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Corruption and Tax Evasion with Competitive Bribes

Antonio Acconcia, Marcello D'Amato and Riccardo Martina

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DIPARTIMENTO DI SCIENZE ECONOMICHE - UNIVERSITÀ DEGLI STUDI DI SALERNO
Via Ponte Don Melillo - 84084 FISCIANO (SA)
Tel. 089-96 3167/3168 - Fax 089-96 3169 – e-mail: csef@unisa.it

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Antonio Acconcia [*] Marcello D'Amato [**] and Riccardo Martina[***]

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In this paper we consider a simple economy where self interested taxpayers may have incentives to evade taxes and to escape sanctions, by bribing public officials in charge for tax collection. The level of monitoring and the level of corruption are endogenously determined assuming that the price for corruption (bribe) sets at a value where expected rents in the public sector are completely dissipated in monitoring costs due to competition among public officials. In the proposed framework, larger fines for evasion will increase tax compliance with ambiguous effects on corruption while larger fine for corruption reduce corruption at the cost of reducing tax compliance. Interestingly, a utilitarian legislator will want to set maximal penalties. Intuitively, preventing corruption through fines is valuable to the planner since it reduces the amount of rent dissipation in the public sector at the cost of decreasing deterrence for the underlying offence (evasion). Finally the shadow value of deterrence is such that the level of public good provided in the economy is smaller than its first best.

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[*] Università di Napoli Federico II and CSEF, University of Salerno

[**] Celpe, CSEF, Dises, University of Salerno

[***] Università di Napoli Federico II and CSEF, University of Salerno

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A. Acconcia, M. D'Amato, and R. Martina[¤]

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In this paper we consider a simple economy where self interested tax-payers may have incentives to evade taxes and to escape sanctions, by bribing public o±cials in charge for tax collection. The level of monitoring and the level of corruption are endogenously determined assuming that the price for corruption (bribe) sets at a value where expected rents in the public sector are completely dissipated in monitoring costs due to competition among public o±cials. In the proposed framework, larger ¯nes for evasion will increase tax compliance with ambiguous e®ects on corruption while larger ¯ne for corruption reduce corruption at the cost of reducing tax compliance. Interestingly, a utilitarian legislator will want to set maximal penalties. Intuitively, preventing corruption through ¯nes is valuable to the planner since it reduces the amount of rent dissipation in the public sector at the cost of decreasing deterrence for the underlying o®ence (evasion). Finally the shadow value of deterrence is such that the level of public good provided in the economy is smaller than its ¯rst best.

1 Introduction

Tax evasion and corruption of public o±cials are interrelated social phenomena whose pervasive e®ects can seriously hurt the economic growth and the stability of social institutions, to the extent they depend on the provision of a public good (Rose-Ackerman, 1978; Shleifer and Vishny, 1993; Bardhan, 1997). An extensive literature has investigated their origins, e®ects, and size, on both theoretical and empirical grounds, and the way in which, in di®erent institutional frameworks, both ¯scal non compliance and corruption are or should be mitigated.

The interaction between tax evasion and corruption and policies to prevent them is based on several fundamental aspects of economic transactions. Tax

[¤] A. Acconcia and R. Martina: Università di Napoli Federico II, Dipartimento di Teoria e Storia dell'Economia Pubblica, via Cinthia Monte S. Angelo, 80126 Napoli, Italy. Marcello D'Amato: Celpe, Csef, Dises, Università di Salerno, Via Ponte don Melillo 84084, Fisciano, Salerno, Italy. We gratefully aknowledge comments and suggestions by Massimo Marrelli, Marco Pagano, Howard Rosenthal and other partecipants at the conference on "Institutions, Enforcement and Corruption " in Villa Orlandi, Anacapri, June 2003.

evasion can be de¯ned as hiding the real value of a legal economic transaction in order to avoid ¯scal liability (see Andreoni, Erard and Feinstein, 1998, for a survey). On similar grounds, corruptive agreements are, per se, secret economic transactions in which one agent pays a sum of money in exchange of an illicit act by a public o±cial in order to escape sanctions for breaking public legislation and regulations (Shleifer and Vishny, 1993). In order to pay bribes economic agents, individuals and ¯rms, have to provide for a due amount of secret funds at their disposal to ¯nance the bribe, these funds are often provided by tax evasion. It is quite common that enforcement authorities detecting bribing agreements also ¯nd evidence of funds that have been hidden to the ¯scal authority. This stylized fact alone may motivate the study of the relationships between tax evasion and bribing agreements and its implication for the design of the enforcement policies. At a more fundamental level, focusing on the incentives to commit o®ences, the possibility of corruption dilutes ¯nes and other forms of punishment and, consequently, has diluting e®ect on the deterrence of the underlying o®ence (Becker and Stigler, 1974, Polinsky and Shavell, 2001).

As a ¯ne dilution agreement, corruption a®ects deterrence and the level of enforcement. Exactly because tax evasion and corruption have potentially disruptive e®ects on social and economic institutions, their surging also triggers incentives, within the legal framework, to any society and established power to ¯ght them through investment of resources in monitoring, by providing wage incentives to enforcers and by designing suitable penalties for misbehavior. Economic analysis has traditionally focused on the optimal mix between incentives and probability of detection to mitigate the e®ects of these problems. The relationships between rewards to public o±cials, ¯nes and probability of punishment, both for the underlying o®ence and for corruption, have usually been analyzed, on normative grounds, as a choice of independent instruments by a Government fully committed to its policy instruments.

Independence of policy instruments and commitment by the Government to a set of policies to achieve a given level of deterrence does not necessarily re°ect many features of how enforcement is actually delivered in the real world. This aspects of the classical theory of enforcement is extensively discussed in Bar-Gill and Harel (2001) who focus on the (feedback) e®ects of crime rates on expected sanctions. As another example, in an extension of the classical theory of enforcement along these directions, Andreoni (1991), in an earlier work, provides a model of jurisdiction where the probability of penalties is inversely related to the magnitude of the ¯nes. With rents seekers public o±cials, for example ¯nes may a®ect the probability of apprehension. If law enforcers are willing to accept bribes, the level of the ¯nes measures the private value of the escaped sanction and is likely to a®ect the price and the amount of corruption. On the other hand, larger ¯nes may also trigger larger e®ort by public o±cials to ¯ght corruption within their administration. This may occur because public o±cials are motivated by career concerns and they may be willing to address e®ort to detect crimes punished by larger ¯nes. On the normative side, to the extent that ¯nes measure the value of deterrence of evasion to the legislator, any compensation to motivate enforcement of anticorruption legislation must be related to the value of the fines[1].

Our interest, is therefore, to study an economy where legislated fines for fiscal non compliance and for corruption influence the incentives to commit the underlying offence and the price for corruption, but also affects the level of monitoring activities and the probability of punishment through the reward to honest public officials. To address these issues, we study the relationship between tax evasion, corruption and monitoring activities as simultaneously determined in a simple exchange economy where a public good is provided in a legal framework set to mitigate the free riding problem associated to fiscal non compliance. Our legal framework is defined by a legislation setting fines and tax rates and by a simple tax administration in charge for rising public funds. Members of the tax administration are assumed to be rent seekers: tax auditors seek to appropriate rents by possibly accepting bribes and public officials, in charge for monitoring corruption, deliver monitoring effort in order to gain rewards positively related to fines.

