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INCOME TAX EVASION: SOME AGGREGATE EMPIRICAL EVIDENCE

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It is well-known that every year a substantial amount of income evades income taxation. This is obviously a significant policy problem. To solve this problem, the tax authorities must have information about the factors that taxpayers consider when deciding how much income to report on their tax returns. The need for such information has prompted a number of theoretical and empirical studies of the evasion problem.

In this paper some aggregate empirical evidence on income tax evasion in the U.S. is provided. This is accomplished by specifying an aggregate tax evasion function which is estimated over the period 1947-78. The results provide (1) empirical evidence which supports some of the predictions of the microtheory, (2) insights where the theoretical results are indeterminant, and (3) an indication of the sensitivity of a measure of aggregate evasion to changes in the aggregate variables which correspond to the microtheoretical determinants of evasion.

The remainder of this paper is organized in the following way. Section I contains background information on the results reported in some of the previous literature. In Section II, an empirical model is specified and estimated, and the results are presented. This is followed in Section III by a brief discussion of some of the possible implications of these results, along with suggestions for further research.

I. BACKGROUND

Most theoretical studies in this field involve microeconomic models of the individual's income declaration decision. Using a standard decision-under-uncertainty framework, most analysts specify models that include four determinants of optimal income tax evasion. These are the taxpayer's true income, his/her tax rate, the penalty rate to which he/she would be subjected if detected, and his/her perceived probability of detection.[2]

Within this common framework, analysts derive comparative static results under a variety of assumptions concerning the factors affecting the evasion decision. For example, different assumptions are made regarding the individual taxpayer's attitude towards risk, and thus his/her objective function, the structure of the tax system, and the properties of the penalty and probability-of-detection functions.

In general, some firm conclusions are reached about the effect on evasion of both the penalty rate and the probability of detection. It is found that higher penalty rates and higher probabilities of detection lead to lower evasion. An implication of this is that, at the margin, the two compliance policy tools can be considered substitutes for each other. Consequently, it should be possible to offset any fall in expected tax revenue due to a reduction in one by increasing the other.[3]

In contrast, ambiguous results emerge from efforts to determine the direction of the relationship between evasion and true income. This proves to depend on the assumptions made regarding the factors mentioned above. For example, Allingham and Sandmo [1, 1972] show that with a proportional tax system, the effect of a change in true income on the level of reported income depends upon the magnitude of the penalty relative to the size of unreported income. Further, they demonstrate that higher income causes the fraction of income reported to increase, decrease, or remain constant depending upon whether relative risk aversion increases, decreases, or remains constant as income increases. On the other hand, Srinivasan [14, 1973] analyzes a risk neutral individual confronted with a progressive tax system and finds that the result depends upon whether the probability of detection is an increasing or a decreasing function of income.

The theoretical work has also been incapable of offering determinate results regarding the relationship between the tax rate and optimal tax evasion. This is because a change in the tax rate produces income and substitution effects, which may reinforce or oppose each other. The net effect depends on assumptions concerning attitude towards risk and the penalty function. As long as penalties are imposed on evaded income, the substitution effect is positive, meaning that higher tax rates result in increased evasion, other things equal. This is because an increase in the tax rate makes evasion more profitable on the margin. In contrast, the income effect can be negative, zero, or positive depending upon whether absolute risk aversion is decreasing, constant, or increasing with income.[4] Thus, the net effect is uncertain. Further, Yitzhaki [17, 1974] has shown that when penalties are based on evaded taxes there is a zero substitution effect. In light of these diverse findings, no general statement can be made about the effect of the tax rate on the evasion decision.

In an effort to clear up these ambiguities, several empirical studies have investigated the responsiveness of various evasion measures to changes in the factors affecting the decision to evade. These studies, like their theoretical counterparts, typically have been undertaken at the microeconomic level. Most of them have employed either a questionnaire or an experimental (game-simulation) approach.[5] These studies confirm the inverse relationship between evasion and the two compliance variables, and tend to suggest direct relationships between evasion and both income and the tax rate.

Other empirical research has focused primarily on the <u>measurement</u> of either unreported income or evaded taxes at the aggregate level.[6] Another procedure has been to measure the magnitude of tax evasion by analyzing the traces it leaves in the economy.[7] Both types of studies are without theoretical underpinnings and make no attempt to systematically analyze the factors which affect tax evasion.

