OPTIMAL PERFORMANCE REWARD, TAX COMPLIANCE AND ENFORCEMENT

by

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Abstract: This paper incorporates the incentives of tax inspectors into an equilibrium model of tax compliance and enforcement when the taxpayers' true income is private information ('*adverse selection*') and the effort of tax inspectors to verify reported income is unobservable ('*moral hazard*'). It characterizes the optimal remuneration for tax inspectors, which is a function of discovered tax evasion, paying particular attention to the determinants of the power of incentives and the curvature of the optimal reward scheme. It is shown that the structure of the optimal reward is increasing, and in general non-linear, in the magnitude of discovered tax evasion. The equilibrium characterized has the features that: taxpayers with higher true income under report less and tax inspectors' auditing effort, and hence the probability of detecting tax non-compliance, decreases with reported income.

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1 Introduction

Tax administration reforms have been central on the policy agenda of many countries (both developing and developed) around the world, and they have become much more prominent since the crisis as countries struggle to restore public deficits.[1] Unsurprisingly, part of the focus of these reforms has been the modernization of the tax administration governance and organizational structures. This resonates very strongly with the view that supports more flexibility in the management of budget and human resources, through well-identified objectives (including the appropriate design of *tax enforcement*) and performance standards appropriately supported by the required resources and incentivization mechanisms, including *performance rewards*. It is this issue that this paper aims to address by developing and exploring a model of a revenue authority, taxpayer and a tax inspector(s) within the setting of a very general form of compensation chosen by the tax authority. The framework builds on the strand of the literature that views compliance as an illegitimate activity in which taxpayers are required by tax law to submit a preliminary report to the tax authority that conveys information regarding their true income, and allows for a very general reward scheme, comprising a fixed wage and, in particular, a possibly non-linear compensation on non-compliance detected.[2] There are, clearly, a number of reward schemes, here the focus is on those based on non-compliance detected.

The key aspect of the generality that the analysis seeks is the remuneration function of a tax inspector required to exert unobservable effort into tax auditing when declared income is private information of the taxpayers, a focus which also reflects its practical importance in the current policy discussions. It should be stressed too that there is another element that can justify the link between tax collections and tax inspectors' remuneration: broadly, it can counter the incentive to collude between the tax payer and tax inspector. And eliminate it completely if the foregone reward of the tax inspector, in the event he colludes with the taxpayer and does not report the discovered tax evasion, is higher than the penalty the taxpayer must pay. In this case, there is no room for collusion between the two. We return to this in Section 4, where conditions are identified on the structure of the reward that makes it collusion-proof.

To anticipate the results that follow what emerges is that the optimal reward scheme is increasing and, in general, non-linear in the magnitude of discovered non-compliance. The slope and curvature of the optimal reward depend on the slope and curvature, respectively, of the inverse of the (familiar) likelihood ratio (the percentage increase in the probability of a successful audit), which captures how costly it is for the authority to incentivize the inspector.[3] The implication of this is that the power of incentives (the slope of the reward function) is higher (lower) the lower (higher) is the slope of the inverse of the likelihood ratio, whereas the slope of the optimal reward function is increasing (constant or decreasing) if the slope of the inverse of the likelihood ratio is decreasing (constant or increasing). In the equilibrium being characterized, taxpayers with greater true income under report less than those with lower true income, tax inspectors' auditing efforts decrease with reported income and the tax inspectors' remuneration is increasing in detected non-compliance. The analysis also highlights the role of multiple tax inspectors who have been allocated different tasks in assessing non-compliance. In a world of multiple tax

[1] There are substantial sums involved behind tax non-compliance. See, for example, Cabral, Kotsogiannis and Myles (2014).

[2] Such performance rewards in tax administrations, as a tool in motivating the tax personnel, are not uncommon with over three quarters of tax administration bodies '. . . hav[ing] some flexibility to reward good performance,' p.148, OECD (2013).

[3] The analysis here abstracts from other schemes that reward performance (such as promotions). For a comprehensive survey of alternative performance reward schemes see Konrad (2008). This is an issue that is left to future research.

inspectors, what emerges is that the design of optimal reward structure critically depends on the strategic relationship of efforts of the team members: when efforts are strategic complements a new force arises in favor of a reward the slope of which is increasing in detected non-compliance, while under strategic substitutability the force is in favor of a reward the slope of which is decreasing in detected non-compliance.

There have been, of course, studies of non-compliance which have investigated a plethora of policy-related issues.[4] Almost all, however, deal with evasion by taxpayers, under the assumption that tax collectors either do not play any active role in tax collection (see, for instance, Allingham and Sandmo (1972), Yitzhaki (1974) and Reinganum and Wilde (1985, 1986)), or they themselves maybe intrinsically dishonest and, therefore, prone to collusive behaviour with the dishonest taxpayers (as in, for example, Besley and McLaren (1993), Chander and Wilde (1998), Mookherjee and Png (1995) and Hindriks, Keen and Muthoo (1999)).[5]

The plan of the paper is as follows. Section 2 sets out the model, which takes the tax inspectors to be the instrument of auditing policy, whereas Section 3 characterizes the equilibrium. Section 4 then constructs an equilibrium and identifies sufficient conditions for its existence. Section 5 extends the analysis to the case of a team of tax inspectors and analyzes the shape of their reward. Finally, Section 6 summarizes.

2 The model

To formalize ideas, use is made of the framework of Reinganum and Wilde (1986) appropriately modified to incorporate the incentives of a tax inspector: it so encompasses both adverse selection and moral hazard. The model features three players: a taxpayer, the revenue authority and (until Section 5) a tax inspector.[6] Events unfold in two stages. In the first stage, the taxpayer and the tax authority move *simultaneously*. In particular, the taxpayer privately observes his true income and chooses how much income to report to the revenue authority (or, equivalently, and the way it will be expressed throughout, he chooses the level of tax evasion). In doing so, he has Nash conjectures regarding the remuneration scheme offered by the tax authority to the tax inspector.[7] The revenue authority, taking as given the income report of the taxpayer, commits to a remuneration scheme for the tax inspector that is a function of discovered tax evasion. In the second stage, the tax inspector, who knows the remuneration scheme, always assesses the

[4]For a survey of the issues see, for instance, Andreoni, Erard and Feinstein (1998), Slemrod and Yitzhaki (2002) and Hashimzade, Myles and Tran-Nam (2012).

[5]The model analyzed also shares elements with the literature that focuses on the design of incentive schemes under both moral hazard and adverse selection, (see, for example, Picard (1987) and Guesnerie, Picard and Rey (1989)). But the analytics here are developed within a set up that is distinctively different from the one employed in that literature. In a standard moral hazard problem, the distribution of output is exogenously given conditional on the agent's unobservable effort. If the distribution of output satisfies the so-called monotone likelihood ratio property, then higher output is used by the principal as evidence of higher effort. As a result, the agent's compensation increases with output. In the present set up, the tax inspector's reward depends on tax evasion, which is not exogenous conditional on the inspector's effort, but rather it is chosen by the taxpayer. This, as will be seen, besides the analytical interest, introduces an important link between tax non-compliance and enforcement which has been, rather surprisingly, neglected in the fairly sizeable tax evasion, theoretical and empirical, literature.