To focus on the relationships between evasion, corruption and enforcement in the simplest possible setting we build up a model that can be described as follows. 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. If evasion is discovered, the possibility of a bribing agreement arises and may lead to corruption. The bribe is defined as a transfer from the non compliant taxpayer to the public official splitting the joint surplus of the coalition, taking as given the level of monitoring in the economy. The incentives to enter the illegal agreement, i.e. the frequency with which bribing coalitions emerge from tax audits, are affected by the level of internal monitoring in the fiscal administration. The probability of corruption detection is endogeneized by introducing a simple two layer structure in the organization in charge for the enforcement of fiscal legislation. The incentives to monitor corruption are related to the amount of fines that can be collected as a result of the activity. In other words monitoring activities and bribing coalitions both emerge as a way for the public officials in the fiscal administration to appropriate rents above their salary. Competition in rent seeking by public officials completely dissipates rents: both corruption and its monitoring, along with bribes, are set at the level where expected costs equate expected benefits from corruption and monitoring.

This specification, in which, for the seek of simplicity we do not consider distortionary effects of taxation on the amount of private good produced in the economy, will allow us to study (among other things) the effects of raising fines on both the underlying offence (evasion) and corruption. The main results can be synthesized as follows: an increase of the fine for evasion reduces tax evasion whereas its effects on the size of corruption are ambiguous. As for the fine for

[1] Of course, Becker and Stigler (1974), in their study of the optimal compensation to enforcers, recognize the mutual dependence of the price of corruption (bribe) from the probability of corruption detection and other variables. However, in the analysis, they assume both as exogenously given.

corruption, its increase lead to a reduction in corruption and monitoring at the cost of increasing tax evasion.

The ¯nal issue analyzed in the paper is normative. In our setting, for both evasion and corruption, the incentives to perform monitoring activities are increasing in the level of ¯nes and are not independent deterrence instruments in the hand of the legislator as usually assumed in the extension to the classical theory of enforcement. Taking into account the implications of the assumption of complete dissipation of rents (bribes and collected ¯nes) into monitoring costs, we consider a utilitarian government who cannot commit the level of corruption monitoring and we ask whether a maximal ¯ne principle holds even when the probability of corruption cannot be set independently of the ¯nes and we study the implications of imperfect enforcement on the provision of public good.

The issues raised in the paper are related to several strands of the literature on tax evasion and corruption and more generally on the optimal deterrence policy against corruption and the underlying o®ence. In a normative perspective, the problem of the relationship between corruption, enforcement and deterrence of the underlying o®ence 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 schedule of ¯nes. 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 for the underlying o®ence. This result holds even if corruption itself is not completely deterred. Moreover, Polinsky and Shavell also show that both the optimal ¯ne for the underlying o®ense and the optimal ¯ne 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 o®ence. A distinctive feature of their approach to the analysis of corruption, as in the classical analysis of the deterrence problem, is the assumption that the Government can fully commit to a monitoring probability independently of the level of the ¯nes, which leads to perfect substitutability between ¯nes and probability of detection for a given level of deterrence.

However, to motivate our normative analysis, 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 ¯nes. 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 ¯nes. For example, a tax authority may have incentives to strengthen its inspection activity when ¯nes for evasion are increased, since this could raise its revenues. As another example, think of prosecutors' incentives to investigate corruption to be high when the ¯nes for corruption are high since this provides better career perspectives. In our model the mutual relationship between ¯nes and probability of detection is based on the idea that larger ¯nes trigger larger monitoring by enforcing authorities.

Other contributions (see, for instance, Chander and Wilde, 1992 and Moohkerjee and Png, 1995,) also consider the e®ect of corruption on deterrence of the underlying o®ence taking the probability of corruption being detected as exogenous. In this case it is of course true that raising ¯nes does not a®ect the probability of corruption monitoring and expected sanctions.

In the speci¯c case of tax evasion, Chander and Wilde (1992), integrate the analysis of corruption and tax evasion studying the e®ects of corruption on optimal auditing strategies by the tax administration. Extending previous work on game theoretic models of tax compliance, they show that the possibility of corruption modi¯es the strategic design of auditing probabilities by a rational tax administration: large auditing costs may induce a revenue maximizing agency to dismantle auditing altogether in the presence of corruption, whereas, for small auditing costs, the presence of corruption may induce the agency to audit evasion more aggressively than in the absence of corruption since, in the context of their model, this raises revenues from honest evaders (not interested in corrupting public o±cials) as a reply to increase in auditing. In their model, the probability of monitoring corruption is exogenously given. It is di±cult to say whether the feature of their equilibrium (and comparative statics results) continue to hold in the case when corruption is allowed to depend on the auditing probability.

Besley and Mc Laren (1993) study the e®ect of corruption on tax compliance in a model where the amount of corruption and the level of monitoring is endogenous. Their model is focused on the analysis of di®erent wage incentive regimes (e±ciency wages, reservation wage and capitulation wages) on expected tax revenues in economies with etherogenous agents (honest and dishonest). In discussing their results the authors argue that a revenue maximizing government faces two broadly de¯ned equilibrium regimes, one in which the degree of honesty in the economy is large and public o±cials are paid their reservation wage and one in which honesty is low and there is room for wage incentives. In this latter case, high (low) costs of monitoring require that corruption is effectively deterred through granting rents (paying reservation wage) to auditing public o±cials. Their analysis, mainly focused on the relationship between tax evasion and corruption in underdeveloped economies, builds on the assumption that public agencies are not able to enforce ¯nes to deter dishonesty neither in tax compliance nor in the bribing agreement. Of course, as a consequence, e±ciency wages to public enforcers are not related to ¯nes in their model.

Mookherjee and Png (1995) also study the problem of optimal compensation policy for a corruptible inspector in charge for monitoring the underlying o®ence (pollution) and its e®ects on the endogenous probability of detection of the underlying o®ence given an exogenous probability that the corruptive agreement is detected. In this paper they propose an interesting view of the bribe: along with its traditional ¯ne dilution e®ect i.e. as a part of the implicit price faced by the ¯rm for committing the underlying o®ence, they also emphasize its role as a form of remuneration for motivating e®ort by public o±cials in their auditing activities. They show that increasing compensation to public o±cials and raising the penalty for corruption will reduce their incentive to exert monitoring e®ort whereas bribes do encourage e®ort. However, in the presence of underdeterrence for the underlying o®ence they also show that bribe is an ine±-

cient way to motivate effort by public officials. Even in this case the probability of discovery the bribing agreement between the public official and the firm is exogenous and does not depend on the level of the fines for corruption.

