Corruptibility and Tax Evasion

Roy Cerqueti*& Raffaella Coppier

Department of Economics and Law
University of Macerata
Email: {roy.cerqueti,raffaellacoppier}@unimc.it

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Abstract

Reduction of fiscal evasion may be pursued by introducing incentive schemes for tax inspectors. The aim of this paper is to explain the role of such bonuses in an economic environment with corruption, i.e. in a world where entrepreneurs and tax inspectors are open to bribery. In detail, we analyze the role of a public incentive scheme, where the tax inspector's bargaining strength is endogenous with respect to an incentive mechanism: indeed the knowledge that even if an entrepreneur does not agree to pay the bribe, s/he can report tax evasion and be partly rewarded for this, increases the tax inspector's bargaining strength.

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1 Introduction

Tax evasion and fiscal corruption have been a general and persistent problem throughout history with serious economic consequences even in countries with developed tax systems. Although there is an extensive literature investigating the origins, effects and extent of evasion and corruption from both theoretical and empirical points of view, interaction between tax evasion and corruption has only been partially explored. It is, in fact, only recently that this relationship has been investigated by the scientific community. When tax authorities are dealing with the possibility of corruption, they must

*Corresponding author: Roy Cerqueti. University of Macerata, Department of Economics and Law. Via Crescimbeni, 20 - 62100 - Macerata, Italy.
Tel.: +39 0733 2583246; Fax: +39 0733 2583205.
Email: roy.cerqueti@unimc.it

consider the possibility of taxpayers who underreport their income, bribing inspectors. It is widely agreed that tax evasion and corruption have several detrimental effects on the economy. The loss of tax revenues can, in fact, imply a reduction in public services; in addition, tax evasion and corruption can seriously harm economic growth (amongst others, Rose-Ackerman, 1975, 1978; Shleifer and Vishny 1993) and distort income distribution as individuals and firms may have different opportunities for evasion (Hindriks et al., 1999). Chu (1990) and Bowles (1999) find that corruption among tax enforcement agents increases income tax evasion, since the effective penalty is weakened, thus providing a theoretical argument for a positive link between tax evasion and corruption. Chander and Wilde (1992) take into account the possibility of collusion between a tax evader and an official auditor whose dishonesty cost is low. In addition, Chander and Wilde (1992) and Sanyal et al. (2000) show that tax revenues may decline along with the income tax rate if there are corrupt tax officials. Besley and McLaren (1993), Hindriks et al. (1999) and Mookherjee and Png (1995) deal with the issue of optimal remuneration of inspectors. Hindriks et al. (1999) consider a model where all the actors are dishonest. They show that distributional effects of evasion and corruption are regressive, as the richest taxpayers have most to gain from evading taxes and are least vulnerable to extortion (as it is harder to credibly over–report their income). Mookherjee and Png (1995) also consider only corruptible agents, although they consider a moral hazard problem, since the inspector has to exert a costly non–observable effort for evasion to be disclosed.

This work develops a theoretical model to analyze the effects incentive schemes, whether private (a bribe) or public (a bonus rate), have on tax evasion and fiscal corruption. The recent literature has highlighted the effect that these two types of incentives, whether considered individually or jointly, may have on tax evasion. Considering them individually, with regard to the effect that private incentive, i.e. the bribe, can have on the evasion, as Mookherjee (1977) stressed, the opportunity to negotiate a bribe with the evading taxpayer, pushes the tax inspector to do more checks in order to detect evasion. The tax payers anticipate that there is higher probability of being inspected and this, the corruptibility of tax inspectors, makes evasion less attractive. In this way, greater corruptibility of tax inspectors could lead to less evasion. With regard to the effect that a public system of incentives, i.e. bonus rate, may have on tax evasion, it should be noted that, as a growing amount of literature has stressed, incentive schemes can motivate the tax inspectors to carry out more exhaustive controls (Chand and Moene, 1999, Das–Guspta and Mookherjee, 1998, Mookherjee, 1997). In fact, Chand and Moene (1999) set out a model that show how bonus payments to tax administrators can reduce corruption; the bonus payments substitute for bribes. A case study from Ghana is used to show how, after a reform in the public service in 1981, "rampant fiscal corruption was brought under control", thank to the use of bonus payments which stimulated fiscal officers to greater honesty[1].

In order to analyze this fact, we consider an incentive scheme (public) which guarantees that the tax inspector takes a share of any evaded taxes which are discovered: this reinforces the inspector's position in negotiating and obtains a higher bribe, reducing the attractiveness of evasion. But we must also consider the interaction between the two incentive mechanisms on tax evasion, in that, as argued by Fjeldstad and Tungodden (2003), the bonus system provides incentives for the corrupt tax inspector. In fact the awareness by the tax inspector that s/he can report tax evasion and be partly rewarded for this, even if the entrepreneur does not agree to pay the bribe, increases the tax inspector's bargaining strength. Greater bargaining strength on the part of the inspector implies that the entrepreneur finds it less worthwhile to be an evader and, therefore, corrupt. Thus, the presence of corruptible inspectors strengthens the role of public incentives to combat tax evasion.

Therefore, we rely on a world where tax inspectors and entrepreneurs are open to bribery and proceed as follows: first, we assume that the State fights tax evasion through the implementation of incentive schemes for tax inspectors. The economic profitability of such incentives should be in contrast with that of the bribes coming out from a negotiation between inspectors and entrepreneurs, hence corruption; second, we take into account that incentive schemes affect the bargaining strength of tax inspectors in determining bribes.