[6]The perspective taken here is that the government delegates the responsibility of auditing to the tax inspector because it is too expensive for it to perform the auditing function by itself and that the revenue authority has the expertise needed to perform the tasks required.

[7]The taxpayer is required to file a report to the tax office and all tax reports are audited. It is the intensity of auditing and, therefore, its success that is a choice variable. There are, of course, additional measures that can be used to detect non-compliance (such as data matching from different sources and third-party reporting). Here the focus is on audits made by qualified tax auditors.

correctness of the tax declaration of the taxpayer and he must decide how much (unobservable) effort, denoted by e, to exert in verifying the taxpayer's true income.[8]

The effort of the inspector determines the probability of successful detection of tax evasion—best thought of as the product of the probability of an audit (assumed to be equal to one) and the probability of detection conditional on audit—with higher effort increasing the probability that the true income will be verified (and so evasion will be detected) and is given by[9] $\text{Prob}(\text{success}|e) = p(e)$, with $p(0) = 0$ and $p(\cdot)$ increasing, concave and three times continuously differentiable. The cost of effort to the tax inspector is given by an increasing, strictly convex and three times continuously differentiable function $c(e)$.

The true income of the taxpayer, denoted I, is distributed continuously with distribution function $F(I)$ on support $[\underline{I}, \overline{I}]$, where $\underline{I} < \overline{I} < \infty$. The objective of the taxpayer is to maximize after tax income. The taxpayer who has verified income x pays tax equal to tx. If tax evasion is discovered, the taxpayer pays a penalty proportional to the amount underreported, $\pi t(I - x)$; the penalty rate, π, is fixed outside the model. The total amount the taxpayer pays in this case is $tI + \pi t(I - x)$. The remuneration scheme consists of a base salary w plus a reward $b(I - x)$, the latter of which is a function of discovered non-compliant income $y = I - x$. To focus on the shape of the reward $b(I - x)$, it will be taken, without loss of generality, that w has been already chosen (as it is often the case) by an outside agency. The variable under the control of the revenue authority is the reward function $b(I - x)$, which is the main focus of this analysis.[10] The tax inspector's total compensation when non-compliance $I - x$ is discovered is $w + b(I - x)$.

All players are risk neutral maximizing expected net income (taxpayer and tax inspector) and expected net tax revenues (revenue authority).[11] The taxpayer who has true income I maximizes

$$U_T = p(e(x))[I - tI - \pi t(I - x)] + (1 - p(e(x)))(I - tx), \tag{1}$$

choosing how much income x to report to the revenue authority. The analysis focuses on a separating equilibrium which has the property that the reporting policy of the taxpayer $x = r(I)$, where $r : [\underline{I}, \overline{I}] \to (-\infty, \infty)$, is strictly monotonic in income and therefore invertible and thus $I = r^{-1}(x)$.[12] All players are rational and have consistent beliefs (regarding the true income of the taxpayer upon observing a report x)[13] denoted by $\tau(x)$, so upon observing an income report x they infer the taxpayer's income, $\tau(x) = I = r^{-1}(x)$. With reporting x the taxpayer of income $I = r^{-1}(x)$ engages in tax non-compliance equal to $y(x) = r^{-1}(x) - x$.

[8]Naturally, one can also think of this in terms of the tax inspector deciding on the intensity of tax inspection. Also the audit is final and conclusive.

[9]Success here is taken to mean that the inspector has gathered sufficient evidence to prove that the taxpayer has concealed taxable income. Reinganum and Wilde (1986) assume that the taxpayer is investigated with a probability and, if it is investigated, success is certain. Their formulation is equivalent to ours, putting the moral hazard issue aside, when one focuses on the probability of successful detection of tax evasion, which is what matters for the taxpayer when he decides how much income to conceal.

[10]As it will become evident later on, the inspector obtains rents, so its expected utility is strictly positive even when $w = 0$. This implies that the inspector's participation constraint is satisfied (assuming a zero outside option). It is also assumed that a limited liability constraint must be satisfied so that $w \geq 0$ and $b(I - x) \geq 0$. Also neither the tax schedule nor the penalty is in the control of the revenue authority or the tax inspector. Both the revenue authority and the tax inspector take these structures are given.

[11]This is not an unrealistic (and it is a fairly standard in the literature) assumption. See, for example, Reinganum and Wilde (1986) and Crémer, Marchand and Pestieau (1990).

[12]A pooling equilibrium, where all types of taxpayers evade the same amount, and the inspector's reward is constant, does not exist, when a separating equilibrium exists.

[13]A formal definition of the equilibrium is given in Section 3.

2.1 Tax inspector

The tax inspector observes the reward function $b(y(x))$ and income report x and maximizes expected utility given by[14]

$$U_{In} = p(e)b(y(x)) - c(e), \tag{2}$$

choosing the amount of effort, e, to exert on auditing. The necessary condition (a prime denotes differentiation with respect to a single variable) of this maximization problem is given by

$$p'(e)b(y(x)) - c'(e) = 0, \tag{3}$$

which implicitly defines[15]

$$e(x) = z^{-1}(b(y(x))), \tag{4}$$

where $z(e) \equiv c'(e)/p'(e)$. Two things thus directly matter for the level of effort exerted by the tax inspector:

- $z(e)$—which following the properties of $p(\cdot)$ and $c(\cdot)$, is monotonically increasing in effort[16]—and
- the *level* of the reward $b(y(x))$.

Interestingly, the slope of the reward (the power of incentives) does not directly affect the level of effort. Where the slope of the reward, given by $b'(y(x))$, matters is in determining—through the choice of income reporting x made by the taxpayer—the change in the probability of success (though changes in the level of effort). To see this notice that, after denoting $f(\cdot) \equiv z^{-1}(\cdot)$,

$$e'(x) = f'(b)b'(y)y'(x). \tag{5}$$

2.2 Additional preliminaries

Denoting, for easy of exposition, the probability of detection, following from equation (4), as

$$p(x) \equiv p(e(x)) = p(f(b(y(x)))), \tag{6}$$

then

$$p'(x) = p'(e(x))e'(x) = p'(e(x))f'(b)b'(y)y'(x). \tag{7}$$

Equation (7) reflects the underlying, and intricate, mechanism of the framework which shapes the equilibrium characterized in Section 3: the success probability of auditing is determined by three components, income reporting x (which determines the degree of non-compliance $y(x)$), the reward schedule $b(y)$ (determined by the extent of detected non-compliance y), and the response (in terms of effort) of the tax inspector to the reward $e(b)$.

Notice, for later use, that, following from differentiating equation (7), the curvature of $p(x)$ is given by

$$p''(x) = p''(e(x)) \left(e'(x)\right)^2 + p'(e(x))e''(x), \tag{8}$$

where $e'(x)$ is given by (5) and

$$e''(x) = f''(b) (b'(y)(y'(x)))^2 + f'(b)b''(y)(y'(x))^2 + f'(b)b'(y)y''(x). \tag{9}$$

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[14] The fixed compensation w has been set, for simplicity, to zero.