The remaining of the paper is organized as follows: in section 2 we introduce the setting for the simple economy to be analyzed, in section 3 we model tax evasion under the possibility of corrupting the tax auditor, in section 4 we introduce the inspection game between the two layers of the public hierarchy, in section 5 the general equilibrium of the simple economy is characterized, in section 6 we provide our normative results, section 7 concludes.

2 A simple economy

We consider a simple economy composed of N identical agents,with N normalized to 1. The preferences of each agent are described by the utility function $U = Ey + u(G)$, where Ey is the expected income and G the amount of public good, with $u' > 0$ and $u'' < 0$. 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 verifiable only at a positive cost, self interested agents have incentives to under report the tax base unless a large enough punishment for misbehavior is credibly anticipated. In 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 taxpayers 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 fines does not prevent agents in the enforcement structure (tax auditors or public officials) 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 (incorruptible) 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 fines for misbehavior, offences 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. Moreover, an institutional setting specifying controls and remuneration of public officials has to be arranged.

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

Stage 1. Income tax rate τ, fines for evasion Φ_e; and fines for corruption Φ_χ are set, the number of public officials n_1 having the right to monitor fiscal reports is hired, an agency, composed of n_2 individuals in charge of controlling public officials, is established.

Stage 2. Given the institutional setting above, n_0 risk neutral taxpayers decide the fraction α 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 verified by each tax auditor.

Stage 4. Among the subset of verified tax evasion acts, pn_1, the possibility of a bribe b arises. The surplus to the parties in the secret coalition is defined by the fine for evasion and the fine for corruption to be paid in the event the bribery agreement is discovered. This surplus 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 benefits (fines collected) and its costs. Monitoring occurs, a fraction 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, in expected terms, corruption and its price (the level of the bribe) are set at a level such that in equilibrium there are no expected rents from working in the public sector either as a tax auditor nor as a an official in charge for monitoring their work.

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 fines and tax rates will be defined given that no commitment to enforcement levels is assumed in the analysis.

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 that evasion is 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 $p(\alpha)$, is offset by the increase in the probability of verification $p'(\alpha)$, 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), corruption will be monitored 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 affirmative, 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.

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 assumptions are motivated by our aim to study the problem of the enforcement of tax legislation and associated bribing transactions such that expected rents (bribes and fines) are dissipated in the process of enforcement.

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 subject 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

[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.

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 $0 \leq \tau \leq 1$ 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 $(1 - \tau\alpha)M$. Assume that taxpayers' reports are subject to an audit with probability a and evasion is discovered with probability p. If 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, measures the fine rate for evasion[3] We assume, with no significant restrictions, $\phi_e > 1$. 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 willing to enter the bribery agreement.

If the evader pays b, she faces a probability m that the auditor will be monitored and the bribe detected. In this case the bribe transaction will be undone[4] and the taxpayer will have to pay both the fine for evasion, Φ_e, and a fine for bribery Φ_χ which we assume to be proportional to the bribe, $\Phi_\chi = \phi_\chi b$, $(\phi_\chi > 0)$. 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

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

or, equivalently,

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

[4] The assumption that the bribe transaction is undone once discovered is common the literature. See, for example, 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.

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

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

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

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]

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

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 not audited, the taxpayer will enjoy a net disposable income given evasion $M - \tau\alpha M$. If audited his evasion will be discovered and verified with probability p. In the event of verification the taxpayer can either pay the due fines for evasion Φ_e or entering a bribing agreement paying a bribe b at the expected cost that the agreement will be discovered and fines for evasion and fines for corruption will be charged. Given the relevant states of the world weighted by the appropriate probabilities, the expected income to the taxpayer will be given by his disposable income, gross of evasion, less expected fines:

$$Ey = (1 - \tau\alpha)M - ap\left\{(1 - \chi)\Phi_e + \chi(1 - m)b + \chi m(\Phi_e + \Phi_\chi)\right\}$$

where a is the probability that a tax auditing will occur, p is the probability that, given auditing, tax evasion is verified, χ is the probability that a bribing agreement will occur and m the probability that the agreement will be discovered.

In making the evasion decision, the taxpayer, being an atom, takes the equilibrium probability of corruption and monitoring as given and anticipates the

[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.

effect of evasion on the fines and the bribe he has to pay, provided the relevant states occur. By substituting the anticipated equilibrium level of the bribe b^* and the expected fines in her expected income, this can be written as follows

$$Ey = (1 - \tau\alpha)M_i - ap[(1 - \eta\chi(1 - m)]\phi_e(1 - \alpha)\tau M_i$$

Under the hypothesis of risk neutrality evasion takes place if and only if E_y is greater than the disposable income from full tax compliance

$$Ey > (1 - \tau)M_i$$

that is, if and only if

$$\phi_e ap[1 - \eta\chi(1 - m)] < 1 \qquad (4)$$

The higher is the probability p 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 by risk neutral agents. Moreover, for any p, the expected income of the taxpayer in case of evasion 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.

To characterize the optimal amount of evasion 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 $q(\alpha) = ap(\alpha)$. We make the following assumptions: 1. $p_\alpha < 0$ i.e. the probability of evasion verification is decreasing in the reported tax base , 2. $p_{\alpha,\alpha} \geq 0$, that is the probability is decreasing at decreasing rate (decreasing returns in the state verification technology). Moreover, to warrant an interior equilibrium report, we also make the following assumptions: 3. $p(1) = 0$, no extortion for any audited taxpayer who truthfully reports[7], 4. the absolute value of $p_\alpha(0)$ large enough, i.e. we assume that at large level of evasion increasing the report on the tax base reduces expected fines sufficiently fast. The problem for a risk neutral taxpayer 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 in the occurrence of evasion being discovered:

$$\underset{\alpha}{Max}\ Ey(\alpha) + V(G).$$

Since the taxpayer 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.

[7] It easy to verify that this assumption is not strictly necessary to warrant an interior equilibrium for α. For $p(1) > 0$ our framework would be consistent with the possibility that some extortion occurs. Polinsky and Shavell (2001) present a detailed analysis of extortion in the framework provided by the classical theory of enforcement. Hindricks, Keen and Muthoo (1999) analyze its regressive effects on income distribution.

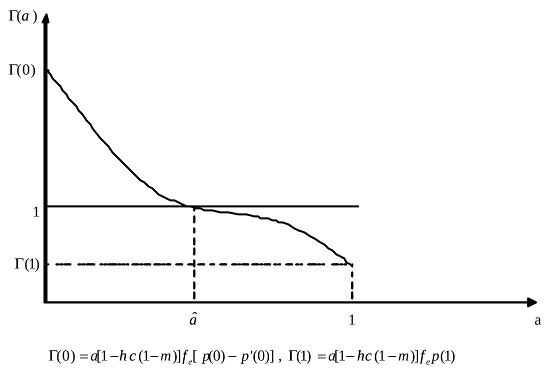

Figure 1: Equilibrium Tax Evasion

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

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

At an interior equilibrium the taxpayer just balances expected marginal cost of an additional unit of tax with the expected marginal benefit of a reduction in expected fines. 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 $\chi; m; \eta; \phi_e;$ and $a > 0$, $0 < \eta < 1$, there exists $0 < \hat{\alpha} < 1$ satisfying 4.

