CRIME, PUNISHMENT, AND TAX

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This paper analyzes how income taxation affects optimal law enforcement. A key insight of the analysis is that if monetary sanctions are deductible, income taxation is equivalent to increasing offenders' wealth. This implies, for example, that income taxation reduces the social costs of crime and law enforcement and generally increases the optimal level of deterrence. This paper also shows that if law enforcement is adjusted in response to income taxation, the tax treatment of monetary sanctions is irrelevant. Otherwise, disallowing (allowing) deductions for monetary sanctions is socially desirable if tax rates or tax rate increases are sufficiently low (high).
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1. INTRODUCTION

Many business activities generate external harm. For example, oil refineries pollute the air, overloaded trucks damage highways, and messenger services obstruct traffic when they double park. To control these harms, the government expands resources to apprehend offenders and impose monetary sanctions on them. Since the pioneering work of Becker (1968), there has been extensive literature exploring the features of optimal law enforcement, in particular, of the optimal probability and magnitude of fines (See, for example, Garoupa, 1997, Polinsky and Shavell, 2000, 2007). This literature, however, has generally overlooked the tax laws and the role they might play in optimal law enforcement policy. This is unfortunate because many business activities that generate external harm are subject to income taxation. Moreover, income tax laws dictate the tax treatment of monetary sanctions and sometimes do so with a view toward deterrence. In particular, under section 162 (f) of the Internal Revenue Code of the United States, which codified the landmark decision of the U.S. Supreme Court Tank Truck Rentals Inc., amounts paid as fines or similar penalties are non-deductible for tax purposes. This tax
rule deviates from regular tax principles that generally allow deductions for all the ordinary and necessary costs of running a business when computing taxable income. This tax rule is usually justified on the grounds of deterrence. Allowing deductions for monetary sanctions is thought to reduce the "sting" of punishment and violate "sharply defined public policy" (*Tank Truck Rentals*, 365 U.S. 30 [1958]). Nevertheless, not all tax jurisdictions share the view embodied in Section 162 (f) of the IRC. For example, the Supreme Court of Canada recently ruled that fines and penalties incurred when running a business can be deductible for tax purposes (*65302 British Columbia Ltd. v. The Queen*, [2000] 1 C.T.C. 57, 99 D.T.C. 5799).\(^1\)

The principal aim of this paper is to analyze how income taxation affects optimal law enforcement, in particular, the optimal probability and magnitude of monetary sanctions and level of deterrence. In addition, this paper examines how income taxation affects deterrence and social welfare if law enforcement cannot be freely and optimally adjusted in response to tax changes. Accordingly, this paper delineates the appropriate tax treatment of monetary sanctions under these alternative scenarios.

This paper shows that law enforcement and income taxation should be coordinated, in the sense that the optimal probability and/or magnitude of monetary sanctions depend on the prevailing tax rule and tax rates. A key insight of the analysis reveals that an income tax allowing full deductions for monetary sanctions can be analyzed simply as an increase in the wealth of potential offenders. The reason being that such an income tax reduces the gains that potential offenders obtain from harmful and non-harmful acts and

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\(^1\) Though the court left a certain limited possibility to deny deductions. Id., paragraph 69. Additionally, deduction of penalties arising under the Income Tax Act are explicitly prohibited under section 18(1)(t). However, the government, following the Supreme Court ruling, recently reacted in a proposed legislation explicitly prohibiting such deduction. Interpretation Bulletin IT-104R3, "Deductibility of Fines and Penalties" (August 9, 2002).
the magnitude of monetary sanctions they have to pay, all at the same proportions, but it does not affect the pre-tax wealth of offenders. Therefore, such an income tax can be viewed as making the wealth of offenders loom larger than all the other parameters.

This insight, which is discussed in greater detail in section 2.2, greatly simplifies the analysis and leads to several important results. For example, the analysis shows that although an income tax allowing full deductions for monetary sanctions maintains, under certain conditions, the pre-tax level of deterrence, if the law enforcement scheme is unaltered, this is not socially optimal. Optimality requires that the pre-tax level of punishment will be increased, so that after-tax punishment will exhaust the entire wealth and after-tax gains of the offenders. This means that Becker's (1968) famous maximal punishment result should be understood on an after-tax basis. In addition, optimality requires that the enforcement efforts, i.e., the probability of punishment, will be either increased or decreased depending on the degree of the pre-tax optimal level of deterrence, which, in turn, should be generally increased. This paper also reveals that income taxation reduces the social costs of crime and law enforcement and is socially desirable in this respect.

This paper demonstrates that an income tax disallowing deductions for monetary sanctions increases the pre-tax level of deterrence, if law enforcement remains the same. It is argued that this is socially desirable for sufficiently low tax rates, because the pre-tax optimal level of deterrence is characterized by some degree of under-deterrence. Nonetheless, optimality requires that punishment will remain maximal and that the probability of punishment will be adjusted exactly as it should be under an income tax that allows full deductions for monetary sanctions. Thus, this paper shows that, given
appropriate adjustments of the law enforcement scheme in response to income taxation, the tax treatment of monetary sanctions is irrelevant for maximizing social welfare.

To fully appreciate the significance of the results in this paper, a comparison should be made with the results derived by Png and Zolt (1989), whose work is an important exception to the general disregard of income taxation in optimal law enforcement analysis. Png and Zolt (1989) argue that once income taxation is considered, efficient deterrence can be maintained either by (1) allowing deductions for monetary sanctions, or (2) adjusting the pre-tax fine downward to replicate the effects of a tax-deductibility rule, if deductions for monetary sanctions are not allowed. Moreover, when comparing these two methods for achieving efficient deterrence, Png and Zolt (1989) embrace the first one on the basis of administrative considerations. They argue that under a deductibility tax rule, there is no need to coordinate income taxation and law enforcement systems. They claim that one punishment can, and should, apply to both those who are and who are not subject to income taxation; and that this punishment needs no adjustment when tax rates change. Png and Zolt's important work played a major role in US policy discussion on organizational sanctions.²

The principal difference between the analysis in this paper and that found in Png and Zolt's paper is that Png and Zolt disregard enforcement efforts as a policy tool at the disposal of the social planner for maximizing social welfare. They implicitly assume that the probability of punishment is fixed both before and after the introduction of income taxation. This leads them to characterize optimal law enforcement as one which achieves first-best behavior, meaning that individuals commit the harmful act if and only if the

²Png and Zolt (1989) paper was the basis of testimony on organizational sanctions before the United States Sentencing Commission on December 2, 1988.
gains they derive are greater than the harm they cause, what Png and Zolt refer to as efficient deterrence. Disregarding enforcement efforts as a viable policy tool also prevents Png and Zolt from examining how the probability of punishment can and should be adjusted in the light of income taxation or tax rate changes. This implicit, unexplained assumption is obviously at odds with the modern analysis of optimal law enforcement initiated by Becker (1968), which emphasizes the significant role of enforcement efforts in designing optimal law enforcement schemes. It is also inconsistent with Png and Zolt's own recognition that "since enforcement is costly, it will be optimal to [apprehend offenders] randomly", and seems generally unreasonable. Why can punishment be optimally set both before and after the introduction of income taxation, but enforcement efforts cannot be optimally set either after or before the implementation of income taxation? As this paper shows, if enforcement efforts are also taken into consideration as an important policy tool, as they obviously should be, policy recommendations are markedly different.

