Società italiana di economia pubblica
XV CONFERENZA
DIRITTI, REGOLE, MERCATO
Economia pubblica ed analisi economica del diritto
Pavia, Università, 3 - 4 ottobre 2003

TAX EVASION AND CORRUPTION IN TAX ADMINISTRATION

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XV Conferenza SIEP - Pavia, Università, 3 - 4 ottobre 2003

pubblicazione internet realizzata con contributo della

Tax Evasion and Corruption in Tax Administration

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September 15, 2003

Abstract

In this paper we consider a simple economy where self interested tax payers may have incentives to evade taxes and, to escape sanctions, to bribing public officials in charge for collection. We analyze the interactions between evasion, corruption and monitoring as well as their adjustment to a change in the institutional setting. At equilibrium we find that the effects of a tougher deterrence policy, increasing fines, reduces evasion, whereas its effect on corruption is ambiguous.

The normative analysis for a utilitarian planner shows that a maximal fine principle holds, despite the fact that, in our setting, raising fines increases incentives to monitoring activities and their cost to society.

1 Introduction

It is widely agreed that tax evasion and corruption of public officials are social phenomena whose pervasive effects can seriously hurt the economic growth and the stability of social institutions (Rose-Ackerman, 1978; Shleifer and Vishny, 1993; Bardhan, 1997). Although an extensive literature has investigated their origins, effects, and size, on both theoretical and empirical grounds, the interaction between tax evasion and corruption has been only partially explored. In general, the level of corruption and tax evasion in the economy mutually depend on several structural and institutional features, such as the degree of risk aversion, the wealth of taxpayers and the wage of public officials, the overall tax burden of the economy, and the organization and the efficiency of the enforcing authorities.

In a normative perspective, the problem of the relationship between enforcement, corruption, and deterrence has been recently analyzed, among others, by Polinsky and Shavell (2001), who examine both the optimal amount of resources to be allocated to law enforcement and detection of bribery and the optimal fines

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structure. Since bribery agreements can dilute deterrence of the underlying violation, it is desirable for society to attempt to detect and penalize corruption in order to preserve a given degree of deterrence. This result holds even if corruption is not completely deterred. An application of this finding to the context of tax evasion would imply that taxpayers have to be audited and auditors have to be monitored since fighting against corruption may be worthwhile in order to foster deterrence of tax evasion. Moreover, Polinsky and Shavell also show that both the optimal fine for the underlying offense and the optimal fine for bribery should be maximal, mainly because detecting any violation involves a cost. These results extend the classical theory of enforcement to the case when corruption may dilute deterrence for the underlying offence.

A distinctive feature of this approach, as in the classical analysis of the deterrence problem, is the assumption that the Government can fully commit to a monitoring probability, which leads to perfect substitutability between fines and probability of detection for a given level of deterrence. Other contributions (see Moohkerjee and Png, 1995, as an example) also consider the effect of corruption on deterrence of the underlying offence taking the probability of detection as exogenous. In this case it is a fortiori true that raising fines does not affect the probability of monitoring. However, committing to a given probability of monitoring is not necessarily a feasible policy to a planner. In principle, ex-post incentives to inspect illegal activities are not independent of the size of the fines. For a given crime level it is possible to argue that the incentives to provide monitoring activities are positively related to the magnitude of the fines. For example, a tax authority may have incentives to strengthen its inspection activity when fines for evasion are increased, since this could raise its revenue. As another example, we could think of prosecutors' incentives to investigate corruption to be high when the fines for corruption are high since this provides better career perspectives.

In this paper we extend the standard tax evasion problem faced by a population of identical taxpayers, who can be audited by self interested public officials, by introducing the possibility that the payment of a bribe arises in return for tax evasion not being reported, once discovered. In particular, we analyse the implications of the absence of commitment to inspecting corruption. When evasion is discovered, the possibility of a bribing agreement may lead to corruption. The incentives to enter the illegal agreement are affected by the probability that a fiscal authority monitors its employees in order to collect fines and to deter evasion. The incentives to monitor corruption, in accordance with the idea that committing monitoring is not feasible, are related to the amount of fines that can be collected as a result of the activity. Differently from the hypotheses of the classical theory of enforcement, according to which the probability of detecting corruption (and the underlying offence) and the fines can be seen as perfect substitute policies for a given level of deterrence, in our setting, for a given level of deterrence for both evasion and corruption, the incentives to perform monitoring activities are increasing in the level of fines.[1] More specifically, in

[1] Notice that our analysis is performed in a setting where reward schedules for corruption

order to analyze the relationships between …nes and monitoring, we consider an inspection game between self interested tax auditors and corruption monitorers within the framework of two di¤erent institutional settings which de…ne the reward structure for monitorers. In the …rst, we model a Tax Authority hierarchy where the incentives to monitoring are provided by collections of …nes for evasion. In the second, we assume that the incentives to the inspectors (e.g. prosecutors) are proportional to the …nes for corruption. These two alternative speci…cations allow us to analyze in detail the e¤ects of raising …nes (among other things) on both the underlying o¤ence and corruption.

The main results of the paper can be sinthesized as follows. Under both institutional arrengements (i.e. the structure of the monitoring agency) an increase of the …ne for evasion reduces tax evasion wheras its e¤ects on the size of corruption are ambiguous. As for the …ne for bribe, its e¤ects are related to the institutional setting; namely, under the hypothesis that the monitoring agency collects …nes for corruption, an increase determines a reduction of the expected bribe, thus reducing incentives to monitoring. The overall e¤ects turns out to be a reduction of both corruption and tax evasion. Under the hypothesis that the monitoring agency collects …nes for evasion, an increase of the …ne for bribe reduces the level of corruption while its e¤ects on tax evasion depend on the level of the …ne.

The …nal issue analized in this paper is normative. Given the setting of the model and by considering a utilitarian government we ask the following questions:

1. What is the e¤ect of the costly enforcement structure on the optimal level of the tax rate compared to the …rst best outcome?

2. What is the optimal composition of the public budget between enforcement expenditures and public good provision?

3. Given the absence of commitment in the inspection game does a maximal …ne principle hold?

2 Setting

We consider a simple economy composed of N identical agents (N is normalized to 1). The preferences of each agent are described by the utility function $U = M + V(G)$, where M is the level of income and G the amount of public good In order to get resources for the provision of the public good G, tax revenues have to be collected. Given that the tax base is veri…able only at a postive cost for society, self interested agents have incentives to under report the tax base unless a large enough punishment for misbehavior is credibly anticipated. In

inspectors are exogenously …xed. A more general analysis would allow for the possibility for the planner to optimally choose the wage schedule for the enforcers. This would, however, indirectly reintroduce the possibility of committing monitoring probabilities, which is not the focus of this paper.

order to deter evasion society assigns to a public enforcement agency, composed by a subset of the total population n_1, the right to audit tax payers and, in case evidence for evasion is found, the right to report misbehavior to the Tax Authority. The right to collect evidence for misbehavior and apply …nes does not prevent agents in the enforcement structure (tax auditors or public o¢cials) to concede on the temptation to collect private gains from their activity in the form of bribes, denoted by b. This opportunity dilutes deterrence of tax evasion and, in order to keep incentives for the taxpayers to report their income large enough, we consider the possibility that resources can be devoted to controlling bribery agreements by another fraction of (uncorruptible) monitorers, n_2.