Proof: The graphical representation for the taxpayer equilibrium condition is reported in figure 1 for generic values of $p(0); p_{\alpha}(0)$ and $p(1)$. $-(\alpha)$ represents the second term in (5). It easy to see that the second order condition, $p(1) = 0$ and $p_{\alpha}(0)$ large enough are sufficient conditions for an interior equilibrium.

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. Also notice that given the hypothesis of risk neutrality and the assumption that the fine for corruption is the same for both parties of the bribing agreement, the equilibrium evasion, along with the equilibrium bribe, does not depend on the fine for corruption. More generally, it is immediate to conclude that $\partial \hat{b}/\partial \phi_e > 0$, $\partial \hat{b}/\partial \chi < 0$, and $\partial \hat{b}/\partial m > 0$, which will turn out to be crucial results in the characterization of the equilibrium of the model. A larger fine for evasion increases the direct cost of evasion and the indirect cost of corruption both leading to an increase in $\hat{b}$; a larger probability of corruption decreases the expected cost of corruption leading to a decrease in $\hat{b}$, corruption diluted tax enforcement; finally, $\hat{b}$ increasing in m since a larger probability of monitoring bribing coalitions increases the expected cost of corruption. As already noticed the level of fiscal non compliance does not directly depend on the fine for corruption: the expected cost of evasion by risk neutral taxpayers, under proportional fines for corruption, is simply determined by the level of the fines for evasion.

4 Endogenous corruption and monitoring

In the previous section we derived the optimal level of tax evasion and the level of bribes when the taxpayer takes the level of fines, the aggregate probability of tax auditing, the aggregate level of corruption and the probability of detection for a corruptive agreement as given. As expected, in our model, in a similar way as, for example, in Polinsky and Shavell (2001), the possibility of corruption dilutes deterrence of tax evasion.

In this section we study, in the simplest possible setting, the case of endogenous level of anti corruption activities. To this aim we determine the probability of monitoring and the level of corruption by modelling the relationship between auditors and the monitorers as a simple inspection game occurring in a two layers hierarchical organization. Differently from Mookherjee and Png (1992) and Besley and McLaren (1993) we keep the level of wages to public officials in charge for the enforcement of the (anti evasion and anti corruption) legislation at the reservation wage[8] and concentrate on the incentives to behave provided to tax auditors by the fines and the probability of monitoring. For given levels of fines for corruption and fines for evasion we determine the fraction χ of tax auditors holding evidence of evasion that decide to become corrupt and the probability m that the corruptive agreement will be monitored and discovered.

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. The secret coalition is monitored with probability m. Both probabilities along with equilibrium bribe, are determined in such a way that the public official holding evidence of evasion 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. This amounts to assuming perfect competition in both rent seeking activities, corruption and monitoring: in both activities expected benefits equate expected costs and in both cases corruption and its monitoring are such that no rents in the aggregate

[8] See Becker and Stigler (1974) for the design of the appropriate life time pay structure such that public enforcers do not receive a lifetime payment that exceed what they could in alternative occupations.

are left.

Consider the case of a Tax Authority inspecting at a level such that if corruption is detected she will collect a pecuniary fine for evasion Φ_e from the tax evader[9]. As for the tax auditor, her revenues are w, whether she honestly reports evasion or not. However if discovered she pays a fine for corruption Φ_χ. We do not formally consider dismissal from the tax agency. However, in our simple economy an outside option could be the endogenous expected income to the taxpayer, therefore we set $w = Ey$. Of course this is not the harshest punishment a tax auditor may incur once caught in a corruptive agreement. By applying to the tax auditor a different fines for corruption compared to the taxpayer, the Government could drive the corrupt public official to the same income level as the taxpayer in the worst possible state of the world, i.e. once both the fine for evasion and the fine for corruption have been applied. However this possibility would not change the basic analysis which is the focus of our paper: studying the effects of the magnitude of the fines on the incentives to monitor, it would just change the equilibrium level of monitoring but not its equilibrium relationship with the level of corruption.

Public officials in the upper layer of the hierarchy also get the reservation wage in the economy w, plus expected benefits from monitoring activity measured by fines. Monitoring entails a cost z. Table 1 reports the payoff matrix for the game.

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

		Tax Authority	
		Monitor (m)	Not monitor $(1 - m)$
Tax Auditor	Corrupt (χ)	$w - \varphi_\chi b; w + p\Phi_e - z$	$w + b; w$
	Not corrupt $(1 - \chi)$	$w; w - z$	$w; w$

Perfect competition in rent seeking is equivalent to no rents and, therefore, to the Nash equilibrium in the inspection game between a public official in the Tax authority and the Tax Auditor. Nash equilibrium in mixed strategies defines an equilibrium probability of monitoring such that rents from corruption are completely dissipated (expected benefits from corruption are equal to expected costs) and an equilibrium probability of corruption such that rents from monitoring are driven to zero. We solve, therefore, for the Nash equilibrium of the inspection game. The expected payoff to the tax authority in case of monitoring corruption will be equal to $\chi(w + \Phi_e p - z) + (1 - \chi)(w - z)$, where χ is the probability of the public official not reporting a detected evasion. The equilibrium level of corruption χ is set at the level where the expected cost are equal to the expected benefit from the monitoring activity, i.e.

$$\chi \Phi_e p = z:$$

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

which delivers an interior solution for the aggregate frequency of corruption if $z < \Phi_e p$.

Looking at the decision of the tax auditor holding evidence of corruption, the equilibrium level of monitoring m is such that her expected profit from taking the bribe are equal to the expected cost, i.e.

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

Thus, the interior solution of the monitoring game implies

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

and

$$\chi = \frac{z}{\Phi_e p}. \tag{7}$$

Notice that, for any given level of α and b, the equilibrium level of monitoring and corruption depend on the fines: the larger the fine for corruption the lower the equilibrium monitoring level. The reason is that a larger fine will reduce the benefit from corruption, triggering a lower level of anticorruption effort within the hierarchy. On the other hand, the level of corruption is inversely related to the level of the fines for evasion: larger fines for evasion will motivate monitoring effort and the equilibrium level of corruption has to decrease in reply.

Of course the simple expressions derived above result from the assumptions we have made about risk neutrality and proportional fines. For example a different punishment structure for corruption (including dismissal), a more general incentive contract involving rents to be distributed in case of honest behavior, a more sophisticated monitoring strategy or a more general fine structure involving a fixed cost for corruption and evasion once detected, would change the expression above. However not much would be added to the analysis of the effect on deterrence of the mutual dependence of monitoring and corruption when the fine structure motivates monitoring effort[10]. Moreover, as simple as it is, our model is devised to analyze an economy where bribes and rewards for fighting corruption do not generate systematic rents in the economy. On the one hand, rent seeking by tax auditors through bribes has a negative externality on the economy, diluting expected fines and exacerbating the free riding problem in the context of tax evasion. On the other hand, rent (reward) seeking by the upper layer of the hierarchy through monitoring limits the disruptive effect of corruption and allows tax revenues to be collected. Competition for rents (bribes) and rewards (expected fines) drives expected profits to zero. From the economic point of view our model is a simple competitive model where the negative externalities of corruptive agreements on the credibility of the whole enforcement structure is limited by competition in monitoring activities.

