An Empirical Analysis of Determinants of Recent Federal Personal Income Tax Evasion in the U.S.

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1 February 2010

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Abstract -- Unaccounted for currency in the U.S. has been argued to reflect the presence of widespread income tax evasion. In turn, income tax evasion is especially problematic in this era of large government budget deficits and growing national debts which have led to debt crises. This empirical study seeks to identify determinants of recent federal personal income tax evasion in the U.S. using the most recent tax evasion data available, data that run through 2008 and are derived from the General Currency Ratio Model and measured in the form of the ratio of unreported AGI (adjusted gross income) to reported AGI. The empirical estimates find that personal income tax evasion is an increasing function of the maximum marginal federal personal income tax rate, the interest rate yield on three year Treasury notes, per capita real income, and a dummy variable for the years in which the second war in Iraq was conducted, while being a decreasing function of the Tax Reform Act of 1986, the ratio of the tax free interest rate yield on high grade municipals to the taxable interest rate yield on ten year Treasury notes, the audit rate by IRS (Internal Revenue Service) personnel, and the average IRS penalty on detected unreported income. Thus, among other things, this study finds that more aggressive IRS policies are effective tools in the war against personal income tax evasion.

Keywords -- Income tax evasion; income tax rates; audit rates; tax evasion penalties

J.E.L. classification code -- G18, G28, H26

1. -- *Introduction*

U.S. households and firms admit to holding only about 15% of the total known stock of U.S. currency outside the banking system. It is suspected that much of this disparity between the actual size of the stock of currency in the U.S. and the accounted for (admitted to) holdings of U.S. currency is attributable to its usage in transactions that are not reported to the IRS, the Internal Revenue Service [Feige, 2009], the IRS. In other words, unaccounted for currency in the U.S. is argued to reflect the presence of widespread income tax evasion. In this era of widespread large government budget deficits and growing national debts, such tax evasion is especially problematic for government policymakers seeking to avert debt crises.

Indeed, income tax evasion would seem to be of increasing importance in this period of government financial crises and rising government deficits and outstanding debt across many parts of the globe. Income tax evasion estimates are available for a number of nations, although all such estimates are admittedly only approximations. That said, according to Christie -- Holzner [2006], income tax evasion/income tax compliance is not modest; nor is it uniform across nations. As

shown in Table 1, the percentage degree of income tax *compliance* among major Western economies ranges from an estimated low of 62.49% for Italy to an estimated high of 84% for the U.S. Of course, the estimated percentage degree of income tax *evasion* therefore ranges widely: 39.51% in Italy to 16% in the U.S. Thus, in this age of financially jeopardized national governments (such as Greece, most obviously, as well as Ireland, Spain, Portugal, and other nations but even including--at some level--the U.K. and U.S., the latter of which whose debt credit ratings have been lowered), income tax evasion may have risen as a greater national and international economic problem than it has at any time since the Great Depression. This is all the more the case in view of the fact that so many nations are raising income taxes or planning to do so. In this category is Greece (which has also committed to cracking down on tax evaders) as well as the U.S. and U.K.

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 or exemptions. 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 -- Sandmo [1972], Falkinger [1988], Klepper -- Nagin -- Spurr [1991], Das-Gupta [1994], Pestieau – Possen -- Slutsky [1994], and Caballe -- Panades [1997]. Second, there are a number of studies that either (a) use questionnaires or (b) undertake experiments, such as Spicer -- Lundstedt [1976], Spicer -- Thomas [1982], Baldry [1987], Alm – Jackson -- McGee [1992], Thurman [1991], and Alm – McClelland -- Schulze [1999]. These studies are of course empirical in nature, deriving the data largely [if not entirely] from the experiments. Certain of these studies indicate an aversion to the prospect of being audited while others reveal a lack of such risk-averse behavior; still others imply that taxpayers may be averse to tax evasion on moral grounds. Additionally, the incentive to try to evade taxation by underreporting income provided by higher marginal income tax rates is also revealed in a number of these studies. Third, there are those studies that largely or in some cases exclusively adopt what is referred to as "official data," i.e., data obtained from the IRS (Internal Revenue Service) or its counterpart outside of the U.S. and/or some other "official," i.e., government source. Among the types of information thusly obtained and analyzed are data on income tax evasion, income tax rates, and audit rates. Such studies endeavor typically either to estimate the aggregate degree of tax evasion or to identify the determinants thereof [Tanzi, 1983; Clotfelter, 1983; Carson, 1984; Long -- Gwartney, 1987; Pyle, 1989; Feinstein, 1991; Erard -- Feinstein, 1994; Feige, 1989, 1994, 1996; Cebula, 2001, 2004; Ali – Cecil -- Knoblett, 2001; Ledbetter, 2004; Alm -- Yunus, 2009; Cebula -- Coombs, 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 higher income tax rates [Tanzi, 1982; Clotfelter, 1983; Feige, 1994]. Interestingly, Yaniv [1994] characterizes Clotfelter [1983] as "the most relevant study" with respect to the impact of income tax rates on tax evasion, whereas Cox [1984] questions his findings. In any event, 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 [Friedland, 1982; Spicer – Thomas, 1985; De Juan, 1989; Errard – Feinstein, 1994].