This basic institutional framework is consistent with the idea that the enforcement structure is organized through a legal system: the legislature sets …nes for misbehavior, crimes have to be proved at a cost and responsibility for enforcement falls on an agency whose actual behavior cannot be precommitted at the legislative stage. This simple society has to decide the amount of public good to be provided given the constraints set by imperfect enforcement. Morevoer, an institutional setting specifying controls and remuneration of public o¢cials has to be arranged.

To analyze the basic features of this problem we set up a speci…c model whose timeline structure is as follows:

Stage 1. Income tax rate ¿, …nes for evasion ©$_e$; and …nes for corruption ©$_Â$ are set, the number of public o¢cials n_1 having the right to monitor …scal reports is hired, an agency, composed of n_2 individuals in charge of controlling public o¢cials, is established.

Stage 2. Given the institutional setting above, n_0 risk neutral taxpayers decide the fraction ® of the tax base M to be reported.

Stage 3. n_1 tax audits are delivered. With probability p(®) the exact amount of tax evasion is discovered and veri…ed by each tax auditor.

Stage 4. Among the subset of veri…ed tax evasion acts, p(®)n_1, the possibility of a bribe arises. The surplus to the parties is de…ned by the …ne for evasion and the …ne for corruption to be paid in the event the bribery agreement is discovered and is divided according to the Nash bargaining solution. Simultaneously the monitoring agency sets the level of internal monitoring to be delivered, taking into account its bene…ts (…nes collected) and its costs. Monitoring occurs, part of the bribery agreements are discovered, punishment is implemented, the public good is produced and consumed.

The distinguishing features of the model outlined above are that the rates of corruption and monitoring are endogenously determined, given the level of tax evasion, to capture the idea that no commitment to enforcement levels is assumed in the analysis. The aim will be the characterization of the decision of atomistic taxpayers, given the enforcement structure outlined above, and the corresponding level of monitoring and corruption emerging in the equilibrium of the game. Finally, at the normative stage optimal …nes and tax rates will be de…ned.

3 Tax evasion with bribery

The seminal paper by Allingham and Sandmo (1972) provides the standard framework for the economic analysis of tax evasion. Given the enforcement structure and the tax system of an economy and assuming that the true tax base of any taxpayer is costly observable by the Tax Authority, rational taxpayers are faced with the decision of whether to reduce tax payments by under-reporting their income level. The private cost of exploiting this opportunity is related to both the probability that under-reporting will be detected and, in case of detection, to a monetary penalty. Thus, the decision of whether, and how much, to evade resembles the choice of whether, and how much, to gamble; it follows that under certain circumstances the taxpayer may decide to report a taxable income below its true value. This basic version of the model has been extended along a number of directions. Among these the most relevant for the purpose of this paper is the one which suggests that the tax evasion decision may be influenced by the probability of corruption of public officials. In our case, we consider the behavior of risk neutral individuals facing the probability of evasion being documented, once an audit takes place, positively related to the amount of evasion. This feature of the verification technology characterizes most tax systems and has been already introduced in the literature (Slemrod and Yitzhaki, 2000). For example, Yitzhaki (1987) assumes that the probability of proving the illicit act is an increasing function of evaded income.[2] Therefore the increase in expected income due to an increase in evasion, for a given probability of verification, is offset by the increase in the probability of verification, this latter limiting the extent of evasion and yielding an interior solution for α, the fraction of tax base reported.

As for the institutional arrangement we assume that the amount of monitoring to be performed in society is positively related to the expected fines that can be collected. For any given level of compensation w to be paid to the enforcers (tax auditors and their monitorers), an agency will monitor corruption to the extent that the expected fines collected cover the cost of monitoring, z. For any given level of expected monitoring, m, the public official who managed to prove evasion has to decide whether or not entering a bribing agreement and, in the affermative, the surplus from the agreement is split according to the Nash bargaining solution. Notice that the level of bribes, corruption and monitoring is set simultaneously, for any given level of tax auditing. Simultaneity is a natural implication of the following assumptions: a. the bribing coalition is atomistic with respect to the economy and takes the probability of monitoring as given at the aggregate level, b. the bribing coalition is secret by definition and, hence, the decision to monitor tax auditors is taken without observing the (aggregate) level of bribes.

[2] "The assumption that the probability of being caught is independent of the amount of income evaded seems very unrealistic. Usually, the tax authorities have some idea of the taxpayer's true income, and it seems reasonable to assume that the probablity of being caught is an increasing function of the undeclared income (or of the ratio of undeclared to true income, as in Srinivasan, 1973)." S. Yitzhaki, 1987, p.127.

It is worth to stress that in our setting we assumed that the compensation to enforcers, w, is exogenous for the fiscal authority and that committing monitoring is not feasible. These two assumptions define the problem above as an inspection game where the public officials who found evidence of evasion have to decide whether to enter the bribing agreement or not and the monitoring agency has to decide whether to monitor the auditors or not, given the fines they expect to gain. As already suggested above, we consider two cases: one in which the expected gain to the monitorers is given by the fines for evasion collected from monitored bribing coalitions and one in which we assign them the fines for corruption. The interpretation may change according to the institution involved in the monitoring. In the first case we may think of a Tax Authority which pursues monitoring in order to raise fines for evasion while in the other we may think of a prosecutor whose benefits are linked to the enforcement of anti corruption legislation.

The model can be summarized as follows: the economy is composed of three types of agents, a monitoring agency (composed of n_2 monitorers), a population of public officials (tax auditors, n_1), and a population of taxpayers ($1 - n_1 - n_2$). Taxpayers are measure zero with respect to the size of the economy and choose the fraction of their taxable income, α, to be reported to the tax authority. In doing so they take into account that, according to the auditing technology, they will be monitored with a given probability $a = \frac{n_1}{1 - n_1 - n_2}$, and evasion will be discovered with probability $p(\alpha)$ which is decreasing in the share of reported income. If a taxpayer evades and the evasion is discovered, she will be subjected to a monetary fine, Φ_e. At the same time the taxpayer expects that, with a given probability, χ, a bribing agreement will be settled. In the latter case, the taxpayer would pay a bribe, b, to the tax collector instead of the fine Φ_e. By exploiting the opportunity of a bribery agreement, however, the taxpayer is aware that if the illegal transaction will be detected by the monitoring agency, which can happen with a probability m, she will incur into an additional penalty Φ_χ, over and above the penalty for evasion.