In detail, we construct a bayesian game played by the State, entrepreneurs and tax inspectors and we explore interaction between fiscal evasion and corruption. In this context, we analyze the role of a public incentive scheme, considering that the tax inspector's bargaining strength is endogenous with respect to an incentive mechanism. In addition, following Fjeldstad and Tungodden (2003), we consider how the corruptibility level of a country can affect a bonus system.

The paper is organized as follows. In Section 2, we present the model. In Section 3, we describe the timing of the game and provide the main results. In Section 4, we endogenize the inspector's bargaining strength considering that it depends on the incentive scheme. Section 5 concludes. All proofs of Propositions are in the Appendix.

2 Theoretical model

Consider an economy composed of three players: the State, tax inspectors and entrepreneurs. Tax inspectors cannot invest in production activity and earn a fixed salary λ. Entrepreneurs work in the production sector. The

[1] For an empirical experiment on the role of public incentives for public official in Punjab, Pakistan, see Khwaja, Olken and Adnan Khan (2012)

population of entrepreneurs and tax inspectors is normalized to 1.
The State monitors entrepreneurs' behavior through tax inspectors, in order to weed out or reduce evasion, and fixes the level of the tax rate t. The State also uses its tax revenues to pay the tax inspectors' wages but there is no space for financing public productive expenditure. Moreover, in order to focus more appropriately on the analysis of the incentive schemes, we do not rely on a budget constraint issue. We assume that taxation is not distortive regarding input provision. Nature decides the amount of entrepreneurs' production: in particular, an entrepreneur produces an income $y - e$ with probability p and y with probability $1-p$. In the first case, the entrepreneur reports the total amount $y-e$ of her/his production, while in the latter case the entrepreneur can decide to underreport her/his income by the amount e, and the evasion can be discovered only if the entrepreneur is checked by a tax inspector[2]. The tax inspector does not check the entrepreneur if an amount of y is reported, while s/he can check the entrepreneur in presence of a declared production of $y - e$. The tax inspector must decide whether to check the entrepreneur or not, depending on the cost of the effort of inspection $\omega \in (0, +\infty)$, on the bribe that the tax inspector can obtain from the tax evader and on the bonus rate $\alpha \in (0, 1)$ that s/he can obtain on any evasion s/he reports. We assume that $\omega < et$ i.e. the evaded amount is higher than the cost of inspection, as it naturally should be. The tax inspector who discovers evasion decides whether to report it or to ask for a bribe: indeed, it is common knowledge that the tax inspector is corruptible and open to bribery, in the sense that s/he pursues her/his own interest and not necessarily that of the State.
Let b^d be the bribe requested by the tax inspector. Then, in the case in which the agreement is not reached, the tax inspector reports the tax evader, the latter incurs a punishment (either monetary, moral or criminal). We assume that the entrepreneurs are not homogeneous agents and they incur different "moral costs" when they are reported for being evader[3]. More precisely, it is common knowledge that the j-th entrepreneur incurs a specific value c_j to the "moral costs" derived from being caught in evasion (see Cerqueti and Coppier, 2009 and Cerqueti et al., 2011). If reported, the entrepreneur does

[2]It is worth noticing that the tax inspector do not have information about the entrepreneur before the check. Spcifically, the inspector does not know which entrepreneurs to control until a superior tells her/him the assigned tasks, and s/he cannot refuse to control the entrepreneurs which have been allocated.

[3]In a micro perspective, the concept of "moral costs" has be used to describe one of the factor which can induce economic agents to engage in corrupt activities. Following Becker (1968): "A person commits an offense if the expected utility to him exceeds the utility he could get by using his time and other resources at other activities. Some persons become criminals, therefore, not because their basic motivation differs from that of other persons, but because their benefits and costs differ". More recently, Harstad and Svensson (2011) consider the individual stigma associated with being penalized for corruption.

not pay the bribe but must pay taxes ty, and suffers the "moral costs" c_j[4].

3 The game: description and solution

Given the framework described above, we can formalize the economic problem into a five-period game with incomplete information.
As already stated in the previous section, the game works as follows: in the first stage, Nature decides the entrepreneur's income: y with probability $1-p$ and $y-e$ with probability p; in the second stage, the entrepreneur declares the amount of income; in the third stage, the tax inspector decides whether to check the entrepreneur's declaration or not; in the fourth stage the tax inspector decides whether to ask for a bribe or not, if a false declaration is detected; in the fifth stage, the entrepreneur must take the decision of whether to pay the bribe or not.
For a clear exposition, we present the game by distinguishing the cases of high or low income. The payoff vector will be indicated with a triple

$$\underline{\pi} = (\pi^E, \pi^S, \pi^I), \tag{1}$$

where π^E, π^S and π^I represent the payoffs of the j-th entrepreneur, the State[5] and the tax inspector, respectively.
The stepwise scheme of the game is the following:

First stage

Nature decides the amount of the entrepreneur's production. In particular, the entrepreneur produces an amount $y-e$ with probability p and y with probability $1-p$.

Bad state of the Nature: income $y-e$

The entrepreneur produces $y-e$.

Second stage

The entrepreneur declares $y-e$.