This study adds to the rich literature on income tax evasion by seeking to identify key determinants of federal personal income tax evasion using data on the latter that run from the year

1970 through the year 2008. In general, earlier studies of aggregate federal personal income tax evasion determinants in the U.S. do not go beyond the year 1997. Thus, by investigating tax evasion through 2008, the study period is more current than the existing published literature. Moreover, unlike previous studies of tax evasion in the U.S., this study also introduces a measure of the opportunity cost of tax compliance. The model is presented in Section 2. Naturally, a variety of potential income-tax-evasion influencing factors are included in the model. Section 3 provides the initial formal empirical analysis, whereas Section 4 provides an extension of the basic model and additional empirical estimates. A summary along with overview observations are found in the conclusion (Section 5).

2. *The Model*

In this study, the *relative* probability that the *representative* economic agent will *not* report his/her taxable income to the IRS is treated as an increasing function of the expected gross benefits to the agent of not reporting income, *eb*, and as 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:

$$pnr/(1\text{-}pnr] = f(eb, ec), f_{eb} > 0, f_{ec} < 0 \qquad [1]$$

Expressing probabilities in *relative* terms such as shown in equation [1] possesses the virtue that it thereby reflects the form of the tax evasion data, i.e., data where [as described below in Section 3] the aggregate degree of federal personal income tax evasion is expressed in such relative terms.

As already observed, the gross expected benefits from *not* reporting income to the IRS are hypothesized to be an increasing function of the federal personal income tax rate [Tanzi, 1982; Clotfelter, 1983; Feige, 1994]. To reflect the federal personal income tax rate, this study adopts the maximum marginal federal personal income tax rate (*MAXT*). This measure of the income tax rate is adopted because it can be argued that it not only is an actual income tax rate but also to some degree reflects the extent to which income tax rates are progressive. Accordingly, it is hypothesized, *ceteris paribus*, that:

$$eb = j(MAXT), j_{MAXT} > 0 \qquad [2]$$

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, i.e., to simplify and increase the equity of the Internal Revenue Code. As Musgrave observed [1987, p. 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 Barth [1991], Barth -- Brumbaugh [1992], Ott -- Vegari [2003], and Sanger -- Sirmans, -- Turnbull [1990]. For example, as observed in Ott and Vegari [2003, p. 279], "The Act introduced major cuts in the personal tax rate. When fully effective in 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...it broadened the tax base by reducing the

itemized deduction." Musgrave [1987, p. 59] further observes that prior to the *TRA*, a slow erosion of the income tax base had been occurring. Musgrave [1987, p. 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. "

Musgrave [1987, p. 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, p. 59] asserted that the *TRA* "…reversed these trends, a major accomplishment that all reformers will welcome." As Barth [1991, pp. 45, 124] observes, 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, as well as findings for an earlier study period in Cebula – Coombs -- Yang [2009], 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 at the time the *TRA* was being enacted and becoming effective, 1986-1987, and also received the greatest publicity, reduced taxpayer resentment of the federal income tax system/Internal Revenue Code *would/could*, at least *temporarily*, have resulted in a reduced degree of aggregate personal income tax evasion, *ceteris paribus*. The reason this reaction to the *TRA* might be only *temporary* is also revealed in the study by Cebula –Coombs -- Yang [2009], who argue that it would likely take at least some time for taxpayers to adequately understand and make adjustments to the newly revised Internal Revenue Code. Consequently, it is hypothesized here that, for the period when the *TRA* was initially implemented, 1986, through the year the *TRA* became "*de facto* fully effective," 1987 [Barth, 1991; Barth -- Brumbaugh, 1992], the *eb* was reduced. Accordingly, [2] above is replaced by [3]:

$$eb = j(MAXT, TRA),\ j_{MAXT} > 0,\ j_{TRA} < 0 \qquad [3]$$

Next, following Cebula [2004], it can be argued that the greater the ratio of *tax free* interest rate yields on high grade municipals relative to *taxable* interest rate yields such as that on federally taxable ten-year U.S. Treasury notes, *TFTEN*, the greater the benefits of *tax avoidance,* which is legal, and hence the less the expected benefits of *tax evasion*, which of course is illegal. Thus, [3] is replaced by [4] as follows:

$$eb = j(MAXT, TRA, TFTEN),\ j_{MAXT} > 0,\ j_{TRA} < 0,\ j_{TFTEN} < 0 \qquad [4]$$