After reviewing this literature on tax evasion, we have concluded that there is something missing. To our knowledge, no link has been estabilished between aggregate measures of evasion and the theoretical work analyzing evasion at the micro level. Clearly, the micro analysis is essential for understanding the phenomenon of tax evasion. But it is also worth remembering that the policymaker's ultimate concern is tax evasion at the aggregate level.

II. AGGREGATE EMPIRICAL ANALYSIS

The primary determinants of income tax evasion as identifed in the literature cited above can be summarized using the following implicit evasion function

(1) $Z = f(Y, \Theta, \Pi, P)$.

In this function, Z is unreported income, Y is true income, Θ is the marginal tax rate, Π is the penalty rate, and P is the probability of detection.

In order to estimate (1) at the aggregate level, we need to specify it in terms of an empirically testable equation, and quantify its arguments using aggregate measures. We begin by postulating the following aggregate empirical evasion equation

(2) $Z_t = a_0 + a_1 \ln Y_t + a_2 \Theta_t + a_3 \Pi_t + a_4 P_t + U_t$,

where all variables are as defined above, t is the time index, and U is the random disturbance term with the usual interpretation. The income variable is expressed in logarithmic form in order to recognize the probable nonlinearity due to risk aversion.

For this equation to be consistent with the findings of microtheory, the signs of a_3 and a_4 should be negative. As for the signs of a_1 and a_2, microtheory provides no clear expectation. But casual observation, recent policy discussions, and some of the empirical work at the micro level might lead one to expect positive signs.

We are now in a position to relate the arguments in (2) to measurable aggregates. For the dependent variable, Z, we use a version of the Adjusted Gross Income (AGI) Gap. The Gap is the difference between the AGI figures derived by the Bureau of Economic Analysis and the AGI figures reported by the Internal Revenue Service (IRS).[8] In effect, the Bureau AGI measures reportable income, while the IRS figure measures AGI actually reported. Thus the difference between the two is a measure of unreported income. The Gap data used here have been adjusted to eliminate the AGI reported on nontaxable returns and the AGI received by those who are not required to file or pay taxes.[9] Since these individuals have no incentive to evade taxes, the adjusted AGI Gap figures should be more accurate estimates of the amount of unreported income.

It should be noted, however, that this measure of evasion is by no means comprehensive. There are many other "underground" income flows from criminal activity, etc. that are not included in the AGI Gap. At best, it measures the amount of "above ground" income that is not reported.[10]

In this aggregate specification of the evasion function, real personal income is used as a measure of true income, Y. This measure has been used, in part, because personal income is a better measure of true income than AGI. In addition, specifying income in real terms allows us to avoid the issue of inflation.[11]

There are several alternatives for calculating an aggregate proxy for the tax rate variable, Θ. One possibility is to use an effective tax rate, calculated as the ratio of total income tax revenue to some measure of income. But, as Tanzi [15, 1980, p. 79] points out,

> [a] variable thus obtained suffers from three shortcomings: first, the numerator of the ratio uses actual tax revenue rather than potential (without evasion) revenue. In other words, the ratio may be reduced by the existence of evasion. Second, the denominator may have been affected by the underreporting of some income. Third, the ratio may remain unchanged even when the rate structure is changing. This last shortcoming is perhaps the most serious, as it is the marginal tax rate on a taxpayer's income--rather than the average rate--that is more likely to determine whether he evades the tax on the marginal income.

Because of these considerations, a measure of the effective tax rate is not used in this paper. Instead, we follow a scheme suggested by Wright [16, 1969] to construct a weighted average marginal tax rate series which we believe is superior to the effective tax rate.[12] As Tanzi [15, 1980, p. 79] puts it, "this series is likely to provide yearly rates that may be closer to some modal average taxpayer's tax rate."

We use a measure of the average cost of underreporting income as a proxy for the penalty rate, Π. The procedure used to construct this measure is to express the additional taxes, penalties, and interest assessed, as reported by the Commissioner of the IRS [6, 1947-78], as a percentage of the AGI Gap. This ratio measures the effective cost (per dollar of unreported income) incurred by detected evaders.

There are a number of problems with this measure. First, its numerator consists of assessed evasion costs rather than potential costs. Thus it may suffer from the same problems as an effective tax rate. Second, this ratio does not measure the statutory penalty rate, which is what matters to the individual taxpayer. Unfortunately, because statutory penalty rates vary with the conditions of underreporting (failure to file, failure to pay, negligence, fraud, etc.), it is not possible to construct a summary series for this variable as in the case of the tax rate. This, coupled with the fact that detected evaders must not only pay penalties but also bear additional taxes and interest charges, led us to use these cost ratios.