[10] To the extent that in a given legal framework the level of the fines measures the private value of corruption to the bribe giver and the shadow value of the underlying offence and corruption to society, any incentive contract to the public official, involving monitoring or not, should depend on the level of the fines.

Finally notice that the simple inspection game described above can easily be extended to alternative assumptions about the information structure of the agents, including etherogeneity in the cost of being detected as a corrupt agent and under di®erent speci¯cation for the rewards to the monitoring agent.[11] In each of these cases the general link between ¯nes (both on the underlying o®ence and on corruption) and monitoring is preserved. More generally our simple structure for the rewards to the monitoring activities resembles what Posner (1998) de¯nes as private enforcement. Our claim is that once we introduce elements of private enforcement to motivate public o±cial the classical dycothomy between ¯nes and the probability of detection is lost since changing ¯nes has impact on the incentives to perform monitoring.

To summarize: at any given level of the bribe and at any given level of the underlying o®ence corruption cannot pay in our economy, but also crime control cannot be a source for systematic rents. In our simple formulation both the lower and the upper level of the tax enforcement hierarchy compete for bribes and ¯ne collection respectively, up to the point where rents are completely dissipated.

Having de¯ned the equilibrium relationship between the level of monitoring and the level of corruption we have to de¯ne the equilibrium level of the price for corruption and the equilibrium level of evasion. The following section contains a characterization of the (general) equilibrium level for the underlying o®ence (tax evasion), corruption and monitoring.

5 Equilibrium Tax evasion, Corruption and monitoring

Given a set $(Á_e, Á_{Â}, ´, ¿, z, M)$, the auditing technology described by a and p(®) we solve for the equilibrium of the economy. Each taxpayer decides the level of evasion, taking m and Â as given, (determining ®b); each public o±cial holding evidence of evasion decides whether to enter into a bribery agreement or not, given m and b; at the same time, the Tax Authority decides the level of monitoring, after having observed the monitoring cost z and given Â and b. The level of b is determined as the Nash bargaining solution of the bilateral monopoly problem of the bribing coalition. It is important to note that the taxpayer conceives her reporting strategy by taking into account the e®ect on p(®), the probability of a tax audit and on b, the amount of the bribe given auditing. However, being measure zero, she does not take into account any

[11] The model was solved also for alternative assumptions on the information structure and in the case of di®erent alternative reward functions for the monitoring activity. For example, we considered the case in which the bene¯ts to the agent in charge for monitoring corruption were related to the ¯ne for corruption rather than the ¯ne for evasion, in the case in which these rewards are related to the total amount of ¯nes applied as a result of the monitoring activity and in the case in which monitoring costs z are private information. In all the cases the equilibrium level of monitoring in the economy is the same as above, whereas the equilibrium level of corruption, although always de¯ned by the equivalence of expected bene¯ts and expected costs from monitoring yields similar equilibrium conditions as for the case provided in the text.

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. We characterize the equilibrium for the economy where taxpayers optimize over the level of fiscal compliance and the level of corruption and monitoring fully dissipate expected rents from bribing and monitoring.

An interior equilibrium with bribe is a triple (α^*, m^*, χ^*) obtained as the solution of the system made of (5), (6), and (7), given (3) with all the elements in the triple being strictly between zero and one.

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

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

and

$$p(\alpha)\phi_e\tau(1-\alpha)M\chi = z \qquad (9)$$

provided that $\chi^* \leq 1$, i.e. $p(\alpha)\phi_e\tau(1-\alpha)M > z$.

We refer to (9) as the zero profit condition in monitoring activities defining couples of χ and α such that no rents are expected from monitoring activities and to (8) as the taxpayer's equilibrium condition defining couples of χ and α such that the taxpayer is optimizing over the level of fiscal compliance.

Since $p_\alpha < 0$ and $p_{\alpha;\alpha} \geq 0$, the taxpayer's equilibrium condition, $\alpha(\chi)$, is continuous and monotonically decreasing in χ. The intuition is straightforward: since corruption dilutes fines, a larger degree of χ calls for an increasing level of evasion. The zero profit condition in monitoring activities, $\chi(\alpha)$, is continuous and monotonically increasing in α, with $\chi(0) = z/[\phi_e\tau M p(0)]$. Even in this case the intuition is quite simple: given a level of monitoring, $\chi(\alpha)$ is monotonically increasing in α and the slope measures the increase in aggregate corruption level which necessary to compensate the increase in tax compliance in order to keep monitoring at a given level.

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 corruption χ with bribery, $b > 0$.

The results can be summarized as follows

Proposition 2 In the economy with no expected rents from corruption and monitoring and with a verification technology satisfying assumptions in Lemma 1, an interior equilibrium exists with α, χ, and m strictly between zero and one.

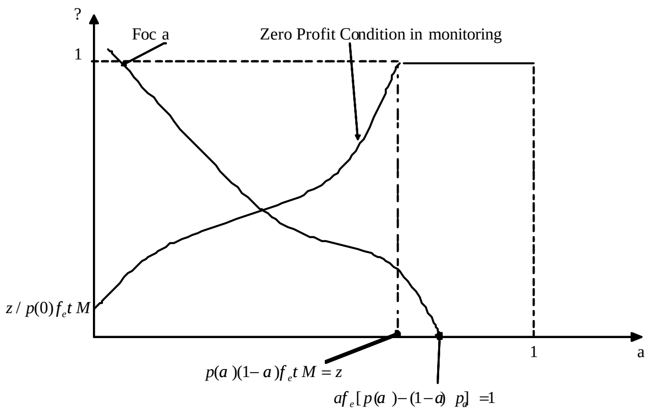

Figure 2: Equilibrium Corruption and Tax Evasion

In the following we provide some comparative statics for the interior equilibrium, which is of our primary interest.

Table 2 - Comparative statics

	E®ect on				
Increase in	Compliance ®	Corruption Â	Monitoring m	Bribe b	Expected bribe bpÂ
Fine for evasion $Á_e$	+	?	=	?	=
Fine for bribing $Á_Â$	i	i	i	+	=
Monitoring cost z	¡	+	=	+	+
Tax Rate ¿	+	+	=	+	=
Income M	¡	¡	=	+	=

We study the e®ects on the behavior of taxpayers and auditors of government's policy against bribery and tax evasion. First, consider the e®ect of a marginal increase in the ¯ne rate for tax evasion, $Á_e$. By (8), for any given amount of reported income, the increase in $Á_e$ both raises the extent of the penalty for evasion and the amount of the bribe to be paid to the public o±cial, if evasion is detected. Thus, an increase of $Á_e$ raises the expected cost of evasion and leads the taxpayer to report a larger share of her income.