Next, the higher the interest rate yield on bonds in the marketplace, the greater the *opportunity cost of tax compliance*. Alternatively stated, the higher the interest rate yield on say, 3-year Treasury notes (*THREE*), the greater the benefits that could be derived from investing funds not reported to the IRS Hence, *eb* is hypothesized to be an increasing function of *THREE*, so that:

$$eb = j(MAXT, TRA, TFTEN, THREE),\ j_{MAXT} > 0,\ j_{TRA} < 0,\ j_{TFTEN} < 0,\ j_{THREE} > 0 \qquad [5]$$

This introduction of a variable to expressly represent the opportunity cost of tax compliance from the expected benefits side of the tax evasion decision calculus is unique to tax evasion studies using official data for the U.S.

Following Feige [1994] and others, it can be argued that the greater the public's dissatisfaction with government (*DIS*), the greater the secondary gain from not reporting or from under-reporting taxable income, *ceteris paribus*. The variable *DIS* is the so-called public dissatisfaction with government index, based on survey questions from the University of Michigan Institute for Social Research [2009]. This variable measures: (a) the degree to which the public distrusts public officials (other than the U.S. 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. With the expected benefits ("secondary gain") from tax evasion being an increasing function of *DIS*, equation [5] now is transformed into:

$$eb = j(MAXT, TRA, TFTEN, THREE, DIS),\ j_{MAXT} > 0,\ j_{TRA} < 0,\ j_{TFTEN} < 0,\ j_{THREE} > 0,\ j_{DIS} > 0 \quad [6]$$

Furthermore, a number of studies of income tax evasion have either concluded or at least implied that empirical studies of aggregate income tax evasion should include one or more control variables to reflect the potential impact of unpopular public policies on income tax evasion [Musgrave, 1987; Feinstein, 1991; Feige, 1994; Cebula, 2004; Saltz, 2001]. Stated somewhat differently, the expected benefits of personal income tax evasion can sometimes be found to reflect the public's response to certain government policies that are *negatively perceived*. For example, when the U.S. is engaged in a war [military conflict], especially an unpopular war, some portion of the public may express its disapproval in part by increasing the degree of its personal income tax evasion [Cook -- Issa, 2007]. In point of fact, earlier studies [Feige, 1994; Cebula, 2001; Saltz, 2001] have found that the U.S. public increased its aggregate degree of personal income tax evasion in response to the involvement in the Vietnam War, which was a very unpopular and controversial war. Similarly, the U.S. War in Iraq ("Operation Iraqi Freedom," also known as the "Second Gulf War"), which began in March of 2003 has been found to be an unpopular war [Cook -- Issa, 2007]. Accordingly, it is hypothesized that the expected benefits of personal income tax evasion would be higher during the period beginning with 2003. To reflect this war, a binary (dummy) variable, *GULFWAR2*, is introduced, assuming a value of 1 for the years of U.S. involvement in the Iraq War. It is expected that this "control variable" will reflect an increased expected benefit, albeit a secondary gain, from personal income tax evasion and hence increased tax evasion for the years of the Iraq War that fall within our study period, *ceteris paribus*. By contrast, over the period of this study, an earlier *de facto* war in Iraq, occurring in 1991, one which was brief, multi-national, and relatively very low in terms of U.S. casualties and pecuniary costs. This war was found not to be unpopular among most of the U.S. populace [Cook -- Issa, 2007] and hence is ignored here. In other words, it is hypothesized here that little to no tax evasion reaction to this earlier war with Iraq should be expected. To reflect the effects of the second Gulf War, then, equation [6] becomes:

$$eb = j(MAXT, TRA, TFTEN, THREE, DIS, GULFWAR2),\ j_{MAXT} > 0,\ j_{TRA} < 0,\ j_{TFTEN} < 0,\ j_{THREE} > 0,\ j_{DIS} > 0,\ j_{GULFWAR2} > 0 \quad [7]$$

The expected gross costs of not reporting income to the IRS are hypothesized to be an increasing function of the expected risks/costs thereof [Pestieau, -- Possen -- Slutsky, 1994; Erard --