Finally, an econometric problem with the cost-of-underreporting variable must be recognized. This ratio contains the AGI Gap in the denominator, which may introduce some simultaneity into the model. In recognition of this potential problem, a technique suggested by Durbin [2, 1954] is used to generate an instrument which replaces this variable in the equation.

As an aggregate proxy for the probability of detection, P, we use the data reported in the Commissioner of the IRS [6, 1947-78] to construct a three-year moving average of the ratio of the number of returns examined to the number of returns filed. Our reasoning is that an individual's subjective evaluation of the probability of being detected may in part depend on whether or not he/she knows someone who has been audited in the recent past, and that this will be a positive function of the percentage of returns that were audited during the previous three years. Given that some evaders may choose not to file returns at all, the denominator of this variable is likely to be understated, causing P to overstate the probability of detection somewhat. However, we believe this to be the best aggregate variable currently available.

Equation (2) has been estimated over the period 1947-78 using a second-order Cochrane-Orcutt autoregressive procedure. The following results (with the absolute values of the t-statistics in parentheses) have been obtained.[13]

$$\hat{Z}_t = \underset{(6.85)}{-52.59} + \underset{(13.97)}{33.439}\ \ln Y_t + \underset{(6.35)}{0.930}\ \Theta_t - \underset{(2.93)}{0.199}\ \Pi_t - \underset{(3.90)}{1.475}\ P_t$$

$$\bar{R}^2 = 0.95 \quad DW = 2.21 \quad \hat{\rho}_1 = \underset{(0.13)}{-0.02} \quad \hat{\rho}_2 = \underset{(3.64)}{-0.56}$$

These results indicate that there is a positive relationship between tax evasion and real income at the aggregate level. This may be taken to imply that, on the average and over the period of study, absolute risk aversion has been an increasing function of real income.

The estimation results also indicate that there is a positive relationship between tax evasion and tax rates. This can be explained as follows. Given that the subsititution effect of a tax rate change is positive, the total effect will depend on the sign or the magnitude of the income effect. As long as the income effect is nonnegative, i.e., absolute risk aversion is a nondecreasing function of income, the income effect will be positive, reinforcing the substitution effect. On the other hand, if the income effect is negative, i.e., absolute risk aversion decreases as income increases, the total effect of an increase in the tax rate will be positive only if the substitution effect dominates the income effect. Of these, the possibility of a positive income effect is consistent with the above result that over the period of study there has been a direct relationship between tax evasion and the level of real income.

The negative signs on the coefficients of the two policy parameters, the average cost of evasion, and the probability of detection, are in line with the predictions of the micro-theoretic models. It also appears that these two policy tools are indeed substitutes for one another as Allingham and Sandmo [1, 1972] have suggested. Thus there does appear to be a link between the predicted micro tax evasion behavior and the macro aggregates.

To summarize, we find all variables in this empirical model to be statistically significant, and have signs that are reasonable and consistent with the microtheory. In addition, the model explains 97% of the variation in unreported income.

III. CONCLUDING REMARKS

In view of the inherent limitations of the data used in this study, we must exercise caution in drawing conclusions. Nevertheless, given the dearth of information about tax evasion at the aggregate level, it seems appropriate to make some tentative statements.

First, the positive relationship between real income and underreporting suggests that evasion is a pro-cyclical phenomenon. This could be because of a change in the composition of income, if more easily underreportable income comprises a greater portion of real personal income during expansions. But regardless of the cause, our estimates indicate that, other things equal and on the average, a one percent increase in real income leads to an increase of more than $33 billion in unreported income. This probably overstates the situation somewhat since part of the increase in unreported income may be due to higher prices. But the highly significant coefficient on real income indicates that underreporting increases during expansion.

The pro-cyclical response of underreporting appears to be strong enough that its budgetary consequences should not be neglected. Of course, the effect of rising underreporting during expansions may very well be overwhelmed by the growth in revenues and the reduction in expenditures that typically occur during this phase of the business cycle. Therefore, additional analysis of the income elasticities of government revenues and expenditures is needed before any firm conclusions can be drawn.

Second, our results offer some support for the argument that cutting marginal tax rates will lead to greater tax revenues. This is because the tax-cut hypothesis assumes, among other things, that tax cuts reduce evasion. According to our estimates, the total effect of a one percentage point reduction in the tax rate over the sample period is to increase reported income by more than $900 million. However, it is questionable whether the resulting tax revenue will be sufficient to cover the revenue loss due to the lower tax rate. Further, tax cuts may provide incentives which may lead to greater income growth, which may, in turn, lead to more evasion. Thus the support our analysis can provide for the tax-cut hypothesis is limited. This is another area where additional research is called for.