Third stage

The tax inspector must decide whether to check the declared income or not. The game ends in both cases. The payoffs are:

$$\begin{cases} \underline{\pi}_2 = ((1-t)(y-e), t(y-e), \lambda), & \text{if not check;} \\ \underline{\pi}_4 = ((1-t)(y-e), t(y-e), \lambda-\omega), & \text{if check.} \end{cases} \tag{2}$$

[4]We assume perfect knowledge of the term c_j by all the players in this game, in the sense that there is an objective measure of the entrepreneurs' moral damage.

[5]Naturally, the payoff of the State should be understood as the income from taxes paid by the j-th entrepreneur net of the bonus share paid to the inspector.

Good state of the Nature: income y

The entrepreneur produces y.

Second stage

The entrepreneur must decide the amount of income to declare: y or $y-e$. If the entrepreneur decides to be honest and declare y, then the tax inspector does not check the entrepreneur's production and the game ends with the following payoff vector:

$$\underline{\pi}_1 = ((1-t)y, ty, \lambda). \tag{3}$$

Otherwise, the game continues to stage three.

Third stage

If the entrepreneur declares $y-e$, then the tax inspector must decide whether to check the entrepreneur's production or not. If the tax inspector does not check the entrepreneur's production, then the entrepreneur pays only the taxes on declared income $(y-e)$. The tax revenues for the State are $(y-e)t$ and the tax inspector receives his wage λ. The game ends with following payoff vector:

$$\underline{\pi}_3 = (y-(y-e)t, t(y-e), \lambda). \tag{4}$$

Otherwise, the game continues to stage four.

Fourth stage

The tax inspector checks the entrepreneur's production and must decide whether to report the evasion or to ask for a bribe b^d. If the tax inspector reports the evasion, then the entrepreneur must pay the taxes on all income y and, in addition, s/he incurs a "moral costs" c_j; the State receives the taxes ty, but must pay the bonus share α on the reported evasion et; finally, the tax inspector obtains her/his wage, minus ω, plus the bonus share αet. The game ends with the following payoff vector:

$$\underline{\pi}_5 = ((1-t)y - c_j, ty - \alpha et, \lambda - \omega + \alpha et). \tag{5}$$

Otherwise, the game continues to stage five.

Fifth stage

The tax inspector asks the entrepreneur for a bribe $b^d > 0$. If the agreement is not achieved, the tax inspector reports the entrepreneur. There is no penalty for the tax inspector, and the game ends with the following payoff vector:

$$\underline{\pi}_6 = ((1-t)y - c_j, ty - \alpha et, \lambda - \omega + \alpha et). \tag{6}$$

Otherwise the negotiation starts, and the two parties will find the bribe b^{NB} corresponding to the Nash solution to a bargaining game, and the game ends. This bribe is the outcome of a negotiation between the inspector and the entrepreneur, who will be assumed to share a given surplus. The entrepreneur pays the bribe and is not reported. The game ends with the payoff vector given by:

$$\underline{\pi}_7 = (y - (y - e)t - b^{NB}, t(y - e), \lambda - \omega + b^{NB}). \tag{7}$$

In order to proceed to the solution of the game, we firstly provide an explicit expression of the bribe b^{NB}.

Proposition 3.1. *There is a unique bribe b^{NB}, as the Nash solution to the bargaining game, given by:*

$$b^{NB} = \alpha et + \mu[c_j + et(1 - \alpha)]. \tag{8}$$

where $\mu \equiv \frac{\epsilon}{\epsilon+\beta}$ is the share of the surplus that goes to the tax inspector, and ϵ and β are parameters that can be interpreted as measures of bargaining strength of the tax inspector and the entrepreneur respectively.

The game with incomplete information has been solved using the backward induction method starting from the last stage of the game. Its solution is formalized by the following proposition.

Proposition 3.2. *There exist two thresholds for the "moral costs" $\xi_1, \xi_2 \in (0, +\infty)$ and a threshold for the probability $p_1 \in (0, 1)$ such that*

(a) If $1 - p > p_1$, then:

(a.1) if $c_j \leq \xi_1$, the game ends with random payoff vector

$$\underline{\pi}_A = \begin{cases} \underline{\pi}_3 & \textit{with probability } 1 - p, \\ \underline{\pi}_2 & \textit{with probability } p; \end{cases}$$

(a.2) if $\xi_1 < c_j \leq \xi_2$, the game ends with random payoff vector

$$\underline{\pi}_B = \begin{cases} \underline{\pi}_7 & \textit{with probability } 1 - p, \\ \underline{\pi}_4 & \textit{with probability } p; \end{cases}$$

(a.3) if $c_j > \xi_2$, the game ends with random payoff vector

$$\underline{\pi}_C = \begin{cases} \underline{\pi}_1 & \textit{with probability } 1 - p, \\ \underline{\pi}_4 & \textit{with probability } p; \end{cases}$$

(b) If $1 - p \leq p_1$, then:

(b.1) if $c_j \leq \xi_1$, the game ends with payoff vector $\underline{\pi}_A$.

(b.2) if $c_j > \xi_1$, the game ends with payoff vector $\underline{\pi}_C$.

The previous proposition shows that we obtain different perfect Nash equilibria in the sub-games, depending on the parameter values. The distinction between the good and the bad state of Nature is needed.
If the income of the entrepreneur is $y - e$, two equilibria without evasion occur:

- $\underline{\pi}_2$ is associated to the equilibrium with no check.
- $\underline{\pi}_4$ is associated to the equilibrium with check.

When the income of the entrepreneur is y, then three equilibria occur:

- $\underline{\pi}_1$ is associated to the equilibrium with no evasion.
- $\underline{\pi}_3$ is associated to the equilibrium with undetected evasion;
- $\underline{\pi}_7$ is associated to the equilibrium with evasion and corruption.