Feinstein, 1994; Caballe -- Panades, 1997]. In this study, two variables reflect these risks/costs. First, to the representative economic agent, the expected risks/costs from not reporting or from underreporting taxable income to the IRS are hypothesized to be increased by an increase in *AUDIT*, the percentage of filed federal personal income tax returns that is *formally audited* by IRS examiners/personnel, *ceteris paribus*. Indeed, the experience of an IRS tax audit could imply non-pecuniary ("psychic") costs as well as pecuniary costs (including outlays for legal or other representation, along with the value of one's own time) above and beyond any potential added taxes, penalties, and interest assessed by the IRS. Second, IRS penalty assessments on detected unreported income are also adopted as a measure of the risks/costs associated with tax evasion. In particular, the greater the average penalty assessed by the IRS per audited tax return (*PEN*), the greater the expected costs of tax evasion. Thus, we have:

$$ec = h(AUDIT, PEN),\ h_{AUDIT} > 0,\ h_{PEN} > 0 \qquad [8]$$

Substituting from [7] and [8] into [1] yields:

$$pnr/(1\text{-}pnr) = f(MAXT, TRA, TFTEN, THREE, DIS, GULFWAR2, AUDIT, PEN),$$
$$f_{MAXT} > 0,\ ff_{TRA} < 0,\ ff_{DIS} > 0,\ ff_{TFTEN} < 0,\ f_{THREE} > 0,\ f_{GULFWAR2} > 0,\ f_{AUDIT} < 0,\ f_{PEN} < 0 \qquad [9]$$

Let *AGI* represent the *actual total value of the aggregate federal adjusted gross income* in the economy, i.e., *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:

$$UAGI = (pnr)*AGI \qquad [10]$$

and

$$RAGI = (1\text{-}pnr)*AGI \qquad [11]$$

It then follows that:

$$UAGI/RAGI = (pnr)*AGI/(1\text{-}pnr)*AGI = (pnr)/(1\text{-}pnr) \qquad [12]$$

Substitution from [9] and [12] into [1] yields:

$$UAGI/RAGI = f(MAXT, TRA, TFTEN, THREE, DIS, GULFWAR2, AUDIT, PEN),$$
$$f_{MAXT} > 0,\ ff_{TRA} < 0,\ ff_{DIS} > 0,\ ff_{TFTEN} < 0,\ f_{THREE} > 0,\ ff_{GULFWAR2} > 0,\ f_{AUDIT} < 0,\ f_{PEN} < 0 \qquad [13]$$

3. -- *Initial Empirical Results*

Based on the framework provided in [13] above, the specification to be estimated initially is, as follows:

$$(UAGI/RAGI)_t = f(MAXT_{t-1}, TRAt, TFTEN_{t-1}, THREE_{t-1}, DIS_{t-1}, GULFWAR2_t, AUDIT_{t-1}, PEN_{t-1}, AR(1)) \quad [14]$$

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;
$MAXT_{t-1}$ = the maximum marginal federal personal income tax rate in year *t-1*, expressed as a percent;
TRA_t= a binary (dummy) variable for the years 1986 and 1987: TRA_t=1 for the years 1986, 1987 and TRA_t =0 otherwise;
$TFTEN_{t-1}$ = the ratio of the average interest rate yield on high grade tax free municipal bonds in year *t-1* to the average interest rate yield on 10-year Treasury notes in year *t-1*, expressed as a decimal;
$THREE_{t-1}$ = the average annual interest rate yield on 3-year Treasury notes in year *t-1*, expressed as a percentage;
DIS_{t-1} = the mean value of the public dissatisfaction with government index, year *t-1*, with values lying between -1.5 and + 1.5;
$GULFWAR2_t$ = a binary (dummy) variable for the years beginning with 2003: $GULFWAR2_t$ = 1 for 2003,…,2008, the last year of our tax evasion data, and $GULFWAR2_t$ = 0 otherwise;
$AUDIT_{t-1}$ = the percentage of filed federal personal income tax returns in year *t-1* that was subjected to a formal IRS audit involving IRS examiners;
PEN_{t-1} = the average penalty assessed by the IRS per audited tax return in year *t-1*, expressed as a percent of the AGI; and
AR(1) = autoregressive term.

The data are annual. The study period runs from 1970 through 2008, reflecting availability of the penalty data used in the analysis.[1] The tax evasion data are provided in Table 2. For the interested reader, descriptive statistics for the study period for each of the variables are found in Table 3.

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[1] The data for *MAXT* and *PEN* were obtained from the Internal Revenue Service [2010, Table 6]. Unfortunately, dependable data for the *PEN* variable are available only from 1970 and the years thereafter; hence, the study period begins with 1970. 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; 2010, Table 469]. The *TRA* variable is a binary (dummy) variable; the Tax Reform Act of 1986 was actually signed into law by President Reagan in 1986. The *GULFWAR2* variable is also a binary variable. The data for the variables *TFTEN* and *THREE* were obtained from the Council of Economic Advisors [2010, Table, B-73]. The *DIS* data were obtained from the University of Michigan Institute for Social Research [2009]. The series adopted to measure income tax evasion, in this case represented by the variable *UAGI/RAGI*), were obtained from Cebula -- Feige [2012]. Based on the General Currency Ratio [*GCR*] model, Cebula -- Feige [2012, Table B-2] estimated the ratio of aggregate *unreported* adjusted gross income to aggregate *reported* adjusted gross income, using a 1973 IRS estimate for this ratio as the baseline in his computations.

