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by
Gideon Yaniv

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## ABSTRACT

*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 applies prospect theory to a simple model of tax evasion, demonstrating, as empirically found in the US, that obligatory advance payments may substitute for costly detection efforts in enhancing compliance. Still, contrary to a recent suggestion in the literature, reasonably high advance payments, which ensure a refund upon filing a return, are unlikely to eliminate the incentives for noncompliance. Moreover, as long as the taxpayer expects a tax refund, an increase in the income tax rate will unambiguously increase evasion, in sharp contrast to the inverse relationship dominating the literature.*

**Key Words:** Tax Compliance, Tax Evasion, Advance Tax Payments, Prospect Theory

**JEL Classification:** H26 (Tax Evasion), D81 (Criteria for Decision-Making under Risk and Uncertainty)

## I. Introduction

Empirical and experimental evidence suggests that advance tax payments may play an effective role in tax authorities' enforcement strategy. Cox and Plumley (1988, hereafter CP) found that voluntary compliance rates in the United States (defined as income reported to the IRS as a fraction of income assessed by the IRS) 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 expected to pay. Chang et al. (1987), Robben et al. (1990) and Webley et al. (1991) confirmed experimentally the empirical findings, whereas Carroll (1992), documenting diaries of taxpayers' tax-related thoughts and behaviors, found that taxpayers thought primarily in terms of the out-of-pocket gains and losses *at the time of filing a return*, concluding that whether taxpayers expect to receive a refund or to have to supplement their prepaid taxes is important for the understanding and control of taxpaying behavior.

In a recent contribution, Elffers and Hessing (1997, hereafter EH) suggest that prospect theory, developed by Kahneman and Tversky (1979), may help explain taxpayers' observed behavior under obligatory advance tax payments. EH 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, he expects 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. EH conclude that the incentives for noncompliance can be eliminated if advance tax payments are set slightly above taxpayers' true tax liability so as to ensure a gain from filing a return.

EH's conclusion is, however, 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 he will *always* pursue risk. More specifically, the ability of non-risky 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 1 percent in the Unites States) switch to safety when subjected to an advance payment which is slightly (or even significantly) higher than his true tax liability? Just because he 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 and under what conditions advance tax payments may effectively *eliminate* the incentives for noncompliance, requires a more rigorous approach than that taken 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 his true taxable income if obliged to pay a tax advance prior to the filing of a tax return.[1] Section II constructs 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, become dependent on the size of the advance payment.[2] Section III proceeds to investigate the relationships between tax evasion and advance tax payments, demonstrating that while obligatory advance payments may substitute for costly detection efforts in enhancing compliance, reasonably high advance payments, which ensure a refund upon filing a return, are unlikely to eliminate the incentives for noncompliance. Moreover, Section IV reveals that as long as the taxpayer expects a tax refund, an increase in the income tax rate will unambiguously increase evasion, in sharp contrast to the inverse relationship dominating the literature. Section V concludes with a summary of the main results.

[1] Analytical treatment of advance tax payments in the tax evasion literature has been restricted to single-job wage-earners with no other income (or deductible expenses) whose taxes are withheld at source by the employer. Since wage-earners' returns must be accompanied by the employer's statement of taxes withheld and wages paid, their only possible way of evasion is to avoid filing a return altogether, given that the withholding rates do not reach as high as the final tax rates (Yaniv, 1988). The withholding system, however, might generate incentives for the employer to evade his employees' taxes by remitting to the tax collector less than the amount withheld, or by collaborating with employees in withholding less than required (Yaniv, 1988 and 1992, respectively).

[2] 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.

**II. The Model**

Consider a taxpayer whose actual income less deductible expenses during a given tax year, $W$, is subject to a constant tax rate, $\theta$. Suppose that the taxpayer is required by law to declare his income and deductible expenses to the tax agency by filing a tax return at the end of the tax year. However, 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 his taxable income. Suppose further that the taxpayer considers the possibility of declaring to the tax agency less than his true taxable income, $X$ ($\leq W$), through either underreporting his true income or overreporting his true expenses. In this case, his evaded taxes, $\theta(W-X)$, will be taxed, if detected, at a penalty rate $\lambda$ ($>1$). 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 $0<p<1$.

