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Tax Compliance and Advance Tax Payments: A Prospect Theory Analysis

Abstract *- While obligatory advance tax payments do not interfere with the taxpayer's evasion decision under expected utility theory, they do affect the decision to evade under prospect theory. The present paper applies prospect theory to a simple model of tax evasion, exploring the role that advance tax payments may play in enforcing tax laws. The paper demonstrates, as empirically found in the United States, that advance tax payments may substitute for costly detection efforts in enhancing compliance. However, contrary to a recent claim in the tax evasion literature, deliberate high advance tax payments are unlikely to eliminate the incentives for noncompliance.*

INTRODUCTION

Empirical and experimental evidence suggests that advance tax payments may play an effective role in tax authorities' enforcement strategy. Cox and Plumley (CP, 1988) found that voluntary compliance rates in the United States increased consistently with the amount of refund that taxpayers expected to receive upon the filing of a tax return and decreased consistently with the amount of taxes that they still had to pay.[1] Chang et al. (1987) and Robben et al. (1990) confirmed experimentally the empirical findings for the United States and several European countries, whereas Carroll (1992), documenting diaries of taxpayers' tax-related thoughts and

[1] Voluntary compliance has been estimated using data from the Taxpayer Compliance Measurement Program (TCMP) of the Internal Revenue Service for tax year 1982, which consisted of a random selection of 50,000 tax returns subjected to a thorough inspection solely for research purposes. The measure of voluntary compliance used is the Voluntary Compliance Rate (VCR), defined as the percentage of total tax liability (as established by a TCMP examination) that is voluntarily reported. With few exceptions, the VCR for all types of income has been found to be the lowest among those who owed the most with their returns (71.6 and 90.7 percent among individuals whose corrected balance due exceeded $1,000 and whose primary source of income was business and wages, respectively), the highest among those who were due the largest refund (95.2 and 96.6 percent among individuals whose corrected refund exceeded $1,000 and whose primary source of income was business and wages, respectively), and to gradually increase as the balance due decreases or the refund increases. A detailed description of CP's (1988) study may also be found in Chang and Schultz (1990) and Robben (1991).

Gideon Yaniv
National Insurance Institute, Jerusalem 95437, Israel

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behaviors, found that taxpayers thought primarily in terms of the out-of-pocket gains and losses *at the time of filing*, concluding that whether taxpayers expect to receive a refund or have to supplement their prepaid taxes is important for the understanding and control of taxpaying behavior.

In a recent contribution, Elffers and Hessing (EH, 1997) suggest, following Robben (1991) and Webley et al. (1991), that prospect theory, developed by Kahneman and Tversky (1979), may help explain taxpayers' observed behavior under obligatory advance tax payments. Elffers and Hessing argue that when prepaid taxes are greater than the true tax liability, the taxpayer expects a gain from filing a return, whereas if prepaid taxes are less than the true tax liability, they expect a loss. Hence, in the spirit of prospect theory, the taxpayer is risk averse with respect to the former case and risk seeking with respect to the latter. Consequently, he will opt to avoid risk in the former case and to take his chances in the latter. Elffers and Hessing conclude that the incentives for noncompliance can be eliminated if the tax authorities deliberately set the advance payments slightly above taxpayers' true tax liability so as to ensure a gain from filing a return.

Elffers and Hessing's conclusion might, however, be a bit hasty; after all, risk aversion does not imply that the individual will *always* avoid risk, the same as risk seeking does not imply that she will *always* pursue risk. More specifically, the ability of nonrisky gains to induce honesty is not unrelated to the risk involved in gaining more through behaving dishonestly. Why should a skillful evader, who is aware of the low probability of getting caught and punished for tax evasion (which is less than one percent in the Unites States), switch to safety when subjected to an advance payment that is slightly (or even significantly) higher than her true tax liability? Just because she is manipulated to play in the risk-aversion domain? Intuitively, it may be possible that prospect theory supports CP's finding that compliance *increases* as the advance payment is raised above the true tax liability and *decreases* as the advance payment is lowered below the true tax liability, but to find out whether this is so, as well as whether advance tax payments may effectively *eliminate* the incentive for noncompliance, requires a more rigorous application of prospect theory to the tax evasion problem than the qualitative considerations pointed out by EH.