The autoregressive least squares estimation of equation [14] in linear form is provided in column (a) of Table 4.[2] In this estimate, all eight of the estimated coefficients exhibit the expected signs. Furthermore, six of these estimated coefficients are statistically significant at the 1% level and one is statistically significant at the 5% level. The coefficient of determination is 0.76, so that the model explains approximately three-fourths of the variation in the independent variable. Based on the *DW* and *Rho* statistics, there is no concern regarding autocorrelation. Finally, the F-statistic is statistically significant at the 1% level, attesting to the overall strength of the model.

According to the results provided in Table 4, column (a), the coefficient on the maximum marginal federal personal income tax variable (*MAXT*) is positive and statistically significant at the 1% level. Thus, as expected, the higher the maximum marginal federal personal income tax rate, the greater the expected benefits of tax evasion and hence the greater the extent of that income tax evasion. This finding is consistent with most previous studies of income tax evasion using official data [Ali -- Cecil -- Knoblett, 2001; Cebula, 2001, 2004; Clotfelter, 1983; Feige, 1994; Klepper -- Nagin -- Spurr, 1991; Tanzi, 1982].

Consistent with the arguments in Musgrave [1987] and findings in Cebula – Coombs -- Yang [2009], the results for *TRA* variable are compelling. In particular, the estimated coefficient is negative and statistically significant at the 1% level. Thus, there is evidence that the Tax Reform Act of 1986 is shown to have reduced federal personal income tax evasion in the U.S., albeit only briefly. Given the specification of TRA as applying to the short-term period of just 1986 and 1987, these results would seem to confirm the prior findings by Cebula -- Coombs -- Yang [2009], who argue that it would take at least some time for taxpayers to understand the revisions in the Internal Revenue Code and to adjust to those revisions.

The estimated coefficient on the tax free/taxable interest rate variable, *TFTEN*, is negative, as expected, and statistically significant at the 3% level, providing evidence that the greater the rewards for legal tax avoidance (as measured here), the less the degree of illegal tax evasion [Cebula, 2004].

The estimated coefficient on the variable *THREE* is positive and statistically significant at the 1% level. Thus, it appears that the greater the opportunity cost of personal income tax compliance, as measured here by a higher taxable interest rate (in this case, the annual federally taxable interest rate yield on 3-year Treasury notes), the greater the degree of income tax evasion. Such a finding is effectively unique in studies of aggregate income tax evasion in the U.S.[3]

The estimated coefficient on the *DIS* variable is positive but fails to be statistically significant at the 10% level, so that this variable does not appear to influence personal income tax evasion in the U.S. This result in this estimate runs contrary to our expectations [Feige, 1994; Cebula, 2001]. The estimated coefficient on the *GULFWAR2* dummy variable is positive and statistically significant at the 1% level, a result entirely consistent with the hypothesis [Cook -- Issa, 2007] that an unpopular policy such as the second war in Iraq would tend to increase taxpayers' resentment of federal government policy and create a secondary gain that would raise the proclivity to underreport taxable income to the IRS [Musgrave, 1987; Feinstein, 1991; Feige, 1994; Cebula, 2001; Saltz, 2001].

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[2] Autoregressive estimates are undertaken in this study in order to address autocorrelation. In addition, the Newey-West [1987] correction for heteroskedasticity is adopted in all of the estimates.

[3] Similar results are obtained using the three month U.S. Treasury bill yield in lieu of *THREE*.

On the cost/risk side of tax evasion, the estimated coefficient on the *AUDIT* variable is negative and statistically significant at beyond the 1% level. Thus, it appears that the audit rate (*AUDIT*) variable, in and of itself, may be viewed as an effective deterrent to federal personal income taxation. In addition, the estimated coefficient on the penalty variable (*PEN*) is also negative and statistically significant at the 1% level, so that higher IRS penalties do appear to deter personal income tax evasion. These findings are consistent with previous studies such as Clotfelter [1983], Ali -- Cecil – Knoblett [2001], Saltz [2001], and Cebula [2004], who suggest that such IRS policies are important tax-evasion disincentives.

As a simple first test of the robustness of the estimation in column (a) of Table 4, the same model is estimated but in semi-log form. These results are provided in column (b) of the Table. Once again, all eight of the estimated coefficients exhibit the expected signs, with five statistically significant at the 1% level and two statistically significant at the 2.5% level. Qualitatively, the pattern of results closely parallels that in column (a).