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 his evasion is detected. These are given by

$$I^+ = W - D + (D - \theta X) \tag{1}$$

and

$$I^- = W - D + [D - \theta X - \lambda\theta(W - X)], \tag{2}$$

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 his target function, the tax advance, $D$, is canceled out in both (1) and (2), and the model collapses to the well-known Allingham and Sandmo's (1972, hereafter AS) 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 one of the alternative 'states of the world' that may result from tax evasion 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. Applying these assumptions to the evasion decision at hand requires first to determine the reference point from which changes in net income are measured. EH suggest that the reference point should be income after the payment of the tax advance and prior to the filing of a return, $W-D$. The changes in the taxpayer's net income are therefore

$$\Delta I^{+} = D - \theta X \tag{1'}$$

and

$$\Delta I^{-} = D - \theta X - \lambda\theta(W-X), \tag{2'}$$

in case of non-detection and detection, respectively. Notice that (1') and (2') imply that the taxpayer expects a certain refund of $D-\theta X$ (or, given that $D < \theta X$, a certain supplementary tax payment), irrespective of whether he is caught or not, and a probabilistic penalty of $\lambda\theta(W-X)$ in case of detection.

The taxpayer now chooses $X^{*}$ so as to maximize the value, $V$, of his prospect

$$V = v(D-\theta X) + pv[-\lambda\theta(W-X)], \tag{3}$$

where, contrary to expected utility theory, his certain refund (or supplementary payment) is valued as $v(D-\theta X)$, and weighted by a probability of unity.[3] Maximizing now (3) with respect to $X$, the first and second-order conditions for an interior optimum are

$$\frac{dV}{dX} = \theta\{-v'(D-\theta X) + p\lambda v'[-\lambda\theta(W-X)]\} = 0 \tag{4}$$

and

$$\frac{d^2V}{dX^2} \equiv \Omega = \theta^2\{v''(D-\theta X) + p\lambda^2 v''[-\lambda\theta(W-X)]\} < 0, \tag{5}$$

[3] This adjustment is called "editing" by Kahneman and Tversky (1979). 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. Since this feature of the theory is not the focus of the present discussion, it is assumed, for convenience, that $\phi(p) = p$.

respectively. Since both $v'(D-\theta X)$ and $v'[-\lambda\theta(W-X)]$ are positive, there are no apparent restrictions on the satisfying of (4). However, since $v''[-\lambda\theta(W-X)]$ is positive (reflecting risk-seeking for losses), (5) may only be satisfied if $D-\theta X$ is positive, so that $v''(D-\theta X)$ is negative (reflecting risk-aversion for gains).

## III. Tax Compliance and the Advance Payment

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

$$p\lambda \;<\; \frac{v'(D-\theta W)}{v'(0)^-}, \tag{6}$$

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 (1972) model, and to its numerous extensions, where the entry condition, $p\lambda < 1$, 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, $\theta$. It is also stricter that Yitzhaki's condition, since $v'(D-\theta W)/v'(0)^- < 1$.

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 determines the probability of detection, and the size (and timing) of advance tax payments. The former is evidently resource consuming, whereas the latter presumably entail no resource costs. Condition (6) 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 non-costly raise of the advance payment [which decreases $v'(D-\theta W)$] so as to increase the gain expected from honest declaration. However, while advance 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 $\theta W$ from above, $v'(D-\theta W)/v'(0)^-$ approaches $v'(0)^+/v'(0)^-$, which has been shown experimentally by McClelland, Schulze and Coursey (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 $\theta W$ to induce honesty. As $p\lambda$ is reduced, $D$ must be increased,[4] and as $p\lambda$ approaches zero, $D$ must be raised to infinity to induce honesty. In view of the substantially low levels of costly enforcement prevailing in most countries,[5] the practical applicability of advance payments to eliminating the incentives for noncompliance is doubtful, even if taxpayers substantially overweight the probability of detection. Still, totally differentiating the first-order condition (4) with respect to $X$ and $D$ reveals that as long as evasion *is* practiced

$$\frac{dX^*}{dD} = \frac{\theta v''(D-\theta X)}{\Omega} > 0, \tag{7}$$

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.

Suppose now that the advance payment is set *below* (or *exactly at*) the taxpayer's true tax liability, so that the taxpayer expects a loss (or neither a loss nor a gain) from declaring honestly. The second-order condition (5) implies that an interior solution may still be obtained at a sufficiently low level of declaration for which $D-\theta X>0$ [although $D-\theta W\leq 0$].

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[4] Mathematically, holding (6) 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.

[5] Alm, McClelland and Schulze (1992) point out that in the United States less than 1 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 0.0075.