Aside from the work of Png and Zolt (1989), there have been limited works in the literature that explore the positive effects of income taxation on deterrence, such as the works of Hilman and Katz (1984), Tabbach (2003, 2005), Hines (2004), and Nussim and Tabbach (2005). This paper brings no additional insights, however, with respect to the positive effects of income taxation on deterrence, such as the claim that, under certain conditions, an income tax allowing full deductions for fines will not affect the level of deterrence. It should be clear that the contribution of this paper lies with its normative analysis, which the above mentioned works lack.
This paper builds on the works of Bowels et al. (2000) and Tabbach (2008), which analyze a model of crime and law enforcement in which offenders’ gains from harmful acts are monetary or monetary-like in nature, and, therefore, can be disgorged. Both papers, however, did not take into consideration income taxation and the role it might play in optimal law enforcement policy.

This paper is organized as follows. Section 2 presents a model of optimal law enforcement that is adjusted to account for the fact that the benefits from harmful acts are necessarily monetary in nature, if income taxation is relevant, and derives the optimal law enforcement scheme. Then Section 3 incorporates income taxation into the model and analyzes how it affects deterrence and social welfare if optimal law enforcement is not adjusted in response to taxation, and how optimal law enforcement should change in light of different tax rules. This section contains the main results of this paper. Section 4 provides additional remarks regarding different aspects of the analysis and Section 5 concludes. Formal proofs of certain results can be found in the Appendix.

2. THE NO-TAX MODEL

This paper adopts a simple model of crime and law enforcement that accounts for the opportunity costs of crime and for the fact that the benefits from the harmful act are monetary in nature and subject to income taxation. The model closely follows a model first developed by Bowels et al. (2000) and analyzed by Tabbach (2008).\(^3\)

Risk-neutral individuals (or firms) contemplate whether to commit a harmful or, alternatively, a non-harmful act. The harmful act causes a positive but non-infinite harm

\(^3\) The only difference between the model presented here and the one analyzed by Tabbach (2008) is that here we also account for the opportunity costs of crime.
of \( h \), and confers upon each individual monetary or monetary-like gains of \( g \), which are assumed to be randomly chosen from a continuous distribution function with a density function \( b(g) \) and a cumulative distribution function \( B(g) \) on the support \([0, \hat{g}]\). Assume that \( \hat{g} > h \), so that some harmful acts are socially desirable in the sense that the gains for certain individuals exceed the harm. The non-harmful act causes no harm and confers upon each individual monetary gains of \( y \) with certainty.

If an individual commits the harmful act, he faces some probability of being caught and punished. Punishment takes the form of monetary sanctions of two types: a fine and disgorgement of illicit gains. The maximum feasible fine, \( f \), is constrained to the level of wealth of the offenders, \( w \), calculated before the offenders commit either the harmful or non-harmful act. \( w \) can also be interpreted as the maximal fine allowed by legal, constitutional, or moral considerations. To simplify some of the results, assume, as seems reasonable, that \( h < w + y \).\(^4\) In addition to being fined, the gains that the offenders derive from the harmful act can be disgorged. This should be contrasted with the standard law enforcement model, which implicitly disregards the possibility of disgorgement, usually because offenders' gains are assumed to be non-monetary in nature.\(^5\) Further assume that there are no legal, constitutional, or moral considerations on the level of disgorgement, so that offenders' gains can be disgorged in full. Thus, the maximum feasible monetary sanctions, which include both fines and disgorgement of gains, may be different for different offenders. For simplicity, assume that punishment, or, equivalently, monetary

\(^4\) The importance of this assumption is explained in notes 18 and 19 below.
\(^5\) For the purpose of analyzing the effects of income taxation on crime, however, such an assumption is unreasonable: How can one assume on the one hand that the gains from the harmful act are taxable, and, therefore, monetary in nature, and on the other hand, disregard the possibility to disgorge them? In any event, note that the qualitative, main results of this paper concerning the effects of income taxation on optimal law enforcement policy are not affected by assuming that the gains from the harmful act can be disgorge, and actually these results are easier to demonstrate without this assumption.
sanctions, must be uniform for all offenders, in the sense that they take the form $f + \eta g$, where $f \leq w$ and $0 \leq \eta \leq 1$ is the fraction of offenders' gains that are confiscated. This assumption allows the existence of a unique solution to the social problem. Denoting different individuals by the index $i$, the maximum feasible punishment can be written as $w + g_i$. As usual, fines are assumed to be a socially costless transfer: they entail no administration costs and the costs imposed on offenders are completely offset by the revenues obtained by the government. The same, it is assumed, applies to the disgorgement of offenders' gains.\(^6\)

The costs of apprehending offenders with probability $p$ are given by a function $c(p)$, which exhibits the usual characteristics $c'(p) > 0$ and $c''(p) \geq 0$. That is, the costs of apprehension increase with $p$ in increasing or constant rates.

Social welfare is the sum of gains obtained by those individuals who commit the non-harmful act, plus the gains obtained by those individuals who commit the harmful act, less the harm done, less enforcement costs. To determine social welfare, observe that individuals will commit the harmful act if and only if the gains they derive from it exceed the expected punishment they face plus the gains they can derive from the non-harmful act, that is, iff $g \geq p(f + \eta g) + y$. Otherwise individuals will commit the non-harmful act.

Therefore, the level of deterrence is determined by:

$$\tilde{g} \equiv \frac{pf + y}{1 - \eta p},$$  

\(^6\) Observe that these two assumptions need not be strictly so. First, while fines are socially costless to administer, disgorgement may nevertheless be socially costly (see the treatment in Bowels et al. (2000). Second, sometimes the loss to offenders is not offset by the gains to the government. For example, if the ill gains are monetary-like in nature and takes the form of illegal goods such as drugs, confiscation has no value in the hands of the government, which will take steps to destroy the illegal goods. However, in most cases, this assumption at least approximately applies, for example, when one discusses stolen goods.
and social welfare can then be formulated as:

\[
SW = \int_{\tilde{g}} [g - h - y]b(g)dg + Y - c(p); \text{ where } Y = \int_{0}^{\tilde{g}} yb(g)dg.
\]

The social problem in the no-tax world is to choose the probability of punishment, \(p\), the magnitude of fines, \(f\), and the fraction of disgorgement of gains, \(\eta\), which maximize (2). The solution to this problem is characterized by the following proposition.

**Proposition 1:** (1) The optimal fine is maximal, \(f^* = w\), and the optimal level of disgorgement is maximal, \(\eta^* = 1\), so that the optimal punishment is, \(w + g\). (2) The optimal probability of punishment, assuming it is positive, satisfies the first order condition \( (h + y - g^*)b(g^*) = \frac{w + y}{(1 - p^*)^2} = c'(p^*) \), where \(g^* = \frac{p^*w + y}{1 - p^*}\), and it is such that there is some degree of under-deterrence, that is, \(g^* < h + y\). This also implies that \(p^* < \frac{h}{w + h + y}\).

