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INFLATION AND TAX EVASION: AN EMPIRICAL ANALYSIS

Steven E. Crane and Farrokh Nourzad*

Abstract—This paper contains an analysis of the effect of inflation on aggregate tax evasion in the United States over the period 1947–81. It is found that tax evasion in both absolute and relative terms is positively related to the inflation rate. Further, the results indicate that aggregate evasion has risen in both absolute and relative terms with increases in the marginal tax rate, but has fallen with increases in the detection probability, the penalty rate, and the wage share of income. Finally, evasion has risen in absolute terms but has fallen in relative terms when real true income has risen.

I. Introduction

SINCE the seminal work by Allingham and Sandmo (1972) the literature on tax evasion has grown significantly.[1] Most studies have involved analysis of the evasion decision in the context of models with constant prices. In a recent contribution Fishburn (1981) has developed a theoretical model of evasion which incorporates the general price level. However, the static nature of Fishburn's analysis precluded him from considering the possibility that the rate of inflation may also influence the evasion decision. Yet the prevalence of cost-of-living adjustment clauses which are based on the inflation rate, together with the bracket-creep effect that may result suggest that such a relationship is likely to exist. Unfortunately, there has been no research addressing this possibility.

From a policy perspective, it is important that the nature of the relationship between the inflation rate and evasion be explored. For example, it has been argued that inflation is a nonlegislated tax increase which enhances government revenues. But if tax evasion is positively related to the inflation rate, the net effect of inflation on tax revenues may not be as significant as is generally believed. Moreover, a positive relationship may have implications for tax compliance policies in that the tax authorities may, depending upon implementation costs, want to intensify their compliance effort during periods of inflation.

In this paper we conduct an empirical investigation of the relationship between inflation and a measure of aggregate income tax evasion in the United States over the period 1947–81. In the process, evidence regarding the effect of the other major determinants of evasion is provided. Our approach is as follows. In the next section we briefly review the findings of the theoretical literature on income tax evasion, and offer our rationale for including the inflation rate in a model of evasion. In section III, an aggregate, empirically testable model of tax evasion is specified. Section IV contains the results from estimating two versions of this model. In the final section some concluding comments and suggestions for further research are offered.

II. Major Determinants of Income Tax Evasion

The standard approach to analyzing tax evasion has been to use a decision-under-uncertainty framework to determine how a risk-averse or a risk-neutral individual's evasion decision is affected by various factors. Typically, the taxpayer is assumed to choose either the level or the proportion of income that is to be underreported, given (1) the detection probability, (2) the penalty rate to which evaders will be subjected if detected, (3) the tax rate, and (4) the level of true income. Recently, Fishburn (1981) has incorporated the general price level into the standard model.[2]

In most cases, negative relationships have been established between underreporting and both the penalty rate and the probability of detection. This is because increasing either of these compliance policy tools reduces expected income for a risk-neutral individual, or expected utility of income

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[1] The early work includes Srinivasan (1973) and Yitzhaki (1974). More recent work, including that by Christiansen (1980) and Koskela (1983), represents extensions of, and variations on the same theme.

[2] Other factors have been analyzed, such as fairness of the fiscal system (e.g., Spicer and Becker, 1980). In addition, work has been done in a more general framework which considers the tax avoidance possibilities (e.g., Cross and Shaw, 1982), and the taxpayer's labor supply decision (e.g., Sandmo, 1981).

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for a risk-averse individual. As a result, some have argued that these two policy instruments are substitutes.

In contrast, multiple results have been obtained regarding the effect of the tax rate on evasion. Comparative static analysis of this effect reveals a positive or a negative response. This is because a change in the tax rate generates a substitution effect and an income effect.

The substitution effect of a tax rate increase results in higher evasion, since with higher tax rates evasion is more profitable on the margin. The income effect, however, depends on attitude towards risk. As higher tax rates reduce disposable income, the effect on evasion depends on whether risk aversion increases or decreases as income decreases. Under Arrow's Hypothesis that absolute risk aversion increases as income decreases the income effect results in lower evasion. In this case, the total effect of a tax rate increase is, a priori, ambiguous due to opposing income and substitution effects.