The reason why the e®ect of $Á_e$ on Â is ambiguous is that on the one hand, it induces a larger bribe but also a larger reward from monitoring, with intuitive opposite e®ects on Â. The e®ect of the increased ¯ne for evasion on equilibrium bribe $b^¤$ is also ambiguous due to the reduced evasion. These e®ects highlight the competitive nature of the price of corruption and the relevance of endogenous monitoring in our model: an increased level of compliance induced by a larger fine for evasion reduces expected benefits from monitoring. To keep monitoring at a given level, corruption and bribes have to adjust in opposite directions so that the expected level of bribes does not change due to increased compliance (remember that $p_\alpha > 0$). Which exact adjustment takes place depends on the elasticity of the level of compliance to the fine for evasion, on monitoring costs and other underlying parameters of the economy. In particular, looking at the equilibrium level of the bribe

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

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 a reduction of the evasion $1-\alpha^*$, that is the equilibrium bribe increases (corruption frequency decreases) if and only if

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

i.e. the bribe is increasing in the fines if the elasticity (absolute value) of evasion to the fine is less than one. In other words if the increase in the fine for evasion triggers a less than proportional reduction in the evasion the equilibrium bribe is going to increase and corruption is going to increase.

In any case the ex-ante expected amount of bribery, χbp, measuring the aggregate value of corruptive transactions 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 $(1-\eta+\eta m)\phi_e\tau(1-\alpha)M$. The rise in the penalty rate ϕ_χ, however, determines a reduction in the value of m^*. Intuitively an increase in ϕ_χ increases the expected cost from corruption and m has to decrease to compensate for the reduction in corruption incentives. As for the effects on corruption, a larger ϕ_χ increases the expected cost of taking a bribe, for any given b, reducing her incentive to be corrupted. Due to the fine dilution effect of corruption, however, the level of fiscal compliance is reduced. This result can be contrasted with the results obtained in Polinsky and Shavell (2001), Mookherjee and Png (1993), Chander and Wilde (1993) where, due to the independence of probability of detecting corruption and fines, it is always true that by increasing the fine for corruption, compliance for the underlying offence is improved. The results above can be summarized in the following

Proposition 3 At an interior equilibrium, an increase in the fines for evasion will reduce the aggregate level of evasion with ambiguous effects on corruption, whereas an increase in the fine for corruption will increase the aggregate level of evasion and reduce corruption.

To summarize, in this section we presented a simple model where fiscal compliance, tax auditing, corruption and corruption monitoring are simultaneously determined. We have shown that increasing ¯nes for evasion in this model will always induce a reduction in tax evasion whereas it has ambiguous e®ects on corruption and bribes which may rise as a consequence. Increasing ¯nes for corruption will reduce corruption and save costs of monitoring at the cost of increasing evasion. Contrary to the common assumption in the literature we have shown that competition among public o±cials, driving to no expected rents in anti corruption activities, may have counterintuitive implications about the relationship between ¯nes for corruption and the equilibrium level for the underlying o®ence. It is still true, as in the classical analysis of optimal ¯nes, that increasing ¯nes for corruption allows a reduction in the level of monitoring activities and savings in related costs. However, this does not leave una®ected the level of deterrence for the underlying o®ence. To further investigate the relationship between ¯nes, corruption and incentives to tax compliance, in the next section we analyze the optimal level of ¯nes from the point of view of a utilitarian planner.

6 Welfare Analysis

In this section we use the results derived in previous sections to assess the normative implications of our model of tax evasion, corruption and monitoring. Let us brie°y summarize the ¯ndings obtained so far. We studied a simple economy composed of a population of measure $1 = n_0 + n_1 + n_2$. A fraction n_0 of the population produces income M pays ¿®M as an income tax, taking the gamble to evade part of it. Tax revenues are collected to ¯nance the public good to be provided in the economy. A fraction n_1 is paid a ¯xed wage w, is assigned the right to audit taxpayers and is endowed with a state veri¯cation technology that allows the tax auditors to verify the true tax base with a probability p(®). In the event evasion is proved the opportunity of corruption emerges, at an equilibrium probability Â. A fraction of incorruptible $n_2 = n_1 m$ 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 ¯scal budget in the aggregate and the objective function of the planner.

In order to write the ¯scal budget and the amount of resources needed to establish the enforcement agency we need to specify the remuneration to law enforcers. We set the salary to the public o±cials equal to the expected income in the economy so that all agents are ex-ante indi®erent across jobs:

$$w \text{ ´ } Ey = (1 \text{ ¡ } \text{®¿})M \text{ ¡ } ap[(1 \text{ ¡ } \text{Â} + \text{Â}m)\text{©}_e + b\text{Â}(1 \text{ ¡ } m) + \text{Â©}_{\text{Â}} m] \qquad (10)$$

Intuitively, expected income is given by net income (gross of evasion) less expected ¯nes. The reduced form for the expected income after substituting the equilibrium conditions for Â and m, the equilibrium value of the bribe and assuming ´ = 1=2 we obtain the following expression for the expected income

$$\overline{Ey} = (1 - \alpha^* \tau)M - ap(\alpha^*)[1 - \frac{\chi^*}{2}(1 - m^*)]\Phi_e \quad (11)$$

$\overline{Ey} = \overline{Ey}(a; \tau; \phi_e; \phi_\chi)$, where fines, tax rates and the auditing frequency are choice variables in the maximization problem to the social planner[12].

The general fiscal budget is then given by

$$n_0 \tau \alpha M + n_1 p(1 - \chi + \chi m)\Phi_e + 2n_1 p\chi\Phi_\chi m = G + B \quad (12)$$

Where G is the value of the public good provided in the economy, $n_0 \tau \alpha M$ is the voluntary component of tax revenues, $n_1 p(1 - \chi)\Phi_e$ is the total value of the enforced fine for evasion not accruing to the budget of the Tax Authority (voluntary payment of the fines by taxpayers not joining a bribing coalition) and, finally, $2n_1 p\chi\Phi_\chi m$ is the value of the fines for corruption obtained as an indirect revenue raised from the monitoring activity, which we assume to be accrued to the provision of the public good. Consistently with the idea that fines motivate monitoring by the upper layer of the tax Authority we leave it outside the general fiscal budget constraint. B is defined as gross transfers from the general fiscal budget to the tax authority. The Tax Authority budget constraint is, in turn as follows

$$B + \Phi_e \chi m p n_1 = w(1 + m)n_1 + zmn_1 \quad (13)$$

Where B is the net transfers from the general fiscal budget, $\Phi_e \chi m p n_1$ is the total revenues from collected fines for evasion, $w(1+m)n_1$ is the total (net) wage paid to law enforcers, zmn_1 is the total amount of direct costs of monitoring. From (7) we get $B = w(1 + m)n_1$. Therefore, from the public budget, we get the amount of public good provided in the economy

$$G = [1 - n_1(1 + m)]M - \overline{Ey} - n_1 zm \quad (14)$$

The planner is modelled as an utilitarian legislator whose problem is to maximize total welfare. Since all agents in our economy are ex-ante indifferent across jobs and get utility $U(\alpha) = Ey + u(G)$ and having normalized our population to one, the objective function of a utilitarian planner is given by

$$U(a; \tau; \phi_e; \phi_\chi) = \overline{Ey} + u(G) \quad (15)$$

where $u(G)$ is such that $u'(0) > 1$ and $u''(G) < 0$. The planner maximizes (15) with respect to the tax rate τ (implicitly defining G), the fine rates, ϕ_e, ϕ_χ and the number of auditors n_1, subject to (14) and to the limited liability constraint