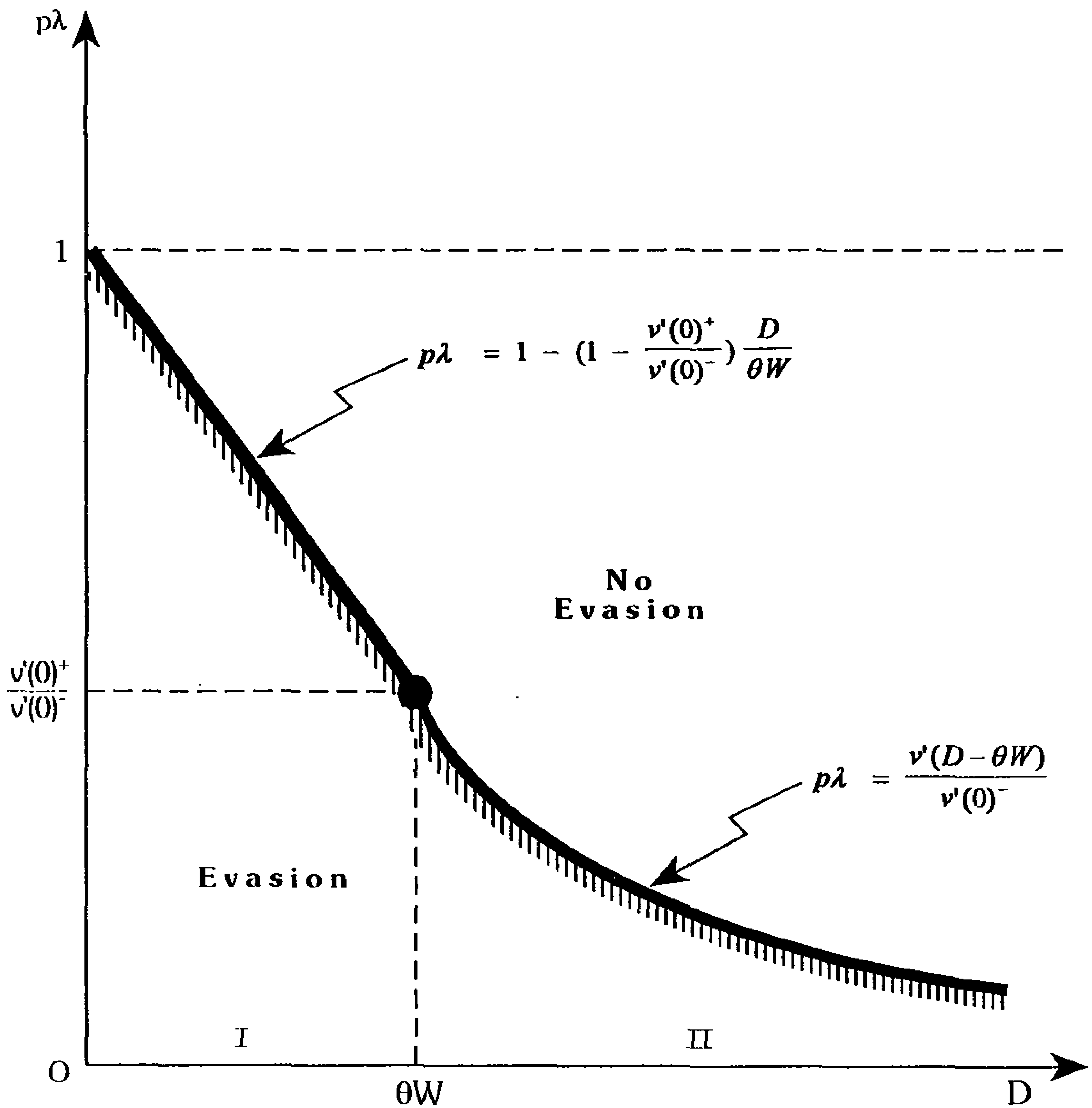


Figure 1: Evasion / No Evasion Regions

In this case, result (7) 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 (4) is solved at a sufficiently high level of declaration for which $D{-}\theta X<0$, such solution would represent a minimum rather than a maximum. Thus, the taxpayer would either report his 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 (3), 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

$$p\lambda \;<\; 1 \;-\; \left(1 \;-\; \frac{v'(0)^{+}}{v'(0)^{-}}\right)\frac{D}{\theta W}\,. \tag{8}$$

Hence, when $D{=}0$ (for which $D{-}\theta X<0$ for any $X>0$), the entry condition reduces to the familiar Yitzhaki's (1972) condition $p\lambda < 1$, but for $D > 0$, the entry condition becomes stricter and dependent on the size of $D$. Hence, given that the first-order condition (4) represents a minimum, advance tax payments may substitute for costly detection efforts in inducing full-compliance even when set below the true tax liability. Figure 1 (part I) demonstrates that when $D{=}0$, $p\lambda$ must be raised to unity to induce honesty. 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, since the latter expression has been estimated to equal one-third, which far exceeds the values of $p\lambda$ in real life, advance payments set at less than (or exactly at) taxpayers' true tax liability are unlikely to eliminate the incentives for evasion.