The present paper applies prospect theory to a simple model of tax evasion with the purpose of inquiring into the taxpayer's decision of whether and to what extent to underreport their taxable income if obliged to pay a tax advance prior to the filing of a tax return.[2] While the tax advance is in part determined by the taxpayer's tax rate and estimated taxable income and in part by the taxpayer's choice (as some tax systems allow taxpayers a certain degree of flexibility as regards their prepaid amount), it may also include

[2] The rationale underlying this requirement is twofold: first, taxes become due when incomes are earned, rather than when tax returns are filed; second, people with low and middle incomes tend to use their income as it becomes available and may find it difficult, if their income falls, to pay a tax debt accrued in the previous year (Pechman, 1983). Analytical treatment of advance tax payments in the tax evasion literature has so far been restricted to wage earners whose taxes are withheld at source by the employer. Under *approximate* withholding with obligatory end-of-year filing (the American system), wage earners may evade taxes simply by failing to file a return (Yaniv, 1988). Under *exact* withholding without obligatory filing of an end-of-year tax return (the British system), wage earners may still evade taxes by splitting their work efforts between two (or more) jobs, failing to inform their employers that they are also employed elsewhere, thus enjoying lower tax brackets (Yaniv, 1998). The withholding system might also generate incentives for the *employer* to evade his employees' taxes by remitting to the tax collector less than the amount withheld (Yaniv 1988, 1995) or by collaborating with his employees in withholding less than required (Yaniv, 1992).

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an exogenous component, permitted to the tax authorities by a variety of policy options. Allowing for such a component, the paper subsequently inquires into the implied trade-offs between advance payments and conventional enforcement in enhancing compliance. The paper, however, abstracts from taxpayers' own discretion in the determination of the prepaid amount, because this implies that taxpayers may have control over whether they owe taxes or have taxes due at the time of filing, rather than view their tax balance at that time as exogenously given. Hence, the application of prospect theory to analyzing the relationships between tax compliance and advance payments, which rests on the assumption that potential tax evaders think primarily in terms of out-of-pocket gains and losses at the time of filing, may not be appropriate.

The paper begins with constructing the formal model, showing that expected utility theory, which has frequently been applied to the tax evasion problem, yields no relationship whatsoever between advance tax payments and the taxpayer's evasion decision, whereas if the taxpayer's behavior conforms with prospect theory assumptions, the entry condition into tax evasion, as well as the extent of evasion, becomes dependent on the size of the advance payment.[3] The paper proceeds to investigate the relationships between tax evasion and advance tax payments, demonstrating, in support of CP's empirical finding, that obligatory advance payments may indeed substitute for costly detection efforts in enhancing compliance. However, only if taxpayers substantially overweight the low probability of detection prevailing in most countries may EH's conclusion hold as well; otherwise, if taxpayers hold realistic assessments of the actual probability level, reasonably high advance payments, even if ensuring a refund upon filing a return, are unlikely to eliminate the incentives for noncompliance. The paper subsequently examines the relationship between tax evasion and the income tax rate under obligatory advance payments, revealing that had the tax advance been independent of the income tax rate, an increase in the latter would unambiguously decrease compliance. Because the tax advance increases with the tax rate, it acts oppositely to encourage compliance. Still, when compliance is sufficiently high, the former effect is shown to dominate, in sharp contrast with the literature's result that compliance increases with the income tax rate.

THE MODEL

Consider a taxpayer whose actual income less deductible expenses during a given tax year, W, is subject to a constant tax rate, θ. Suppose that the taxpayer is required by law to declare her income and deductible expenses to the tax agency by filing a tax return at the end of the tax year.[4] Suppose also that the tax agency requires the taxpayer to pay a tax advance of a given size, D, prior to filing a return, to be offset later against the taxes due on her taxable income.[5] The tax advance is assumed to consist of two components: an

[3] Prospect theory has failed so far to attract the attention of economists as a possible tool of analyzing tax evasion, an exception being Alm and Beck (1990), who applied it to the analysis of tax amnesties.