If the income effect is dominated by the substitution effect, higher tax rates lead to increased evasion, even if Arrow's Hypothesis holds. Thus, this hypothesis is a necessary condition only for a negative relationship between tax rates and evasion. Further, if absolute risk aversion is independent of income or an increasing function of income, there are no contradictory effects.[3]

Turning to the effect of changes in true income, the result depends on attitude towards risk and the choice of the measure of evasion. With a few exceptions, increases in true income lead to reductions in the proportion of income underreported.[4] This holds regardless of the assumptions made about the nature of the other determinants of evasion. But, when risk aversion is assumed, the result depends on the properties of the relevant risk-aversion function.

For example, Fishburn (1981) has shown that with a progressive tax function, a penalty function based on evaded taxes, and Arrow's Hypotheses of increasing relative and decreasing absolute risk aversion, increases in true income result in reductions in the proportion of income underreported. This has also been shown to hold (Allingham and Sandmo, 1972; Fishburn, 1981) even if the underlying tax structure is assumed to be proportional, provided relative risk aversion is an increasing function of income. This result is also obtained (Srinivasan, 1973) for a risk-neutral individual under proportional taxes, probability of detection that is an increasing function of true income, and progressive penalties imposed on evaded income.

Some general statements can also be made in the case of the level of unreported income. Under decreasing absolute risk aversion a positive relation from true income to the level of unreported income is expected. This, coupled with the above finding regarding the proportion of income underreported, indicates that increases in true income lead to less than proportionate increases in the level of underreporting.

Having discussed the determinants common to most models, we now consider the effect of inflation. One way inflation can affect the decision to evade is by eroding the real value of a given level of nominal disposable income. This provides an incentive for the taxpayer to restore his/her purchasing power through evasion. This price-level effect is what Fishburn (1981) has analyzed. He has found that while a risk-neutral individual's evasion decision is independent of the price level, that of a risk-averse individual depends on the properties of the relative risk-aversion function. Further, the observed proportion of true income that is underreported by a risk-averse individual is a nondecreasing (nonincreasing) function of the price level if relative risk aversion is an increasing (decreasing) function of income.

However, because Fishburn uses a static framework in which nominal before-tax income is assumed constant, he is unable to consider another way inflation can affect evasion.[5] In a dynamic world where nominal before-tax income can change in response to inflation, the rate of change of prices can also affect the evasion decision. For example, under a nonindexed progressive tax system, even if cost-of-living adjustments cause nominal income to rise at the same rate as inflation so

[3] Yitzhaki (1974) argues that as long as penalties are levied on evaded taxes rather than evaded income there is no ambiguity because there is no substitution effect.

[4] Examples of exceptions include Srinivasan's (1973) Corollary 2, and Fishburn's (1981) Special Cases I and II.

[5] Fishburn actually assumes a constant nominal disposable income. But this assumes either a constant nominal before-tax income or a 100% tax rate. Given that the tax rate is less than 100%, the assumption of constancy of nominal disposable income reduces to the assumption of constancy of nominal before-tax income.

that real before-tax income remains unchanged, real after-tax income may still fall as inflation pushes taxpayers into higher tax brackets. Thus, through the bracket-creep effect, the inflation rate can have a bearing on the decision to evade. Of course, the actual response of taxpayers depends on their attitudes towards risk. If risk aversion increases with real disposable income, a positive relationship between the rate of inflation and evasion may be expected.

To summarize, the major determinants of evasion can be incorporated into the following implicit evasion function:

$$Z = f(D, F, TR, Y, \dot{P}) \quad (1)$$

where Z is a measure of tax evasion, D is the probability of detection, F is the fine rate, TR is the tax rate, Y is real true income, and $\dot{P}$ is the inflation rate. A negative relationship is expected between Z and both D and F. However, theoretical analysis has been unable to establish a unique relationship between Z and the other explanatory variables. Therefore, pending additional theoretical developments, these relationships are empirical issues.

III. An Empirical Model of Tax Evasion

Aggregate empirical analysis of tax evasion requires specification of (1) in terms of an empirically testable equation, and quantification of its arguments using aggregate measures. We begin by postulating the following equation:

$$Z_{it} = a_0 + a_1 D_{t-0,1,2} + a_2 F_t + a_3 TR_t + a_4 \ln Y_t + a_5 \dot{P}_t + a_6 S_t + a_7 t + U_t \quad (2)$$

where S represents an institutional factor reflecting income from sources that are difficult to conceal, U is the random disturbance term, and all other notations are as defined previously. Equation (2) is a logarithmic transformation of a relation reflecting nonlinearities in the income variable that may arise from risk-averse behavior. In this equation, $i = 1, 2$ refers to two different specifications of the dependent variable, t is an annual time index, and $t - 0, 1, 2$ denotes the moving average of the current, one-year, and two-year lagged values of D.

