

# Determinants of Aggregate Income-Tax-Evasion Behavior: The Case of the US<sup>\*</sup>

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## 1. Introduction

Edgar Feige (1994, p. 119) has observed that "Federal Reserve surveys [...] of currency usage by American households determined that adult U.S. residents admit to holding only 12% of the nation's currency in circulation outside the banking system". Feige further observes that "Allowing for U.S. business holdings of currency, the whereabouts of perhaps 80% of the nation's [US] currency supply is presently unknown". He proceeds to conclude that "Our inability to identify the holders and location of a large fraction of the U.S. currency stock gives rise to a \$240 billion problem of 'missing money'". It is hypothesized by Feige (1994, pp. 119 and 121) as well as by others that this missing currency is a critical component of the so-called "underground economy", both in the US and in other nations.

There is a highly developed literature dealing with issues surrounding the size of the underground economy and tax evasion behavior. First, there are a variety of principally theoretical models of tax evasion behavior (Falkinger 1988; Allingham and Sandmo 1972; Klepper, Nagin and Spurr 1991; Das-Gupta 1994; Pestieau, Possen and Slutsky 1994). In addition, there are a number of studies of tax-evasion behavior using *a*) questionnaires or experiments (Spicer and Lundstedt 1976; Friedland 1982; Spicer and Thomas 1982; Benjamini

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and Maital 1985; Alm, Jackson and McKee 1992; Baldry 1987; De Juan 1989; Thurman 1991), or, in some cases, *b*) what De Juan, Lascheras and Mayo (1994) refer to as "official data" (Clotfelter 1983, Slemrod 1985, Pommerehne and Weck-Hannemann 1989, Erard and Feinstein 1994, Feige 1994).<sup>1</sup> In effect, the issue of the size of the underground economy consists essentially of economic transactions (or income) that are not reported or that are underreported to the government tax-collection authority. At the economy-wide level, most of these unreported or underreported transactions reflect private decisions regarding income-tax-evasion behavior.

It is generally accepted that, as a reflection of aggregate income-tax-evasion-behavior, the size of the underground economy should be affected by income tax rates (Clotfelter 1983, Slemrod 1985, Pommerehne and Weck-Hannemann 1989, Feige 1994). Presumably, the higher the pertinent income tax rate, the greater the economic benefit (in terms of a reduced tax liability) from not reporting or from underreporting taxable income, *ceteris paribus*. Clearly, every time a new federal income tax statute is enacted, it alters effective income tax rates and by so doing alters the incentive to underreport or not report income to the tax-collection authority. It is also commonly argued that the greater the perceived risk associated with participating in the underground economy, the less the extent to which economic agents will choose either to not report or to underreport income, *ceteris paribus* (Friedland 1982; Spicer and Thomas 1982; De Juan 1989; Alm, Jackson and McKee 1992; Erard and Feinstein 1994).

Within this context and based on revised and updated data through 1994 on the relative size of the underground economy in the US, this study empirically seeks to provide updated and hopefully improved insight into determinants of aggregate income-tax-evasion behavior as reflected by the relative size of the underground economy. In particular, this study investigates the potential impact on the relative size of the underground economy in the US of the following factors: the federal personal income tax rate, the social security

<sup>1</sup> For instance, using a sample (for 1987) of 716 tax filers in the state of Oregon and audit and income tax data for these Oregon taxpayers obtained from the IRS, Erard and Feinstein (1994) attempt to assess the role of expected tax audits as well as guilt and shame in determining the underreporting of income. Studies such as Clotfelter (1983), using actual individual tax return information, find that higher tax brackets are associated with higher degrees of underreporting.

tax rate, the federal corporation income tax rate, the public's dissatisfaction with government, IRS (Internal Revenue Service) audit rates (the percentage of federal income tax returns that is investigated by the IRS), and IRS penalty assessments (penalties plus interest) on detected unreported income. The findings presented in this study may have potential policy implications not only for the US but also for other developed nations, especially those whose income tax systems bear at least some resemblance to that in the US.

Section 2 provides the model that constitutes the basis for the empirical estimates, whereas Section 3 describes the data used in this study. The initial empirical estimations are found in Section 4, with additional estimates provided in Section 5. Finally, conclusions are presented in Section 6.