The case of the good state of Nature is the one allowing corruption and evasion. Therefore, even if the game is solved by taking into account both the states of Nature, we will focus our discussion on the case in which the income of the entrepreneur is y, i.e. on equilibria $\underline{\pi}_1$, $\underline{\pi}_3$ and $\underline{\pi}_7$.
In order to give greater insight to the presentation of the results, let us rename the thresholds found for the "moral costs":

- ξ_1. We call this threshold the *Inspector Monitoring Threshold (IMT)* because if the "moral costs" are less than ξ_1, the tax inspector will find it worthwhile not to carry out any checks on the entrepreneur; if the "moral costs" are greater than ξ_1, the tax inspector will find it worthwhile to carry out checks on the entrepreneur;
- ξ_2. We call this threshold the *Entrepreneur Evasion Threshold (EET)* because if the j-th entrepreneur has "moral costs" greater than ξ_2, the entrepreneur will find it worthwhile to be honest; the j-th entrepreneur with "moral costs" less than ξ_2 will find it worthwhile to evade.

The equilibria achieved depend, in almost all cases, on the probability of occurrence of a state of Nature. In fact a high probability p $(1 - p \leq p_1)$ implies that there is high probability that bad states of Nature, i.e. with low production, will occur and, therefore, in this case, the inspector will consider it more plausible if income equal to $y - e$ is reported. To make a more intuitive representation of results, we call the cases in which $1 - p > p_1$ "Expansion" and those in which $1 - p \leq p_1$ "Recession".
In particular:

(a) "Expansion". In this circumstance, there is a low likelihood of adverse states of Nature (production equal to $y - e$).

(a.1) **Equilibrium with undetected evasion** applies. As the "moral costs" of the j-th entrepreneur are less than the IMT, the inspector will find that it is not worthwhile to carry out checks on the entrepreneur, for the simple reason that the effort of inspecting is not compensated by the small amount of the bribe. Simultaneously, the entrepreneur will find it worthwhile to underreport her/his income, because the "moral costs" are low.

(a.2) **Equilibrium with evasion and corruption** applies. Under these parameter conditions, the entrepreneur will find it worthwhile to underreport her/his income, since the "moral costs" are smaller than the EET. Now the "moral costs" are higher than the IMT, and the possible bribe is quite large. Moreover, there is a high probability that the low production declared is not the real entrepreneur's income, in that the expansion case is actually occurring. Therefore, the tax inspector finds it worthwhile to check the entrepreneur's production. The negotiated bribe is so small for the entrepreneur, that the detected evader prefers to agree to it rather than being reported.

(a.3) **Equilibrium without evasion** applies. Following the arguments of the previous case, the inspector checks the entrepreneur's production. Furthermore, since the "moral costs" are higher than the EET, the payoff that the entrepreneur can get by evading (with corruption) is lower than that which would be obtained by declaring all her/his income. In this case, then the entrepreneur will be honest and will report all income.

(b) "Recession". In this case, a high probability p $(1 - p \leq p_1)$ implies that there is a high probability that bad states of Nature, i.e. with low production $(y - e)$, will occur.

(b.1) **Equilibrium with undetected evasion** applies. The "moral costs" of the j-th entrepreneur are less than the IMT. Hence, the inspector will find that it is not worthwhile to check entrepreneur's production, for two reasons: firstly, the effort of inspecting is greater than the equilibrium bribe; secondly, there is a high probability that the low production declared is the entrepreneur's real income. At the same time, the entrepreneur underreports her/his income, because the "moral costs" are low.

(b.2) **Equilibrium without evasion** applies. The monitoring activity takes place, because the "moral costs" are higher than the IMT, and then the possible bribe is of a large amount. Furthermore, since the "moral costs" are higher than the EET, then the same arguments developed in (a.3) apply, and the entrepreneur will be honest.

The State, in order to reduce evasion and corruption, can use different tools. It is important to note that tax evasion can be reduced through greater control by the inspectors and greater social stigma associated with corruption, i .e. the corruptibility level of entrepreneurs. The probability of being controlled by an inspector is endogenous and depends on economic factors such as incentive schemes, bargaining power of the inspector and tax rate. With regard to the effect that a public system of incentives, i.e. bonus rate, may have on ta evasion, we will demonstrate in the next paragraph, that incentive schemes can motivate the tax inspectors to carry out more exhaustive controls. In addition we will consider the link between incentive schemes and bargaining power of the tax inspector. Therefore, here we perform a sensitivity analysis on the role of tax rate on the level of honesty. As we said, we found two thresholds ξ_1 and ξ_2. We called ξ_1 the *Inspector Monitoring Threshold (IMT)* because if the "moral costs" are less than ξ_1, the tax inspector will find it worthwhile not to carry out any checks on the entrepreneur; if the "moral costs" are greater than ξ_1, then the tax inspector will find it worthwhile to carry out checks on the entrepreneur. The threshold ξ_2 will be denoted hereafter as the *Entrepreneur Evasion Threshold (EET)* because if the j-th entrepreneur has "moral costs" greater than ξ_2, the entrepreneur will find it worthwhile to be honest, while the j-th entrepreneur with "moral costs" less than ξ_2 will find it worthwhile to evade. ξ_1 is the relevant threshold in the "Recession" case:

$$\frac{\partial \xi_1}{\partial t} = -\frac{1}{\mu}\alpha e - (1-\alpha)e < 0 \tag{9}$$

