (9.60)
$APPROV_{t-1}$	-0.327*** (-10.92)	-0.334*** (-12.58)
$AUDIT_{t-1}$	-1.95** (-2.47)	-2.08*** (-2.93)
$\Delta PENALTY_{t-1}$	-0.269*** (-4.82)	-0.327*** (-5.17)
$\Delta RBaa_{t-1}$	0.225* (2.25)	—
$\Delta RTHREE_{t-1}$	— (2.92)	0.24***
ΔDIS_t	1.96** (2.58)	1.76*** (2.78)
<i>F</i>	20.35***	25.57***
<i>DW</i>	2.04	2.02
<i>Rbo</i>	-0.02	-0.01

***Indicates statistically significant at the 1 percent level; **indicates statistically significant at the 2.5 percent level; and *indicates statistically significant at the 5 percent level.

the model. Overall, except for the *RTHREE* and *DIS* variables (which are not included in the earlier estimates in this study), the results in column (a) are entirely compatible with their counterparts in Equation (14) and in Tables 1 and 2. Thus, as in these other estimates, the TSLS

results in column (a) of Table 3 imply that personal income tax evasion is an increasing function of $\Delta MAXT$ and UN and a decreasing function of (TF/TEN) , $APPROV$, $AUDIT$, and $\Delta\Delta PENALTY$. In addition to these findings, the results in column (a) of Table 3 imply that income tax evasion is an increasing function of both the *ex post* real interest rate, $\Delta RBaa$, and the public's dissatisfaction with government *per se*, namely, ΔDIS . Thus, a higher real interest rate yield on Moody's Baa-rated corporate bonds can be expected to reduce tax compliance (increase tax evasion), whereas an increase in the public's dissatisfaction with government (other than the president) can also be expected to reduce tax compliance (increase tax evasion).

In the estimate in column (b) of Table 3, all eight of the coefficients on the explanatory variables exhibit the expected signs and are statistically significant at the 1 percent level. The F-statistic in this TOLS estimate is statistically significant at the 1 percent level, attesting yet again to the overall strength of the model. Once again, except for the $RTHREE$ and DIS variables (which are not included in the earlier estimates in this study), the results in column (a) are entirely compatible with their counterparts in Equation (14) and Tables 1 and 2. Thus, as in these other estimates, the TOLS results in column (b) imply that income tax evasion is an increasing function of $\Delta MAXT$ and UN and a decreasing function of (TF/TEN) , $APPROV$, $AUDIT$, and $\Delta\Delta PENALTY$. In addition to these findings, the results in column (b) imply that personal income tax evasion is an increasing function of both the *ex post* real interest rate, $\Delta RTHREE$, and the variable reflecting the public's dissatisfaction with government *per se*, namely, ΔDIS . Thus, a higher real interest rate yield on three-year Treasury notes can be expected to increase tax evasion, whereas an increase in the public's dissatisfaction with government (other than the president) can also be expected to increase tax evasion.

Based on the findings summarized in Table 3, it appears that the aggregate degree of federal personal income tax evasion, ($UAGI/RAGI$), is *directly impacted* by the variables $\Delta MAXT$, UN , $\Delta RBaa$, $\Delta RTHREE$, and ΔDIS , while being negatively impacted by the variables (TF/TEN) , $APPROV$, $AUDIT$, and $\Delta\Delta PENALTY$. The variables $RTHREE$ and $RBaa$ have not previously been investigated in aggregate

time-series studies of personal income tax evasion in the United States, whereas the variable *APPROV* has been previously studied only once (Cebula 2008) and the variable ΔDIS has previously been studied only twice (Feige 1994; Cebula 2001). In any event, the empirical results in Table 3 further affirm the robustness and consistency of the basic model examined in this study.

Conclusion and Policy Implications

This study has used OLS and TSLS estimations to identify key determinants of aggregate federal personal income tax evasion in the United States for the period 1976–2005. Only one related study has appeared that investigates beyond the year 1997, and that more narrowly focused study (Cebula and Coombs 2009) runs only through the year 2001 and uses a non-IRS dataset (Ledbetter 2004).