[12] Having assumed no commitment to the probability of detection of corruptive agreements, 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, n_2 is set, in equilibrium, as in the previous section. The allocation is equivalent to letting the planner choose optimally the number of n_2 and letting n_1 to adjust to the equilibrium conditions.

$$\Phi_e + \Phi_\chi \leq (1 - \alpha\tau)M \tag{16}$$

The problem can therefore be written as

$$\begin{aligned} &\underset{\tau,\phi_e,\phi_\chi,n_1}{Max} && \overline{Ey} + u(G) \\ &s.to && G = [1 - n_1(1+m)]M - \overline{Ey} - n_1 zm \\ &&& \Phi_e + \Phi_\chi \leq (1 - \alpha\tau)M \\ &&& U_\alpha = 0 \end{aligned} \tag{17}$$

Before solving the problem let us analyze 16 at an interior equilibrium for $\alpha; \chi; m; b$. By substituting (3), (6) and (7) into (16) we get

$$\phi_e\left(1 + \frac{\phi_\chi}{4}\right)(1 - \alpha)\tau \leq 1 - \alpha\tau.$$

The solution for this program can be characterized by standard techniques. The Lagrangian for the maximization problem can be written as follows.

$$L = \overline{Ey} + u(G) + \lambda\left[(1 - \alpha\tau)M - \phi_e(1 - \alpha)\tau M\left(1 + \frac{\phi_\chi}{4}\right)\right] \tag{18}$$

By solving the Lagrangian we obtain the following

Proposition 4 At an interior equilibrium ($0 < \alpha^* < 1$; $0 < m^* < 1$; $0 < \chi^* < 1$; $\tau > 0$): i. maximal fines principle holds in (17) at $G > 0$, ii. $\phi_e > 0$ and $\phi_\chi > 0$.

Proof. Set $\lambda = 0$ in (17) and get a contradiction. See Appendix B for further details.

The intuition is rather simple. Part i. can be explained as follows: assume maximal fine does not hold i.e. $\lambda = 0$. No maximal fines immediately implies no underdeterrence ($G = G^{FB}$). Where G^{FB} is given by the first best level public good in the case of no enforcement problem, $u'(G^{FB}) = u'(\tau M) = 1$. At no maximal fine the planner can increase the fine for corruption to save on monitoring costs and increase fine for evasion to keep the desired level of deterrence. Part ii. is an immediate implication of the equilibrium being interior. The reason is that both fines are necessary to deter the underlying offence (tax evasion) at interior equilibrium. Intuitively, $\phi_e = 0$ would imply no income reported contradicting interior equilibrium. At $\phi_e > 0$ and $\phi_\chi = 0$ the monitoring costs of corruption are too large. To save on costs of enforcement increasing ϕ_χ is a better instrument than ϕ_e to increase deterrence.

Jointly considered the two parts of the proposition state that the design of the two fines, at equilibrium, has to saturate the limited liability constraint of the offender (maximal fines) in this model. The reason for fighting corruption through fines however is not due to the usual argument that raising fines for corruption increases deterrence for the underlying violation. In our model raising fines for corruption reduces fiscal compliance and monitoring costs. Differently from the classical analysis where ¯nes and the probability of detection are independent instruments in the hand of the planner and can be set at any level for given deterrence, in our case the level of anti corruption activities replies to incentives depending on the ¯nes. Increasing the ¯ne for corruption reduces corruption and monitoring. The social cost of increasing ¯nes for corruption in our model is measured by the lower ¯scal compliance induced.

We ¯nally analyze the optimal amount of public good provided in the model. To motivate the analysis notice that increasing the tax rate ¿ will reduce corruption and increase tax compliance in our simple economy. Can it be the case that a utilitarian planner, to motivate monitoring and foster deterrence both for tax evasion and corruption, may decide to increase the tax rate at a level such that more than the ¯rst best level of public good is provided? In other words can the tax rate substitute ¯nes to provide the optimal amount of deterrence? The answer to this question is no, as shown in the following

Proposition 5 In an economy with imperfect commitment to monitoring corruption and maximal ¯nes we get $G < G^{FB}$.

Proof: see Appendix B.

The reason why it is never e±cient to upward distort the provision of the public good by increasing ¿ in spite of its positive e®ects both on the deterrence of the underlying o®ence and corruption is that, by increasing ¿, makes the limited liability constraint more strict, therefore the tax rate is an ine±cient instrument to increase deterrence compared to ¯nes.

7 Conclusions

We considered a simple economy where self interested taxpayers may have incentives to evade taxes and to escape sanctions by bribing public o±cials in charge for tax collection. Public o±cials, both those involved in tax auditing and those in charge for anticorruption activities, are rents seekers. Tax auditors try to appropriate rents through bribes, those in charge for monitoring corruption are motivated by rewards measured by the size of the ¯nes. In this setting we study the case where the price for corruption sets at a level where no ex ante rents from corruption and its monitoring are anticipated, i.e. any rent in the public sector is dissipated via monitoring costs and both bribing and monitoring are competitive activities. We characterize the equilibrium with corruption and bribing and study the interactions between evasion, corruption and monitoring as well as their adjustment to a change in the institutional setting. In the proposed framework, larger ¯nes for evasion will increase tax compliance with ambiguous e®ects on corruption. Complete dissipation of rents in the public sector implies that the bribe and the level of corruption move in opposite directions in reply to an increase in the ¯ne for evasion. A larger ¯ne for corruption will reduce corruption at the cost of reducing tax compliance.

We also considered the optimal design of ¯nes in this setting, where the classical dichotomy between ¯nes and probability of detection is lost. Corruption activities along with their ¯ne dilution e®ect interact in a non trivial way with the amount of rents dissipated in monitoring costs. Interestingly, a maximal ¯ne result holds in the case of a utilitarian legislator, the reason being that increasing ¯nes reduces monitoring costs at the cost of increasing ¯scal non compliance. Intuitively, ¯ghting corruption through ¯nes is valuable to the planner since it reduces the amount of rent dissipation in the public sector. The shadow value of imperfect enforcement is de¯ned in terms of the public good provided by a utilitarian government: in the presence of evasion and corruption: imperfect enforcement induces a smaller level of public good to be provided compared to the ¯rst best.