The estimated coefficient on *MAXTAX* is positive and statistically significant at the 2% level. In this case, a one percentage point increase in the maximum marginal personal income tax rate would elicit a 3% *increase* in the aggregate degree of federal personal income tax evasion. The coefficient on the Tax Reform Act of 1986 is negative and statistically significant at the 1% level. Based on Halvorsen -- Palmquist [1980], the interpretation of this coefficient is that the Tax Reform Act of 1986 elicited a *temporary reduction* in personal tax evasion of roughly 12-13%. The estimated coefficient on the *TFTEN* variable is negative and statistically significant at the 2.5% level. In this case a 1% increase in the ratio of the tax free interest rate yield on high grade municipals to the federally taxable interest rate on ten year Treasury notes would elicit a 5.77% *reduction* in tax evasion. The estimated coefficient on the variable *THREE* is positive and statistically significant at the 1% level. In this case, a rise in the interest rate yield on three year Treasury notes of 100 basis points would elicit a 2% *increase* in the degree of income tax evasion. Once again the *DIS* variable exhibits a statistically insignificant coefficient. However, the second war in Iraq, Operation Iraqi Freedom (*GULFWAR2*), appears to have elicited a 1.9%-2% *temporary increase* in income tax evasion [Halvorsen -- Palmquist, 1980]. Finally, there are the two IRS policies. The estimated coefficients on both *AUDIT* and *PENALTY* are negative and statistically significant at the 1% level. A rise in the audit rate of 1% (nearly doubling the use of this policy tool) would appear to *reduce* personal income tax evasion by roughly 18%, whereas a 1% increase in the IRS penalty assessment rate would *reduce* personal income tax evasion by 3%. Thus, it appears that more aggressive IRS enforcement policies can be effective tools in mitigating the degree of federal personal income taxation.

4. -- *An Extension of the Model*

Prior to the passage of the Tax Reform Act of 1986, to the extent that inflation increased peoples' taxable incomes, often-times the phenomenon of "bracket creep" was experienced, i.e., many people would be subjected to higher marginal tax rates simply because of the impact of inflation on their nominal incomes. Furthermore, of course, to the extent that peoples' *real* incomes rose, i.e., increased by more than the inflation rate, bracket creep was also a very real prospect. Faced by the prospect of bracket-creep-induced higher marginal tax rates, people with higher nominal or higher real income had an added incentive to engage in income tax evasion because the

expected benefits of such behavior were greater. Naturally, this bracket creep phenomenon leads to "fiscal drag" as an economy is expanding, i.e., as the real GDP level is growing.

After the passage of the Tax Reform Act of 1986, the basic income tax structure was indexed for inflation. Thus, if one's nominal taxable income rose by the same approximate degree as the inflation rate, i.e., one's *real* taxable income theoretically remained unchanged, one's highest marginal tax bracket generally remained the same. However, if one's *real* taxable income rose, i.e., one's nominal taxable income rose by more than the inflation rate, one's taxable income could still move into a higher marginal tax bracket. The latter fact would quite obviously raise the specter of a higher tax bracket and increase the expected benefits of income tax evasion.

Thus, despite the indexing for inflation built into the Internal Revenue Code by provisions the Tax Reform Act of 1986, the higher the average *real* per capita taxable income (*RINC*) in the economy, the greater the expected benefits of tax evasion, *ceteris paribus*. Adding this additional factor into the basic model yields the following augmented specification:

$$(UAGI/RAGI)_t = f(MAXT_{t-1}, TRAt, TFTEN_{t-1}, THREE_{t-1}, DIS_{t-1}, GULFWAR2_t, AUDIT_{t-1}, PEN_{t-1}, RINC_t, AR(1), AR(2)) \quad [15]$$

Observe that the dependent variable $(UAGI/RAGI)_t$ is contemporaneous with $RINC_t$ .This is because the taxpayer typically does not know until year t whether his/her real income growth has put them in a higher marginal tax bracket. This specification of course introduces the possibility of simultaneity bias. Accordingly, the expanded model in [15] is to be estimated by two-stage least squares. The instrument chosen was the two-year lag of the percentage unemployment rate of the civilian labor force, U_{t-2} [Council of Economic Advisors, 2010, Table B-42]. The variable U_{t-2} was chosen because it was found to be highly correlated with $RINC_t$ while being uncorrelated with the error term in the system. *AR(1)* and *AR(2)* are autoregressive terms.

The autoregressive two-stage least squares estimate of equation [15] in *linear* form is found in column (a) of Table 5, whereas the autoregressive two-stage least squares estimate of equation [15] in *semi-log* form is found in column (b) of Table 5. In column (a) of Table 5, all nine of the estimated coefficients exhibit the expected signs. In addition, six are statistically significant at the 1% level, one is statistically significant at the 2.5% level, and one is statistically significant at beyond the 10% level. In column (b) of Table 5, once again all of the estimated coefficients exhibit the hypothesized signs. In this estimate, six are statistically significant at the 1% level, two are statistically significant at the 5% level, and one is statistically significant at the 10% level.