3.1 The bribery agreement

Let M be the level of income earned by a taxpayer and τ be the income tax rate in the economy. If the taxpayer reported a fraction α of her income, with $0 \leq \alpha \leq 1$, the net disposable income will be $M - \tau\alpha M$. Assume that a taxpayer reports less than her true income, is subject to an audit with probability a and evasion is discovered with probability $p(\alpha)$. If the evasion is reported, the taxpayer will have to pay a fine Φ_e, which we assume to be proportional to the tax evasion, that is $\Phi_e = \phi_e [\tau (1 - \alpha) M]$ where the parameter ϕ_e ($\phi_e > 1$) measures the fine rate for evasion.[3] In this state of the world the taxpayer may be willing to pay a bribe, b, to the auditor in return for her evasion not being reported. In order to define the surplus to be split in the bribing coalition, we examine under which conditions both the tax auditor and the taxpayer are

[3] In this case, the tax payer's disposable income will be $M - \tau\alpha M - \phi_e [\tau (M - \alpha M)]$.

willing to enter the bribery agreement.

If the evader pays b, she faces a probability m that the auditor will be monitored by the tax authority and the bribe detected. In this case the bribe transaction will be undone and the taxpayer will have to pay both the fine for evasion, $\phi_e[\tau(M - \alpha M)]$, and a fine for bribery which we assume to be proportional to the bribe, $\phi_\chi b$ ($\phi_\chi > 0$).[4] Thus, the expected payment for the taxpayer is $\left[\phi_\chi b + \phi_e \tau(1-\alpha)M\right] m + b(1-m)$.[5] It follows that once audited and detected as an evader, the taxpayer will be willing to pay a bribe rather than comply to the fine for evasion if and only if

$$\left[\phi_\chi b + \phi_e \tau(1-\alpha)M\right] m + b(1-m) < \phi_e[\tau(M - \alpha M)]$$

or equivalently

$$b \leq \frac{1-m}{1-m+\phi_\chi m}\phi_e[\tau(M-\alpha M)]:$$

Consider now the incentives to take a bribe faced by an auditor. We assume that if she takes a bribe and the bribery agreement will be detected, the bribing agreement is undone and she will have to pay a fine. For simplicity, this fine is set at the same level as for the taxpayer. Hence, the auditor will accept a bribe if and only if

$$b(1-m) > \phi_\chi bm$$

or, equivalently,

$$b > 0 \text{ and } \phi_\chi \leq \frac{1-m}{m}. \tag{1}$$

Thus, a bribery agreement can be implemented for any bribe b such that

$$0 < b < \frac{(1-m)}{1-(1-\phi_\chi)m}\left[\phi_e \tau(1-\alpha)M\right]: \tag{2}$$

We assume that when the conditions above are satisfied, the bribery agreement is implemented and the outcome b^* will be determined as the solution of a Nash bargaining problem. In particular, by denoting with η the bargaining power of the evader and with $1-\eta$ the bargaining power of the public official, it follows that [6]

[4] The assumption that the bribe transaction is undone when discovered is similar to that in Polinsky and Shavell (2001).

[5] It follows that the disposable income of the evader would be either $M - \tau\alpha M - b$, if the public official will not be monitored, or $M - \tau\alpha M - \phi_e\tau(1-\alpha)M - \phi_\chi b$, if the public official will be monitored.

[6] In the worst state of the world, that is after having paid both the fine for evasion and the fine for bribery, the taxpayer's disposable income will be $M - \tau\alpha M - \phi_e\tau(1-\alpha)M - \phi_\chi b^*$. By recognizing the inability of individuals to pay extreme fines and that in general individuals are rarely fined an amount approximating their wealth, it seems appropriate to assume at least $M - \tau\alpha M - \phi_e\tau(1-\alpha)M - \phi_\chi b^* \geq 0$. The latter implies a constraint on the fines structure designed by the tax authority to be credible.

$$b^* = (1-\eta)\frac{(1-m)}{1-(1-\phi_\chi)m}\left[\phi_e\tau(1-\alpha)M\right] \tag{3}$$

Notice that the bribe is increasing in the fine for evasion, at a rate less than one, as well as of course in the bargaining power of the public official. At the same time, the bribe is decreasing in the monitoring probability, a feature that will be crucial to characterize the equilibrium solution of the model.

3.2 The tax evasion decision

We turn now to the taxpayer's income reporting decision. If the taxpayer reported a fraction of her taxable income, the auditor verified the illicit act and the bribery agreement is implemented, taxpayer's income is defined by $M - \tau\alpha M - \left[(1-m+\phi_\chi m)b^* + m\phi_e\tau(1-\alpha)M\right]$. By substituting b^* we get

$$M - \tau\alpha M - [(1-\eta)(1-m)+m]\phi_e\tau(1-\alpha)M.$$

We can define now the expected income faced by the tax payer after an audit has taken place and evasion has been verified as Π_b, given by

$$\begin{aligned}\Pi_b \equiv\ & M - \tau\alpha M - [\phi_e\tau(1-\alpha)M](1-\chi) \\ & - \{[(1-\eta)(1-m)+m]\phi_e\tau(1-\alpha)M\}\chi \\ =\ & M - \tau\alpha M - [1-\eta\chi(1-m)]\phi_e\tau(1-\alpha)M.\end{aligned}$$

Let now $q(\alpha) = ap(\alpha)$ be the joint probability that an audit takes place, a, and that evasion is verified, $p(\alpha)$. Let Π_e be the expected income to the taxpayer facing the evasion decision defined as

$$\begin{aligned}\Pi_e \equiv\ & q\Pi_b + (1-q)(1-\tau\alpha)M \\ =\ & M - \tau\alpha M - q[1-\eta\chi(1-m)]\phi_e\tau(1-\alpha)M.\end{aligned}$$

Clearly $\Pi_e \geq \Pi_b$. Under the hypothesis of risk neutrality evasion takes place if and only if Π_e is greater than the disposable income after paying the due amount of the income tax

$$\Pi_e - (1-\tau)M > 0$$

that is, if and only if

$$\phi_e p[1-\eta\chi(1-m)] < 1 \tag{4}$$

The higher is the probability $p(\alpha)$ of verifying tax evasion and/or the lower the joint probability $\chi(1-m)$ of a bribery agreement not being monitored, the lower would be the fine necessary to discourage underreporting of taxable income. The assumption of a linear fine for bribery implies that the fine rate ϕ_χ does not have any role in exploiting the opportunity of evasion. Moreover, for any p the expected income of the taxpayer in case of evasion Π_e is decreasing in α provided that (4) holds, which implies the usual prediction that a risk-neutral taxpayer either reports the true taxable income ($\alpha = 1$), or reports no income at all ($\alpha = 0$), depending on whether evasion has a positive expected payoff.