## 2. A general model

The economic system consists of a variety of economic agents. These agents generate economic value: income. Each of these economic agents has a choice as to whether or not to report (or underreport) their income to the tax-collecting authority. To the extent that income is reported to the government tax-collecting authority, a tax liability may be incurred.

It is argued here that the *relative* probability that the *representative* economic agent will *not* report its taxable income to the tax authority is an increasing function of the expected gross benefits to the agent of not reporting income, *eb*, and 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, *pnr*, to the probability of reporting income,  $(1 - pnr)$ , can be described for the representative economic agent by the following:

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

For simplicity, since the values for *pnr* will likely vary across different sectors of the economy, *pnr* may be viewed as a weighted average of these various probabilities. Expressing probabilities in *relative* terms such as shown in (1) reflects the form of the data, i.e., data

where the magnitude of the underground economy is expressed in relative terms.

In turn, the expected gross benefits from *not* reporting income or from underreporting income are hypothesized to be an increasing function of the income tax rate (Cagan 1958, Bawley 1982, Tanzi 1982 and 1983, Clotfelter 1983, Slemrod 1985, Pyle 1989, Feige 1994). Presumably, federal income taxation rate measures could effectively take at least three forms, the personal income tax rate (*PT*), the social security tax rate (*ST*), and the corporation income tax rate (*CT*).

Furthermore, it is hypothesized in this study that a rising public dissatisfaction with the performance of government and/or a growing public distrust and resentment of government may potentially contribute to the size of the underground economy (Feige 1994). It can be argued that the more the public attributes worsening unemployment or inflation to a poor performance by the government in promoting a healthy economy and/or the more people resent how government officials conduct themselves and spend tax dollars, the more benefit/utility people derive from avoiding taxes through the underreporting of income or through not reporting income, i.e., the greater will be the subjective benefits of income-tax-avoidance behavior. Consequently, the greater the public's dissatisfaction with government (*DIS*), the larger the relative size of the underground economy.

Thus, the expected gross benefits from not reporting or from underreporting income can be represented by:

$$eb = h(PT, ST, CT, DIS), h_{PT} > 0, h_{ST} > 0, h_{CT} > 0, h_{DIS} > 0 \quad (2)$$

It is argued here that the expected gross costs of not reporting or of underreporting income are likely to be an increasing function of the risks thereof, risks that can include penalties (Pestieau, Possen and Slutsky 1994) such as fines, interest on unpaid past tax liabilities, an increased likelihood of tax audits in the future (Alm, Jackson and McKee 1992; Pestieau, Possen and Slutsky 1994; Erard and Feinstein 1994) and/or imprisonment, as well as potential fees resulting from legal or other representation. In this study, to the representative economic agent in the society, the expected penalty from not reporting taxable income, *if* said activity is detected, can be *proximately* measured by the total pecuniary penalty (including both penalties and interest) assessed by the IRS (aside from added tax liabilities *per se*) per dollar of reported adjusted gross income (*PEN*). Furthermore, these

risks will presumably be enhanced by a rise in *AUDIT*, the percentage of filed federal income tax returns that is audited by the IRS. Thus, it follows that:

$$ec = j(AUDIT, PEN), j_{AUDIT} > 0, j_{PEN} > 0 \quad (3)$$

This classification of 'risk' factors is effectively based on the theoretical model in Pestieau, Possen and Slutsky (1994), and to some degree on Alm, Jackson and McKee (1992) and Erard and Feinstein (1994).

Substituting from equations (2) and (3) into equation (1) yields the following:

$$pnr/(1 - pnr) = b(PT, ST, CT, DIS, AUDIT, PEN),$$

$$\text{where } b_{PT} > 0, b_{ST} > 0, b_{CT} > 0, b_{DIS} > 0, b_{AUDIT} < 0, b_{PEN} < 0 \quad (4)$$

We let *AGI* represent the true value of the total actual adjusted gross income in the economy, i.e.,  $AGI = UGE + RAGI$ , where *UGE* is the dollar size of the underground economy, i.e., the dollar size of the *unreported* AGI, and *RAGI* is the dollar size of the *reported* AGI. It then follows that:

$$UGE = (pnr) * AGI \quad (5)$$

and

$$RAGI = (1 - pnr) * AGI \quad (6)$$

since  $(pnr) * AGI + (1 - pnr) * AGI = AGI$ .