Third, the magnitudes of the coefficients on the two policy variables, the penalty rate and the probability of detection, indicate that, other things equal, they are far from perfect substitutes as far as revenue generation is concerned. The coefficient on P is more than seven times that of Π. According to our estimates, a one percentage point increase in the probability of detection will increase reported income by nearly $1.5 billion, while a one percentage point increase in the penalty rate will only generate an additional $200 million of reported income.

The finding that increasing the audit rate is a more effective policy can be explained in part by the fact that over the period of study the mean value of this variable was relatively low, 3.5 percent. Starting with a low P, a small increase will have a larger <u>marginal</u> impact on unreported income than when P is already relatively high. Moreover, it is sensible that high penalties coupled with low probabilities of detection are not strong enough deterrents. As Kolm [8, 1973, p. 266] puts it, this is like "hang[ing] tax evaders with probability zero." On the other hand, a high probability of detection even with low monetary costs may be a more effective deterrent, partly due to nonpecuniary costs associated with prosecution. Of course, raising the probability of detection through more frequent audits involves the use of resources, while increasing the penalty rate is virtually free of costs. Therefore, a complete assessment of the relative effectiveness of these two policy tools must account for not only gross tax revenues, but also enforcement costs. Additional research is needed to determine this net return.

Finally, our analysis has followed the theoretical literature and avoided the issue of inflation. The conventional wisdom is that the government will benefit from inflation because the progressive income tax structure generates a nonlegislated tax increase. However, this argument would lose part of its appeal if it could be shown that evasion increases with inflation. Intuitively, inflation may generate an incentive to evade taxes for two reasons. First, inflation may cause nominal incomes to rise, subjecting some taxpayers to higher tax rates (bracket creep). Second, inflation erodes the taxpayer's purchasing power and thus reduces his/her standard of living. As far as we know, only Fishburn [3, 1981] has made a preliminary attempt to explicitly incorporate inflation into the standard evasion model. We believe that this is an interesting and important issue that is deserving of additional theoretical and empirical analysis.

FOOTNOTES

1. We wish to thank an anonymous referee and the editor for their helpful comments.

2. See, for example, Allingham and Sandmo [1, 1972], Srinivasan [14, 1973] and Yitzhaki [17, 1974]. Other factors, not shared by all models include the taxpayer's sex, age, education, marital status, ethnic background, and the perceived inequality in the fiscal system, to name a few.

3. For criticism of this proposition, see Kolm [8, 1973].

4. See Allingham and Sandmo [1, 1972]. Note, however, that in their model the choice variable is the level of reported income rather than unreported income or evaded taxes. Thus, they find that the substitution effect is negative and the income effect is positive, zero, or negative depending upon whether absolute risk aversion is decreasing, constant, or increasing with income.

5. See, for instance, Friedland, Maital, and Rutenberg [5, 1978], Mork [10, 1975], Spicer and Becker [12, 1980], and Spicer and Lundstedt [13, 1976].

6. See, for instance, Long [9, 1980], and Park [11, 1981]. These approaches are surveyed and critically evaluated by Frey and Pommerehne [4, 1982].

7. See, for instance, Tanzi [15, 1980].

8. The BEA derives its AGI figures by adjusting Personal Income for the conceptual differences between Personal and Adjusted Gross Income. This is necessary because each measure contains items that the other omits. Of course, imperfections in the data mean that this residual probably measures more than evaded income. But after surveying the available data, we concluded that the AGI Gap was the most appropriate measure for our purposes.

9. This adjustment was made by Long [9, 1980, p. 108]. Long's data were through 1977. The 1978 figure has been extrapolated. The results reported here are not materially affected by this procedure.

10. The Gap and other measures of tax evasion are described and critically evaluated by Frey and Pommerhene [4, 1982].

11. Little is known about the effect of inflation on tax evasion. Almost all of the theoretical work has avoided the issue. To date,

the only theoretical work in this area has been a preliminary effort by Fishburn [3, 1981].

12. The tax rates are constructed from the data in the IRS [7, 1947-78].

13. We have also estimated the tax evasion function using a double-log, a semi-log with logs on the righthand side, a semilog with the log on the lefthand side, and a purely linear functional form. The signs and significance of the estimated coefficients are generally consistent across these functional forms, although there is the expected variation in the magnitudes of the estimated coefficients.

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