[15] It can be readily shown that, at an interior solution, the second order condition is satisfied. It can be also easily verified that the presence of moral hazard on the part of the tax inspector induces inefficiency in the level of effort being exerted and so the audit probability.

[16] This follows from the fact that $z'(e) = (c''(e)p'(e) - c'(e)p''(e))/(p'(e))^2 > 0$ where the inequality follows from $p'(e), c'(e) > 0$ and $c''(e) > 0 > p''(e)$.

2.3 Taxpayer

Equipped with the determination of effort $e(x)$, given in (4), and the definition of the audit success probability and its property, given in (6) and (7), the taxpayer with income I maximizes (1) choosing how much income x to report to the tax inspector, with necessary condition

$$-p'(x)(1+\pi)(I-x)+p(x)(1+\pi)-1=0, \tag{10}$$

which defines reporting policy $x = r(I)$ (which, it has to be emphasized, is independent of the distribution of income).

Sufficiency of the maximization problem of the taxpayer implies that

$$-p''(x)(I-x)+2p'(x)<0, \tag{11}$$

where, again, $p'(x)$ and $p''(x)$ are given, respectively, by (7) and (8).

2.4 Revenue authority

The revenue authority, for given income reporting x and upon making use of the fact that $I = r^{-1}(x)$ and $y(x) = r^{-1}(x) - x$, maximizes expected revenue. Making use of (6), expected tax revenue is thus

$$R = p\left(f(b(y(x)))\right)\left[tr^{-1}(x)+t\pi y(x)-b(y(x))\right]+\left(1-p(f(b(y(x))))\right)tx. \tag{12}$$

Since income reported x is taken as given, and so is $y(x)$, (12) is maximized pointwise with respect to b giving

$$p'(b)t(1+\pi)y(x)=p'(b)b+p(b), \tag{13}$$

where, for ease of exposition, we denote $p'(b) \equiv p'(e)f'(b)$ and thus $p(b) \equiv p(e(b))$.

Equation (13) is the standard optimality condition: at the optimum, the revenue authority sets b such that the marginal benefit from an additional unit of b (the LHS) equals the marginal cost (the RHS). When b increases marginally the increase in tax revenue depends on $p'(b)$, the increase in the probability of a successful audit, through the higher effort exerted by the tax inspector. But incentivizing the inspector is costly because a marginal increase in b has two effects on the revenue authority's cost: when the audit is successful this marginal increase in b needs to be paid, the $p(b)$ term, and the marginal increase in b increases the probability of success, suggesting a higher expected cost for all the inframarginal units of b, the $p'(b)b$ term.

A measure of how effective the reward is in motivating the inspector to exert effort is the percentage increase in the probability of a successful audit following a marginal increase in the reward, $p'(b)/p(b)$, which is the likelihood ratio.[17] It will prove convenient to define the inverse of the likelihood ratio $\psi(b) \equiv p(b)/p'(b)$ and express (13) as

$$t(1+\pi)y(x)=b+\psi(b). \tag{14}$$

Observe that the LHS of (14) is independent of b. The RHS of (14) is the *Marginal Cost of Incentivizing the Inspector*, ('MCII') or, equivalently, the sum of the reward and the inverse

[17] Note the differences and similarities between the likelihood ratio in this model and the one in standard moral hazard models. In a standard moral hazard model, $f(q|e)$ is the density of output as a function of the agent's effort and the likelihood ratio is $f_e(q|e)/f(q|e)$, where f_e is the derivative with respect to e. In our three-player model, the equivalent of output q is the successful detection of tax evasion y. The probability of success is in the direct control of the inspector, but tax evasion y is not, as it is chosen by the taxpayer. Moreover, the likelihood ratio in our model is with respect to the reward b and not with respect to effort e, although b affects e.

of the likelihood ratio (which it will be useful to note that it depends on the shapes of the probability function $p(e)$ and the cost of effort function $c(e)$—a point elaborated in Appendix C). Sufficiency of the revenue authority's maximization requires that the MCII is increasing in b, that is,

$$1 + \psi'(b) > 0. \tag{15}$$

What will be of particular interest is the slope and the curvature of the MCII, $b + \psi(b)$, which, as will be shown shortly below, shapes the structure of the optimal reward offered to the tax inspector.

3 Equilibrium definition and main results

This section defines a separating equilibrium, where the revenue authority and the taxpayer are making their choices simultaneously anticipating the response of the tax inspector, and then characterizes the differential equations that the optimal reward and taxpayer's evasion must satisfy in such an equilibrium.

Definition 1 *A separating equilibrium is a quadruple $\{\tilde{e}(b(y)), \tilde{y}(x), \tilde{b}(y), \tilde{\tau}(x)\}$, with $\tilde{r}^{-1}(x) = \tilde{y}(x) + x$ strictly monotonic, such that:*

i) given income reporting x, beliefs $\tilde{\tau}(x)$ and reward $b(y)$, the effort $\tilde{e}(b(y))$ maximizes the inspector's expected utility,

ii) given effort $\tilde{e}(\tilde{b}(y))$ and reward $\tilde{b}(y)$, the amount of tax evasion $\tilde{y}(x)$ maximizes the taxpayer's expected utility,

iii) given beliefs $\tilde{\tau}(x)$, effort $\tilde{e}(b(\tilde{y}))$ and tax evasion $\tilde{y}(x)$, reward $\tilde{b}(y)$ maximizes the expected tax revenue, and

iv) beliefs are consistent, $\tilde{\tau}(x) = \tilde{r}^{-1}(x)$ for all x.

Equipped with this definition, and the discussion in Section 2, we have that:

Proposition 1 *Assuming that the revenue authority's and taxpayer's second order conditions are satisfied, the inspector's optimal reward $b_0(y)$ and the taxpayer's tax evasion $y_0(x)$ must satisfy the following differential equations:*

$$b'(y) = \frac{t(1+\pi)}{1+\psi'(b)} > 0, \tag{16}$$

$$y'(x) = -\frac{\big(1+\psi'(b(y))\big)\big(1-p(b(y))(1+\pi)\big)}{(1+\pi)\big(p'(b(y))b(y)+p(b(y))\big)}, \tag{17}$$

where $\psi(b) \equiv p(b)/p'(b)$.

Proof of Proposition 1. The proof of Proposition 1 is in Appendix A. □

Following from (16)—with the strict inequality following (15)—the expression $t(1+\pi)/(1+\psi'(b))$ is continuously differentiable in b on $[0, \infty)$. This implies that for any given boundary condition a unique solution $b_0(y)$ exists, at least in the neighborhood of the boundary condition. The solution itself is continuously differentiable and thus the right-hand-side of (17) is also continuously differentiable in y. A unique solution $y_0(x)$ then exists in the neighborhood of the boundary condition, Birkhoff and Rota (1989).

It also readily follows from Proposition 1—and by routinely differentiating (16)—that:

Corollary 1 *The slope of the reward function ('power of incentives') depends positively on the tax rate t and the penalty π and negatively on the slope of the MCII $1 + \psi'(b)$.*

There is some simple intuition behind this, following directly from equation (14): for given tax evasion $y(x)$ an increase in either t or π increases tax revenue, in the event of a successful audit. As there is now more tax revenues available for collection, the revenue authority needs to incentivize the tax inspector, with a higher reward b at that given level of $y(x)$, holding the slope of the MCII, $1 + \psi'(b)$, fixed. Moreover, as $1 + \psi'(b)$ increases it becomes more costly to incentivize the inspector, yielding a flatter optimal reward function.