The proof and explanation of Proposition 1 are as follows. Fines should be set at their maximum level, because otherwise it would be possible to increase the fine and reduce the probability of punishment such that the same level of deterrence, including the optimal level of deterrence, would be obtained at lower enforcement costs. The same argument applies with respect to the level of disgorgement, which should be maximal as well. This is essentially Becker's argument. Since the optimality of maximal fines is well-known, and since its application to the disgorgement of illegal gains has been formally proven by Bowels et al. (2000) and also by Tabbach (2008), it is omitted.\(^7\)

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\(^7\) A sketch of a proof by contradiction is as follows. Suppose to the contrary that \(\eta^* < 1\), \(f^* = w\), and \(p^* > 0\). The level of deterrence is thus given by \(g^* = \frac{p^*w + y}{1 - \eta^* p^*}\) (equation 1). Now increase \(\eta\) to \(\eta^*\).
Proposition 1(2), as discussed and proven by Tabbach (2008), is derived from the observation that at the optimum the marginal benefits and costs of increasing the probability of punishment should be equal. The marginal costs are definitely positive for any \( p > 0 \), so the marginal benefits must be positive as well. But the marginal benefits of increasing the probability of punishment are the benefits resulting from greater deterrence, that is, from less crime. If these marginal benefits are positive, then it must be that at the optimum, some inefficient harmful acts are committed. Put differently, at the optimum, certain offenders must commit the harmful act even though the gains they derive from doing so are less than the harm they cause plus the gains they could obtain from committing the non-harmful act. Formally, the optimal probability of punishment, \( p^* \), assuming it is positive, should satisfy the first order condition

\[
(h + y - g^*)b(g^*)\frac{w + y}{(1 - p^*)^2} = c'(p^*),
\]

where

\[
g^* = \frac{p^*w + y}{1 - p^*}
\]

is the gains-threshold, which determines the level of deterrence obtained after substituting \( f^* = w \) and \( \eta^* = 1 \) in equation (1). Since \( c'(p) > 0 \) for any \( p > 0 \), then \( h + y - g^* > 0 \), which implies that:

and change \( p \) to \( p_i = \frac{p^*(w + \eta^* y)}{w(1 + p^*(\eta_i - \eta^*)) + \eta_i y} \), so that the level of deterrence remains the same,

\[
\frac{p_iw + y}{1 - \eta_i p_i} = \frac{p^*w + y}{1 - \eta^* p^*} = g^*. \quad \text{Since} \quad \eta_i > \eta^*, \quad \text{it follows that} \quad p_i < p^*, \quad \text{implying that the costs of enforcement are lower. Therefore, social welfare increases, and} \quad \eta^* < 1 \quad \text{could not be optimal. Similar reasoning shows that fines should be maximal as well.} \quad f^* = w.\]
This exactly means that some degree of under-deterrence is optimal. Moreover, substituting (4) into (5), one obtains that:

\begin{equation}
(6) \quad p^* < \frac{h}{w + h + y}.
\end{equation}

Proposition 1 (2), which is a generalization of the standard result in the literature regarding the optimality of under-deterrence (see, for example, Polinsky and Shavell, 2007), will have important implications when the effects of income taxation on social welfare are analyzed.

Finally, to facilitate the comparison between the analysis in this paper and that found in Png and Zolt (1989), let us demonstrate how first-best behavior can be optimally achieved in the present model.\(^8\) Punishment, of course, should be maximal, that is, \(w + g_i\), for the usual argument discussed above. In contrast, the probability of punishment should be set at \(\bar{p} = \frac{h}{w + h + y}\), so that expected punishment is given by:

\begin{equation}
(7) \quad \frac{w + g_i}{w + h + y} h.
\end{equation}

This expected punishment would guarantee, at the lowest costs, that individuals for whom \(g \leq h + y\) are deterred, while individuals for whom \(g > h + y\) are not deterred. Observe that the expected punishment increases with the gains that offenders derive from the harmful act. It is less than the harm for individuals for whom \(g < h + y\), and more than the harm if the reverse is true. Nevertheless, the expected punishment increases with

\(^8\) Recall, however, that Png and Zolt (1989) do not discuss how first-best behavior can be optimally derived. Rather, they derive first-best behavior, assuming that the probability of punishment is given and fixed.
the gains from the harmful act, but at a lower rate than the increase of the gains themselves (i.e., less steeply), as illustrated in Figure 1. Therefore, first-best behavior can be obtained if the expected punishment is equal to the harm for individuals for whom \( g = h + y \), which is achieved by setting the expected punishment according to (7). This is also illustrated in Figure 1.

**Figure 1: How First-Best Deterrence Is Achieved**

![Graph illustrating how first-best deterrence is achieved](http://law.bepress.com/taulwps/art98)

### 3. INCORPORATING INCOME TAXATION

Having characterized the optimal law enforcement scheme, let us now incorporate income taxation and analyze its effects. Assume that a tax at a flat rate \( t \ (0 < t < 1) \) is imposed on both the non-harmful and the harmful acts. Assume that the rate of the tax is

\[ g = h + y \]
exogenously determined, meaning that it is not treated as a policy tool at the disposal of the social planner with regard to the problem at hand. This is quite reasonable since tax rates are determined by a variety of other, presumably more significant, parameters, such as revenue requirements. In Section 4, however, the optimal tax rate will be discussed. Assume also that revenues from taxation are used to finance government spending that enters individuals’ utility function in an additively separable fashion. Assume further that taxes are truthfully and fully paid, eliminating the problem of tax evasion. This assumption is also quite reasonable in many cases, including those cases in which the harmful act is associated with an otherwise lawful activity, such as oil refineries that pollute, trucking enterprises that overload, messenger services that double park, and so on and so forth. Assume finally that taxes are socially costless, in the sense that they entail no administrative costs and create no distortionary effects, except for their possible behavioral effects on the decision to commit the harmful or non-harmful acts.

The aims of the analysis are to (1) examine how income taxation affects deterrence and social welfare, if law enforcement is not adjusted or not optimally adjusted in response to the tax (2) characterize the post-tax optimal law enforcement scheme, and (3) compare the pre and post-tax optimal law enforcement schemes and, consequently, social welfare. The analysis is conducted with respect to two alternative tax rules. The first tax rule allows amounts paid as monetary sanctions to be fully deductible for tax purposes, with refunds if necessary. This is sometimes termed a deductibility tax regime (D). The other tax rule disallows any such deductions, and it is sometimes termed a non-deductibility tax regime (N). Finally, note that the following analysis should be understood to apply not

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10 It should be noted that from a legal, tax perspective there might be a difference between the tax treatment of fines and disgorgement of gains. By and large, however, disgorgement of gains in criminal proceedings
merely to the "imposition" of income taxation, but also to changes in tax rates thereof. This latter interpretation is very important, because changes in tax rates occur very often and rarely, if ever, are their effects on optimal law enforcement and social welfare considered.