The results summarized in Table 5 essentially parallel those in Table 4, aside from the additional findings for the *RINC* variable. In particular, the aggregate degree of federal personal income tax evasion in the U.S. is an increasing function of *MAXT*, *THREE*, and *GULFWAR*. In addition, the aggregate degree of federal personal income taxation in the U.S. is a decreasing function of *TRA*, *TFTEN*, *AUDIT*, and *PEN*. Finally, the autoregressive two-stage least squares estimates provided in Table 5 indicate that the aggregate degree of federal personal income taxation in the U.S. is an increasing function of *RINC*. The latter result suggests that bracket creep caused by a rising *real* income continues to create an incentive to engage in income tax evasion.[4]

[4] The correlation matrix is provided in the Appendix. In the case of the variables *PEN* and *RINC*, r = -0.773, which accounts for weakness of *PEN* in Table 5 relative to Table 4.

5. -- *Summary and Overview*

The empirical estimates in this study indicate consistently that the aggregate degree of federal personal income taxation in the U.S. is an increasing function of the maximum marginal federal personal income tax rate and the interest rate yield on three year U.S. Treasury notes, where the latter serves as a proxy for the opportunity cost of income tax compliance.[5] In addition, there is evidence that that unpopular U.S. military actions such as the second war in Iraq (Operation Iraqi Freedom) lead to increased income tax evasion.[6] Furthermore, as hypothesized above, there is compelling evidence that the higher the per capita *real* income in the U.S, the greater the degree of aggregate federal income evasion.

Furthermore, the estimates provided in this study indicate consistently that the aggregate degree of federal personal income evasion in the U.S. is a decreasing function of the ratio of the tax free interest rate yield on high grade municipals to the federally taxable interest rate yield on ten year Treasury notes, the audit rate by IRS personnel, and the IRS penalty assessment rate on detected unreported income. In addition, the Tax Reform Act of 1986 elicited a temporary reduction in personal income tax evasion.

Arguably, from a policy perspective, two results that stand out are those regarding the variables *AUDIT* and *PEN*. In particular, the empirical evidence provided in this study strongly implies that higher audit rates by IRS personnel *per se* and higher/harsher IRS penalty assessments on detected unreported income would be effective means by which to discourage federal income evasion and thereby raise federal tax revenues, reduce federal budget deficits, and slow the growth of the national debt. Moreover, by reducing budget deficits, such IRS policies might help to lower market interest rates [Al-Saji, 1992, 1993; Barth – Iden -- Russek, 1984,1985; Cebula, 1997; Cebula -- Cuellar, 2010, Findlay, 1990; Gissey, 1999; Hoelscher, 1996; Johnson, 1992; Tanzi, 1985; Zahid, 1988]. Potentially, these findings may be useful to policymakers outside the U.S.

The problem in part with pursuing such policies in the U.S., at least in an aggressive fashion, is Public Law 104-168, known as the "Taxpayer Bill of Rights 2," which was signed into law by former President Clinton on July 30, 1996. In effect, this law contains numerous provisions intended to protect U.S. taxpayers and taxpayer rights in complying with the Internal Revenue Code and in dealing with the IRS. In effect, a policy of significantly more aggressive IRS policies would likely run counter to the spirit (and perhaps even the letter) of this law and prove to be politically unfeasible. That said, a *modest* increase in the IRS audit rate and/or IRS penalty assessments might prove worthwhile in providing some net federal revenue increases.

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[5] Very similar results can be obtained using U.S. Treasury bill yields.

[6] This finding is similar to earlier studies [Feige, 1994; Saltz, 2001; Cebula, 2001] have found that the U.S. public increased its aggregate degree of personal income tax evasion in response to the involvement in the Vietnam War, which was a very unpopular and controversial war.

Appendix

For the interested reader, the Appendix to this study provides the correlation matrix for the explanatory variables. These can be found in Table 6. For the most part, the only variable of any concern is *RINC*. Nevertheless, the results reported in Table 5 remain nearly as robust as those in Table 4.