In turn, it also follows that:

$$UGE/RAGI = (pnr) * AGI / (1 - pnr) * AGI = (pnr) / (1 - pnr) \quad (7)$$

From (4) and (7), we find that:

$$UGE/RAGI = b(PT, ST, CT, DIS, AUDIT, PEN), \quad (8)$$

$$\text{where } b_{PT} > 0, b_{ST} > 0, b_{CT} > 0, b_{DIS} > 0, b_{AUDIT} < 0, b_{PEN} < 0$$

The specification in (8) constitutes the basic model for the empirical estimates provided in Sections 4 and 5 below.

### 3. The data

In this analysis, three income tax rate measures are investigated: (1) the average effective federal personal income tax rate (*AEPIT*), (2) the average effective social security tax rate (*AESST*), and (3) the average effective federal corporation income tax rate (*ACIT*). In addition to *AEPIT*, *AESST* and *ACIT*, the variable *AUDIT*, which is the percentage of filed federal income tax returns in the US that has actually been subjected to an IRS audit (investigation) in each year, is included as a measure of the expected likelihood of being subjected to an IRS audit. The variable *PEN*, which is the total pecuniary penalty (inclusive of both penalties per se plus interest) assessed by the IRS per dollar of reported AGI in each year, is included to reflect the penalty (above and beyond added tax liabilities per se) from not reporting income if said activity is detected. As observed above, the variables *AUDIT* and *PEN* are adopted in this study, based on arguments found in Pestieau, Possen and Slutsky (1994), Alm, Jackson and McKee (1992), and Errard and Feinstein (1994), as identifiable and quantifiable measures of risks associated with underreporting income. The variable *DIS* is represented by the 'dissatisfaction index'. This index is constructed as an equally weighted average of three normalized indices reflecting answers to the University of Michigan's Institute for Social Research (ISR) surveys concerning whether government officials can be trusted (to honor obligations to the public), whether they are dishonest, and whether government wastes tax dollars. Values for this index of dissatisfaction lie within a range of (-1.5), which corresponds to least dissatisfied, to (+1.5), which corresponds to most dissatisfied, so that the algebraic value of this index is higher as the public is more dissatisfied with government.

Naturally, there are other possible measures of the federal personal income tax rate that could have been adopted rather than *AEPIT* (the average effective federal personal income tax rate), including perhaps the maximum marginal federal personal income tax rate, *MMPIT*. Nevertheless, in effect paralleling Feige (1994, p. 135),<sup>2</sup> we fo-

<sup>2</sup> Feige (1994, p. 135, n. 18) states that "The average tax rate is simply the sum of total government tax receipts divided by AGI [aggregate]". In this study, the *AEPIT* variable is total federal government income tax receipts from individuals divided by the aggregate AGI.

cus on the variable *AEPIT*. We adopt a view that, given the complexity of the Internal Revenue Code and the variety of marginal tax brackets in the Internal Revenue Code, a variable such as *AEPIT* may be a reasonably useful (albeit only proximal) measure for tax filers *generally* of tax benefits from underreporting income. By contrast, the *MMPIT* variable can be viewed as too narrow (and hence irrelevant) for most of the income spectrum and thus potentially as neglecting a very large portion of taxpayers. Essentially paralleling Feige (1994), we define the variable *AEPIT* as the ratio of total federal personal income tax collections to aggregate reported AGI, expressed as a percentage; we adopt variable *AEPIT* as the personal federal income tax rate measure/proxy. Similarly, the focus on (choice of) variables *AESST* and *ACIT*, as defined, as the measures of the social security tax rate and the federal corporation income tax rate, respectively, also parallels the approach in Feige (1994). The data for variables *AEPIT*, *AESST* and *ACIT* were obtained from the IRS (1971-1996) and the Council of Economic Advisors (1997).

In order to measure variables *AUDIT* and *PEN*, data indicating the percentage of filed federal income tax returns in any given year that were actually audited by the IRS and the total penalty (penalties plus interest) assessed by the IRS per dollar of reported AGI were obtained from the IRS (1971-1996).