[4] The tax law may actually allow taxpayers certain margins of time for filing their tax returns (in the United States, for example, returns must be filed not earlier than January 31 and not later than April 15 of the following tax year). This gives rise to the question of when to file one's return (i.e., whether to file promptly at the earliest possible day or to delay filing), a decision modeled by Slemrod et al. (1997), which we ignore here.

[5] Practically, wage and salary earners have their tax advances deducted at source by their employers in the form of tax withholdings. Self-employed and recipients of property income usually pay their tax advances in monthly or quarterly installments during the year in which their income is received. The tax advance, D, defined above, may be viewed as the sum of all tax prepayments, abstracting, within the single-period framework, from timing considerations.

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endogenous one, which is a positive function of estimated tax liability, S; and an exogenous one determined by the tax agency as part of its tax enforcement policy, $\overline{D}$. Hence,

$$[1] \quad D = a(S) + \overline{D}$$

where $a'(S) > 0$. Estimated tax liability will be assumed to equal θb, where b is some income base serving as an estimate of the taxpayer's actual income (e.g., last year's income or average income in the taxpayer's profession).

Suppose now that the taxpayer considers the possibility of declaring to the tax agency less than her true taxable income, X ($\leq W$), through either underreporting true income or overreporting true expenses. In this case, her evaded taxes, $\theta(W - X)$, will be taxed, if detected, at a penalty rate λ (>1). The probability of being detected evading taxes is assumed to be independent of the taxpayer's activity, set by the tax agency at the level of p (<1). While taxpayers in general may have subjective perceptions of the probability of detection, which differ from its true value, we begin by assuming that the potential evader is fully informed of the actual probability level.

Underreporting of actual income gives rise to two possible levels of final net income: I^+, if the taxpayer's evasion is not detected; and I^-, if her evasion is detected. These are given by

$$[2] \quad I^+ = W - D + (D - \theta X)$$

and

$$[3] \quad I^- = W - D + [D - \theta X - \lambda\theta (W - X)]$$

respectively. The taxpayer is assumed to choose a level of declaration, X^*, so as to maximize a given target function. If expected utility, $EU(I) = (1-p)U(I^+) + pU(I^-)$, is assumed to be her target function, the tax advance, D, is canceled out in both equations 2 and 3, and the model collapses to the well-known Allingham and Sandmo (AS, 1972) model, with the penalty function suggested by Yitzhaki (1974), implying that the imposition of an obligatory advance payment would play no role in the taxpayer's evasion decision.

Consider, however, prospect theory, which replaces the utility function by a "value function," $v(\bullet)$. The value attached by the taxpayer to each possible outcome of the risky decision is assumed to depend on the *change* in net income from some reference point, rather than on the level of net income itself. Most importantly, the value function is assumed to be concave for gains but convex for losses, so that the taxpayer is risk averse with regard to the former but risk seeking with regard to the latter.[6] Applying these assumptions to the evasion decision at hand first requires determination of the reference point from which changes in net income are measured. Elffers and Hessing suggest that the reference point should be income after the payment of the tax advance and prior to the filing of a return, $W - D$.[7] The changes in the taxpayer's net income therefore are

$$[2'] \quad \Delta I^+ = D - \theta X$$

and

$$[3'] \quad \Delta I^- = D - \theta X - \lambda\theta(W - X)$$

[6] Also, prospect theory replaces the probability of the risky occurrence, p, with a "weighting function," $\phi(p)$, that depends positively on p but that overweights low probabilities and underweights high ones. As noted above, we abstract first from the possible discrepancy between the actual and the perceived probability of detection, assuming therefore that $\phi(p) = p$.

[7] While this is the most plausible reference point for examining the effect on behavior of out-of-pocket gains or losses at the time of filing, it also seems to be the only possible reference point that maintains D as a relevant parameter in the taxpayer's problem. For other possible reference points, such as income before taxes, W, or income after taxes due, $(1 - \theta)W$, D will be canceled out in both equations 2′ and 3′.

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in case of nondetection and detection, respectively. Notice that equations 2′ and 3′ imply that the evading taxpayer anticipates a certain refund of $D - \theta X$ (or, given that $D < \theta X$, a certain supplementary tax payment of $\theta X - D$), irrespective of whether they are caught, and a probabilistic penalty of $\lambda\theta(W - X)$, due to the possibility of detection.