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Table 1– *Income tax compliance and evasion rates*

Nation	Percentage Compliance Rate	Percentage Evasion Rate
United States	84.0	16.0
United Kingdom	77.97	22.03
Switzerland	77.7	22.3
France	75.38	24.62
Austria	74.8	25.2
Netherlands	72.84	27.16
Belgium	70.15	29.85
Portugal	68.09	31.91
Germany	67.72	32.28
Italy	62.49	37.51
Source: Christie and Holzner (2006)		

Table 2 **-** *Data for dependent variable, UAGI/RAGI, by year, 1960-2008*

Year	**UAGI/RAGI**	**Year**	**UAGI/RAGI**
1960	16.10	1985	21.11
1961	15.47	1986	18.89
1962	15.86	1987	17.42
1963	16.44	1988	18.74
1964	15.88	1989	21.06
1965	14.62	1990	21.06
1966	14.86	1991	21.39
1967	15.36	1992	19.04
1968	15.21	1993	17.70
1969	15.32	1994	17.98
1970	16.30	1995	20.01
1971	16.04	1996	18.64
1972	16.16	1997	18.66
1973	16.27	1998	18.30
1974	17.47	1999	20.55
1975	18.81	2000	22.29
1976	20.17	2001	22.73
1977	20.37	2002	23.94
1978	20.63	2003	23.17
1979	21.14	2004	21.57
1980	22.84	2005	21.98
1981	22.25	2006	23.85
1982	22.93	2007	24.90
1983	21.46	2008	23.94
1984	21.86		

UAGI/RAGI is expressed as a percentage. Source: Cebula -- Feige [2012, Table B- 2]

Table 3 **-** *Descriptive statistics*

Variable	Mean	Standard Deviation
(*UAGI/RAGI*)	21.03	2.057
MAXT	44.19	13.72
TRA	0.061	0.242
TFTEN	0.908	0.112
THREE	6.894	3.047
GULFWAR2	0.1818	0.3917
DIS	0.459	0.641
AUDIT	1.242	0.485
PEN	1.401	1.14
RINC	29,338	5,485

Table 4 – *Autoregressive least squares estimates*

Variable\Estimate	(a) Linear Form	(b) Semi-log Form
a_0	31.49	3.54
MAXT	0.063***	0.003**
	(2.67)	(2.55)
TRA	-2.28***	-0.116***
	(-3.82)	(-4.21)
TFTEN	-12.04*	-0.577**
	(-2.39)	(-2.44)
THREE	0.405***	0.02***
	(5.04)	(4.98)
DIS	0.94	0.48
	(1.27)	(1.36)
GULFWAR2	3.93***	0.0018***
	(3.39)	(3.47)
AUDIT	-3.76***	-0.178***
	(-4.44)	(-4.61)
PEN	-0.598***	-0.0029***
	(-3.48)	(-3.36)
AR(1)	0.006**	0.005**
	(2.39)	(2.40)
R^2	0.76	0.76
AdjR^2	0.65	0.66
F	7.31***	7.40***
DW	2.04	2.05
Rho	-0.02	-0.03
No. Iterations For Convergence	7	7

Terms in parentheses are t-values. ***indicates statistical significance at 1% level; **indicates statistical significance at 2.5% level; *indicates statistical significance at 5% level.

Table 5 – *Autoregressive two stage least squares estimates*

Variable\Estimate	(a) Linear	(b) Semi-log
a_0	28.41	3.42
MAXT	0.105*** (4.01)	0.0049*** (3.79)
TRA	-3.41*** (-5.48)	-0.17*** (-5.59)
TFTEN	-17.03*** (-4.72))	-0.818*** (-4.59)
THREE	0.467*** (5.07)	0.023*** (5.58)
DIS	0.84 (1.67)	0.045# (1.87)
GULFWAR2	3.65*** (6.72)	-0.174*** (-6.60)
AUDIT	-4.696*** (-5.03)	-0.222*** (-4.98)
PEN	-0.22# (-1.80)	-0.012* (-2.16)
RINC	0.0002** (2.53)	0.00005* (2.32)
AR(1)	-0.4599*** (-2.87)	-0.445*** (-2.73)
AR(2)	-0.2586# (-1.76)	-0.2485# (-1.77)
DW	2.15	2.15
Rho	-0.08	-0.08

Terms in parentheses are t-values. ***indicates statistical significance at 1% level; **indicates statistical significance at 2.5% level; *indicates statistical significance at 5% level; #indicates statistical significance at 10% level.

Table 6 - *Correlation matrix*

	MAXT	*TRA*	*TFTEN*	*THREE*	*DIS*	*GULFWAR2*	*AUDIT*	*PEN*	*RINC*
MAXT	1.00								
TRA	0.001	1.00							
TFTEN	-0.436	0.077	1.00						
THREE	0.455	0.040	-0.477	1.00					
DIS	0.301	-0.122	-0.608	0.320	1.00				
GULFWAR2	-0.321	-0.120	0.456	-0.454	-0.162	1.00			
AUDIT	0.423	-0.075	-0.476	0.477	0.387	-0.342	1.00		
PEN	0.129	0.450	-0.256	0.392	-0.085	-0.281	0.140	1.00	
RINC	-0.509	-0.141	0.486	-0.499	-0.409	0.484	-0.523	-0.773	1.00