In this equation the variable which is most difficult to quantify is the dependent variable, Z_i, measuring tax evasion. This is primarily because evasion is not a directly observable phenomenon. Four approaches have been used to generate estimates of evasion. These are (1) auditing tax returns to detect unreported income, (2) comparing "true" and observed labor force participation rates to determine the extent of "off-the-record" activity, (3) following the traces that evasion leaves in monetary aggregates, and (4) analyzing the discrepancies between income measures derived from national income accounts and those derived from tax return data. Each procedure suffers from shortcomings which have been discussed in Frey and Pommerehne (1982).

After examining the available estimates, we chose to base our dependent variable on a measure obtained from the fourth procedure. This is the Adjusted Gross Income (AGI) Gap, which is the difference between the AGI figure derived by the Bureau of Economic Analysis (BEA) and that reported by the Internal Revenue Service (IRS). The former is a proxy for reportable income while the latter is income actually reported to the IRS. Thus the Gap may be viewed as an approximation of aggregate unreported income, and consequently a rough indicator of the extent of evasion. However, we modify the AGI Gap as discussed below.

We base our dependent variable on the Income Gap, in part, because of data availability. We believe that it is more appropriate to examine the effect of inflation on evasion over time. This requires time-series data spanning a period of sufficient length. Unfortunately, the measures based on the other procedures do not meet this requirement.[6]

This choice was also influenced by our belief that some of the most important weaknesses of the Gap can either be overcome, or need not introduce serious distortions into our analysis. For example, a major shortcoming of the AGI Gap is that it treats income of those not legally required to file returns as evaded income. To alleviate this problem, we adjust the AGI Gap by removing from it an imputed value of the AGI of those not required to file tax returns. To accomplish this, we follow an approach used by Goode (1976). This involves using exemption data to estimate the percentage of

[6] The IRS underreporting estimates based on the Tax Compliance Measurement Program are perhaps the most reliable figures. But they are only available for selected years. On the other hand, time-series estimates based on the monetary aggregate approach are available (e.g., Tanzi, 1982). But since these are obtained from an econometric model which includes some of the explanatory variables used here, it would not be appropriate to use them.

the population not covered by tax returns, and assuming that the income of this group equals, on average, that reported on nontaxable returns. Hereafter, this modified Gap is referred to as the Adjusted Gap.

Another potential problem with using an evasion estimate based on the AGI Gap is that national income estimates are partially dependent upon the income reported on tax returns. This means that unreported income may also not appear in the national income estimates. However, since only a small fraction (e.g., about 6% in 1976, according to Parker (1982)) of national income is based on tabulations from tax returns, this should not create serious problems.

A further weakness of the Income Gap is its failure to account for all income from underground activities. Thus, the Gap tends to underestimate the true extent of the problem. But this does not preclude our use of the Adjusted Gap. Rather, it suggests that this measure is a lower bound estimate. Therefore, we use the Adjusted Gap as our measure of the level of underreporting, Z_1. It is also used to calculate the other specification of evasion, the proportion of income underreported, Z_2.

We are now in a position to quantify the independent variables in (2).

Probability of Detection, D: For this we use the moving average of the current, one-year, and two-year lagged values of the percentage of total tax returns audited each year by the IRS. The reason for using this moving average is as follows. An individual's subjective evaluation of the detection probability may, in part, depend on whether he/she knows someone who has been audited recently. This, in turn, is assumed to be a positive function of the percentage of total returns audited. Theory suggests that a negative relationship between D and both Z_1 and Z_2 should be expected.

Fine Rate, F: Because the U.S. Tax Code specifies different fines for different types of offenses, no single statutory fine figure can be used. Therefore, we use the ratio of the additional taxes, penalties, and interest assessed by the IRS during the year in question, to the amount of taxes evaded.[7] The fines are expressed as a percentage of evaded taxes in order to be consistent with the U.S. practice. Since the evaded taxes depend on unreported income, the way this variable is constructed may introduce an error-in-variable bias. Therefore, we follow Durbin's (1954) approach for constructing an instrumental variable. This involves ranking the sample in order of the variable measured with error and using this rank order as an instrument. Theory suggests that this variable will be negatively related to both Z_1 and Z_2.