We now follow Yitzhaki (1987) and introduce the assumption that the joint probability of an audit taking place and the proof of evasion obtained is given by $q(\alpha) = ap(\alpha)$, with $p_\alpha < 0$ and $p_{\alpha;\alpha} \geq 0$. Moreover, given the auditing technology it holds $p(1) = 0$ for any audited taxpayer and $p(0) \leq 1$.[7] The taxpayer's problem is to determine α in order to maximize the expected income, given the deterrence policy and the opportunity of paying a bribe to the auditor whether the evasion will be discovered:

$$\underset{\alpha}{\mathrm{Max}}\ \Pi_e(\alpha) \equiv ap(\alpha)\Pi_b + [1 - ap(\alpha)](1 - \tau\alpha)M] + V(G):$$

Since the tax payer is measure zero with respect to the economy, she takes as null the effect of its contribution to the aggregate level of the public good. Therefore, the first order condition of the expected utility maximization problem implies a maximizing value $\hat{\alpha}(\chi; m; \eta; \phi_e; a)$ such that

$$a\phi_e[1 - \eta\chi(1 - m)][p(\hat{\alpha}) - (1 - \hat{\alpha})p_{\hat{\alpha}}] - 1 = 0 \tag{5}$$

Further, the second order condition for a maximum requires that

$$2p_\alpha - (1 - \alpha)p_{\alpha;\alpha} < 0$$

which is satisfied by the assumptions on $p(\alpha)$.

Lemma 1 Given the assumptions on $p(\alpha)$, for any set of $\chi; m; \eta; \phi_e; a$ and $0 < \eta < 1$, there exists $0 < \hat{\alpha} < 1$.

Proof: see the appendix.

The intuition is straightforward. For α low enough the assumptions on $p(\alpha)$ guarantee large enough incentives to reduce evasion, the opposite being true for α close enough to 1. More generally, it is immediate to conclude that $\partial\hat{\alpha}/\partial\phi_e > 0$, $\partial\hat{\alpha}/\partial\chi < 0$, and $\partial\hat{\alpha}/\partial m > 0$, which will turn out to be crucial results in the characterization of the overall equilibrium of the model[8]. A larger fine for evasion increases the direct cost of evasion and the indirect cost of corruption both leading to an increase in $\hat{\alpha}$; a larger probability of corruption decreases the expected cost of corruption leading to a decrease in $\hat{\alpha}$; finally, the intuition for $\hat{\alpha}$ increasing in m is that a larger probability of monitoring bribing coalitions increases the expected cost of corruption leading to an increase in $\hat{\alpha}$:

4 Endogenous corruption and monitoring

In this section, for a given b, we determine the probability of monitoring and the level of corruption by modelling the relationship between auditors and the

[7] We implicitly assume that when any evidence of evasion is detected the auditor is able to reveal the true taxable income of the taxpayer.

[8] As shown before, the fine for bribing, ϕ_χ, does not have any effect on the decision of evading.

monitorers as an incomplete information inspection game. In the event that an auditor manages to prove an act of evasion, which occurs with probability $ap(\alpha)$, the opportunity of forming a bribing coalition emerges with probability χ and the secret coalition is monitored with probability m. Both probabilities are determined in such a way that the public official is indifferent between taking the bribe (not reporting the act of evasion) or not. The monitoring level is such that the monitoring authority is indifferent between inspecting or not. As already described in the introduction we consider two cases of the inspection game. In the first case a prosecutor monitors so that if any auditor takes a bribe b, she will collect a pecuniary fine $\phi_\chi b$ from both members of the monitored bribing coalition.[9] Alternatively, we consider the case where a Tax Authority's inspects at a level such that that if any auditor takes a bribe b, she will collect a pecuniary fine for evasion Φ_e from the tax evader.

As for the tax auditor, her revenues are w whether she honestly reports evasion or not. If discovered he always pays a fine for corruption Φ_χ. Monitoring activity entails a cost, z, which is private information to the tax authority. In particular, we assume that from the perspective of the public official the monitoring cost z is drawn from a uniform distribution on $[0; \overline{z}]$. Figure 1 reports the payoff matrix for the game (for $b > 0$).

Figure 1 - The inspection game for a given $b > 0$

		Prosecutor	
		Monitor (m)	Not monitor ($1 - m$)
Public Official	Corrupt (χ)	$w - \phi_\chi b; w + 2\phi_\chi b - z$	$w + b; w$
	Not corrupt ($1 - \chi$)	$w; w - z$	$w; w$

We solve for the Bayes-Nash equilibrium of the inspection game. If the prosecutor monitors then its expected payoff will be equal to $\chi(w + 2\phi_\chi bp - z) + (1 - \chi)(w - z)$, where χ is the probability of the public official not reporting a detected evasion. Hence, for any given χ the tax authority's best response implies a cutoff rule: it monitors the public official if and only if $z \leq 2\phi_\chi b\chi p$. From the perspective of the public official, however, the tax authority monitors with a given probability, m. Hence, in equilibrium m, is such that

$$2\phi_\chi b\chi p = m\overline{z}.$$

Looking at the decision of the public official, by inspection of the payoff matrix it follows that she is indifferent between the two pure strategies, corrupt or not corrupt, if and only if

$$-\phi_\chi bm + b(1 - m) = 0.$$

[9] Remember that when the bribe agreement is discovered the bribe agreement is undone. Remember also that, to simplify, we are assuming that the same fine rate to be applied both to the public official and the taxpayer.

Thus, the interior solution of the monitoring game implies

$$m = \frac{1}{1+\phi_\chi} \tag{6}$$

and

$$\chi = \frac{\bar{z}}{2(1+\phi_\chi)\phi_\chi bp}. \tag{7}$$

For any given b the probability of a corruptive coalition to occurr decreases with the fine rate ϕ_χ. Moreover, in equilibrium, the proportion of public officials who take a bribe and do not report the detected evasion, χ, is inversely related to the amount of the bribe. A higher bribe implies that any public official expects a higher probability of monitoring by the public official which, in turn, implies a lower probability of taking the bribe and not reporting the evasion. By assuming proportional fines it follows that, in equilibrium, m does not vary with b.[10]

4.1 Monitoring by a Tax Authority

We now consider the case where the monitoring activity takes place within a Tax Authority hierarchy. In this case, the incentive to monitoring for the Tax Authority are provided by the collection of fines for evasion, whereas the payoffs for the public officials in charge of the tax auditing are the same as before. Thus, the payoffs matrix of the inspection game is given by:

Figure 2 - The inspection game for a given $b > 0$

		Tax Authority	
		Monitor (m)	Not monitor ($1-m$)
Public Official	Corrupt (χ)	$w - \phi_\chi b;\ w + \Phi_e - z$	$w + b;\ w$
	Not corrupt ($1-\chi$)	$w;\ w - z$	$w;\ w$

In this case, the interior solution of the inspection game is given by:

$$m = \frac{1}{1+\phi_\chi}$$

and

$$\chi = \frac{m\bar{z}}{p(\alpha)\Phi_e}.$$

It can be noticed that, with respect to the institutional setting examined in the previous section, the monitoring probability is the same from the point of view of the public official but the probability of corruption is inversely related to the fine for evasion and does not depend (neither directly, nor indirectly) on the fine for corruption.