The empirical estimates provided in the present study indicate that the aggregate degree of federal personal income tax evasion, (*UAGI/RAGI*), is *directly impacted* by the maximum marginal federal personal income tax rate ($\Delta MAXT$), the unemployment rate (*UN*), the *real* interest rate yield (represented as either the real annual average interest rate yield on Moody's Baa-rated long-term corporate bonds, $\Delta RBaa$, or the real annual average interest rate yield on three-year Treasury notes, $\Delta RTHREE$), and the public's dissatisfaction with government, other than the president, (ΔDIS). Aggregate personal federal income tax evasion also is *negatively impacted* by the variables (*TF/TEN*), the ratio of the tax-free interest rate yield on high-grade municipals to the taxable interest rate yield on 10-year Treasury notes, *APPROV*, the public's job approval rating of the president *per se* (that is, as opposed to government in general), the IRS audit rate on filed federal personal income tax returns, *AUDIT*, and $\Delta \Delta PENALTY$, the interest rate penalty imposed by the IRS on detected unreported income.

Interestingly, *none* of these factors has been investigated to date for the years 2002–2005, the most recent years for which the IRS has developed its newest estimates of household (personal) income tax evasion. Furthermore, this is the only study to date to investigate the impact of the real interest rate on personal income tax evasion.

Moreover, only one previous study has investigated the tax evasion impact of the presidential approval rating (Cebula 2008), whereas only two previous studies have considered the tax evasion impact of the index of the public's dissatisfaction with government other than the president (Feige 1994; Cebula 2001).

So why does personal income tax evasion matter? According to Burman (2003), personal income tax evasion undermines the tax system in several ways. On the one hand, it is patently unfair because "unless caught, cheaters pay less taxes . . ." than law-abiding citizens (Burman 2003: 2). Arguably, it ultimately also means higher taxes will be imposed on law-abiding citizens and/or lower levels of government services will be provided and/or larger federal budget deficits and a larger national debt will result (Burman 2003: 2, 6). Indeed, to the extent that budget deficits are elevated, there is evidence that long-term interest rates may be forced upwards and private investment may be crowded out (Burman 2003: 3; Carlson and Spencer 1975; Cebula 1978).

Given that income tax evasion *does* matter, what are some of the policy implications of our results? To answer this question, it is useful to review some of the empirical results from this empirical study. As observed, the results obtained in the study that can perhaps be most easily interpreted for and explained to policymakers and the public are those yielded by the log-log estimates found in Table 2. As summarized above, those basic findings include the following: (a) a 1 percent increase in the maximum marginal federal personal income tax rate would be expected to elevate aggregate personal income tax evasion by roughly 0.127 percent; (b) a 1 percent increase in the unemployment rate would elicit a 0.72 percent increase in tax evasion; (c) a 1 percent increase in the *formal* audit rate of filed personal income tax returns *by IRS examiners* would act to reduce tax evasion by about 0.2 percent; and (d) a 1 percent increase in the IRS penalty interest rate assessment on detected unreported income would be expected to reduce aggregate personal income tax evasion by roughly 0.22 percent.

Clearly, to the extent that economic policy can promote real economic growth and a reduction in the unemployment rate, obviously there is evidence that this will do much to raise tax compliance and

hence IRS revenues. However, it appears that policymakers should be circumspect about elevating the maximum marginal tax rate since such a policy does elevate tax evasion, and according to Burman (2003: 2), this is especially true of the highest income segment of our society. Furthermore, such tax increases may also act to reduce “fiscal freedom” and thereby to reduce economic growth (Heckelman and Stroup 2000; Nelson and Singh 1998).

Moreover, based on the empirical findings provided in this study, there appears to be strong evidence that increased IRS audit rates and penalty interest rate assessments could effectively increase federal personal income tax compliance. This finding is consistent in varying degrees with both recent and less recent studies of earlier time periods in the United States (Alm and Yunus 2009; Burman 2003; Cebula 2008; Cebula and Coombs 2009; Clotfelter 1983; Connelly 2004; Feige 1994; Feinstein 1991; Long and Gwartney 1987; Thurman 1991). Thus, it would seem that increasing the IRS audit rate and the IRS penalty interest rate assessment would be viable policies for reducing the “tax gap.” Indeed, it is claimed by Burman (2003: 2) that if the IRS could successfully close *half* the tax gap through such policies, “we could [among other things] . . . cut [personal] income tax rates by 10 percent.”

The potential benefits of these policies notwithstanding, it must also remain clear to policymakers that there is “a risk that compliance activity could go too far” (Burman 2003: 3). Indeed, although it lies beyond the scope of this study, there clearly could well exist, for any given set of circumstances, an “optimum” IRS audit rate and an “optimum” penalty interest rate assessment. Future related research might well endeavor to develop a paradigm that identifies the nature and dimensions of such an optimum.

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