3.1 Monetary Sanctions Deductible

Assume first that amounts paid as monetary sanctions are fully deductible, with refund if necessary. The introduction of a deductibility tax regime has three immediate effects, assuming the optimal enforcement scheme described in Section 2 is not changed. First, the private gains from the non-harmful act are reduced from $y$ to $y(1-t)$. Second, the private gains from the harmful act are also reduced from $g_i$ to $g_i(1-t)$, which also immediately implies that the maximum feasible after-tax punishment is reduced from $w + g_i$ to $w + g_i(1-t)$. Last, punishment is reduced from $w + g_i$ to $(w + g_i)(1-t)$. Observe that the after-tax punishment is still feasible but no longer maximal, $(w + g_i)(1-t) < w + g_i(1-t)$. Together, these effects imply that the offenders' decision to commit the harmful or non-harmful act is unchanged. This can be seen by observing that $g(1-t) \geq p^*(w + g)(1-t) + y(1-t)$, after dividing by $1-t$ and rearranging, gives $g \geq g^* \equiv \frac{p^*w + y}{1-p^*}$, which is precisely the same condition that prevails in the no-tax world (equation 4). Therefore, the before-tax level of deterrence is unaffected by income taxation.

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11 Note that since fines are deductible for tax purposes, there is a difference between the feasible fine before and after taxation. Feasibility is meaningful if examined on an after-tax basis.
The logic of this result, which is derived by Png and Zolt (1989) and Tabbach (2003), is simple. An income tax allowing full deductions for monetary sanctions reduces both the gains and the costs, and therefore the expected gains, from the harmful act at the same proportions that it reduces the gains from the non-harmful act, i.e., by a factor $t$. Therefore, a tax deductibility regime does not change the relative attractiveness of the harmful versus the non-harmful act, and, accordingly, the decision to commit these acts. Note further that if the probability of punishment were set to achieve first-best behavior in the no tax world, that is, if $\tilde{p} = \frac{h}{w+h+y}$, then first-best behavior would be achieved after-tax as well, which is essentially Png and Zolt’s (1989) result.

Observe, however, that any level of deterrence, including the optimal and the first-best level of deterrence, could be achieved, after the introduction of income taxation, at lower costs, because the effective after-tax punishment is no longer maximal. Therefore, before-tax punishment could be increased from $w+g$ to $\frac{w}{1-t}+g$, so that after-tax punishment just satisfies the constraint $w+g(1-t)$, and the probability of punishment could be changed to $\hat{p} = \frac{p(w+y)}{w(1-pt)+y}$. This would maintain any pre-tax level of deterrence (depending on the value of $p$) while saving enforcement costs, since $\hat{p} < p$. As this analysis suggests, a tax deductibility regime facilitates a reduction of the social costs of crime and law enforcement and therefore increases social welfare. This analysis also implies that the introduction of a tax deductibility regime renders the pre-tax optimal law

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12 For this result to hold, it should also be demonstrated that income taxation does not affect the social gains from committing harmful or non-harmful acts, as is explained below.
enforcement scheme non-optimal, and therefore calls for its re-optimization, to which we will now turn.

Let us characterize the post-tax optimal law enforcement. Recall first that income taxation is assumed to be socially costless, except for its possible behavioral effects on the decision to commit the harmful or non-harmful acts. From a social perspective taxes remitted to the government are a mere transfer; the loss to taxpayers is completely offset by the gains to the government. This implies that the social value of committing the harmful or non-harmful acts remains completely the same, although after tax individuals obtain only a fraction of the gains. Observe also that income taxation allowing full deductions for monetary sanctions reduces, from an individual perspective, all relevant parameters, i.e., y, g, f and \( p(f + g) \), by a factor \( t \), except for wealth \( w \). This is simply because income taxation is imposed on income rather than on wealth. This requires some explanation, because one may argue that \( w \), which effectively represents current wealth, was subject to income taxation in the past so it too is affected by income taxation in precisely the same way as the other parameters. However, it should be recognized that in practice, in all tax systems, including the U.S. tax system, not all sources of wealth are subject to income taxation. Some sources of wealth, for example, inheritance or gifts, are usually tax exempt or subject to lower tax rates than ordinary income. Therefore, income taxation will affect wealth less than the monetary gains from harmful and non-harmful acts, and make wealth loom larger than these parameters. Second, and perhaps more importantly, as long as one is concerned with the effects of changes in tax rates, then

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13 In reality, of course, taxes should presumably increase social welfare, because tax revenues are used to finance public goods or to redistribute wealth, but such an increase is assumed away in this paper.

14 This observation suggests that it is misleading to think of the effects of introducing income taxation as the sum of the effects of real changes in the different parameters, such as the reduction in the private gains from the harmful and the non-harmful act.
these changes will affect only future income rather than past income. In other words, tax rate changes under a tax deductibility regime will affect all relevant parameters except for past, accumulated wealth. This means that income taxation or tax rate increases can be viewed as *increasing* the wealth of individuals relative to all the other parameters, or, more precisely, making wealth loom larger than the other parameters. Together, the above observations lead to the following key result:

**Result 1:** If monetary sanctions are deductible, the (solution to the) after-tax social problem is *equivalent* to the (solution to the) before-tax social problem, assuming that the feasible maximum monetary sanction has been increased from $w + g_i$ to $\frac{w}{1-t} + g_i$.

Result 1 implies that the after-tax social problem can be viewed as the before-tax social problem, *pretending* that offenders' wealth, or the fine constraint, has been increased from $w$ to $\frac{w}{1-t}$. Since wealth is not directly counted in the social welfare function, as formulated in equation (2), such an interpretation is indeed valid. Observe also that for $t = 0$, the after-tax social problem coincides with the before-tax social problem, as it should.

Result 1 makes the solution of the social problem after the introduction of income taxation straightforward and completely analogous to Proposition 1. It leads to the following proposition.

**Proposition 2:** (1) The optimal fine is maximal, $f_D^* = \frac{w}{1-t}$, and the optimal level of disgorgement is maximal, $\eta_D^* = 1$, so that the optimal punishment is $\frac{w}{1-t} + g_i$. (2) The optimal probability of punishment should satisfy the first order condition
\[(h + y - g_D^* b(g_D^*) \frac{w + y}{1- p_D}) \frac{w + y}{(1 - p_D)^2} = c'(p_D^*), \text{ where } g_D^* = \frac{p_D^*}{1- p_D}, \text{ and it is such that under-} \\
\text{deterrence prevails, that is, } g_D^* < h + y. \text{ This also implies that } p_D^* < \frac{h}{w + h + y}.\]

The proof and explanation of proposition 2 are completely analogous to those of proposition 1, and therefore are omitted. Note that setting the punishment at \(\frac{w}{1-t} + g_i\), implies that the effective after-tax punishment, \(w + g_i(1-t)\), is both feasible and maximal, in the sense that it will exhaust the entire wealth and after-tax gains of the offender. This suggests that Becker’s maximal punishment result should be applied on an after-tax basis. Observe also that with income taxation, first-best behavior can be optimally achieved by setting the punishment at \(\frac{w}{1-t} + g_i\), and the probability of punishment at \(\tilde{p}_D = \frac{h}{w + h + y}\), so that the expected punishment is equal to:

\[(8) \quad \frac{w}{1-t} + g_i \frac{h}{w + h + y}.\]

Since \(\tilde{p}_D = \frac{h}{w + h + y} < \frac{h}{w + h} = \tilde{p}\), it follows that first-best behavior can be achieved, after the introduction of income taxation, at lower enforcement costs.\(^{15}\)

\(^{15}\) In terms of Figure 1, after the introduction of income taxation, the curve representing Expected sanction plus the opportunity costs of crime shifts up and flattens, as illustrated by the dotted line in Figure 1.
Once the equivalency between the after-tax and the before-tax social problems is recognized, the comparison between the pre and post-tax optimal law enforcement schemes (or the question how should the pre-tax optimal law enforcement scheme change) becomes relatively easy. This leads to the following proposition.