Therefore, as the tax rate increases, the economic incentive for the tax inspector to control increases as well, in that ξ_1 decreases. This greater control induces entrepreneurs to be more honest.
Viceversa, ξ_2 is the relevant threshold in the "Expansion" case:

$$\frac{\partial \xi_2}{\partial t} = \frac{(1-\mu)e(1-\alpha)}{\mu} > 0 \tag{10}$$

Therefore, as the tax rate increases, the economic incentive for the entrepreneur to evade increases as well, in that ξ_2 grows. This leads to a reduction of the entrepreneur's honesty.
Thus, the tax rate has a twofold effect. If the economy is in "Recession" case, then the monitoring activity level of inspectors is low and, therefore, an increase of the tax rate, which increases control, promotes entrepreneur's honesty. Viceversa, in the "Expansion" case, the incentive to evading and bribing increases as the tax rate grows. In fact, when the tax rate increases, then the growth of the surplus deriving from evasion compensates largely the greater control of the inspector. This opens up spaces for evasion and corruption. With regard to corruptibility level of entrepreneurs, the State, in order to reduce evasion, could increase the social stigma due to being

detected in a corrupt transaction[6]. In this case, the greater "moral costs" reduce, at aggregate level, the number of entrepreneurs corrupted, i.e. with specific "moral costs" $c_j > \xi_2$.

4 The role of incentives in fighting evasion

The presence of an incentive scheme for tax inspectors reduces the occurrence of tax evasion, as evidence suggests. A formal proof of this fact can be derived directly from the solution of the game in Proposition 3.2. Such a case is associated to the following conditions:

$$\begin{cases} 1 - p > p_1, \ c_j > \xi_2; \\ \\ 1 - p \leq p_1, \ c_j > \xi_1. \end{cases} \tag{11}$$

The measure of the interval $[\xi_2, 1]$ (case of expansion) or $[\xi_1, 1]$ (case of recession) can be viewed as a proxy of the honesty level of the society. In particular, the level of honesty of the Country grows as the measure of such an interval increases.

If $\xi_2 \geq 1$ (case of expansion) or $\xi_1 \geq 1$ (case of recession), then Proposition 3.2 assures that the equilibrium with no evasion does not occur.

The idea that supports the analysis in this section, as already stated, is that not only the introduction of a public bonus certainly make evasion less attractive for the tax inspector, but also the bonus system interacts with the corruptibility of tax inspectors. To be more precise, the bonus rate for the tax inspector makes her/him stronger in her/his negotiation with the taxpayer and, as a result, when corruption takes place, s/he receives a larger part of the pie for not reporting the evasion to the tax authorities (see Fjeldstad and Tugodden, 2003). In light of this consideration, we would like to point out the interaction between bonus share and corruptibility, endogenyzing the bargaining power of the tax inspector μ with respect to the bonus rate α. In particular, we model the hypothesis that, as the bonus rate grows the bargaining strength of the tax inspector also grows and, consequently, the bargaining power of the taxpayer decreases. This simple analysis allows us to highlight the increased effectiveness of the public system of incentives in the presence of widespread corruptibility. In order to do this, we analyze how incentives α influence the honesty level of the Country in two situations:

[6] However, it is poorly understood what exactly, on the micro-level, the determinants of corruptibility are and what institutional arrangements could be used to fight (the causes of) corruption. For an experiment see e.g. Dusek (2005): their results suggest strongly that the extent of corruption in a society is a major determinant of corruptibility. The related but preliminary results confirm this result and suggest that inequality aversion is an additional determinant.

- the parameter α does not affect the other terms of the model. This will be denoted as the *simple case*;
- the parameter α influences the bargaining strength of the inspector. In this case, we consider the interaction between the bonus rate and the bargaining strength of tax inspector: to be more precise, greater α means greater μ. This will be denoted as the *complex case*.

While the analysis in the former case is straightforward and we report it only for comparison purposes, in the latter we have a further effect of the incentive parameter on the honesty level through the bargaining parameter μ.

Simple case

The relationship between the honesty level of the society and the bonus rate α is formalized in the following result.

Proposition 4.1. *Assume that $1 - p > p_1$. There exists $\alpha_1 \in \mathbb{R}$ such that:*

- *$\alpha \leq \alpha_1$ is equivalent to $\xi_2 \geq 1$, and the equilibrium with no-evasion vanishes;*
- *$\alpha > \alpha_1$ if and only if $1 - \xi_2$ increases with respect to α.*

Assume that $1 - p \leq p_1$. There exists $\alpha_2, \alpha_3 \in \mathbb{R}$ such that:

- *$\alpha \leq \alpha_2$ is equivalent to $\xi_1 \geq 1$, and the equilibrium with no-evasion disappears;*
- *$\alpha \in (\alpha_2, \alpha_3)$ if and only if $1 - \xi_1$ increases with respect to α;*
- *$\alpha \geq \alpha_3$ equals to $\xi_1 \leq 0$, and the game ends always in the equilibrium with no-evasion.*

Complex case

In this case, the bargaining power of the tax inspector μ is assumed to be positively related to the bonus rate α. To model this behaviour, we assume the existence of a number $\tau \in (0,1)$ such that $\mu = \tau\alpha$. The thresholds ξ_1 and ξ_2 become:

$$\xi_1 = \frac{1}{\tau\alpha} \cdot \left(\frac{\omega}{1-p} - \alpha et\right) + (\alpha - 1)et; \qquad (12)$$

$$\xi_2 = \frac{et(1-\tau\alpha)(1-\alpha)}{\tau\alpha}. \qquad (13)$$

The following result summarizes how the honesty level of the society depends on the bonus rate.