The taxpayer now chooses X^* so as to maximize the value, V, of their prospect

$$[4] \quad V = v(D - \theta X) + p v[-\lambda\theta(W - X)]$$

where, contrary to expected utility theory, the certain refund (or supplementary payment) is valued as $v(D - \theta X)$ and weighted by a probability of unity.[8] Maximizing equation 4 now with respect to X, the first- and second-order conditions for an interior optimum are

$$[5] \quad \frac{dV}{dX} = \theta\{-v'(D - \theta X) + p v'[-\lambda\theta(W - X)]\} = 0$$

and

$$[6] \quad \frac{d^2V}{dX^2} \equiv \Omega = \theta^2\{v''(D - \theta X) + p\lambda^2 v''[-\lambda\theta(W - X)]\} < 0$$

respectively. Because both $v'(D - \theta X)$ and $v'[-\lambda\theta(W - X)]$ are positive, there are no apparent restrictions on satisfying equation 5. However, because $v''[-\lambda\theta(W - X)]$ is positive (reflecting risk seeking for losses), equation 6 may only be satisfied if $D - \theta X$ is positive, so that $v''(D - \theta X)$ is negative (reflecting risk aversion for gains).

TAX COMPLIANCE AND THE ADVANCE PAYMENT

Suppose first that the advance tax payment, D, is set above the taxpayer's true tax liability, θW, so that the taxpayer expects a gain from reporting honestly. Nevertheless, she might opt to report dishonestly (i.e., choose $X^* < W$) if it serves to increase the value of her prospect. A sufficient condition for doing so is that $dV/dX < 0$ at $X = W$, or that

$$[7] \quad p\lambda < \frac{v'(D - \theta W)}{v'(0)^-}$$

where $v'(0)^-$ denotes the left-hand derivative of the value function at the origin, which is assumed by prospect theory to be steeper than the right-hand derivative, $v'(0)^+$. Contrary to Yitzhaki's (1974) model, and to its numerous extensions, where the entry condition into tax evasion, $p\lambda < 1$, depends on the probability of detection and the penalty rate alone, the entry condition in the present model depends also on the size of the tax advance, D, as well as on the income tax rate, θ. It is also stricter than Yitzhaki's condition, because $v'(D - \theta W)/v'(0)^- < 1$. Quite surprisingly, a deterrent to tax evasion may exist even if detection does not involve an effective penalty but just the payment of the taxes due (i.e., if $\lambda = 1$).[9]

Consider now the implications of the entry condition for tax enforcement. Tax agencies usually face exogenously given tax and penalty rates (stipulated in the tax laws), having discretion over the extent and intensity of tax audits, which determine the probability of detection, and, presumably, some discretion over the size of the advance tax payment through its

[8] That is, contrary to expected utility theory, V is not written as $(1 - p)v(\Delta I^+) + p v(\Delta I^-)$. Because $D - \theta X$ is due in both states of the world, it is grouped under the certain value of $v(D - \theta X)$, an adjustment called "editing" by Kahneman and Tversky (1979). The taxpayer then faces a modified prospect of $v(D - \theta X) + (1 - p)v(0) + p v[-\lambda\theta(W - X)]$, the middle term of which drops out, because $v(0) = 0$ in prospect theory.

[9] This, however, is in line with the fiscal psychology literature, which suggests that taxpayers may perceive even the payment of taxes due as a penalty (Hessing et al.,1992).