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8 Appendix A

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

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

$$F^2 \equiv \phi_e \tau (1-\alpha^*) M p(\alpha^*) \chi^* - z$$

and

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

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

$$|J| \equiv \begin{vmatrix} F^1_\alpha & F^1_\chi \\ F^2_\alpha & F^2_\chi \end{vmatrix} = \begin{vmatrix} \overline{\phi_e}[2p_\alpha - (1-\alpha)p_{\alpha\alpha}] & -\frac{a\phi_e \eta \phi_\chi}{(1+\phi_\chi)\overline{\phi_e}} \\ -\frac{z}{(1-\alpha)p\overline{\phi_e}} & \frac{z}{\chi} \end{vmatrix}$$

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

$$\begin{vmatrix} F^1_{\phi_\chi} & F^1_\chi \\ F^2_{\phi_\chi} & F^2_\chi \end{vmatrix} = \begin{vmatrix} -\frac{a\phi_e \eta \phi_e \chi}{(1+\phi_\chi)^2\overline{\phi_e}} & -\frac{a\phi_e \eta \phi_\chi}{(1+\phi_\chi)\overline{\phi_e}} \\ 0 & \frac{z}{\chi} \end{vmatrix}$$

evaluated at the optimum. The determinant is always strictly negative, therefore $d\alpha^*/d\phi_\chi < 0$. The sign of the derivative of χ^* with respect to ϕ_χ is the same as the sign of the following determinant

$$\begin{vmatrix} F^1_\alpha & F^1_{\phi_\chi} \\ F^2_\alpha & F^2_{\phi_\chi} \end{vmatrix} = \begin{vmatrix} \overline{\phi_e}[2p_\alpha - (1-\alpha)p_{\alpha\alpha}] & -\frac{a\phi_e \eta \chi}{(1+\phi_\chi)^2\overline{\phi_e}} \\ -\frac{z}{(1-\alpha)p\overline{\phi_e}} & 0 \end{vmatrix}$$

evaluated at the optimum, which is negative, therefore $d\chi^*/d\phi_\chi < 0$

The sign of the derivative of α^* with respect to ϕ_e is the same as the sign of the following determinant

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

evaluated at the optimum. The determinant is always strictly positive, therefore $d\alpha^*/d\phi_e > 0$. The sign of the derivative of χ^* with respect to ϕ_e is the same as the sign of the following determinant

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

evaluated at the optimum, whose sign is ambiguous.

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

$$
\begin{array}{lll}
\underset{\tau;\phi_e;\phi_\chi;n_1}{Max} & \overline{Ey} + u(G) & \\
s.to & & \\
c1. & G = [1 - n_1(1+m)]M - \overline{Ey} - n_1 z m & \\
c2. & \Phi_e + \Phi_\chi \leq (1-\alpha)\tau M & (19)\\
c3. & U_\alpha = 0 & \\
c4. & m = \frac{1}{1+\phi_\chi} & \\
c5. & p(\alpha)\Phi_e \chi = z &
\end{array}
$$

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 $\overline{Ey}$, define the Lagrangian for the Kuhn Tucker problem as

$$L = \overline{Ey} + u(G) + \lambda[(1-\alpha\tau)M - \phi_e(1-\alpha)\tau M(1+\frac{\phi_\chi}{4})] \quad (20)$$

$$
\begin{array}{ll}
L_\lambda = 1 - \alpha\tau - \phi_e(1+\frac{\phi_\chi}{4})(1-\alpha)\tau \geq 0 & \lambda \geq 0 \\
L_\tau = \frac{\partial \overline{Ey}}{\partial \tau}[1 - u'(G)] + \lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1](\alpha + \tau\frac{d\alpha}{d\tau}) - \phi_e(1+\frac{\phi_\chi}{4})\right\} \leq 0 & \tau \geq 0 \\
L_{\phi_e} = \frac{\partial \overline{Ey}}{\partial \phi_e}[1 - u'(G)] + \lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_e} - (1+\frac{\phi_\chi}{4})(1-\alpha)\tau\right\} \leq 0 & \phi_e \geq 0 \quad (21)\\
L_{\phi_\chi} = \frac{\partial \overline{Ey}}{\partial \phi_\chi}[1 - u'(G)] - u'(G)[(M+z)n_1\frac{dm}{d\phi_\chi}] + \lambda\left\{[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{d\phi_\chi} + (\frac{\phi_e}{4})(1-\alpha)\tau\right\} \leq 0 & \phi_\chi \geq 0 \\
L_{n_1} = \frac{\partial \overline{Ey}}{\partial n_1}[1 - u'(G)] - u'(G)[(1+m)M + mz] + \lambda[\phi_e(1+\frac{\phi_\chi}{4}) - 1]\tau\frac{d\alpha}{dn_1} \leq 0 & n_1 \geq 0
\end{array}
$$

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

Proof of Proposition 4.

Assume $\lambda = 0$, $\phi_e > 0$, $\phi_\chi > 0$, $n_1 > 0; \tau > 0$. >From $L_\tau = 0$, by $u'(0) > 1$ we get $u'(G^{FB}) - 1 = 0$, at $G^{FB} > 0$ i.e. if the fiscal liability constraint is not binding, there must be 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 $G > 0$ and $G = G^{FB}$ the planner would like to increase the fine for corruption to saturate the fiscal liability constraint (maximal fine). Moreover from L_{n_1} we get: $-[(1+m)M + mz) < 0$, that is, provided that no underdeterrence holds at first best the planner is willing to save on monitoring cost by reducing the number of auditors contradicting the hypothesis that the equilibrium is at interior α, m and χ. □

Proof of Proposition 5.

Assume $\lambda > 0$, $\phi_e > 0$, $\phi_\chi > 0$, $n_1 > 0$ and $G \geq G^{FB}$ in 21. Since $G \geq G^{FB}$ is assumed, it must be that $\tau > 0$ and proposition 3 holds. Therefore substitute $L_\lambda = 0$ into $L_\tau = 0$ to get $L_\tau = \frac{\partial \overline{Ey}}{\partial \tau}[1 - u'(G)] + \lambda[-\frac{1}{\tau} + \frac{1-\tau}{1-\alpha}\frac{d\alpha}{d\tau}] \leq 0$. Since we assumed $G \geq G^{FB}$, given the hypothesis on $u'(G)$ and $u''(G)$, it must be that $1 - u'(G) > 0$ and since $\frac{\partial \overline{Ey}}{\partial \tau} < 0$ and $-\frac{1}{\tau} + \frac{1-\tau}{1-\alpha}\frac{d\alpha}{d\tau} > 0$ i.e. $\frac{d\alpha}{d\tau} > \frac{1-\alpha}{\tau(1-\tau)}$. From the comparative statics on (7) and (5) after some simple algebra we get

$$\frac{d\alpha}{d\tau} = \frac{F^1_\chi F^2_\tau}{|J|} < \frac{1-\alpha}{\tau(1-\tau)}$$

yielding a contradiction. Therefore it must be $G < G^{FB}$. □