Table 1: Simple case

Expansion		
	Low bonus rate	Minimum level of honesty
	High bonus rate	Increasing level of honesty
Recession		
	Low bonus rate	Minimum level of honesty
	Medium bonus rate	Increasing level of honesty
	High bonus rate	Maximum level of honesty

Table 2: Complex case

Expansion		
	Low bonus rate	Minimum level of honesty
	High bonus rate	Increasing level of honesty
Recession		
	Low bonus rate	Minimum level of honesty
	High bonus rate	Increasing level of honesty

Proposition 4.2. *Assume that* $1 - p > p_1$. *There exists* $\alpha_4 \in (0, 1)$ *such that:*

- $\alpha \leq \alpha_4$ *is equivalent to* $\xi_2 \geq 1$, *and the equilibrium with no-evasion disappears;*
- $\alpha > \alpha_5$ *if and only if* $1 - \xi_2$ *increases with respect to* α.

Assume that $1 - p \leq p_1$. *There exists* $\alpha_5 \in (0, 1)$ *such that:*

- $\alpha \geq \alpha_5$ *is equivalent to* $\xi_1 \geq 1$, *and the equilibrium with no-evasion disappears;*
- $\alpha < \alpha_5$ *if and only if* $1 - \xi_1$ *increases with respect to* α.

Tables 1 and 2 sum up the relationship between honesty level and bonus rate in simple and complex cases, respectively.

Comparison between the cases

A comparison between the simple case and the complex one is now needed. We start from the evidence, already stressed above, that the measure of honesty level is given by $1-\xi_2$ (case of expansion) or $1-\xi_1$ (case of recession).

Propositions 4.1 and 4.2 assure that the honesty level grows as the entity of the bonus rate increases, in the whole set of cases and in recession as well as in expansion. We here want to discuss how such a growth takes place, i.e. we want to emphasize the effectiveness of the instrument of public incentives when we are in the presence of corruptible inspectors. More specifically, we perform a comparison between the rates of growth in the simple and complex cases.
The following result summarizes our findings.

Proposition 4.3. *Assume that* $1-p>p_1$. *Define:*

$$f_S(\alpha)=\frac{\partial}{\partial\alpha}(1-\xi_2), \qquad \xi_2 \text{ as in } (24);$$

$$f_C(\alpha)=\frac{\partial}{\partial\alpha}(1-\xi_2), \qquad \xi_2 \text{ as in } (13).$$

We have: $f_C(\alpha)-f_S(\alpha)>0$ *if and only if* $\mu>\tau\alpha^2$.
Now, assume $1-p\leq p_1$. *Define:*

$$g_S(\alpha)=\frac{\partial}{\partial\alpha}(1-\xi_1), \qquad \xi_1 \text{ as in } (19);$$

$$g_C(\alpha)=\frac{\partial}{\partial\alpha}(1-\xi_1), \qquad \xi_1 \text{ as in } (12).$$

We have: $g_C(\alpha)-g_S(\alpha)>0$ *if and only if* $\mu>\tau\alpha^2\cdot\frac{1-p}{p_1}$.

It is worth noting that $\mu=\tau\alpha$ implies that the conditions on μ in the first and in the second part of the enunciation are trivially true. Indeed:

- $\mu=\tau\alpha>\tau\alpha^2$, being $\alpha\in(0,1)$;
- $\mu=\tau\alpha>\tau\alpha^2\cdot\frac{1-p}{p_1}$, being $\alpha\in(0,1)$ and $1-p\leq p_1$.

Hence, the rate of growth of the honesty level with respect to the bonus rate α is higher in the complex case than in the simple one, in both cases of recession or expansion and for each level of $\alpha\in(0,1)$. This result was rather expected: indeed, as already discussed above, the action of the parameter α on the honesty level is stronger in the complex case than in the simple one. In fact, when considering not only the effect of the two incentive schemes (private and public) individually, but also their interaction, we obtain the result that an environment in which inspectors are highly corruptible, the introduction or strengthening of an incentive system is more effective.

5 Conclusions

This work develops a theoretical model for analyzing the role of incentive schemes where there is fiscal corruption, i.e. in a world where tax inspectors are open to bribery. We consider that two types of incentives for the reduction of evasion can exist: a legal, public incentive scheme which implies that the tax inspector takes a share of any discovered evaded taxes; an illegal private incentive represented by a bribe which the tax inspector can ask from the entrepreneur caught evading. We analyze not only the effects which these two incentives can have on evasion, but also the effect which derives from the interaction between these two different incentives.