[10] If $\bar{z} > 2(1+\phi_\chi)\phi_\chi bp$ the monitoring game is solved for the corner solution $\mu = 1$. In this case the public official expects to be monitored with probability $m = 2\phi_\chi bp/\bar{z}$, which implies a positive (expected) payoff, $b\left[1 - \left(2\phi_\chi bp/\bar{z}\right)\left(1+\phi_\chi\right)\right] > 0$. Of course, the tax authority monitors if and only if $z \le 2\phi_\chi bp$.

5 Tax evasion and bribery agreement in equilibrium

Given a set $(\phi_e, \phi_\chi, \eta, \tau, \bar{z}, M)$, the auditing technology $p(\alpha)$ and Authority budget constraint we solve for the equilibrium of the economy. Each taxpayer decides the level of evasion, taking m and χ as given, (this determines b); each public official decides whether to enter into a bribery agreement or not, given m and b; at the same time, the prosecutor decides whether to monitor a given public official, after having observed the monitoring cost z and given χ and b. The level of b is determined as the Nash bargaining solution of the related problem.

It is important to note that the taxpayer conceives his reporting strategy by taking into account the effect on $p(\alpha)$, but, being measure zero, she does not take into account any effect of her choice on the strategies to be chosen in the continuation game, χ and m. $p(\alpha)$ is the probability of state (tax base) verification, under the assumption that the larger the size of the evasion the easier is to prove it. Technically, this amounts to solve for the optimal reporting strategy simultaneously with the monitoring game between the monitoring agency and the public officials. The assumption of taxpayers being measure zero also has the implication that, in determining the bribe b, no effect on the value of m is anticipated and taken into account. Therefore, Nash bargaining can be solved independently of the monitoring game.

An interior equilibrium with bribe is a triple (α^*, m^*, χ^*) obtained as the solution of (5), (6), and (7), given (3).

After substituting for m^* from (6) into (5) and (7), the equilibrium level of evasion, α^* and the level of corruption in the economy, χ^*, are determined by the two equations

$$a\phi_e\left(1-\eta\chi\frac{\phi_\chi}{1+\phi_\chi}\right)[p(\alpha)-(1-\alpha)p_\alpha]=1 \tag{8}$$

and

$$(1+\phi_\chi)\phi_\chi(1-\eta)\phi_e\tau(1-\alpha)Mp(\alpha)\chi=\bar{z} \tag{9}$$

provided that $\chi^* \leq 1$.

On the other hand in the case that (9) and (8) lead to $\chi^* > 1$ the solution is characterized by

$$\begin{cases} a\phi_e[1-\eta(1-m)][p(\alpha)-(1-\alpha)p_\alpha]=1 \\ \phi_\chi(1-\eta)\phi_e\tau(1-\alpha)Mp(\alpha)=m\bar{z} \end{cases}$$

and $\chi^* = 1$.

By abusing language we refer to (9) as the auditor's reaction function and to (8) as the taxpayer's reaction function.[11]

[11] Strictly speaking, the two equations do not properly define the reaction functions for the auditor and the taxpayer given that we substituted out the equilibrium value for m.

Since $p_\alpha < 0$ and $p_{\alpha;\alpha} \geq 0$, the taxpayer's reaction function, $\alpha(\chi)$, is continuous and monotone decreasing in χ, while the auditor's reaction function, $\chi(\alpha)$, is continuous, convex, and monotone increasing in α, with $\chi(0) = \overline{z}/\left[(1+\phi_\chi)\phi_\chi(1-\eta)\phi_e\tau M p(0)\right]$. The same qualitative features characterize the system of equations for $\chi^* = 1$. Thus, we conclude that for any set of parameters satisfying assumptions in Lemma 1, the equilibrium exists and it involves both some evasion, $\alpha < 1$, and bribery, $b > 0$. In the following we provide some comparative statics focusing on the case of $\chi < 1$, which is of our primary interest.

Figure 2 - Comparative statics

	Effect on		
Increase in	Evasion	Corrupted auditors	Expected bribe
Fine for evasion, ϕ_e	$-$	?	=
Fine for bribing, ϕ_χ	$-$	$-$	$-$
Monitoring cost, $\overline{z}$	+	+	+

We study the effects on the behavior of taxpayers and auditors of government's policy against bribery and tax evasion. First, consider the effect of a marginal increase in the fine rate for tax evasion, ϕ_e. By (8), for any given amount of reported income, the rise of ϕ_e both raises the extent of the penalty for evasion and the amount of the bribe to be paid to the public official, if evasion is detected. Thus, an increase of ϕ_e raises the expected cost of evasion and leads the taxpayer to report a larger share of her income. At the same time, for any given χ and α, the larger bribe that the taxpayer would be willing to pay would induce the auditor to expect a higher probability of monitoring by the prosecutor. Therefore, from the auditor's perspective, the higher fine ϕ_e would reduce the incentive to take a bribe, reinforcing the previous effect on α^*: after a small increase in the fine for evasion, the equilibrium share of reported taxable income, α^*, will definitely be higher.

The effect of the increased fine for evasion on b^* and χ^* is ambiguous. In particular, looking at the equilibrium level of the bribe

$$b^* = (1-\eta)\phi_e\tau\left[1-\alpha^*\left(\phi_e;\phi_\chi;\eta;\tau;\overline{z};M\right)\right]M/2$$

it follows that by raising ϕ_e the bribe will rise when the positive direct effect of ϕ_e on b^* is stronger than the negative indirect effect which operates through $1-\alpha^*$, that is the bribe increases if and only if

$$1-\alpha^* > \phi_e\frac{\partial\alpha^*}{\partial\phi_e}.$$

A fall in χ^* is consistent with a rise in b^* while a rise in χ^* is consistent with any variation in b^*; in any case the ex-ante expected amount of bribery, χbp, does not vary.

Consider next the effect of a marginal increase in the fine rate for bribery, ϕ_χ. As shown before a change in ϕ_χ determines direct effects neither on the amount of the penalty for evasion nor on the expected cost of exploiting the opportunity of bribery, the latter being $(1 ¡ ´ + ´m)Á_e¿(1 ¡ ®)M$. The rise in the penalty rate $Á_Â$, however, determines a reduction in the value of $m^¤$ which implies, for any given Â, that the taxpayer's incentive to evade will be reduced. For the auditor, a larger $Á_Â$ increases the expected cost of taking a bribe, for any given b, reducing her incentive to be corrupted.[12] It can be shown that after a rise in the penalty rate for bribery the new equilibrium will be characterised by a lower level of corruption, $Â^¤$, as well as a lower level of evasion, that is higher $®^¤$ (see appendix).[13] Both the equilibrium level of $b^¤$ and the expected amount of bribery, Âbp, will be definitively reduced.[14]

Finally, consider a change in government's policy when the corruption rate is $Â^¤ = 1$, that is all detected evasion are not reported to the prosecutor. A small increase in $Á_e$ reduces the extent of evasion.