Next, we consider the data for measuring aggregate income-tax-evasion behavior, i.e., the relative size of the underground economy. A number of studies have estimated the size of the underground economy over the years. Among the well-known past major contributions in this area in terms of the US are those by Tanzi (1982 and 1983), Feige (1989 and 1994), Bawley (1982), Carson (1984), Pozo (1996) and Pyle (1989). Based on such studies, there appear to be three primary approaches to estimating the size of the underground economy for the US:

- 1) the Taxpayer Compliance Measurement Program;
- 2) the AGI gap approach; and
- 3) Currency Ratio Models.

The third of these approaches includes the General Currency Ratio model (*GCR*).



In this study, to measure the relative size of the underground economy, we adopt the series generated by Edgar Feige. Feige has generated revised and updated estimates of aggregate unreported income as a percent of reported aggregate adjusted gross income (AGI) based on the GCR model, employing an IRS estimate of unreported income for 1973 as the base year. Because these data are available for the years 1973-94, and because they appear to be the most current complete data set presently available on the relative size of the underground economy in the US, they are used as the dependent variable (UGE/RAGI) in the empirical estimates.

#### 4. Initial empirical findings

Initially, it is hypothesized that the public's *current* choices regarding the underreporting or non-reporting of income should depend more on the public's *current* level of dissatisfaction with government rather than on some past level thereof. Thus, in the model examined in this section of the study, the variable DIS initially is unlagged (estimates where the DIS variable is lagged one period are provided in Section 5). By contrast, given the time lag in the transmission of information to the public regarding IRS activities, i.e., given the absence of accurate information on *current* IRS audit rates and penalties, a lagging of variables AUDIT and PEN seems reasonable. Likewise, given the sometimes difficult-to-evaluate changes that occur in the Internal Revenue Code and given that determining the impact of new tax statutes presumably involves a time lag before the taxpaying public becomes fully aware of the effective tax-rate implications of those new statutes, the tax variables are all lagged as well. Of course, lagging right-hand-side variables has the virtue of avoiding simultaneity-bias problems.

Predicated on the model in (8), the data described in Section 3, and the reasoning above, we initially estimate the following quasi reduced-form equation:

$$(UGE/RAGI)_t = a_0 + a_1 AEPIT_{t-2} + a_2 AESST_{t-1} + a_3 ACIT_{t-1} + a_4 AUDIT_{t-1} + a_5 PEN_{t-1} + a_6 DIS_t + a_7 TREND + u \quad (9)$$

where:

$(UGE/RAGI)_t$  = the revised and updated Feige GCR estimates of the underground economy as a percent of aggregate reported adjusted gross income in year  $t$ ,  $t = 1973, \dots, 1994$ ;

$a_0$  = constant;

$AEPIT_{t-2}$  = the average effective federal personal income tax rate in year  $t-2$ , i.e., total federal personal income tax collections in year  $t-2$  divided by the total reported AGI in year  $t-2$ , as a percent;

$AESST_{t-1}$  = the average effective social security tax rate in year  $t-1$ , expressed as a percent, i.e., total personal social security contributions in year  $t-1$  as a percent of total reported AGI in year  $t-1$ ;

$ACIT_{t-1}$  = the average effective percentage federal corporation income tax rate in year  $t-1$ , i.e., aggregate corporate federal income tax liabilities as a percent of reported corporate profits (after inventory valuation and capital consumption adjustments) in year  $t-1$ ;

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

$PEN_{t-1}$  = the average penalty from underreporting income to the IRS, computed as the total pecuniary penalty, including interest charges, on unreported income assessed by the IRS per dollar of reported AGI in year  $t-1$ , expressed as a percent;

$DIS_t$  = the dissatisfaction index for year  $t$  derived by the University of Michigan's Institute for Social Research (ISR); DIS values lie within a range of (-1.5) up to (+1.5);

$u$  = stochastic error term.