The question now is how tax evasion is affected by the level of income. It is the case that:

Lemma 1 *Under the conditions of Proposition 1, $dI/dx = r_0^{-1\prime}(x) > 0$ and $y_0'(x) < 0$, that is, taxpayers with higher true income also report higher income and tax evasion is a decreasing function of the income report (and the taxpayer's true income) .*

Proof of Lemma 1. The proof of Lemma 1 is in Appendix B. □

There is a simple intuition behind the strong result of Lemma 1.[18] Fix the structure of the reward $b(y)$—which is increasing in the amount of non-compliance detected $y(x)$—and consider the interaction between the tax inspector and the taxpayer. Following from (5) and thus the fact that $e'(x) < 0$, the tax inspector will exert a lower effort upon having observed a higher income report, and following from (7) that $p'(x) < 0$ a taxpayer who reports higher income faces a lower probability of being found in non-compliance. The taxpayer's best-response to a lower audit probability is to report more income when his true income increases. As the taxpayer reports more income when his true income increases, it is the tax inspector's best-response to exert less effort when higher income is being reported. The type of the taxpayer (his true income) is revealed in a separating equilibrium through the income report—in the sense that the tax inspector, by observing the taxpayer's income report, can perfectly infer, in equilibrium, the true income—but still effort must be exerted in order for this true income to be verified.

Thus far it has been established that the compensation offered to the tax inspector is increasing in the detected evaded income and its slope depends on t, π and the slope of the MCII $b + \psi(b)$. Naturally, the question that arises next is what determines the curvature of the reward function and so the response of the power of incentives. This is the question that we now turn to.

Lemma 2 *The optimal tax inspector's reward $b_0(y)$ is concave, (convex or linear) in y if and only if $\psi(b)$ is convex (concave or linear) in b that is, if and only if the MCII is convex (concave or linear) in b.*

Proof of Lemma 2. Differentiate (16) to obtain

$$b_0''(y) = -\frac{\psi''(b_0)b_0'(y)t(1+\pi)}{(1+\psi'(b_0(y)))^2}. \tag{18}$$

Since, $t(1 + \pi) > 0$, and, following from (16), $b_0'(y) > 0$, the curvature of (minus) $\psi(b_0)$ (which is the curvature of the modified marginal cost reward) determines the curvature of the reward function. □

[18] Lemma 1 is reminiscent of the result in Reinganum and Wilde (1986) who show that tax evasion decreases with income. The introduction of moral hazard does not have a qualitative effect on the taxpayer's incentives to evade his tax liabilities as his income increases.

Interestingly, there is thus a wide range of shapes the optimal reward can take (convex, linear or concave, where the power of incentives increases, stays constant, or decreases with detected non-compliance) and that its actual shape (not the level) depends on the shape of the MCII: if the MCII $b+\psi(b)$ increases at a decreasing (increasing) rate, then the power of incentives should be increasing (decreasing) in the magnitude of tax evasion. In more practical terms, as noted earlier, what is important for the actual curvature of the tax inspector's optimal compensation scheme are the shapes of the cost of effort $c(e)$ and probability of success $p(e)$.

The next section characterizes the conditions required for Lemma 1 to hold.

4 Characterization of the equilibrium

Proposition 1 and Lemma 1 have shown that in a separating equilibrium $b_0'(y) > 0$, $y_0'(x) < 0$ and $r_0^{-1\prime}(x) > 0$. The slope of the reward function, $b_0'(y)$, is positive provided that $1 + \psi'(b)$ is positive, which holds in lieu of the second order condition of the revenue authority's maximization problem in (15).

Next, we construct an equilibrium[19] by identifying conditions that would guarantee that $y_0'(x) < 0$ and $r_0^{-1\prime}(x) > 0$. Since $y_0'(x) = r_0^{-1\prime}(x) - 1$, $r_0^{-1\prime}(x) > 0$ if and only if $y_0'(x) > -1$.

Using (17), the reward $b_0(y)$ must satisfy

$$\frac{\big(1+\psi'(b_0)\big)\big(1-p(b_0)(1+\pi)\big)-p(b_0)(1+\pi)}{p'(b_0)(1+\pi)} \equiv b_1 \leq b_0 < b_2 \equiv f^{-1}\left(p^{-1}\left(\frac{1}{1+\pi}\right)\right), \qquad (19)$$

where[20] $b_0 < b_2$ ensures that tax evasion decreases with x, $y_0'(x) < 0$ and $b_0 \geq b_1$ ensures that tax evasion does not decrease too fast, so that there is a strictly monotonic reporting strategy, $r^{-1\prime}(x) > 0$, except possibly at the boundary of the income report.

The Theorem that follows summarizes the characterization of the equilibrium.[21]

Theorem 1 *If $b_0(y)$ and $y_0(x)$ exist throughout $[\underline{x}, \overline{x}]$ and satisfy the second order conditions of the taxpayer and the tax inspector and* (19)*, then the following quadruple is an equilibrium:*

(i.) The equilibrium reporting policy $\tilde{y}(x)$ in $[\underline{x}, \overline{x}]$ is the unique solution, $y_0(\cdot)$, to $y'(x)$ from (17).

[19] Following similar steps as in Reinganum and Wilde (1986).

[20] This follows again from (17) and the fact that $y_0'(x) < 0$ requires $1-p(b(y))(1+\pi) > 0$. This implies—recalling that $p(b(y)) \equiv p(f(b(y)))$— that $y_0'(x) < 0$ if $b_0 < p^{-1}(f^{-1}(1/(1+\pi))) \equiv b_2$.

[21] The analysis has abstracted from the consideration that the tax inspector might be dishonest and engage in collusive behaviour with the taxpayer so the latter under-reports the discovered tax evasion in return of a side payment from the taxpayer (for elements of this see Hindriks, Keen and Muthoo (1999)). Such collusion will be mutually profitable if and only if $b(y) < t\pi y$, that is, if the loss to the inspector in terms of the foregone reward when he does not report the evasion to the revenue authority is less than the gain of the taxpayer in terms of the saved tax penalty. A sufficient condition for a collusion-proof reward is $b' \geq t\pi$, which, together with $b(\overline{y}) > 0$, guarantees that $b_0(y) \geq t\pi y$. If $\pi \leq 1$, the above condition is always satisfied when the inspector's reward is either linear or convex in y. Collusion-proofness can also arise even when the reward is concave in y (details are available upon request).

(ii.) The equilibrium reward is given by

$$\tilde{b}(x) = \begin{cases} b_0(\underline{I} - x) & \text{for } x < \underline{x} \\ b_0(y_0(x)) & \text{for } x \in [\underline{x}, \overline{x}] \\ b_0(\overline{I} - x) & \text{for } x > \overline{x}, \end{cases}$$

where $b_0(\cdot)$ is the unique solution to $b'(\cdot)$ from (16).