**Proposition 3:** In comparison to the optimal pre-tax law enforcement scheme, the after-tax optimal law enforcement scheme is associated with (1) a lower effective after-tax punishment, $w + g_i(1-t) < w + g_i$, (2) a probability of punishment that can be either higher or lower $p^*_D \geq p^*$, depending on the pre-tax level of optimal deterrence (3) a level of deterrence that is generally higher, $g^*_D > g^*$ (4) a higher level of social welfare.

The proofs of Propositions 3(2) and 3(3) can be found in the Appendix, which also contains the specific conditions under which $p^*_D \geq p^*$. The proofs of Proposition 3 (1) and 3 (4) are straightforward. Observe first that the effective after-tax punishment is lower than the punishment that applies in the no tax world, that is, $w + g_i(1-t) < w + g_i$, for the obvious reason that income taxation reduces the gains offenders derive from the harmful act. Also observe that social welfare is necessarily higher, because, as explained above, any level of deterrence can be achieved after the introduction of income taxation at lower enforcement costs by increasing the level of fines and reducing the probability of punishment appropriately. We now turn to a more in depth explanation of Propositions 3 (2) and 3 (3).

The possibility that the optimal probability of punishment will be higher after the introduction of income taxation seems to contradict the observation that the optimal probability of punishment that achieves first-best behavior is definitely lower with income taxation than without it, $\tilde{p}_D < \tilde{p}$. It also seems to contradict the notion that the
introduction of income taxation increases social welfare, as it allows maintenance of the same level of deterrence by increasing the level of fines and reducing the probability of punishment. However, Proposition 3 (2) is consistent with these observations. In fact, Proposition 3 (2) can be viewed as a variant of a result first demonstrated by Garoupa (2001) and extended by Tabbach (2008), according to which the probability and the maximum level of fines are not necessarily substitutes, but are possibly complements.\footnote{Garoupa (2001) derives his result without accounting for the fact that the gains from the harmful act can be disgorged. Tabbach (2008) derives a similar result while accounting for the fact that the gains from the harmful act can be disgorged, disregarding the opportunity costs of crime.}

The explanation of Proposition 3 (2) is roughly as follows. If optimal deterrence in the no tax world is characterized by substantial under-deterrence, that is, by the marginal offenders imposing significant net harm from committing the harmful act, then introducing income taxation, which is equivalent to increasing offenders' wealth, allows the achievement of greater deterrence not merely by increasing the magnitude of fines, but also by increasing the probability of punishment. If under-deterrence is substantial, the gains from the additional increase in deterrence stemming from the increased enforcement efforts will outweigh the additional costs of increasing enforcement efforts. This can be possible after the introduction of income taxation because as fines increase, the impact of enforcement efforts, say of a 1\% increase in the probability of punishment on the level of deterrence (i.e. the \textit{deterrent value of enforcement efforts}), increases as well, while the marginal costs of enforcement efforts are unaffected (for any level of $p$).

However, if the reverse is true and optimal deterrence in the no tax world is only slightly less than first-best deterrence, then the marginal offenders impose relatively little net harm from committing the harmful act. Then, the introduction of income taxation, which again is equivalent to increasing offenders' wealth, calls for reducing the probability of
punishment and saving enforcement costs. This is because much deterrence is gained simply by the increase in the level of fines, so that even though the deterrent value of enforcement efforts increases, the gains from additional deterrence are decreased. In the extreme case, if the level of under-deterrence is very small, so that an increase in the level of fines will in itself lead to over-deterrence, the gains from a further increase in enforcement efforts are actually negative, implying that the probability of punishment should definitely decrease. As noted above, the precise conditions under which the probability of punishment increases or decreases with changes in tax rates are derived in the Appendix.

Proposition 3 implies that even though the effective, after-tax fines are reduced and the probability of punishment may be either higher or lower, the optimal level of deterrence will be generally higher after the introduction of income taxation.\(^\text{17}\)

\(^{17}\) Formally, the effects of introducing income taxation, which is equivalent to increasing offenders' wealth, on the optimal probability of punishment can be analyzed by examining how the first order condition, 

\[(h + y - g^*)b(g^*) \frac{w + y}{(1 - p^*)^2} = c'(p^*),\]

which determines \(p^*\), is affected once the level of fines is increased to \(\tilde{w} = \frac{w}{1-t}\) and, accordingly, the level of deterrence is increased to 

\[\tilde{\tilde{g}} = \frac{p^*}{1-t} \frac{w + y}{1 - p^*}.\]

Observe first that the marginal costs of enforcement efforts, \(c'(p^*)\), are unaffected. Observe next that the marginal benefits, which are the product of the gains from increased deterrence, \((h + y - \tilde{g})b(\tilde{g})\), and the deterrent value of enforcement efforts, \(\frac{\tilde{w} + y}{(1 - p^*)^2}\), are affected in opposite ways. On the one hand, since deterrence is increased, the marginal benefits from additional deterrence are reduced, 

\[(h + y - g)b(g) < (h + y - g^*)b(g^*).\]

On the other hand, since fines are increased, the deterrent value of enforcement efforts is increased, 

\[\frac{\tilde{w} + y}{(1 - p^*)^2} > \frac{w + y}{(1 - p^*)^2}.\]

Therefore, whether the marginal benefits of enforcement efforts are increased or decreased, and, consequently, whether the probability of punishment should be increased or decreased will depend on the magnitude of these opposing effects. As explained in the text, the former effect dominates (is dominated by) the latter effect, if the pre-tax level of deterrence is sufficiently high (low).

\(^{18}\) The qualification generally is used because the optimal level of deterrence after the introduction of income taxation may be lower than in the no tax world, if \(w + y < h\). See the Appendix.
Proposition 3 (3) is based on a result derived by Tabbach (2008). Its explanation is roughly as follows. Recall that the optimal probability of punishment, and, consequently, the optimal level of deterrence, \( g^* \), in the no tax world are characterized by the equality between the marginal benefits and costs of increasing the probability of punishment, given the optimal level of fines, \( w \). Income taxation, or, equivalently, increased wealth, allows for the achievement of this optimal level of deterrence, \( g^* \), by increasing the fine to its new maximum level, \( \frac{w}{1-t} \), and reducing the probability of punishment appropriately to \( \hat{p} = \frac{p^*(w+y)}{w(1-p^*t)} + y \). Consider now how these changes affect the marginal costs and benefits of increasing enforcement efforts, i.e., the probability of punishment. Note that if the marginal benefits are higher than the marginal costs, the post-tax optimal probability of punishment should be higher than \( \hat{p} \), implying that the optimal level of deterrence should increase as well. Assuming the enforcement costs function is convex (linear), the marginal costs of enforcement efforts, \( c'(\hat{p}) \), are decreased (unaffected), because \( \hat{p} < p^* \). In addition, since the optimal fine is higher, the deterrent value of enforcement efforts is higher, implying that the marginal benefits of increasing the probability of punishment are higher as well.\(^{19}\) Therefore, since the