The AEPIT, AESST, AUDIT and PEN data were obtained from the IRS (1970-1996); the ACIT data were obtained from the Council of Economic Advisors (1997); the DIS series was obtained from the University of Michigan's ISR; and the estimated data for the UGE/RAGI data were provided by Edgar Feige. The AEPIT variable is lagged two periods due solely to multicollinearity problems. The time series examined in this study are annual and cover the 1973-94 period. The Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests indicate that the following four variables in equation (9) are non-stationary in levels but stationary in first differences: AESST, ACIT, PEN and AUDIT. The remaining variables are stationary in levels. These PP and ADF test statistics are summarized in Table 1. Thus, in estimation equation (10), variables AESST, ACIT, PEN and AUDIT are expressed in first differences form.

TABLE 1

## PP AND ADF TESTS FOR A UNIT ROOT

Variable	Levels		First differences	
	$\tau_{\mu}$		$\tau_{\mu}$	
	PP	ADF	PP	ADF
UGE/RAGI	-3.40*	-3.15*	-2.76	-2.65
AEPIT	-4.56*	-4.44*	-2.35	-2.54
ACIT	-2.01	-2.34	-6.25*	-6.59*
AUDIT	-1.33	-1.57	-3.75*	-3.03*
PEN	-2.26	-2.76	-3.31*	-4.04*
DIS	-3.18*	-3.06*	-2.66	-2.01
AESST	-1.22	-1.49	-3.41*	-3.52*
$U_{t-3}$ <sup>a</sup>	-3.29*	-3.68*	-2.88	-2.76
INTER	-2.82	-2.85	-2.90*	-2.92*

\* Rejects null hypothesis of unit root at 95% confidence level (cv = -3.00).

<sup>a</sup> Instrumental variable for DIS.

Since the (dependent) variable  $(UGE/RAGI)_t$  is contemporaneous with variable  $DIS_t$ , the possibility of simultaneity bias exists. As a result, equation (9) is estimated using an Instrumental Variables (IV) technique to correct for possible simultaneous equation bias, with the instrument being  $U_{t-3}$ , the average unemployment rate of the civilian labor force in year  $t-3$ , as a percent. Table 1 shows that the instrument is stationary in levels. The choice of instrument is based on the finding that  $DIS_t$  is highly correlated with  $U_{t-3}$ , whereas the error terms in the system are not contemporaneous with the lagged (by three periods) instrument. Data for  $U_{t-3}$  were obtained from the Council of Economic Advisors (1997, Table B-40). To correct for heteroscedasticity, the White (1980) procedure is used.

The IV estimate of equation (9) is provided below in equation (10):

$$\begin{aligned}
 (UGE/RAGI)_t = & -5.04 + 1.99 AEPIT_{t-2}^{**} + 3.04 \delta AESST_{t-1}^* - 0.18 \delta ACIT_{t-1} \\
 & (-0.78) \quad (+4.75) \quad (+2.18) \quad (-1.51) \\
 & -0.59 \delta AUDIT_{t-1} - 0.15 \delta PEN_{t-1}^{**} + 4.17 DIS^{**} - 0.14 TREND, F=9.17^{**} \quad (10) \\
 & (-0.30) \quad (-4.28) \quad (+3.93) \quad (-1.01)
 \end{aligned}$$

where terms in parentheses are t-values and ' $\delta$ ' is the first-differences operator. In equation (10), \* indicates statistically significant at the 5% level and \*\* indicates statistically significant at the 1% level. The F-statistic is significant at the 1% level. In estimate (10), three of the coefficients are statistically significant with the hypothesized signs at the 1% level, and one is significant with the expected sign at the 5% level.

In equation (10), the estimated coefficient on the AEPIT variable is positive and significant at the 1% level, while the coefficient on the AESST variable is positive and significant at the 5% level. Hence, it appears that the higher the average effective federal personal income tax rate, the larger the relative size of the underground economy. Furthermore, the higher the average effective social security tax rate, the larger the relative size of the underground economy. These findings are consistent with the study of data from audits of individual tax returns by Clotfelter (1983), who finds underreporting of income to be an increasing function of marginal income tax rates. These results are also consistent with the findings based on 'official data' in Slemrod (1985) and Pommerehne and Weck-Hannemann (1989), as well as the findings based upon experimentation in Baldry (1987), Alm, Jackson and McKee (1992), and Benjamini and Maital (1985). Moreover, this finding is also consistent with the regression estimate in Feige (1994, p. 135, n. 19), where the size of the underground economy is regressed in levels against a lagged tax variable (and a lagged second variable, D, which corresponds to the variable DIS in the present study).