(iii.) The equilibrium effort is $\tilde{e}(x) = f(\tilde{b}(x))$.

(iv.) Finally, the equilibrium beliefs are

$$\tilde{\tau}(x) = \begin{cases} \underline{I} & \text{for } x < \underline{x} \\ y_0(x) + x & \text{for } x \in [\underline{x}, \overline{x}] \\ \overline{I} & \text{for } x > \overline{x}. \end{cases}$$

Proof of Theorem 1 The proof of Theorem 1 is in Appendix D. □

Figures 1-3 illustrate Theorem 1.[22]

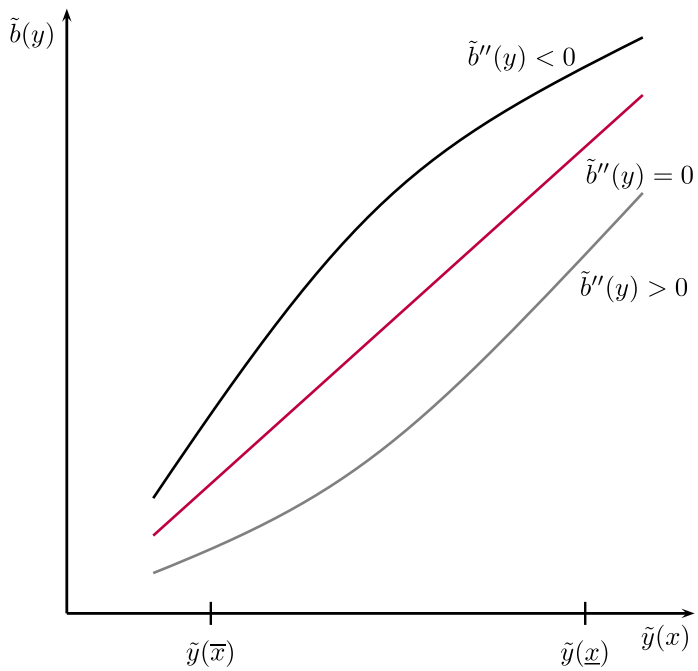

Figure 1: **Equilibrium reward $\tilde{b}(y)$ as function of detected noncompliance $y(x)$**

[22]Notice that the figures depict the shapes of the relevant functions and not their levels which have been chosen arbitrarily. Examples underlying the Theorem exist. See the longer version of this paper, Kotsogiannis and Serfes (2015).

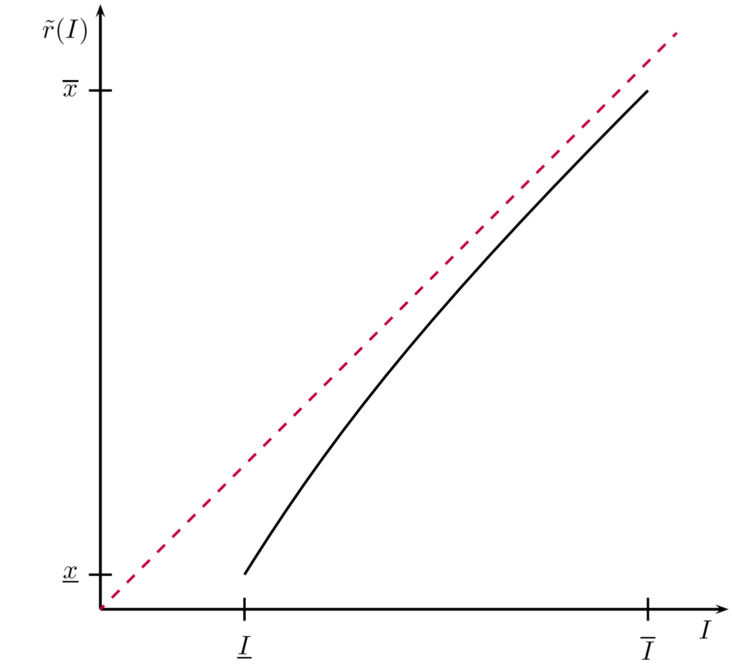

Figure 2: **Equilibrium income reporting $\tilde{x} = \tilde{r}(I)$ as function of true income I**

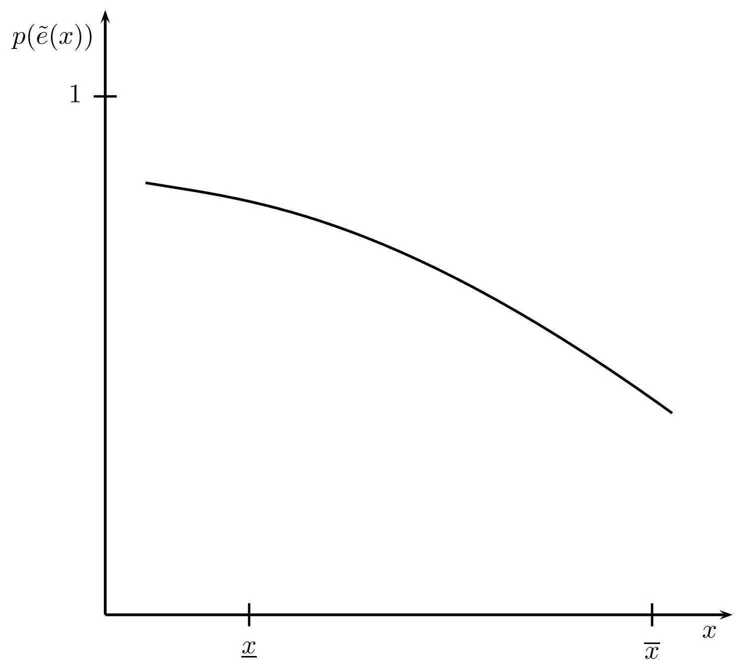

Figure 3: **Equilibrium auditing $p(\tilde{e}(x))$ as function of income reporting x**

Beyond its technical content, there is a practical element—related to the tax administration issues discussed at the outset—behind the result of Theorem 1 (which is independent of assumptions on the distribution of income, the latter of which does not feature in the theorem): in the presence of moral hazard the auditing strategy requires to be supported by an appropriate reward schedule that is increasing in the amount of tax evasion discovered.

Perhaps more fundamentally, what lies underneath Theorem 1 is that if a separating equilibrium which satisfies (19) exists, then a reward that is constant in evaded income does not exist. To emphasize:

Proposition 2 *If the separating equilibrium characterized by Theorem 1 exists, then there does not exist an equilibrium with constant tax evasion and constant reward.*

Proof of Proposition 2 The proof of Proposition 2 is in Appendix E. □

5 Multiple tax inspectors and optimal performance reward

Thus far the analysis has focused on the revenue authority consisting of (and the audit policy being implemented by) one tax inspector. In practice, tax audit implementation is an outcome of several tax inspectors who may be allocated certain activities and take joint action in assessing the taxpayer's behaviour. This joint action can, of course, take many forms possibly including, the tasks of gathering specific evidence, processing, evaluating and communicating information. It is their common interest (detecting non-compliance) through different activities and the individual incentives which raise the natural question (addressed next) of what is the structure of the performance reward for a team of tax inspectors?