---

\(^{19}\) This analysis is, in fact, only partial. The deterrent value of enforcement efforts, \( \frac{\partial g^*}{\partial p} = \frac{w+y}{(1-p)^2} \), is a function of both the level of fines and the probability of punishment. This means that increasing the fine and reducing the probability of punishment generates opposing effects on the deterrent value of enforcement efforts. The increase in the level of fines increases the deterrent effect of enforcement efforts, as explained in the text, but the decrease in the probability of punishment reduces the deterrent effect of enforcement efforts. However, as demonstrated by Tabbach (2008), and revealed in the Appendix, as long as the probability of punishment in the no tax world is less than 1/2, the fine effect dominates the probability of punishment effect, so that, in total, the deterrent value of enforcement efforts is increased.
marginal costs are either decreased or unaffected while the marginal benefits are increased, it is not socially desirable to reduce the probability of punishment so as to maintain the level of deterrence in the no tax world. Rather, the probability of punishment should be greater than \( \hat{p} \), implying that the optimal level of deterrence should be higher after the introduction of income taxation.\(^{20}\)

To conclude this Section, Table 1 summarizes Proposition 3.

**Table 1: Comparison between the Pre and Post-Tax Optimal Law Enforcement Schemes (Tax Deductibility Regime)**

<table>
<thead>
<tr>
<th></th>
<th>Effective -Fines</th>
<th>Enforcement</th>
<th>Deterrence</th>
<th>Social Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Tax</td>
<td>Higher</td>
<td>Higher/Lower*</td>
<td>Lower*</td>
<td>Lower</td>
</tr>
<tr>
<td>Post-Tax</td>
<td>Lower</td>
<td>Higher/lower*</td>
<td>Higher*</td>
<td>Higher</td>
</tr>
</tbody>
</table>

\* Depending on the extent of the pre-tax level of deterrence.

\*\* Assuming that the wealth of offenders plus the gains they can derive from the non-harmful act are greater than the harm.

### 3.2. Monetary Sanctions Non-Deductible

Assume next that amounts paid as monetary sanctions are non-deductible for tax purposes. In this case, the introduction of income taxation has two immediate effects, assuming again that the law enforcement scheme described in Section 2 is not altered. First, the private gains from the non-harmful act are reduced from \( y \) to \( y(1-t) \). Second, the private gains from the harmful act are reduced from \( g_i \) to \( g_i(1-t) \), which also

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Moreover, as can be easily verified from equation (6), if \( w + y > h \), the optimal probability of punishment is necessarily less than 1/2.

\(^{20}\) If \( p^* > 1/2 \), which is possible but not necessary if \( h < w + y \), then the marginal benefits of enforcement efforts will be actually lower. Then, the optimal probability of punishment may be actually lower.
immediately implies that the maximum feasible punishment is also reduced from $w+g$, to $w+g(1-t)$. Together, these effects change the offenders' decision to commit the non-harmful or the harmful act, which is now determined by

$$g(1-t) \geq p^*(w+g(1-t)) + y(1-t),$$

or equivalently by:

$$g \geq g^*_N \equiv g^* + \frac{t}{(1-p^*)(1-t)}(g^*(1-p^*) - y).$$

From equation (4) it follows that $g^*(1-p^*) = p^*w + y > y$, therefore a non-deductibility tax regime will increase the level of deterrence, $g^*_N > g^*$. Indeed, if the probability of punishment were set at $\hat{p} = \frac{h}{w+h+y}$, so as to achieve first-best behavior in the no tax world, then a non-deductibility tax regime would lead to over-deterrence, as argued by Png and Zolt (1989). The explanation, again, is simple (see Png and Zolt, 1989, Tabbach, 2003). An income tax disallowing deductions for monetary sanctions reduces the expected gains from the harmful act proportionally more than it reduces the gains from the non-harmful act. Therefore, it biases the decision to commit the non-harmful or the harmful act in favor of the former.

However, since the no tax world is characterized by under-deterrence rather than first-best deterrence (Proposition 1(2)), the introduction of a non-deductibility tax regime will decrease the level of under-deterrence for sufficiently small values of the tax rate, and may lead to over-deterrence only if the tax rate is high enough. Formally, a non-deductibility tax regime will decrease under-deterrence or lead to over-deterrence as:

$\text{Observe that if income taxation affects pre-tax level of wealth by the applicable tax rate, then a non-deductibility tax regime will essentially be meaningless, since the feasible fine will be reduced exactly as if the fines were deductible, that is, it will become } (w+g)(1-t).$
(10) \[ t < \frac{h + y - g^*}{h - \frac{yp^*}{1 - p^*}}. \]

Therefore, it is clear that a non-deductibility tax regime may itself, i.e., without any adjustments of the law enforcement scheme, be socially desirable. In particular, for

\[ t \leq \frac{h + y - g^*}{h - \frac{yp^*}{1 - p^*}} \]

no costs. However, even for \( t > \frac{h + y - g^*}{h - \frac{yp^*}{1 - p^*}} \), social welfare may increase, if the gains from eliminating under-deterrence are greater than the loss associated with over-deterrence. Formally, social welfare will increase as long as the tax rate is such that:

\[ \int_{g^*}^{\Sigma^*} [(g - y - h)b(g)dg > 0. \] \(^{22}\)

Consider now the possibility of adjusting the law enforcement scheme in response to income taxation. Note first that the pre-tax level of deterrence, \( g^* \), can be maintained by scaling down the magnitude of monetary sanctions from \( w + g \) to \( (w + g)(1-t) \). This will ensure that punishment is not only feasible, \( (w + g)(1-t) < w + g,(1-t) \), but also that offenders' decision to commit the non-harmful or the harmful act is not disturbed. This can be seen from the fact that the after-tax condition to commit the harmful act \( g(1-t) \geq p^*(w + g)(1-t) + y(1-t) \) is, after dividing by \( 1-t \) and rearranging, the

---

\(^{22}\) It should be observed that the range of tax rates that increase social welfare depends critically on the pre-tax level of deterrence. The lower is the pre-tax level of deterrence relative to first-best deterrence, that is, the lower is \( g^* \) relative to \( h + y \), the higher are the possible beneficial tax rates.
same condition that prevails in the no tax world, \( g^* \equiv \frac{p^*w + y}{1 - p^*} \) (see equation 4). Indeed, as Png and Zolt (1989) note, scaling down punishment by a factor \( t \) replicates the effects of a deductibility tax regime. However, there is a better course of action to maintain the pre-tax level of deterrence. The probability of punishment, instead of its magnitude, can be reduced and set at \( \hat{p} = \frac{p^*(w + y)}{w(1 - p^*t)} + y \). This will also ensure that the level of deterrence is maintained, but at lower costs since \( \hat{p} < p^* \).