Regarding the corporation income tax rate variable, the coefficient fails to be either positive or statistically significant at even the 10% level. Thus, the evidence in estimation equation (10) implies that this variable does not have a significant effect on the relative magnitude of the underground economy, i.e., on aggregate income-tax-evasion behavior. This finding may to some extent reflect the fact that, in the US, many corporations (particularly the large ones) are publicly owned, so that they are subject to a variety of disclosure requirements and extensive public scrutiny. Such scrutiny would make underreporting income very difficult. In addition, officers in publicly-owned corporations tend to have incentives to report income fully in order to provide a record of good performance to their stockholders.

Whereas the coefficient on the AUDIT variable in equation (10) is negative (as expected), it is not significant at even the 10% level. By

contrast, the coefficient on the PEN variable in equation (10) is negative and significant at the 1% level. Thus, as tax evasion theory predicts (Pierre, Possen and Slutsky 1994), the greater the penalty from underreporting AGI, as measured in this study by variable PEN, the smaller the relative size of the underground economy because the greater PEN, the greater the expected IRS penalty if unreported income is detected.

The coefficient on the DIS variable in equation (10) is positive and significant at the 1% level. Therefore, there is evidence, as suggested by Feige (1994), that the public's dissatisfaction with government impacts positively on the relative size of the underground economy. Apparently, the more dissatisfied the public is with government, as measured by the variable DIS, the greater the extent to which the public chooses to underreport or not report income.

### 5. Additional estimates

In this Section of the study, we provide three alternative estimates of the basic model. In the first of these, we estimate the basic model in equation (9) with the DIS variable lagged one period. This scenario is feasible simply because if one decides to underreport or not report income, it may take time to make the necessary preparations to do so. Thus, it *may* well be the year *following* the *decision* to underreport or not report income before the decision is actually fully *executed/manifested*.

With the DIS variable lagged one period, OLS is used rather than IV because simultaneity bias is not a concern with lagged right-hand-side variables. Accordingly, estimating equation (9) by OLS with the White (1980) heteroscedasticity correction yields:

$$\begin{aligned} (UGE/RAGI)_t = & + 0.25 + 1.5 AEPIT_{t-2}^{**} + 3.6 \delta AESST_{t-1}^{\sigma} - 0.11 \delta ACIT_{t-1} \\ & (+0.003) \quad (+3.49) \quad (+1.85) \quad (-0.82) \\ & + 0.9 \delta AUDIT_{t-1} - 0.15 \delta PEN_{t-1}^{**} + 2.48 DIS_{t-1}^* - 0.06 TREND \quad (11) \\ & (+0.36) \quad (-3.66) \quad (+2.25) \quad (-0.31) \end{aligned}$$

$$F = 5.30^*, R^2 = 0.76, \text{adj.}R^2 = 0.61$$

where  $\sigma$  indicates statistically significant at the 10% level, \* indicates significant at the 5% level, and \*\* indicates significant at the 1% level.

These results are extremely similar to those in equation (10). The principal difference between the two sets of results is that the social security variable was significant at the 5% level in the initial estimate, equation (10), but now is significant at only the 10% level. Aside from this caveat, the results in equation (11) are consistent with those in equation (10) and with the conclusions that were derived from same.

Next, in order to further investigate the issue at hand, we introduce a new variable,  $\delta INTER_{t-1}$ . This variable is an interaction term such that:

$$\delta INTER_{t-1} = \delta AUDIT_{t-1} \times \delta PEN_{t-1} \quad (12)$$

This variable might be regarded as the 'expected IRS penalty on detected unreported income'. In effect, this variable attempts to express the expected penalty from underreporting or not reporting income as the product of the probability of being audited and the average penalty assessed (above and beyond added income tax liabilities per se) on detected unreported income if one is audited. As shown in Table 1, this variable is non-stationary in levels but stationary in first differences; hence, in the estimates that follow, it is expressed in first differences.