To begin exploring some of the implications of multiple tax inspectors, suppose now that tax auditing is performed by two tax inspectors, indicated by the subscript $i = 1, 2$. To further simplify matters at some point the probability of a success will take the form

$$p(e_1, e_2) = e_1 + e_2 + \theta e_1 e_2, \tag{20}$$

and the tax inspectors will be treated symmetrically[23] with cost function $c\left(e_i\right) = e_i^2/2$, and performance reward $b\left(y\left(x\right)\right)/2$. Conveniently, the parameterization of $p(e_1, e_2)$ in (20) implies that (with a subscript denoting the derivative of the function with respect to that variable) $p_{e_i e_i} = 0$ and $p_{e_i e_j} = \theta$, $i = 1, 2$, $i \neq j$, and so the parameter θ in (20) captures whether efforts are strategic complements ($\theta > 0$) or substitutes ($\theta < 0$).

Clearly, the introduction of a team of tax inspectors leaves the structure of the taxpayer's maximization problem (and so Lemma 1) unaffected. But it changes the incentives to exert effort of the tax inspectors, and, therefore, the probability of audit success and consequently the shape of the tax inspectors' reward function. To see this, notice that for a given reward function $b(y(x))/2$ and the taxpayer's income report $x = r(I)$, inspector $i = 1, 2$ maximizes expected utility given by

$$U_{In_i} = p(e_1, e_2)\frac{b(y(x))}{2} - c(e_i), \tag{21}$$

with necessary and sufficient conditions, respectively,

$$p_{e_i}\left(e_1, e_2\right)\frac{b\left(y(x)\right)}{2} - c'\left(e_i\right) = 0, \tag{22}$$

$$p_{e_i e_i} b\left(y\left(x\right)\right) - 2c''\left(e_i\right) < 0. \tag{23}$$

For given reward function $b\left(y\left(x\right)\right)$, equations (22) can be simultaneously solved for the equilibrium efforts $e_i\left(b\left(y\left(x\right)\right)\right)$, $i = 1, 2$, and, thus, the probability of successful audit can be written as $p\left(e_1\left(b\left(y\left(x\right)\right)\right), e_2\left(b\left(y\left(x\right)\right)\right)\right)$. Denote this by $p(b)$.

[23] But they neither need be symmetric nor the performance reward of the revenue authority should be of the egalitarian form.

Notice also that (22) implicitly defines the best-response of inspector i $e_i(e_j)$, for $i = 1, 2$, $i \neq j$, with

$$e_i'(e_j) = -\frac{p_{e_ie_j} b\left(y\left(x\right)\right)}{p_{e_ie_i} b\left(y\left(x\right)\right) - 2c''(e_i)}, \tag{24}$$

and so, following (23), whether efforts are strategic complements (in the sense of $e_i'(e_j) > 0$) or substitutes (in the sense of $e_i'(e_j) < 0$) depends on $p_{e_ie_i} = \theta$. It is easy to verify that the specific functional forms employed for $p(e_1, e_2)$ and $c(e_i)$ imply that $e_1 = -b\left(y\left(x\right)\right) / \left(b\left(y\left(x\right)\right)\theta - 2\right) = e_2$.

Equipped with the above discussion, the revenue authority maximizes (12) with the structure of the necessary and sufficient conditions of this maximization problem being the ones given, respectively, in (14) and (15). Following from the functional forms employed, what this implies is that the curvature of the reward function—recalling from the discussion in Lemma 2 that this is related to the shape of the MCII $b + \psi(b)$ and, in particular, takes the opposite sign of $\psi''(b)$—is given by[24]

$$\psi''(b) = \frac{3\theta}{4}\Big(\theta b\left(y\left(x\right)\right) - 2\Big). \tag{25}$$

Since, following from (23), $b\left(y\left(x\right)\right)\theta - 2 < 0$, $\psi''(b)$ takes the opposite sign of θ. Summarizing:

Lemma 3 *Assuming that the success probability takes the form of (20), and the cost of effort is quadratic in effort, the optimal tax inspectors' reward $b_0(y)$ is concave, (convex) in y if and only if $\psi(b)$ is convex (concave) in b, which is the case if and only if the tax inspectors' effort are strategic substitutes (complements).*

Here is, therefore, an example where the fundamental determinant of the shape of the reward function is the strategic relationship of tax inspectors' efforts exerted in the allocated tasks: if they are strategic complements (in the sense of $p_{e_ie_j} = \theta > 0$), the MCII $b + \psi(b)$ increases at a decreasing rate, implying that the power of incentives should be increasing in the magnitude of tax non-compliance. The opposite holds if they are strategic complements. The intuition is as follows. When efforts are strategic complements, the effort of one inspector reinforces that of the other and an increase in the reward is more effective in motivating both inspectors to exert higher effort, implying that the MCII increases but at a decreasing rate. So, the optimal reward itself must be increasing at an increasing rate (convex). The reverse is true when efforts are strategic substitutes, in which case a higher effort on part of one inspector is partly offset by the effort reduction of the other. In this case, the MCII increases at an increasing rate.

Clearly, if the two inspectors are independent and so $\theta = 0$ (or, as in the case in the previous sections, there is one tax inspector), then the reward function is increasing linearly in non-compliance. It needs to be emphasized, however, that in this section even though the cost function is quadratic and the probability of success linear in own effort the reward function is not a linear function in non-compliance. What drives the shape of the reward function is not entirely the cost of effort and the shape of the probability of success with respect to own effort but, more importantly, the specific interaction of the efforts exerted by the team members in the allocated tasks.

6 Summary

This paper has incorporated the incentives of tax inspectors into an equilibrium model of tax compliance and enforcement and characterized the optimal compensation policy of the revenue

[24] The details are available upon request.

authority, the audit policy of the tax inspector and the compliance strategy of the taxpayer, when true income is private information and the inspector's effort in verifying an income report is unobservable to the revenue authority (moral hazard). It has shown that the reward of tax inspector (a function of detected tax evasion) is, in general, nonlinear and that the power of incentives (in the sense of the slope of the optimal reward function), can be constant, decreasing, or increasing in the magnitude of the discovered tax evasion. The other two features of the equilibrium characterized are consistent with those of Reinganum and Wilde (1986), in the sense that taxpayers with greater true income under report less than those with lower true income and tax inspectors' auditing efforts decrease with reported income: the latter being determined by the interplay of properties of the cost of effort and probability of success functions.

The paper has also highlighted the role of multiple tax inspectors in assessing non-compliance. The simple analysis of this paper—with two tax inspectors and analytically convenient functional forms for the cost of effort functions and probability of audit success—has also pointed to a rich set of possibilities, driven by the strategic relationship of efforts of the team members regarding the structure of the optimal reward structure.

Appendices

Appendix A

Proof of Proposition 1. This appendix establishes that the tax inspector's optimal award follows (16) and the taxpayer's tax evasion (17).