Finally, let us characterize the post-tax optimal law enforcement scheme. To do this, observe that a non-deductibility tax regime is equivalent to a deductibility tax regime in which the before-tax punishment has been inflated by \( \frac{1}{1-t} \).\(^{23}\) Put differently, the two tax regimes are identical as long as the before-tax fines maintain the relationship:

\[
(12) \quad f_N = f_D(1-t).
\]

Since optimal fines should be maximal, the optimal law enforcement scheme in light of an income tax disallowing deductions for monetary sanctions is identical to the optimal law enforcement scheme in light of an income tax allowing deductions for monetary sanctions, except for the fact that the optimal punishment is \( w + g,(1-t) \) rather than \( \frac{w}{1-t} + g_i \). This guarantees that the (after-tax) punishment is indeed both feasible and maximal. Accordingly, the optimal probability of punishment, the optimal level of

\(^{23}\) Alternatively, a non-deductibility tax regime can be viewed as being equivalent to the no tax social problem assuming that the feasibility constraint is reduced to \( f \leq w + g(1-t) \), but that the "real" impact of any punishment is inflated by a factor of \( \frac{1}{1-t} \).
deterrence, and the maximum social welfare are identical to those obtained under an income tax allowing deductions for monetary sanctions, and so are the comparisons of these parameters to the no tax world. These results are summarized in the following proposition.

**Proposition 4:** An income tax disallowing deductions for monetary sanctions is identical to an income tax allowing such deductions as long as fines maintain the relationship \( f_N = f_D (1-t) \). Accordingly, the optimal law enforcement scheme, including the optimal probability of punishment, the optimal level of deterrence, and the maximum social welfare are the same.

4. FURTHER ANALYSIS

4.1. Deductibility versus Non-Deductibility

As Section 3.2 shows, the tax treatment of monetary sanctions is completely irrelevant for maximizing social welfare if law enforcement is optimally adjusted in response to income taxation. Both deductibility and non-deductibility tax rules call for the same adjustment of enforcement efforts and both lead to the same level of deterrence and social welfare. The only difference between these rules is that the former requires increasing punishment; while the latter requires decreasing it to meet the feasibility constraint. This, it should be observed, is in sharp contrast to Png and Zolt's policy recommendation according to which under a non-deductibility tax rule fines should be decreased, while under a deductibility tax rule they need no adjustment at all. Moreover, since both tax rules require adjustments of the law enforcement scheme, these rules are also essentially equivalent with respect to administrative considerations, again in contrast to Png and Zolt's claim.
The irrelevancy of the tax treatment of monetary sanctions assumes a free and costless coordination between law enforcement and income taxation, however. In reality we observe very little of such coordination. Rarely, if ever, are monetary sanctions or enforcement efforts adjusted as tax rates change. This suggests that it might be costly to coordinate the law enforcement and the income tax systems. If so, the tax treatment of monetary sanctions may become relevant. To consider this briefly, suppose, for example, that when tax rates change (increase), the necessary adjustments of the law enforcement scheme described in Section 3 are not immediately implemented. Then, based on the analysis in Section 3, the following results emerge. For sufficiently small tax rate increases, a non-deductibility tax regime is superior to a deductibility tax regime, because the former increases the level of deterrence (reduces the level of under-deterrence) at no cost, while the latter maintains the level of under-deterrence. In contrast, for sufficiently large tax rate increases a deductibility tax rule may be preferable to a non-deductibility tax rule because it maintains the level of under-deterrence, while a non-deductibility tax rule leads to over-deterrence which may be more socially costly than the losses associated with the original position of under-deterrence.\textsuperscript{24} All these suggest that the choice of the tax treatment of monetary sanctions depends on how well the law enforcement and income tax systems are coordinated. If they are well-coordinated, then policy makers, legislators and judges, need not worry about the choice of the tax rule. Otherwise, when deciding whether to allow or disallow deductions for monetary sanctions, policy makers should pay attention to issues such as the features of the original

\textsuperscript{24} Formally, a non-deductibility tax regime is preferable to a deductibility tax regime for tax rates that are equal to or less than those satisfying equation (11). Otherwise the reverse is true.
position – how great under-deterrence is – and the likely direction and magnitude of tax rate changes. Admittedly, this is not an easy task.

4.2. The Optimal Tax Rate

The analysis assumes that the tax rate is exogenously determined. This is quite reasonable because tax rates are generally determined by a variety of presumably more significant parameters, such as revenue requirements. Nevertheless, let us inquire into the consequences of treating the tax rate itself as a policy tool at the disposal of the social planner within our simple model. It can be easily shown that, under the present model, the optimal tax rate approaches 100%! This is simply because an increase in tax rates is equivalent, as explained in Section 3, to an increase in individuals' wealth. As shown, at rate \( t \) a tax deductibility rule can be viewed as if it increases the wealth of individuals from \( w \) to \( \frac{w}{1-t} \). For example, if the tax rate is 50%, wealth is as if doubled; if the tax rate is 66%, wealth is as if tripled. More generally, as a function of tax rates, the wealth of individuals is as if increased at a rate of \( \frac{w}{(1-t)^2} \). Therefore, increasing tax rates reduces the costs of achieving any level of deterrence. Observe that as the tax rate approaches 100%, the wealth of individuals is as if increased to infinity! This brings the optimal law enforcement scheme precisely to the one envisioned by Gary Becker: the fine is set arbitrarily high and the probability of punishment is set arbitrarily close to zero. In addition, deterrence reaches its first-best level. In these respects, income taxation manages to do what no other policy tool can actually do; it overcomes the problem of

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25 Strictly speaking, there is no optimal tax rate!
offenders having insufficient wealth to pay monetary sanctions, i.e., what is commonly known as the judgment proof problem. Income taxation overcomes this problem not actually by increasing the wealth of potential offenders, but by reducing the gains from the harmful act and all the other relevant parameters arbitrarily low, so as to make actual wealth loom arbitrarily high.

The optimality of very high tax rates, although suggestive, should not be taken at face value, however. It depends critically on the assumption that taxes entail no other costs, but those associated with the behavioral effects on the choice to commit the harmful or non-harmful act. In contrast to the present model, in reality taxes are not socially costless. They entail significant administrative costs and they impose deadweight losses, which are the result of the fact that some activities, such as leisure, are non-taxable. Taxes in the real world always create distortions and entail social costs. These costs, deadweight losses in particular, are assumed to increase non-linearly with the tax rate. Therefore, these other costs limit the social desirability of high tax rates implied in this paper. Nevertheless, the insight of this paper - that income taxation reduces the costs of crime and optimal law enforcement - remains valid.

5. CONCLUSION AND POSSIBLE EXTENSIONS

This paper has incorporated income taxation into a simple model of optimal law enforcement and analyzed (1) how deterrence and social welfare are affected, and (2) how optimal law enforcement should be adjusted. This analysis has been conducted under two alternative tax rules. The first tax rule allows amounts paid as monetary sanctions to be fully deductible for tax purposes, with refund, if necessary. The other tax
rule disallows such deductions. This paper has shown that optimal law enforcement should be coordinated with income taxation. In particular, Becker's famous maximal punishment result should be applied and understood on an after-tax basis. It has also been shown that the choice of the tax rule is essentially irrelevant if law enforcement can be optimally adjusted in response to income taxation. A key insight of the analysis has revealed that, in terms of the solution to the social problem, the introduction of an income tax that allows for monetary sanction deductions is equivalent to increasing individuals' wealth. This insight made the analysis easier and provided important results.