In details, we develop a bayesian game played by the State, entrepreneurs and tax inspectors and we explore interaction between fiscal evasion and corruption. The possibility of negotiating bribes with tax evaders (corruption) pushes the inspectors to carry out more checks. If this is anticipated by the taxpayers, the potential corruption makes tax evasion less attractive because it increases the likelihood of detection. In this way, greater corruptibility of tax inspectors could lead to less evasion and higher tax revenues. Furthermore, we analyze the role of a public incentive scheme, considering that the tax inspector's bargaining strength is endogenous with respect to an incentive mechanism: indeed the knowledge that even if the entrepreneur does not agree to pay the bribe, the tax inspector can report tax evasion and be partly rewarded for this, increases the tax inspector's bargaining strength. We take into account that entrepreneurs have different degrees of corruptibility: in fact we assume that the entrepreneurs incur different "moral costs" when they are reported for evasion. More precisely, the j-th entrepreneur suffers a moral damage of value c_j due to the objective punishment when the evasion is detected, and this assumption can modify the implications of a bonus system. Our model provides guidance on the relationship between the integrity of a country, the bonus rate for tax inspectors and evasion. To be more precise, we demonstrate that, in countries with high inner honesty there is no evasion, regardless of incentive schemes. In countries with inner honesty in the middle range, in expansion, there is evasion and corruption is not detected. Conversely, in countries with low inner honesty, we must distinguish between favorable or unfavorable economic situations. Indeed, in an economy in recession, there is only undetected evasion because, in this case, it is very plausible that the low income reported by the entrepreneurs is grounded on a negative economic situation rather than evasion. Then the tax inspectors, with low incentives (and bargaining power), will not make checks and thus, the entrepreneurs will find it worthwhile to evade. In contrast, in an economy in expansion, the inspector does not have necessary incentives to check the entrepreneur.

Regarding the interaction between the tax inspector's corruptibility and public incentive schemes, we show that the presence of widespread corruptibility reinforces the effectiveness of government incentives. In fact, the presence of a system of bonus shares for the inspectors strengthens their position in negotiating the bribe, making corruption, and therefore tax evasion, less attractive. This simple model, therefore, offers an easy policy: the instrument of incentives paid to the inspectors is more effective and therefore, more desirable in the fight against tax evasion in a highly corrupt environment.

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Appendix

Proof of Proposition 3.1

Let $\underline{\phi}_\Delta = \phi_\Delta^{(E)}, \phi_\Delta^{(I)}$ be the vector of the differences in the payoffs between the case of agreement and disagreement regarding the bribe between the entrepreneur and the tax inspector. In accordance with generalized Nash bargaining theory, the division between two agents will solve:

$$\max_{b \in \mathbf{R}^+} [\phi_\Delta^{(E)}]^\beta \cdot [\phi_\Delta^{(I)}]^\epsilon \tag{14}$$

in formula

$$\max_{b \in \mathbf{R}^+} [et - b + c_j]^\beta \, [b - \alpha et]^\epsilon \tag{15}$$

which is the maximum of the product between the elements of $\underline{\phi}_\Delta$. The parameters β and ϵ can be interpreted as measures of bargaining strength of the entrepreneur and tax inspector, respectively.
The first order condition gives:

$$[et - b + c_j]^{\beta-1} \, [b - \alpha et]^{\epsilon-1} \, \{\beta \, [b - \alpha et] + \epsilon \, [et - b + c_j]\} = 0,$$

which leads to an asymmetric (or generalized) Nash bargaining solution, which is the unique equilibrium bribe b^{NB} in the last subgame:

$$b^{NB} = \alpha et + \mu[c_j + et(1 - \alpha)]. \tag{16}$$

The parameter $\mu = \frac{\epsilon}{\epsilon+\beta}$ reflects the distribution of bargaining strength between the two agents.

Proof of Proposition 3.2

The static game is solved using backward induction, which enables the equilibria to be obtained.

(5) At stage five, the entrepreneur negotiates the bribe if, and only if,

$$\Delta_A^E = \pi_7^E - \pi_6^E > 0,$$

that is: if the entrepreneur negotiates the bribe her/his payoff is greater than her/his payoff if s/he refuses. Such a condition is equivalent to

$$c_j > et(\alpha - 1),$$

that is always satisfied. Hence, s/he will find it worthwhile to negotiate the bribe.

(4) Ascending the decision-making tree, at stage four the tax inspector decides whether or not to ask for a bribe. The tax inspector knows that if s/he asks for a bribe then the entrepreneur will start a negotiation and the final bribe will be b^{NB}. Then, at stage four the tax inspector asks for a bribe if and only if the tax inspector's payoff on asking for a bribe is greater than the payoff if s/he doesn't, i.e. if

$$\Delta_B^I = \pi_7^I - \pi_5^I > 0.$$

Such a condition is equivalent to

$$c_j > (\alpha - 1)et,$$

that is always true. Hence, the tax inspector will ask for a bribe.

(3) At stage three, the tax inspector must decide whether to inspect the entrepreneur or not: the tax inspector checks the entrepreneur's behavior if and only if the tax inspector's expected payoff on checking the evader is greater than her/his expected payoff if s/he doesn't. Denote as $\pi_C^{(I)}$ and $\pi_{NC}^{(I)}$ the random variables associated to the payoff of the tax inspector when checking or not checking the entrepreneur, respectively. We introduce the expected value operator as $\mathbf{E}$. We need to analyze

$$\Delta_C^{(I)} = \mathbf{E}[\pi_C^{(I)}] - \mathbf{E}[\pi_{NC}^{(I)}].$$

We have

$$\mathbf{E}[\pi_{NC}^{(I)}] = p\lambda + \lambda(1-p) = \lambda. \tag{17}$$

When checking, the tax inspector will ask for a bribe and such a bribe will be negotiated by the entrepreneur. Therefore, the expected payoff of the tax inspector when checking is:

$$\mathbf{E}[\pi_C^{(I)}] = p(\lambda - \omega) + (1-p)\{\lambda - \omega + \alpha et + \mu[c_j + et(1-\alpha)]\}. \tag{18}$$

Therefore

$$\Delta_C^{(I)} = -\omega + (1-p)\{\alpha et + \mu[c_j + et(1-\alpha)]\} > 0$$

if and only if

$$c_j > \xi_1 = \frac{1}{\mu} \cdot \left(\frac{\omega}{1-p} - \alpha et \right) + (\alpha - 1)et, \tag{19}$$

so that:

(3.1) if $c_j > \xi_1$, the tax inspector checks the entrepreneur's production;

(3.2) if $c_j \leq \xi_1$, the tax inspector does not check the entrepreneur's production.