Estimating equation (9) by IV after substituting  $\delta INTER_{t-1}$  for the  $\delta AUDIT_{t-1}$  and  $\delta PEN_{t-1}$  variables yields:

$$\begin{aligned} (UGE/RAGI)_t = & -2.44 + 1.89 AEPIT_{t-2}^{**} + 3.39 \delta AESST_{t-1}^{\sigma} - 0.11 \delta ACIT_{t-1} \\ & (-0.27) \quad (+3.63) \quad (+2.03) \quad (-1.49) \\ & -0.16 \delta INTER_{t-1}^{**} + 1.58 DIS_t - 0.15 TREND, F = 6.95^{**} \quad (13) \\ & (-3.80) \quad (+1.61) \quad (-0.61) \end{aligned}$$

where \*\* indicates significant at the 1% level and  $\sigma$  indicates significant at the 10% level.

In this estimate, although the DIS variable fails to be significant, the estimated coefficients for the average effective income tax rate and expected IRS penalty variables are significant at the 1% level while the estimated coefficient for the social security variable is significant at beyond the 10% level. Thus, to a large degree, this specification of the basic model confirms the findings in Section 4.

Alternatively, estimating by OLS after lagging the DIS variable one period and dropping the consistently insignificant corporate tax variable yields:

$$\begin{aligned} (\text{UGE/RAG})_t = & -2.33 + 1.81 \text{AEPIT}_{t-2}^{**} + 3.14 \delta \text{AESST}_{t-1} \sigma - 0.16 \delta \text{INTER}_{t-1}^{**} \\ & (-0.32) \quad (+4.02) \quad (+1.93) \quad (-4.54) \\ & + 2.57 \text{DIS}_{t-1}^* - 0.12 \text{TREND}, F = 8.60^{**} \quad (14) \\ & (+2.64) \quad (-1.59) \end{aligned}$$

$$F = 8.60^{**}, R^2 = 0.75, \text{adj. } R^2 = 0.67$$

where \*\* indicates significant at the 1% level, \* indicates significant at the 5% level, and  $\sigma$  indicates significant at the 10% level.

Clearly, these results are reasonably similar to those in equation (10). Overall, from equation (14), it appears that the relative size of the underground economy is an increasing function of the average effective federal personal income tax rate, the average effective social security tax rate (although this result is only marginally significant), and dissatisfaction with government, while being a decreasing function of the expected IRS penalty.

## 6. Concluding observations

From the empirical estimates presented in this study, it appears that aggregate income-tax-evasion behavior in the US, as manifested by the relative size of the underground economy, may be an increasing function of the average effective federal personal income tax rate and the average effective social security tax rate, as well as the public's general level of dissatisfaction with government. It also appears that the relative size of the underground economy may be a decreasing function of IRS penalty assessments (penalties plus interest) on unpaid taxes. However, the average effective federal corporate income tax rate and IRS audit rates do not seem to significantly impact on the relative size of the underground economy.

Thus, among other things, it appears that the growth in the relative size of the underground economy in the US might, at least in theory, be diminished by increased IRS penalties on detected unreported income. On the other hand, given the unpopularity of the IRS

with the general public in the US, it remains dubious whether higher penalty rates are politically feasible. Furthermore, such policy actions must also be very carefully evaluated in a general equilibrium cost-benefit context.

It also appears that restraint from further increases in personal income tax rates and the social security tax rate might help to restrain the growth of the underground economy, if not reduce its size. This finding may well generalize to nations in addition to the US. In any case, to the extent that such restraint is in fact pursued, it may yield long-term benefits to the Treasury in the form of greater income tax revenues because of diminished tax-evasion behavior. Indeed, a Laffer-curve phenomenon might well be experienced.



## DATA APPENDIX

For the convenience of the reader, this data Appendix provides the raw data on the relative size of the underground economy. These data are found in Table A.1 and are expressed as a percentage.

TABLE A.1

## THE RELATIVE SIZE OF THE UNDERGROUND ECONOMY

Year	(UGE/RAGI) <sub>t</sub> , as a percent
1973	14.84
1974	18.21
1975	20.87
1976	24.17
1977	26.2
1978	26.9
1979	28.36
1980	30.04
1981	29.04
1982	27.95
1983	26.01
1984	26.56
1985	25.39
1986	21.99
1987	20.03
1988	21.73
1989	24.2
1990	25.08
1991	24.77
1992	21.46
1993	19.79
1994	20.71

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