The analysis in this paper can be extended in numerous ways that parallel the countless ways in which optimal law enforcement models have been developed. It is therefore pretentious, as well as impractical, to suggest or even point to all possible extensions and qualifications. Instead, let us just mention a few issues that seem to be interesting for future analysis and that might bear on the results of this paper.

5.1. Imprisonment

First, the analysis assumes that punishment takes the form of monetary sanctions, that is, fines and disgorgement of offenders' gains. In reality, non-monetary sanctions such as imprisonment can be used. Imprisonment as such does not pose serious problems with respect to the effects of income taxation. The tax treatment of imprisonment stems from general tax principles that regard income but not utility the touchstone of taxation. Since imprisonment inflicts on offenders both utility related costs, such as loss of freedom, and income related costs, such as reduced current and future income, it operates as if a partial deductibility tax regime is in place. That means that income taxation can be viewed as if
it "allows" deductions for the income related costs, but "disallows" deductions for the utility related costs. This is similar to the fact that income taxation effectively reduces the maximal feasible monetary sanctions, because it taxes offenders' gains. Yet, income taxation increases the costs of imprisonment relative to all other parameters, and therefore makes imprisonment loom larger. This suggests that income taxation will reduce the costs of imprisonment and, therefore, it will increase social welfare. However, a full analysis of the effects of income taxation on optimal law enforcement when imprisonment is utilized should take into account that imprisonment affects the features of the standard optimal law enforcement model without taxation. As is well known, under certain conditions, the optimal imprisonment term, assuming it is the sole form of punishment, is maximal; and optimality is generally characterized by either under or over-deterrence (see Polinsky and Shavell, 1984, 2007).

5.2 Risk Aversion

Second, it was assumed that potential offenders are risk neutral. If, however, potential offenders exhibit aversion to risk, the analysis in this paper can be affected in several interesting ways. As is well known, in standard models of optimal law enforcement, risk aversion generally implies that fines are not necessarily maximal (see Polinsky and Shavell, 1979, 2007), and that optimality may be characterized by over-deterrence rather than under-deterrence (Kaplow, 1992). Moreover, as Tabbach (2003) shows, if offenders are risk averse, a deductibility tax regime generates two risk effects; it reduces the risk associated with criminal activities, and it affects the willingness of offenders to bear risk. This suggests that such an income tax cannot be viewed as equivalent to increasing
potential offenders' wealth any longer if risk aversion is considered. All these imply that the consequences of risk aversion require careful analysis.

5.3. Offenders/Taxpayers are Subject to Different Tax Rates

Third, the analysis assumes that all individuals are subject to the same tax rate. In reality, potential offenders, for example corporations and individuals, may be subject to different tax rates. Moreover, some offenders may be exempt from taxation altogether. A natural question that arises is how optimal law enforcement should be adjusted in these circumstances. This question can be elegantly managed under certain conditions by exploiting the equivalency between income taxation and increasing individuals' wealth, that is, Result 1. Potential offenders who are subject to different tax rates can be viewed under the standard model simply as possessing different levels of wealth.26

As these examples show, there is certainly the opportunity for a fruitful future research.

APPENDIX

Proof of Proposition 3 (2):

Let us examine how the optimal probability of punishment changes with the tax rate.

Based on Result 1, this is equivalent to examining how it changes with wealth, that is,

\[ \text{sign}\left[ \frac{\partial p^*}{\partial t} \right] = \text{sign}\left[ \frac{\partial p^*}{\partial w} \right]. \]

By the Implicit Function Theorem, we have that:

\[ \frac{dp^*}{dw} = -\frac{SW_{pw}}{SW_{pp}}. \]

---

26 For an analysis of optimal law enforcement when wealth varies among potential offenders see Polinsky and Shavell (1984, 1991). This analysis does not take into account the possibility to confiscate the gains offenders derive from the harmful act, or analyze how optimal law enforcement should change as the wealth of a subgroup of offenders is changed.
Since, \(-SW_{pp} > 0\) (SOCs), then \(\text{sign}\left[\frac{dp^*}{dw}\right] = \text{sign}[SW_{pw}]\).

Differentiating \(SW\) with respect to \(p\) and \(w\), and rearranging, we get:

\[
SW_{pw} = \frac{b(g^*)}{(1-p)^2} \left[ h + 2y - 2g^* - \varepsilon(g^*)(h + y - g^*) \right], \quad \text{where} \quad \varepsilon(g^*) = -\frac{b'(g^*)}{b(g^*)}(g^* - y).
\]

Since, \(\frac{b(g^*)}{(1-p)^2} > 0\), if follows that \(\text{sign}[SW_{pw}] = \text{sign}[h + 2y - 2g^* - \varepsilon(g^*)(h + y - g^*)]\).

Therefore, if \(\varepsilon(g^*) > 1\) and \(g^* < \frac{h[\varepsilon(g^*) - 1]}{[\varepsilon(g^*) - 2]} + y\) then \(\text{sign}[SW] = \text{sign}\left[\frac{dp^*}{dw}\right] < 0\),

Otherwise, if \(\varepsilon(g^*) \leq 1\) or \(g^* > \frac{h[\varepsilon(g^*) - 1]}{[\varepsilon(g^*) - 2]} + y\), then \(\text{sign}[SW] = \text{sign}\left[\frac{dp^*}{dw}\right] > 0\).

**Proof Proposition 3(3):**

Let us examine how the optimal level of deterrence, \(g^*\), changes with the tax rate. Based on Result 1, this is equivalent to examining how \(g^*\) changes with wealth, that is,

\[
\text{sign}\left[\frac{dg^*}{dt}\right] = \text{sign}\left[\frac{dg^*}{dw}\right].
\]

Differentiating \(g^*\) with respect to \(w\) and rearranging we get:

\[
\frac{dg^*}{dw} = \frac{\partial g^*}{\partial w} + \frac{\partial g^*}{\partial p} \cdot \frac{dp^*}{dw} = \frac{p^*}{1-p^*} - \frac{w + y}{(1-p^*)^2} \cdot \frac{SW_{pw}}{SW_{pp}} =
\]

\[
= -\frac{1}{(1-p^*)^2 SW_{pp}} \{(w + y)SW_{pw} - p^*(1-p^*)SW_{pp}\},
\]

Therefore, \(\text{sign}\left[\frac{dg^*}{dw}\right] = \text{sign}[(w + y)SW_{pw} - p^*(1-p^*)SW_{pp}]\).

But direct calculation reveals that:
\[ [(w+y)SW_{pw} - p^* (1- p^*)SW_{pp}] = \frac{(w+y)b(g^*)}{(1-p^*)^2} [h + y - g^*][1 - 2p^*] + c''(p^*). \]

Therefore, since \( c''(p) \geq 0 \), it is clear that if \( p^* < \frac{1}{2} \), then \( \frac{dg^*}{dw} > 0 \).

If, however, \( p^* > \frac{1}{2} \) (and \( c''(p) = 0 \)), then \( \frac{dg^*}{dw} < 0 \).

Observe, however, that if \( h < w + y \) (as assumed in the text) then \( p^* < 1/2 \), but that if \( h > w + y \), then \( p^* \) may be less than 1/2 (equation 6).

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