## IV. Tax Evasion and the Income Tax Rate

Consider now the taxpayer's response to a change in the income tax rate. Totally differentiating the first-order condition (4) with respect to $X$ and $\theta$ yields

$$\frac{dX^*}{d\theta} = -\frac{\theta}{\Omega}\{Xv''(D-\theta X) - p\lambda^2(W-X)v''[-\lambda\theta(W-X)]\} < 0, \qquad (8)$$

as long as the taxpayer expects a refund from filing a return (which is surely the case when the tax advance is set above the true tax liability, but may also be the case when the tax advance is set below the true tax liability). Hence, an increase in the income tax rate will decrease declaration and increase evasion.[6] This result, while according with common sense and intuition, is in sharp contrast with Yitzhaki's (1974) result dominating the tax evasion literature, that declaration *increases* with the income tax rate. Moreover, a negative relationship between declaration and the income tax rate would arise in the present model even if the penalty on tax evasion is imposed on the evaded taxable income, as assumed by AS (1972). This is so since the first-order condition (4) would then become (assuming $\lambda > \theta$)

$$\frac{dV}{dX} = -\theta v'(D-\theta X) + p\lambda v'[-\lambda(W-X)]\} = 0, \qquad (4')$$

yielding

$$\frac{dX^*}{d\theta} = -\frac{1}{\Omega}\{-v'(D-\theta X) + \theta Xv''[D-\theta X)\} < 0, \qquad (8')$$

in contrast with the ambiguous prediction characterizing AS's model. Hence, given that the taxpayer expects a refund from filing a return and that his behavior conforms with prospect theory assumptions, tax evasion will unambiguously increase with the income tax rate, irrespective of whether the penalty is imposed on evaded taxes or on evaded taxable income.

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

[6] While (8) implies that an increase in $\theta$ will necessarily increase the amount of tax evaded, $\theta(W-X)$, the effect on the amount of taxes paid , $\theta X$, is ambiguous at first glance. However, differentiating $\theta X$ with respect to $\theta$, substituting (8) and (5) and rearranging, yields $d(\theta X)/d\theta = \theta^2 Wp\lambda^2 v''[-\lambda\theta(W-X)]/\Omega < 0$, implying that the amount of taxes paid decreases as well.

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 (whether detected or not), 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 (8'). However, as evident from (4'), a tax rate increase affects just the certain refund 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 (8'), is independent of risk-aversion behavior, reflecting the taxpayer's attempt to cushion the reduction in refund resulting from a tax rate increase by subjecting less income to taxation.

In Yitzhaki's model, the substitution effect disappears, because an increase in the income tax rate increases the marginal cost (expected penalty) of tax evasion by the same proportion as its marginal benefit. 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 *negative* components: the certain refund component (as discussed above) and the uncertain penalty component, captured by the first and second terms of (8), respectively. The latter component affects 'value' in the loss domain where the taxpayer is risk seeker, and where a tax rate increase, which increases the loss expected at a given level of evasion, compensatively encourages evasion.

## V. *Conclusions*

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, *sufficiently 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, unless taxpayers substantially overweight the probability of detection, it seems unlikely that *reasonably* high advance tax payments, although ensuring a refund from filing a return, will practically suffice to eliminate tax evasion. A surprising result emerging from the analysis is that a tax rate increase, when expecting a tax refund, will further increase evasion. While this result accords with common sense and intuition, it is in sharp contrast with the inverse relationship between evasion and the income tax rate established in the tax evasion literature under expected utility theory. Finally, while ensuring a gain from reporting honestly does not necessarily induce honesty, ensuring a loss does not necessarily prevent honesty. Advance tax payments may substitute for costly detection efforts in eliminating evasion even if set *below* taxpayers' true tax liability, only that detection efforts must be sufficiently high, far above their real life levels.

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ניתן להזמין פרסומים במוסד לביטוח לאומי, מינהל המחקר והתכנון,
שד' ויצמן 13, ירושלים 91909, טל. (02)6709579

ח.מ. 9801 520068.7