The results above may be summarized in the following

Proposition 2 If bribery is profitable $b^¤ > 0$, a tougher deterrence policy, in the form of increased fines, will always be effective for reducing evasion. On the other hand the effect on corruption is ambiguous if a tougher policy is implemented through the level of fine for evasion.

We now briefly present the comparative statics results of the model in the case where the monitoring activity of public officials is delegated to the Tax Authority.

The effect of an increase of the fine for evasion on both the level of evasion and the level of corruption is qualitatively the same as in the framework described above. On the contrary, in the present case, an increase in the fine for corruption can determine an increase in the level of evasion for relatively low levels of the fine for corruption.

The intuition for this result is the following: an increase in the fine for corruption reduces the monitoring probability of an amount which is the same in the two institutional arrangements. Thus, the negative effect on ®, through m is the same. However, in both cases, an increase of the fine for corruption affects ® also through the probability of corruption Â. While, in the previous framework, the positive effect on ® was always stronger than the negative one, thus leading to an unambiguous prediction, in the present case the overall effect

[12] Given m, a larger $Á_Â$ reduces the incentiveof the public official to take a bribe, due to the larger expected cost of bribery, that is reduces Â. The net effect of larger $Á_Â$ and a lower Â will induce, however, the auditor to expect that the tax authority will monitor more, determining a further reduction in Â.

[13] From the perspective of the auditor, the monitoring probability of the tax authority, $m^¤$, will be reduced.

[14] Note that even if the qualitative effect of a rise in either $Á_e$ or $Á_Â$ on Â can be similar, the mechanics are completely different. In the case of a rise in $Á_e$ the direct effect as well as the equilibrium effect on Â operate, coeteris paribus, mainly through a change in the bribe, that is the revenue of bribery. In particular, if in equilibrium the bribe will reduce the level of Â will increase. On the contrary, in the case of a rise in $Á_Â$ the bribe does not change in a direct way. Thus, the effect of an increase in $Á_Â$ operates, in a first instance, through the cost of bribing.

on tax evasion depends on the size of the fine for corruption: if this is greater (smaller) than one, tax evasion will be reduced (increased). The reason for this result is to be found in the particular structure of the payoff matrix in the present setting: namely, the fine rate for corruption does not influence the size of the revenue form the monitoring activity.

Finally, let us consider briefly the case when the monitoring cost z is common knowledge (a case of interest for the following welfare analysis). The main result is that an increase in the fine for corruption (in both the institutional settings discussed above) determines an increase in the level of evasion.

6 Welfare Analysis (Preliminary)

In this section we use the results derived above to assess the normative implications of our model of tax evasion, corruption and monitoring. Let us briefly summarize the findings obtained so far. We study an economy composed of a population of measure $1 = n_0 + n_1 + n_2$. A fraction n_0 of it produces income M pays $\tau\alpha M$ as an income tax taking the gamble to evade part of it. Tax revenues are collected to finance the public good to be provided in the economy. A fraction n_1 is paid a fixed wage w, is assigned the right to audit tax payers and is endowed with a state verification technology that allows the tax auditors to verify the true tax base with a probability $p(\alpha)$. In the event evasion is proved the opportunity of corruption emerges at an equilibrium probability χ. A fraction of (uncorruptible) $n_2 = n_1 m$ agents is assigned the right to monitor the tax auditors.

In order to provide normative results we need to specify the institutional setting of the monitoring game, the budget constraints of the monitoring authority and the fiscal budget in the aggregate. Before doing that, however, it is worth discussing the issue of the remuneration of the law enforcers. Having assumed no commitment to the probability of detection of corruption on the part of the planner we let the planner to choose the number of tax auditors n_1 but not the number of agents monitoring corruption. The number of agents in charge for the enforcement of anti-corruption legislation is set in equilibrium by the model as in the previous section. The remuneration to all enforcers is set at the expected income in the economy:

$$w \equiv Ey = (1 - \alpha\tau)M - ap[(1 - \chi + \chi m)\Phi_e + b\chi(1 - m) + \chi\Phi_\chi m] \qquad (10)$$

Intuitively, expected income is given by net income (gross of evasion) less expected fines. Notice that, by this assumption, all the agents in our economy are ex-ante indifferent across jobs and get utility

$$U(\cdot) = Ey + V(G) \qquad (11)$$

satisfying the envelope condition $U_\alpha(\cdot) = \frac{dEy}{d\alpha} = 0$.

After substituting the equilibrium condition of the inspection game and the equilibrium value of the bribe and assuming ´ = 1=2 we obtain the following expression for the expected income

$$Ey = (1 ¡ ®¿)M ¡ ap[1 ¡ \frac{Â}{2}(1 ¡ m)]©_e \tag{12}$$

We can de…ne now the budget for the Tax Authority as follows

$$B + ©_e Âmpn_1 = w(1 + m)n_1 + zmn_1 \tag{13}$$

Where B is the transfers from the …scal budget, $©_e Âmpn_1$ is the total revenues from collected …nes for evasion as in the second inspection game described in the previous section, $w(1 + m)n_1$ is the total (net) wage paid to law enforcers, zmn_1 is the total amount of direct costs of monitoring. From equilibrium conditions in the inspection game we get $B = w(1 + m)n_1$. The general …scal budget is then given by

$$G + B = n_0¿®M + n_1 p(1 ¡ Â + Âm)©_e + 2n_1 pÂ©_Â m \tag{14}$$

Where G is the value of the public good provided in the economy, $n_0¿®M$ is the volontary component of tax revenues, $n_1 p(1 ¡ Â)©_e$ is the total value of the enforced …ne for evasion not accruing to the budget of the Tax Authority (voluntary payment of the …nes by tax payers not joining a bribing coalition) and, …nally, $2n_1 pÂ©_Â m$ is the value of the …nes for corruption obtained as an indirect revenue for the monitoring activity, which we assume to be accrued to the provision of the public good. After substituting the equilibrium conditions from the inspection game we get a reduced form for the amount of public good provided in the economy

$$G = [1 ¡ n_1(1 + m)]M ¡ Ey ¡ n_1 zm \tag{15}$$

The planner is modelled as an utilitarian legislator whose problem is to maximize total welfare (remember that the total population is normalized to 1)

$$U(:) = Ey + u(G) \tag{16}$$

with respect to the tax rate ¿ (implicitly de…ning G), the …ne rates, $Á_e$, $Á_Â$ and the number of auditors n_1, subject to (??) and to the limited …scal liability constraint

$$©_e + ©_Â \cdot (1 ¡ ®¿)M \tag{17}$$

The problem can therefore be written as

$$\begin{array}{ll} \underset{¿;Á_e;Á_Â;n_1}{Max} & Ey + u(G) \\ s.to & G = [1 ¡ n_1(1 + m)]M ¡ Ey ¡ n_1 zm \\ & ©_e + ©_Â \cdot (1 ¡ ®¿)M \\ & U_® = 0 \end{array} \tag{18}$$

the solution for this program can be characterized by standard techniques. By substitituting equilibrium values for ψ_e and ψ_χ for the case of symmetric bargaining power in the bribing coalition, we can write the Lagrangean as follows. (See Appendix).

$$L = Ey + u(G) + \lambda[(1 - \alpha\tau)M - \phi_e(1 - \alpha)\tau M(1 + \frac{\phi_\chi}{4})] \tag{19}$$

By solving the Lagrangean we obtain the following

Proposition 3 At an interior equilibrium $(\alpha^*; m^*; \chi^*)$ i. maximal fines principle holds in (18) and $G = G^*$ ii. $\phi_e > 0$, $\phi_\chi > 0$.