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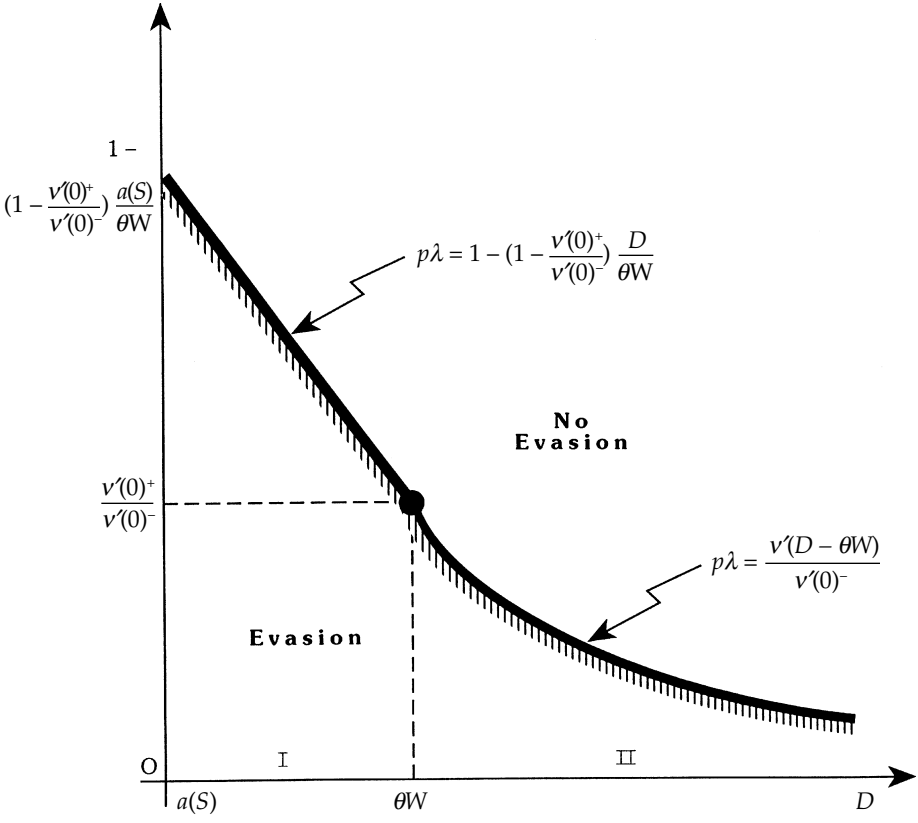
exogenous component, $\overline{D}$. The former is evidently resource consuming, whereas the latter presumably entails no resource costs. To allow the tax agency full flexibility in setting the advance payment as low as it wishes above the taxpayer's true tax liability, it will be assumed that $a(S) \leq \theta W$. Condition 7 now implies that the incentive for tax evasion can be eliminated not only through a costly increase in detection efforts (which increases $p\lambda$), but also through a noncostly raise of $\overline{D}$ [which increases D and decreases $v'(D - \theta W)$], so as to increase the gain expected from honest declaration. However, while advance tax payments may substitute for costly detection efforts in inducing full compliance, they must be set at a sufficiently high level, which is inversely related to the level of detection efforts. Figure 1 (part II) demonstrates that when D is relatively small, approaching θW from above, $v'(D - \theta W)/v'(0)^-$ approaches $v'(0)^+/v'(0)^-$, which has been shown experimentally by McClelland et al. (1986) to equal approximately one-third. Hence, when $p\lambda$ is relatively high, approaching one-third from below, D may be set only slightly above θW to induce honesty. As $p\lambda$ is reduced, D must be increased,[10] and as $p\lambda$ ap-

Figure 1. Evasion/No Evasion Regions



[10] Mathematically, holding equation 7 as an equality and differentiating $p\lambda$ with respect to D yields $d(p\lambda)/dD = v''(D - \theta W)/v'(0)^- < 0$, so that $p\lambda$ is inversely related to D along the full-compliance contour.

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proaches zero, D must be raised to infinity to induce honesty. In view of the substantially low levels of costly enforcement prevailing in most countries,[11] and given that taxpayers who opt to engage in tax evasion hold realistic assessments of the actual probability level, reasonably high advance payments, even if ensuring a refund upon filing a return, are unlikely to eliminate the incentive for noncompliance. Still, totally differentiating the first-order condition 5 with respect to X and $\overline{D}$ reveals that as long as evasion *is* practiced,

$$[8] \quad \frac{dX^*}{d\overline{D}} = \frac{\theta v''(D - \theta X)}{\Omega} > 0$$

so that higher advance payments, while not necessarily eliminating evasion, would at least *reduce* evasion. This supports CP's empirical finding that compliance increases consistently with the amount of refund due to taxpayers upon filing a tax return.[12]