Making use of (6) and (7), and of the fact that $y(x) = I - x = r^{-1}(x) - x$, into (10) and rearranging gives

$$(1+\pi)y(x) = -\frac{\big(1 - p(b)(1+\pi)\big)}{p'(b)b'(y)y'(x)}, \tag{A.1}$$

which upon substituting (A.1) into (13) gives

$$b'(y)y'(x) = -\frac{t\big(1 - p(b)(1+\pi)\big)}{p'(b)b(y) + p(b)}. \tag{A.2}$$

Substituting (A.2) into (A.1) gives

$$y(x) = \frac{1}{t(1+\pi)}\big(b(y(x)) + \psi(b(y(x)))\big), \tag{A.3}$$

where $\psi(b) \equiv p(b)/p'(b)$. Since (A.3) holds for any admissible x, differentiating both sides with respect to x one obtains

$$y'(x) = \frac{1}{t(1+\pi)}\big(b'(y(x))y'(x) + \psi'(b(y(x)))b'(y(x))y'(x)\big). \tag{A.4}$$

The second order condition given by (11), making use of (8), becomes

$$\begin{aligned} A \equiv \;& - \;\; \Big\{p'(e)f''(b)\,(b'(y)(y'(x)))^2 + p'(e)f'(b)b''(y)(y'(x))^2 + p'(e)f'(b)b'(y)y''(x) \\ & + \;\; p''(e)(f'(b)b'(y)y'(x))^2\Big\}y(x) + 2p'(e)f'(b)b'(y)y'(x) < 0. \end{aligned} \tag{A.5}$$

Equation (A.4) points to two cases: (i) $y'(x) = 0$ and (ii) $y'(x) \neq 0$.

Case (i): If $y'(x) = 0$, then from (A.2) follows that $p(b) = 1/(1+\pi)$, which implies that $b(y) = f^{-1}\left(p^{-1}\left(1/(1+\pi)\right)\right) = c'\left(p^{-1}(1/(1+\pi))\right)/p'\left(p^{-1}(1/(1+\pi))\right)$ (with the second equality following from the fact that $f(\cdot) \equiv z^{-1}(\cdot)$, where $z(\cdot) \equiv c'(\cdot)/p'(\cdot)$). Differentiating (10) with respect to x, allowing also I to change according to $r^{-1}(x)$ gives[25]

$$A - p'(b)b'(y)y'(x)r^{-1\prime}(x) = 0, \tag{A.6}$$

where $A < 0$ is the second order condition of the taxpayer in (A.5). With $y'(x) = 0$, $b'(y)y'(x) = 0$, (A.6) is not satisfied. Clearly, for the constant reward and verification case to be an equilibrium, the taxpayer must be indifferent among all reports, in which case the second order condition is satisfied with equality. Section 3 examines this case and shows that such an equilibrium does not exist.

Case (ii): With $y' \neq 0$, then (A.4) is satisfied if (omitting the x for ease of exposition)

$$b'(y) = \frac{t(1+\pi)}{1+\psi'(b(y))}, \tag{A.7}$$

which is (16). Consistency between (A.7) and (A.2) implies that $y'(x)$ takes the form of (17). □

Appendix B

Proof of Lemma 1. Since, following from Proposition 1, $b'(y) > 0$, and, following from (A.5), $A < 0$ then from (A.6) it is the case that

$$b'(y)y'(x)r^{-1\prime}(x) < 0. \tag{B.1}$$

It is thus the case that either (i) $b'(y) > 0$, $y'(x) < 0$, and $r^{-1\prime}(x) > 0$, or (ii) $b'(y) > 0$, $y'(x) > 0$, and $r^{-1\prime}(x) < 0$.

Case (ii) is ruled out since $y(x) = I - x = r^{-1}(x) - x$ and so $y'(x) = r^{-1\prime}(x) - 1 > 0$ is inconsistent with $r^{-1\prime}(x) < 0$. It follows that only case (i) holds. □

Appendix C

Derivation of $\psi''(b)$ and dependence of MCII on $p(e)$ and $c(e)$. Differentiating $\psi(b_0)$ twice gives

$$\psi''(b_0) = -\frac{p''(b_0)}{p'(b_0)} + \frac{2p(b_0)(p''(b_0))^2}{(p'(b_0))^3} - \frac{p(b_0)p'''(b_0)}{(p'(b_0))^2}, \tag{C.1}$$

where, recalling that $p(b) \equiv p(f(b))$, with $f(\cdot) \equiv z^{-1}(\cdot)$, $z(\cdot) \equiv c'(\cdot)/p'(\cdot)$,

$$p'(b) = p'(e)f'(b), \tag{C.2}$$

$$p''(b) = p''(e)f'(b) + p'(e)f''(b), \tag{C.3}$$

$$p'''(b) = p'''(e)\left(f'(b)\right)^2 + p''(e)\left[f''(b)\left(1+f'(b)\right) + f'''(b)\right], \tag{C.4}$$

where $f'(b) = 1/(z'(z^{-1}(b))) > 0$ and $z'(\cdot) = (c''(\cdot)p'(\cdot) - c'(\cdot)p''(\cdot))/(p'(\cdot))^2$.

We turn now to MCII. Since MCII is $b + \psi(b)$, with $\psi(b) \equiv p(b)/p'(b)$ that MCII depends on $p(e)$ and $c(e)$ follows from (C.2). □

[25] Notice that to arrive at (A.6), during differentiation the inspector's effort $e(x)$ responds to changes in the type of the taxpayer in the sense that $y(x) = r^{-1}(x) - x = I - x$, $y'(x) = r^{-1\prime}(x) - 1$ and $y''(x) = r^{-1\prime\prime}(x)$.

Appendix D

Proof of Theorem 1. Let $\overline{x}$ be the highest reported income associated with the highest true income $\overline{I}$ and let $\overline{y} \equiv y(\overline{x}) \equiv \overline{I} - \overline{x}$ be the amount of tax evasion at the highest true income. The boundary condition of the ordinary differential equation (16) is the b that solves, following from (13),

$$b = t(1+\pi)\overline{y} - \psi(b). \tag{D.1}$$

The claim now is that if (19) is satisfied the right-hand-side of (D.1) must be strictly positive that is, $t(1+\pi)\overline{y} - \psi(0) > 0$ which implies that $\overline{y} > \psi(0)/(t(1+\pi))$. To see that this is the case suppose $\overline{y} \leq \psi(0)/(t(1+\pi))$. Then, the right-hand-side of (D.1) is nonpositive at $b(\overline{y}) = 0$ (and for any positive b) and $b(\overline{y}) = 0$, since only that value satisfies (D.1) (with an inequality in the case of $b(\overline{y}) = 0$, assuming that the reward is not allowed to take negative values). But this boundary would imply zero effort on part of the tax inspector, that is, $f(0) = 0$ and hence $p(0) = 0$. This implies, following from (19), that $b_1(\overline{y}) > 0$, which in turn implies that $b(\overline{y}) = 0$ violates the condition $b_0 \geq b_1$. As it has just been established, $t(1+\pi)\overline{y} - \psi(0) > 0$ and, it will be recalled, that $\psi'(b) > 0$. This implies that there exists a boundary condition for b', $b(\overline{y}) > 0$, that uniquely satisfies equation (D.1).