(2) At stage two the entrepreneur must decide whether to underreport her/his income. The case with production $y - e$ is trivial. If the income is y, the decision is driven by the payoffs. Denote as $\pi_R^{(E)}$ and $\pi_{NR}^{(E)}$ the payoff of the entrepreneur when reporting y or $y - e$, respectively. In this case, the entrepreneur reports her/his income if and only if

$$\Delta_R^{(E)} = \pi_R^{(E)} - \pi_{NR}^{(E)} > 0.$$

We can write

$$\pi_R^{(E)} = (1 - t)y. \tag{20}$$

The payoff of the entrepreneur when underreporting depends on the value of c_j.

(2.1) If $c_j \leq \xi_1$, then the tax inspector does not check the entrepreneur's production. In this case:

$$\pi_{NR}^{(E)} = y - t(y - e), \tag{21}$$

and we have

$$\Delta_R^{(E)} = -et < 0.$$

The game ends with random payoff

$$\begin{cases} \underline{\pi}_3 & \text{with probability } 1 - p, \\ \underline{\pi}_2 & \text{with probability } p. \end{cases} \tag{22}$$

(2.2) If $c_j > \xi_1$, then the tax inspector finds it worthwhile to check the entrepreneur. Moreover, in this case the bribe b^{NB} is required by the tax inspector and accepted by the entrepreneur.

$$\pi_{NR}^{(E)} = y - (y - e)t - \alpha et - \mu(c_j + et(1 - \alpha)). \tag{23}$$

Thus we have

$$\Delta_R^{(E)} = \mu c_j - et(1 - \alpha)(1 - \mu) > 0$$

if and only if

$$c_j > \xi_2 = \frac{et(1 - \mu)(1 - \alpha)}{\mu}. \tag{24}$$

Some cases can be distinguished.

(2.2.1) If $c_j > \xi_2$, and the entrepreneur decides to report y. The game ends with random payoff

$$\begin{cases} \underline{\pi}_1 & \text{with probability } 1 - p, \\ \underline{\pi}_4 & \text{with probability } p. \end{cases} \tag{25}$$

(2.2.2) If $c_j \leq \xi_2$, then the entrepreneur decides to report $y-e$. The game ends with random payoff

$$\begin{cases} \underline{\pi}_7 & \text{with probability } 1-p, \\ \underline{\pi}_4 & \text{with probability } p. \end{cases} \tag{26}$$

To complete the proof, define

$$p_1 = \frac{\omega}{et}.$$

Some straightforward computations give:

$$\begin{cases} 1-p > p_1 & \Rightarrow \; \xi_2 > \xi_1; \\ 1-p < p_1 & \Rightarrow \; \xi_2 < \xi_1. \end{cases} \tag{27}$$

Proof of Proposition 4.1

The proof is trivial. The critical values of α are:

$$\alpha_1 = 1 - \frac{\mu}{(1-\mu)et}, \;\; \alpha_2 = \frac{\frac{\omega}{1-p} - \mu(1+et)}{(1-\mu)et}, \;\; \alpha_3 = \frac{\frac{\omega}{1-p} - \mu et}{(1-\mu)et}.$$

Proof of Proposition 4.2

Some tedious and straightforward algebraic manipulations give that:

- if $1-p > p_1$, then $\xi_2 \in (0,1)$ if and only if

  $$\alpha > \alpha_4 = \frac{et(1+\tau) + \tau - \sqrt{[et(1+\tau)+\tau]^2 - 4(et)^2\tau}}{2et\tau},$$

  where $\alpha_4 \in (0,1)$;

- if $1-p \leq p_1$, then $\xi_1 \in (0,1)$ if and only if

  $$\alpha < \alpha_5 = \frac{et(1+\tau) + \tau - \sqrt{[et(1+\tau)+\tau]^2 - \frac{4et\tau\omega}{1-p}}}{2et\tau},$$

  where $\alpha_5 \in (0,1)$.

Tho complete the proof, it is sufficient to observe that

$$\frac{\partial(1-\xi_2)}{\partial\alpha} = \frac{et(1-\tau\alpha^2)}{\tau\alpha^2} > 0, \qquad \forall\, \alpha \in (\alpha_4, 1]$$

and

$$\frac{\partial(1-\xi_1)}{\partial\alpha} = \frac{\frac{\omega}{1-p} - et\tau\alpha^2}{\tau\alpha^2} > 0, \qquad \forall\, \alpha \in [0, \alpha_5).$$

Proof of Proposition 4.3

The result states immediately, by observing that

$$f_S(\alpha) = \frac{et(1-\mu)}{\mu}; \;\; f_C(\alpha) = \frac{et(1-\tau\alpha^2)}{\tau\alpha^2}$$

and

$$g_S(\alpha) = \frac{et(1-\mu)}{\mu}; \;\; g_C(\alpha) = \frac{\frac{\omega}{1-p} - et\tau\alpha^2}{\tau\alpha^2}.$$