Suppose now that $a(S) < \theta W$ and that the advance payment is set below (or exactly at) the taxpayer's true tax liability. That is, suppose that $a(S) + \overline{D} = D \leq \theta W$. Hence, the taxpayer expects a loss (or neither a loss nor a gain) from declaring honestly. The second-order condition 6 implies that an interior solution may still be obtained at a sufficiently low level of declaration for which $D - \theta X > 0$ (although $D - \theta W \leq 0$). In this case, result 8 would hold just the same, implying, again in support of CP's findings, that compliance is greater the lower the amount of taxes still due to the tax collector, $\theta W - D$. Given, however, that the first-order condition 5 is solved at a sufficiently high level of declaration for which $D - \theta X < 0$, such a solution would represent a minimum rather than a maximum. Thus, the taxpayer would either report their true taxable income or report no taxable income at all, depending on whether "value" is greater for $X = W$ or $X = 0$, respectively. Substituting $X = W$ and, alternatively, $X = 0$ into equation 4, rearranging, and setting $v(0) = 0$ (as prospect theory assumes), the taxpayer will report no taxable income if $v[-(\theta W - D)] < v(D) + pv(-\lambda\theta W)$ and will report all taxable income if this inequality is reversed. Linearly approximating the changes in "value" around $v(0)$, the entry condition into evasion becomes

$$[9] \quad p\lambda < 1 - \left(1 - \frac{v'(0)^+}{v'(0)^-}\right)\frac{D}{\theta W}.$$

Hence, the entry condition in this case is stricter than Yitzhaki's (1974) condition as well and dependent on the size of D. Given that the first-order condition 5 represents a minimum, advance tax payments may thus substitute for costly detection efforts in inducing full compliance even when set below the true tax liability. Figure 1 (part I) demonstrates that when $\overline{D} = 0$, $p\lambda$ must be raised to $1 - [1 - v'(0)^+ / v'(0)^-][a(S)/\theta W]$ to induce honesty (which would collapse to unity had D been free of an endogenous component). As D is increased, $p\lambda$ may be lowered, and when $D = \theta W$, $p\lambda$ may be set as low as $v'(0)^+ / v'(0)^-$ to induce honesty. Still, because the latter expression has been estimated to equal one-third, which far exceeds the values of $p\lambda$ in real life, advance payments set below (or exactly at) taxpayers' true tax liability are unlikely to eliminate the incentive for evasion of fully informed taxpayers.

[11] Alm et al. (1992) point out that in the United States less than one percent of individual income tax returns are subject to a thorough tax audit and that the penalty on fraudulent evasion is only 75 percent of unpaid taxes. Hence, the expected penalty rate, $p\lambda$, is as low as 0.0175.

[12] While taxpayers in the United States have some flexibility in determining their advance payments, it does not necessarily follow that they also determine ahead whether they owe taxes or have taxes due at the time of filing, because final income and deductibles may unexpectedly differ from those anticipated when the prepayment decision was made (see Martinez-Vazquez et al., 1992). Hence, taxpayers' tax balance when filing a return may still be viewed as exogenously given and prospect theory applied to explain their compliance behavior.

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A crucial assumption of the analysis is, of course, that taxpayers' perceived probability of getting caught and penalized for tax evasion coincides with the true probability of detection. However, recent empirical and experimental evidence seems to suggest, in line with prospect theory presumptions, that individuals often overweight the true probabilities of low-probability events and, in particular, that taxpayers tend to overweight the low probability of audit that they in fact face.[13] Such evidence may help explain why people pay far more in taxes than suggested by the standard expected utility theory of compliance, as the latter implies that the real-life parameter values of the tax evasion gamble are not likely to deter 'rational' taxpayers from reporting dishonestly. Allowing for taxpayers' overweighting of the low probability of detection would obviously moderate the pessimistic conclusion of the present discussion regarding the effectiveness of advance tax payments to eliminate the incentive for noncompliance: given that taxpayers substantially overweight the actual probability of detection, tax advances set only slightly above taxpayers' true tax liability may indeed suffice to induce honesty, as argued by EH (1997).[14] Moreover, given substantial overweighting, taxpayers could be induced to report honestly even if tax advances are set *below* their true tax liability.