Proof. Set $\lambda = 0$ in 18 and get a contradiction. See Appendix for details.

The intuition is rather simple. Part i. can be explained as follows. Assume maximal fine does not hold. Since $d\alpha/d\phi_e > 0$ there must be overdeterrence. The planner can increase G up to its first best level G^*. Furthermore in order to save costs the planner is willing to cut on monitoring costs by reducing n_1 and increasing the number of tax payers producing M at the cost of diluting deterrence, the reported α by each tax payer decreases. This argument holds true at any given level of G^*, leading to a corner solution in $n_1 = 0$ and $\alpha = 0$. The intuition for part ii. is an immediate implication of the equilibrium being interior. The reason is that both fines are useful to deter the underlying offence (tax evasion): raising the fine for evasion makes a bribing more costly and increases deterrence on the underlying offence and would tend to increase monitoring activities and costs (fines for evasion can be increased only by increasing monitoring costs, which in equilibrium of the inspection game will be paid in terms of larger corruption). To save on costs of enforcement the only instrument to the planner is to increase the fine for corruption. Jointly considered the design of the two fines saturates the fiscal liability constraint of the offender (maximal fines). Notice that, differently from the classical analysis of optimal deterrence, increasing fines in our model tend to raise the cost of enforcement.

For future reference define $\bar{\phi}_e$ and $\bar{\phi}_\chi$ as the maximal possible fines at the optimum. Before characterizing the optimal trade off between the fine for evasion and the fine for corruption another result is worth noticing. Let us denote G as the amount of public good to be provided in the economy at the optimum as defined by (??) where $\tilde{\tau}$ (the tax rate at the optimum), $\bar{\phi}_e$ and $\bar{\phi}_\chi$ are used to compute Ey. The following result can be shown to hold

Proposition 4 In an economy with imperfect commitment to monitoring and maximal fines a utilitarian planner will choose $\tilde{\tau}$ such that $G < G^*$.

Proof. See appendix

The reason is the following: at maximal fine the tax rate that implements $G = G^*$ is $\tilde{\tau} > \tau^*$ (since the costs of the enforcement structure have to be financed) and underdeterrence holds. Notice also that in our model large τ induces some deterrence since, by increasing bribes, gives larger incentives to monitor. On the other hand total punishment is limited by the tax rate. At

$G = G^*$ the fine for evasion is a more efficient instrument to deter evasion therefore the planner is willing to reduce τ and increase ϕ_e.

In other words, in our model, the planner would like to raise τ in order to increase the level of monitoring. At the equilibrium cum evasion, however, the increased incentives to monitor are settled by reducing evasion and decreasing corruption. The limited fiscal liability is thus reduced.

Notice also that since the general budget has to finance wages to monitorer, $\tilde{G} < G^*$ does not necessarily imply that $\tilde{\tau} < \tau^*$. The actual tax rate in an economy with imperfect enforcement may well be above the optimal level of taxation obtained in the case of honest taxpayers (first best).

7 Conclusions

We considered a simple economy where self interested tax payers may have incentives to evade taxes and, to escape sanctions, to bribing public officials in charge for collections. Differently from the classical theory of law enforcement we let the legislator not be committed to a given level of detecting corruption and we analyzed the interactions between evasion, corruption and monitoring as well as their adjustment to a change in the institutional setting. In the proposed framework, larger fines induce two effects. On the one hand, an increase in the size of the fine induces a stronger deterrence; on the other hand, however, it determines a larger incentive to corrupt, by increasing the difference between the disposable income if evasion is detected and the disposable income if it is not. Furthermore, we find that, in equilibrium, an increase in the fines reduces tax evasion whereas the effect on corruption can be ambiguous.

We also considered the optimal design of fines in a normative perspective. Interestingly enough a maximal fine principle holds in the case of a utilitarian legislator, despite the fact that raising fines increases monitoring activities and their cost to society. The reason for this result is that, in an environment with imperfect enforcement, the amount of public good provided by a utilitarian government is smaller than its level at first best: underdeterrence hold at the constrained optimal tax rate. This leads to maximal fine.

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8 Appendix A

To determine the behaviour of the endogenous variables at the optimum after a local variation in the parameter of interest, let denote

$$F^1 \equiv \phi_e\left(1 - \eta\chi^*\frac{\phi_\chi}{1+\phi_\chi}\right)\left[p(\alpha^*) - (1-\alpha^*)p_{\alpha^*}\right] - 1,$$

$$F^2 \equiv (1+\phi_\chi)\phi_\chi(1-\eta)\phi_e\tau(1-\alpha^*)M\,p(\alpha^*)\chi^* - \bar{z}$$

and

$$\bar{A}_e \equiv \phi_e\left(1 - \eta\chi^*\frac{\phi_\chi}{1+\phi_\chi}\right).$$

It is straightforward to conclude that the determinant of the Jacobian matrix

$$|J| = \begin{vmatrix} F^1_\alpha & F^1_\chi \\ F^2_\alpha & F^2_\chi \end{vmatrix} = \begin{vmatrix} \bar{A}_e\left[2p(\alpha) - (1-\alpha)p_{\alpha\alpha}\right] & -\frac{\phi_e\eta\phi_\chi}{(1+\phi_\chi)\bar{A}_e} \\ -\frac{\bar{z}}{(1-\alpha)\bar{A}_e p} & \frac{\bar{z}}{\chi} \end{vmatrix}$$

evaluated at the optimum is strictly negative. Hence, the sign of the derivative of α^* with respect to ϕ_χ is the same as the sign of the following determinat

$$\begin{vmatrix} F^1_{\phi_\chi} & F^1_\chi \\ F^2_{\phi_\chi} & F^2_\chi \end{vmatrix} = \begin{vmatrix} -\frac{\phi_e\eta\phi_\chi}{(1+\phi_\chi)^2\bar{A}_e} & -\frac{\phi_e\eta\phi_\chi}{(1+\phi_\chi)\bar{A}_e} \\ \frac{\bar{z}(1+2\phi_\chi)}{(1+\phi_\chi)\phi_\chi} & \frac{\bar{z}}{\chi} \end{vmatrix}$$