Tax Rate, TR: Here we use a weighted average marginal tax rate constructed using a scheme suggested by Wright (1969). This involves averaging the marginal rates in each year's tax schedule after weighting them by the percentage of total AGI in the corresponding tax bracket. As the discussion in section II indicates, the sign of this variable will depend on the associated income and substitution effects. However, some previous empirical work (Clotfelter, 1983) suggests that a positive sign may be expected.

True Income, Y: Given that both versions of the dependent variable are based on the Adjusted Gap, the appropriate measure of true income is BEA AGI adjusted for the income of those not required to file or pay taxes. Because the inflation rate is included in the model as a separate variable, we express true income in real terms. However, using Adjusted BEA AGI as an independent variable may produce a simultaneity bias. Therefore, we instrument this variable by regressing it on all exogenous variables in the model, as well as the current and past values of the money stock and government expenditures. In general, a positive sign is expected in the case of Z_1, and a negative sign is expected in the case of Z_2.

Inflation Rate, $\dot{P}$: Since most cost-of-living adjustment clauses are tied to the rate of change of the Consumer Price Index, we use this rate as our measure of the rate of inflation.[8] As indicated above, Arrow's Hypothesis of increasing relative risk aversion suggests that a positive sign may be expected for the coefficient of this variable.

Institutional Variable, S: In the United States, some forms of income are more difficult to conceal. For example, taxes on wages and salaries are

[7] Note that unlike our measure of the detection probability, our fine rate is completely contemporaneous. The reason for this is that while the former is an attempt to capture the expected value of an inherently subjective variable, the latter is an estimate of an objective variable whose value should, at least in principle, be known with certainty.

[8] We also used the GNP Deflator, and the consumption expenditures component of the Deflator. The results were consistent with those reported in section IV.

withheld at the source. As a result, the composition of income should affect underreporting. To capture this, we include the share of wages and salaries in national income in equation (2). We expect the sign on the coefficient of this variable to be negative.

Time, t: This is added to control for the trend movements of Z_1 and Z_2. Although desirable in time-series analysis, this often causes severe multicollinearity problems in aggregate analysis. This is particularly true in the present study, since the tax rate, real income, and the inflation rate have strong trends. To handle this problem, we detrended all independent variables prior to adding the time trend.

IV. Estimation Results

Both versions of equation (2) were estimated using the Cochrane-Orcutt second-order autoregressive procedure. From the figures reported in table 1, it is evident that our model successfully captures the aggregate evasion relationship. All relevant coefficients have the expected signs, and all but one are significant at the 0.05 level. The equations explain 97% and 87% of the variation in the level of unreported income, Z_1, and the proportion of income not reported, Z_2, respectively.

TABLE 1.—ESTIMATED EQUATIONS FOR AGGREGATE TAX EVASION IN THE UNITED STATES 1947–1981 (*t*-ratios in parentheses)

Independent Variables	(2-1) Z_1	(2-2) Z_2
$D_{t-0,1,2}$	−2.034	−0.006
	(−2.90)	(−0.122)
F_t	−3.765	−0.059
	(−2.43)	(−2.80)
TR_t	1.311	0.051
	(3.35)	(2.28)
$\dot{P}_t$	0.577	0.137
	(2.12)	(4.34)
$\ln Y_t$	58.299	−0.190
	(2.20)	(−8.18)
S_t	−3.306	−0.139
	(−2.97)	(−3.38)
t	6.145	−0.504
	(1.18)	(−3.83)
Constant	−3.925	20.336
	(−0.03)	(6.29)
$\bar{R}^2$	0.967	0.872
Rho_1	1.73	−0.39
	(15.88)	(−3.10)
Rho_2	−0.78	−0.69
	(−7.16)	(−5.48)
Durbin-Watson Statistic	2.50	1.62

Consider first the compliance-policy-related variables, D, F, and S. As expected, all three are negatively related to Z_1 and are significant. This is also true with Z_2, except that the detection probability is insignificant. Based on equation (2-1), increases in either the detection probability or the fine rate, on average, lead to lower underreporting. As a result, these two policy tools do appear to be substitutes. However, since the coefficient of detection probability is smaller than that of the fine rate in (2-1), and not significant in (2-2), it appears that this substitutability is less than perfect. Thus, no firm conclusions can be drawn regarding this matter. Furthermore, differences in implementation costs need to be considered. The negative sign of the coefficient of the wage and salary share variable confirms that automatic withholding is an effective compliance policy.