TAX EVASION AND THE INCOME TAX RATE

Given an interior optimum, consider now the taxpayer's response to a change in the income tax rate. Totally differentiating the first-order condition 5 with respect to X and θ yields (recalling that D contains an endogenous component, $a(S)$, where $S = \theta b$)

$$[10] \quad \frac{dX^*}{d\theta} = -\frac{\theta}{\Omega}\{[X - a'(S)b]v''(D - \theta X) - p\lambda^2(W - X)v''[-\lambda\theta(W - X)]\}$$

the sign of which is negative if $X \geq a'(S)b$ and ambiguous otherwise. It may be reasonable to assume that $a(S) = \alpha S$, so that the endogenous component of the tax advance is some fraction, $0 \leq \alpha \leq 1$, of estimated taxable income, S. This implies that the sign of equation 10 will be negative if $X \geq \alpha b$, which is definitely satisfied if $\alpha = 0$, but may also be satisfied if $\alpha = 1$.[15] Hence, had the tax advance been independent of the income tax rate, an increase in the latter would unambiguously decrease declaration. Because the tax advance increases with the tax rate, it acts oppositely to encourage declaration. Still, as long as declaration is sufficiently high, the former effect will dominate. While this result accords with common sense and intuition, it is in sharp contrast with Yitzhaki's (1974) result dominating the tax evasion literature, that declared income always increases with the tax rate. Furthermore, a negative relationship between declared income and the income tax rate would arise in this case even if the penalty on tax evasion is imposed on the concealed income, $W - X$, as assumed by AS (1972). This is so because the first-order condition 5 would then become (assuming $\lambda > \theta$)

[13] See Alm et al. (1992).

[14] Formally, this implies that the probability of detection, p, should be replaced by a weighting function, $\phi(p)$, such that $\phi(p) > p$. Substituting into condition 7 and setting D only slightly above θW, the inequality sign may be reversed if $\phi(p)$ is sufficiently high so that $\phi(p)\lambda$ approaches one-third.

[15] Notice that, at an interior solution, $D - \theta X$ must be positive to ensure that $v''(D - \theta X)$ is negative (otherwise, the second-order condition 6 does not hold and equation 4 is maximized at a corner solution). For $\alpha = 1$, this requires that $X < b + \bar{D}/\theta$, still allowing for $X > b$.

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$$[5'] \quad \frac{dV}{dX} = -\theta v'(D - \theta X) + p\lambda v'[-\lambda(W - X)]\} = 0$$

yielding

$$[10'] \quad \frac{dX^*}{d\theta} = -\frac{1}{\Omega}[-v'(D - \theta X) + \theta(X - \alpha b) v''(D - \theta X)]$$

which for $X \geq \alpha b$ is negative, in contrast with the ambiguous prediction characterizing AS's model.

How can we account for the differences in implications between expected utility theory and prospect theory in this regard? Consider first AS's expected-utility model of a risk-averse taxpayer, where an increase in the income tax rate has been interpreted by AS to generate opposing substitution and income effects on declaration: on the one hand, a tax rate increase makes evasion more profitable at the margin, inducing the taxpayer to reduce declaration; on the other hand, a tax rate increase makes the taxpayer less wealthy (regardless of whether detected), which, assuming decreasing absolute risk aversion, reduces the tendency to take risks, thus inducing the taxpayer to increase declaration. In the prospect theory model, the substitution effect is still preserved, reflected through the first term of equation 10′. However, as evident from equation 5′, a tax rate increase affects just the certain component of the value function (which, contrary to expected utility theory, is weighted by a probability of one). Consequently, the income effect in the present model, captured by the second term of equation 10′, is independent of risk-aversion behavior. It reflects, on the one hand, the taxpayer's attempt to cushion the resulting increase in tax payments by subjecting less income to taxation and, on the other hand, her greater tendency for compliance when being subjected to a higher tax advance. When $X \geq \alpha b$, the former effect dominates (or is exactly offset by) the latter, supporting the substitution effect in generating a negative relationship between declared income and the income tax rate.