evaluated at the optimum. The determinant is always strictly positive. Moreover, the sign of the derivative of χ^* with respect to ϕ_e is the same as the sign of the following determinat

$$\begin{vmatrix} F^1_\alpha & F^1_{\phi_e} \\ F^2_\alpha & F^2_{\phi_e} \end{vmatrix} = \begin{vmatrix} \bar{A}_e\left[2p(\alpha) - (1-\alpha)p_{\alpha\alpha}\right] & -\frac{1}{\phi_e} \\ -\frac{\bar{z}}{(1-\alpha)\bar{A}_e p} & \frac{\bar{z}}{\phi_e} \end{vmatrix}$$

evaluated at the optimum. It follows that

$$\operatorname{sign}\left(\frac{\partial\chi}{\partial\phi_e}\right) = \operatorname{sign}\left(\frac{\bar{z}\bar{A}_e\left[2p(\alpha) - (1-\alpha)p_{\alpha\alpha}\right]}{\phi_e} + \frac{\bar{z}}{(1-\alpha)\bar{A}_e p\phi_e}\right).$$

A sufficient condition for $\frac{\partial\chi}{\partial\phi_e} > 0$ is

$$(1-\alpha)p_{\alpha\alpha} - 2p(\alpha) < \frac{1}{\phi_e^2}.$$

9 Appendix B

In this section we provide the derivation of the main results on the normative analysis.

The planner's problem has been written as

$$
\begin{array}{lll}
\underset{\tau;\phi_e;\phi_\chi;n_1}{Max} & Ey + u(G) & \\
s.to & & \\
c1. & G = [1 - n_1(1+m)]M - Ey - n_1 zm & \\
c2. & \psi_e + \psi_\chi \leq (1 - \alpha\tau)M & (20) \\
c3. & U_\alpha = 0 & \\
c4. & m = \frac{1}{1+\phi_\chi} & \\
c5. & p(\alpha)\psi_e\chi = z &
\end{array}
$$

By taking account of the constraints c.3, c.4 and c.5 (holding as strict equalities at an interior equilibrium) into the definition of Ey, define the lagrangian for the Kuhn Tucker problem as

$$L = Ey + u(G) + \lambda[(1-\alpha\tau)M - \phi_e(1-\alpha)\tau M(1+\frac{\phi_\chi}{4})] \quad (21)$$

$$
\begin{array}{ll}
L_\lambda = 1 - \alpha\tau - \phi_e(1+\frac{\phi_\chi}{4})(1-\alpha)\tau \geq 0 & \lambda \geq 0 \\
L_\tau = \frac{\partial Ey}{\partial \tau}[1 - u'(G)] + \lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1](\alpha + \tau\frac{d\alpha}{d\tau}) - \phi_e(1+\frac{\phi_\chi}{4})\right\} \leq 0 & \tau \geq 0 \\
L_{\phi_e} = \frac{\partial Ey}{\partial \phi_e}[1 - u'(G)] + \lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_e} - (1+\frac{\phi_\chi}{4})(1-\alpha)\tau\right\} \leq 0 & \phi_e \geq 0 \\
L_{\phi_\chi} = \frac{\partial Ey}{\partial \phi_\chi}[1 - u'(G)] - u'(G)[(M+z)n_1\frac{dm}{d\phi_\chi}] + -\lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_\chi} + (\frac{\phi_e}{4})(1-\alpha)\tau\right\} \leq 0 & \phi_\chi \geq 0 \\
L_{n_1} = \frac{\partial Ey}{\partial n_1}[1 - u'(G)] - u'(G)[(1+m)M + mz) + \lambda[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{dn_1} & n_1 \geq 0
\end{array}
$$

By studying different cases we prove now the proposition in the text.

Proof of Proposition 3.

Assume $\lambda = 0$, $\phi_e > 0$, $\phi_\chi > 0$, $n_1 > 0$,. From $L_\tau = 0$ we get $u'(G) - 1 = 0$, i.e. if the fiscal liability constraint is not binding, there is no underdeterrence and τ is set to obtain the first best level of G. From L_{ϕ_χ} get $-[(M+z)n_1\frac{dm}{d\phi_\chi}] > 0$ from the comparative statics results holding for $\frac{dm}{d\phi_\chi} < 0$. Therefore we get a contradiction: at first best the planner would like to increase the fine for corruption to saturate the fiscal liability constraint. Moreover from L_{n_1} we get: $-[(1+m)M + mz) < 0$, that is provided that underdeterrence holds at first best the planner is willing to save on monitoring cost by redicing the number of auditors contradicting the hypothesis that the equilibrium is at interior α, m and χ. $\square$

Proof of Proposition 4 (Preliminary).

Assume $\lambda > 0$, $\phi_e > 0$, $\phi_\chi > 0$, $n_1 > 0$ and $G = G^*$ and use the following

$$
\begin{array}{ll}
L_\lambda = 1 - \alpha\tau - \phi_e(1 + \frac{\phi_\chi}{4})(1 - \alpha)\tau = 0 & \lambda \geq 0 \\
L_\tau = [\phi_e(1 + \frac{\phi_\chi}{4}) - 1](\alpha + \tau\frac{d\alpha}{d\tau}) - \phi_e(1 + \frac{\phi_\chi}{4}) = 0 & \tau \geq 0 \\
L_{\phi_e} = [\phi_e(1 + \frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_e} - (1 + \frac{\phi_\chi}{4})(1 - \alpha)\tau = 0 & \phi_e \geq 0 \\
L_{\phi_\chi} = -[(M + z)n_1\frac{dm}{d\phi_\chi}] & \\
\quad - \lambda\left\{[\phi_e(1 + \frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_\chi} + (\frac{\phi_e}{4})(1 - \alpha)\tau\right\} \leq 0 & \phi_\chi \geq 0 \\
L_{n_1} = -u'(G)[(1 + m)M + mz) + \lambda[\phi_e(1 + \frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{dn_1} \leq 0 & n_1 \geq 0
\end{array}
$$

Use $L_\lambda = 0$, $L_\tau = 0$ and $L_{\phi_e} = 0$ to get

$$
\tau\frac{d\alpha}{d\tau} = \frac{1-\alpha}{1-\tau}
$$

$$
\frac{\phi_e}{1-\alpha\tau}\frac{d\alpha}{d\phi_e} = \frac{1-\alpha}{1-\tau}
$$

Intuitively, these two conditions require that at $G = G^*$ the deterrence effect of both α and ϕ_e is the same. By substituting $d\alpha/d\tau$ and $d\alpha/d\phi_e$ from the comparative statics for the interior equilibrium we get that the requirement is not verified, yielding a contradiction. Intuitively Fines are more efficient in deterrence compared to τ. The planner is willing to reduce τ and increase ϕ_e. (To be completed). $\square$