In contrast, a positive sign is obtained for the tax rate. Our estimates indicate that increases in marginal tax rates not only lead to increases in the level of unreported income, Z_1, but also to increases in the proportion of income underreported, Z_2.[9] This suggests that the income effect of a tax rate change either reinforces the substitution effect or is dominated by it. These results also provide some support for the proposition that cutting tax rates need not lead to a reduction in tax revenue. However, given the relatively small magnitudes of the coefficients, it is questionable whether the gain in revenue from reduced evasion would be large enough to offset the revenue loss due to lower tax rates.

Next, consider the income variable. In (2-1) the coefficient of this variable is positive, as expected, suggesting that the level of underreporting is procyclical. As a result, it appears that the favorable effect of economic expansion on budget deficits will be at least partially neutralized by the revenue loss due to increased underreporting. In equation (2-2) the coefficient of the income variable is negative, as expected, which indicates that the *proportion* of income not reported falls as income rises. When coupled with the results from (2-1), this

[9] We also used four other estimates of the tax rate taken from Barro and Sahasakul (1983). Their estimates using AGI as weights produced results comparable to those reported here. However, their estimates using the number of tax returns as weights did not perform as well.

suggests that underreporting increases with income, but less than proportionately, as theory indicates.

Turning to the inflation rate, a positive impact is clearly indicated on both Z_1 and Z_2. Based on (2-1), a one percentage point increase in the inflation rate generates nearly $600 million of additional unreported income on an average annual basis. Using (2-2), the same one percentage point increase in the inflation rate results in a nearly 0.14% increase in the proportion of income underreported. Increased underreporting, other things equal, means less tax revenues. As a result it appears that, subject to implementation cost considerations, tax authorities may indeed want to increase their efforts during inflationary periods.

Our finding that evasion is positively related to the inflation rate also has a bearing on the argument that inflation is a nonlegislated tax increase which enhances government revenues. Estimates of the elasticity of income tax revenue with respect to the inflation rate range from 1.5 to 1.9.[10] But our results demonstrate that taxpayers, on average, respond to the inflation-induced tax increase by instituting their own nonlegislated tax cut through evasion. As a result, the net effect of inflation on tax revenues is not as large as the standard elasticity estimates indicate. However, in light of the relatively small magnitudes of our parameter estimates, it seems likely that evasion-adjusted elasticity estimates would still be greater than unity.

Finally, we note that while evasion has increased in absolute terms over time, it has declined in relative terms. This is evident from the positive, but weak, trend of the level of unreported income, and the strong negative trend of the proportion of income underreported.

In general, our results support some of the findings of the theoretical literature on tax evasion. In addition, the results with respect to the tax rate, income, and the wage share are consistent with the cross-sectional findings of Clotfelter (1983). In view of the weaknesses associated with our evasion measure, the consistency with Clotfelter's findings is reassuring. This is because his analysis is at the micro level, and involves a more direct measure of evasion. As a result, we have more confidence in our aggregate time-series model in general, and in our finding regarding the effect of inflation in particular. This is important because, as far as we know, no previous empirical evidence exists regarding the inflation–evasion relationship.

[10] See Greytak and McHugh (1978), and the references cited therein.

V. Summary and Concluding Comments

In this paper we presented an analysis of aggregate tax evasion in the United States over the period 1947–81. We found that aggregate income tax evasion in both absolute and relative terms is positively related to the inflation rate. Further, our results indicated that aggregate evasion appears to have risen in absolute and relative terms with increases in the marginal tax rate, but to have fallen with increases in the detection probability, the penalty rate, and the wage share of income. Finally, evasion has risen in absolute terms but has fallen in relative terms when real true income has risen.

The analysis presented in this paper can be extended in a number of directions. On theoretical grounds, work is needed on the bracket-creep channel of influence of inflation. From a policy standpoint, more detailed analysis of the implications for compliance and stabilization policies should be undertaken. With respect to compliance policy, attention should be devoted to estimating the net revenue effects of various policy changes, as well as to the sensitivity of various types of income to different policy actions. Similarly, in the case of stabilization policy, efforts should be directed toward determining the revenue effects of cutting taxes and fighting inflation.

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