In Yitzhaki's (1974) model, the substitution effect disappears, because an increase in the income tax rate increases the marginal cost of tax evasion ($p\lambda\theta$) by the same proportion as its marginal benefit (θ). The remaining income effect is thus responsible for the positive relationship between declaration and the income tax rate identified in that model. In the present model, however, the income effect consists of two components: the certain refund component (as discussed above) and the uncertain penalty component, captured by the first and second terms of equation 10, respectively. The latter component affects 'value' in the loss domain where the taxpayer is a risk seeker, and where a tax rate increase, which increases the loss expected at a given level of evasion, compensatively discourages declaration.

Finally, considering the taxpayer's response to a change in the traditional law enforcement parameters, the penalty rate, and the probability of detection, we obtain

$$[11] \quad \frac{dX^*}{d\lambda} = -\frac{\theta p}{\Omega}\{v'[-\lambda\theta(W - X) - \lambda\theta(W - X)\, v''[-\lambda\theta(W - X)]\}$$

and

$$[12] \quad \frac{dX^*}{dp} = -\frac{\theta\lambda}{\Omega} v'[-\lambda\theta(W - X)]$$

respectively. While the sign of equation 12 is unambiguously positive, implying, in line with the expected utility model, that an increase in the probability of detection will increase declaration and decrease evasion, the sign of equation 11 is ambiguous, in contrast with the positive and intuitively expected sign generated by the expected utility model. The reason for this is that the income effect of an increase in the penalty

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rate is positive in the latter model but negative in the present model where a penalty rate increase affects 'value' in the loss domain, acting to encourage risk taking. Regrettably, prospect theory does not always generate a more plausible prediction than does the expected utility model.

CONCLUDING REMARKS

While advance tax payments play no role in the taxpayer's evasion decision under expected utility theory, they do affect the decision to evade under prospect theory. The present paper has applied prospect theory to a simple model of tax evasion, inquiring into the relationships between tax compliance and advance tax payments. The results support the empirical and experimental evidence that advance tax payments, even if set below taxpayers' true tax liability, may substitute for costly detection efforts in enhancing compliance. Moreover, s*ufficiently high* advance payments may induce *full compliance*. However, while advance payments may be set only slightly above taxpayers' true tax liability to induce full compliance when detection efforts are relatively high, they must be raised considerably as detection efforts are reduced, approaching infinity as detection efforts approach their low real-life levels. Hence, as long as taxpayers hold realistic assessments of the actual probability of detection, it is unlikely that *reasonably* high advance payments, although ensuring a tax refund, will suffice to eliminate tax evasion. This pessimistic conclusion is, however, moderated if taxpayers are known to overweight the low probability of detection, in which case, if overweighting is substantial, tax advances set even *below* taxpayers' true tax liability may suffice to induce honesty.

The application of prospect theory to analyzing the taxpayers' compliance behavior under advance payments rests on the assumption that the taxpayer cannot self-select into a tax-refund or a tax-due status, thus viewing their tax balance at the time of filing as exogenously fixed. Relaxing this assumption suggests that evasion and prepayment may be interrelated; hence, a decision to evade *may have led* to a given tax status rather than being induced by it.[16] Modeling the taxpayer's joint evasion-prepayment decision necessitates, however, a different analytical framework, as it implies that the taxpayer does not think merely in terms of out-of-pocket gains and losses at the time of filing. It also involves weighing the alternative cost of self-selecting into a refund status against the benefit of doing so, which is rather obscure. As recently noted by Slemrod et al. (1997), why taxpayers choose to grant the government an interest-free loan is a fascinating question. Highfill et al. (1998) suggest that taxpayers may overwithhold so as to avoid a penalty in case that withholding does not reach a certain percentage of their current (or last year) tax liability, if facing income and deductibles *uncertainty* at the time of withholding. Given this motive, Highfill et al. model the prepayment decision of a risk-neutral taxpayer who does not seek to avoid or evade taxes. Allowing for tax evasion would substantially complicate the model because of the additional source of uncertainty involved.

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[16] This problem is discussed by Martinez-Vazquez et al. (1992), who used an experimental approach to examine whether underwithheld taxpayers are more likely to evade taxes, controlling for the possible interrelationship between underwithholding and evasion through distinguishing between intended and unintended underwithholding and concentrating on the impact of the latter.

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