Next, we choose the boundary for the differential equation (17). Since $\overline{y}$ is the lowest tax evasion, and $b'(y) > 0$, $b(\overline{y})$ is also the lowest. Recall that $b_0 \geq b_1$ must be satisfied. We choose as a boundary the $\overline{y}$ that solves $b_1(\overline{y}) = b_0(\overline{y})$. This amounts to solving $y'(b(\overline{y})) = -1$. If this solution does not exist, it means that either $y' < -1$ or $y' > -1$ for all possible boundary conditions. In the former case, a separating equilibrium does not exist because $r^{-1}(x)$ is decreasing in x. In the latter case, we solve $y'(b(\overline{y})) = -k$ and we choose the $\overline{y}(k)$ that corresponds to the maximum $k \in (0,1)$.[26] Once the boundary condition $\overline{y}$ has been chosen, the $\overline{x}$ is given by $\overline{y} = \overline{I} - \overline{x}$. The lower bound $\underline{x}$ is the solution to $y_0(\underline{x}) = \underline{I} - \underline{x}$. Such an $\underline{x}$ clearly exists since $y_0(x)$ increases as x decreases with slope less than one (in absolute) and x can approach $-\infty$.

In addition, it is assumed that

$$b_0' \left[\frac{t(1+\pi)}{1+\psi'(b_0)} (\overline{I} - x) \left\{ 1 - \frac{\psi''(b_0)}{1+\psi'(b_0)} \right\} + 2 \right] \geq 0 \quad \text{for } x > \overline{x}$$

$$b_0' \left[\frac{t(1+\pi)}{1+\psi'(b_0)} (\underline{I} - x) \left\{ 1 - \frac{\psi''(b_0)}{1+\psi'(b_0)} \right\} + 2 \right] \geq 0 \quad \text{for } x < \underline{x}. \tag{D.2}$$

The above condition always holds if $\psi''(b_0) \leq 0$, that is if the reward is either linear or convex. It may also hold if $\psi''(b_0) \geq 0$, and so the reward is concave.

Given the assumptions outlined in text, the solutions to the differential equations, (16) and (17), that govern the evolution of the reward and the taxpayer's reporting respectively, exist and are unique. Further, we assume that this is true throughout $[\underline{x}, \overline{x}]$.

We next show that the taxpayer has no incentive to report an x outside the $[\underline{x}, \overline{x}]$ interval. Let $x > \overline{x}$. The belief of the inspector is $\tau(x) = \overline{I}$. So, $y(x) = \overline{I} - x$ and $y'(x) = -1$. The optimal reward for any $x > \overline{x}$ is now $b_0(y)$, with $y = \overline{I} - x$, so $b_0(\overline{I} - x)$. Fix the type of the taxpayer at $\overline{I}$ and consider the first order condition of the taxpayer given by (10), re-written here for convenience,

$$-p'(b)b'(y)y'(x)(1+\pi)y(x) + p(b)(1+\pi) - 1 = 0. \tag{D.3}$$

[26] Of course, this is only one equilibrium among, possibly, a continuum of equilibria, each one corresponding to a different initial condition. Nevertheless, all equilibria share the same qualitative properties.

At $x = \overline{x}$, the first order condition is satisfied with equality. Differentiating (D.3) with respect to x one obtains

$$-[p'(b)(b'(y))^2 + p'(b)b''(y)]y(x) - 2p'(b)b'(y). \tag{D.4}$$

The above expression is negative if and only if

$$[(b'(y))^2 + b''(y)]y(x) + 2b'(y) \geq 0, \tag{D.5}$$

which, after using the expressions for b' and b'', becomes

$$b' \left[\frac{t(1+\pi)}{1+\psi'(b)} y(x) \left\{ 1 - \frac{\psi''(b)}{1+\psi'(b)} \right\} + 2 \right] \geq 0, \tag{D.6}$$

which is satisfied given (D.2).

Therefore, the slope of the taxpayer's utility function decreases as x increases beyond $\overline{x}$. Given that the slope is zero at $x = \overline{x}$, it follows that it becomes negative when $x > \overline{x}$. Thus, the taxpayer has no incentive to report an income higher than $\overline{x}$. While so far we have set $I = \overline{I}$, the same steps can be used to show that even if $I < \overline{I}$ the taxpayer has no incentive to report an x higher than $\overline{x}$. Suppose $I < \overline{I}$. The slope of the taxpayer's objective function is zero if he reports $x = r(I) < \overline{x}$ and the objective function is strictly concave, implying that the slope of the objective function is negative at $x = \overline{x}$. After this point, as we showed above, the slope becomes even more negative, making a deviation in that region unprofitable.

The same steps can be used to prove that any $x < \underline{x}$ is a dominated strategy, using in this case $b_0(\underline{I} - x)$ for any $x < \underline{x}$. □

Appendix E

Proof of Proposition 2. Following the proof of Proposition 1, $y' = 0$ (and so tax evasion is the same across all taxpayer types), implies $b = f^{-1}\left(p^{-1}\left(1/(1+\pi)\right)\right)$. This, however, cannot be an equilibrium. The reason is as follows. The constant reward gives rise to a constant probability of detection $p(e(b)) = 1/(1+\pi)$, which implies that the taxpayer is indifferent among all income reports x for any I. So, he will choose some constant tax evasion consistent with this equilibrium (the constant y, denoted by $\hat{y}$, can be determined from the first order condition of the revenue authority (13)).

The income reports are in the interval $[\underline{I} - \hat{y}, \overline{I} - \hat{y}]$. Note, using (19), that the reward associated with the constant solution is higher than the reward from the separating equilibrium.

First, assume that $\hat{y} < \tilde{y}(\underline{x})$. This implies that $\underline{I} - \hat{y} > \underline{I} - \tilde{y}(\underline{x}) = \underline{x}$. Consider now the taxpayer with $I = \underline{I}$ who, according to the constant reward equilibrium, should report $\underline{I} - \hat{y}$. Suppose this taxpayer deviates to $x \in (\underline{x}, \underline{I} - \hat{y})$. The beliefs are $\tau(x) = \underline{I}$ and the optimal reward is now the $b_0(y)$ which is discretely lower than the constant reward. The taxpayer becomes better off because tax evasion increased, while the probability of detection decreased. This is true for a positive measure of taxpayers.

Assume now that $\hat{y} > \tilde{y}(\overline{x})$. This implies that $\overline{I} - \hat{y} < \overline{I} - \tilde{y}(\overline{x}) = \overline{x}$. Consider now the taxpayer with $I = \overline{I}$ who, according to the constant reward equilibrium, should report $\overline{I} - \hat{y}$. Suppose this taxpayer deviates to $x \in (\overline{I} - \hat{y}, \overline{x})$. The beliefs are $\tau(x) = \overline{I}$ and the optimal reward is now the $b_0(y)$ which is discretely lower than the constant reward. The taxpayer becomes better off because tax evasion has decreased marginally, while the probability of detection decreased discontinuously. This is true for a positive measure of taxpayers.

Finally, because $\tilde{y}(\overline{x}) < \tilde{y}(\underline{x})$ the above two cases exhaust all the possibilities. Therefore, the constant reward cannot be an equilibrium, provided that the separating equilibrium satisfies (19). $\square$

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