Imperfect Detection of Tax Evasion in a Corrupt Tax Administration

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This article models the imperfect detection of tax evasion motivated by the existence of a corrupt tax administration. Consistent with previous literature, fines and audit probabilities both have a positive effect on compliance. Moreover, the model shows that they have a negative effect on the bribes paid to corrupt tax officials. More corruption decreases compliance levels, giving honest auditors incentives to work harder to detect evasion. Giving inspectors a share of the detected evasion (tax farming) makes auditors work harder; however, increasing their wages reduces their exerted effort to discover evasion. Higher compliance can as well be achieved by hiring more efficient inspectors.

Keywords: Taxation, evasion, corruption

1 Introduction

Tax evasion is an important problem at the moment of collecting taxes. For the U.S., the Internal Revenue Service estimates that 17% of the income tax liability is not paid (Slemrod and Yitzhaki, 2002). To deter taxpayers from evading taxes, the tax administration runs occasional audits with penalties often assessed if the taxpayer is discovered evading taxes. Empirical evidence presented in Feinstein (1991) shows that audits are imperfect, with the average examiner's detection rate being approximately 50%. However, a standard assumption in the tax evasion literature is that all tax evasion is detected once the taxpayer is audited (e.g., Allingham and Sandmo, 1972; Chander and Wilde, 1992). Lee (2001) considers imperfect detection by modeling the possibility that taxpayers exert a costly effort to self-insure and reduce the risk involved when evading taxes. In Lee's model the amount of evasion found in the auditing process will depend on the taxpayer's self-insurance.

The present paper follows a similar argument as in Lee (2001), but imperfect detection of evasion arises because the auditors are the ones who exert a costly effort to discover evasion. A corrupt tax administration is introduced to model this imperfect tax evasion detection and to analyze the effect of different auditors' remuneration alternatives on tax evasion. Because potential bribes obtained through audits are modeled as a function of the

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amount of evasion found, corruption presents an incentive for auditors to work harder towards discovering evasion. Consistent with previous literature, the model finds that fines and audit probabilities both have a positive effect on compliance levels. Moreover, giving the tax inspectors a share of the evasion found will increase compliance levels, while increasing their lump-sum income (wage) will reduce it. Lower evasion levels can as well be achieved by decreasing the inspectors' costs of finding evasion or by reducing corruption.

Modeling tax evasion with corrupt tax officials is an important area of research. Tanzi and Davoodi (2001) explain that economies characterized by a great extent of corruption are argued to be plagued by substantial tax evasion activities as well. Chu (1990) mentions that in a survey undertaken by the city government of Taipei in 1981, 94% of the taxpayers polled reported being 'led to' paying bribes to a corrupt tax administrator. Cited in Sanyal, Gang and Goswami (2000), The Police Group (1985) suggests that at least 76% of all Indian tax auditors are corrupt.

There is a growing literature that considers the joint roles of tax evasion and corruption. Chu (1990) finds that the fine and the audit probability can encourage taxpayers to intensify their bribing activities. Chander and Wilde (1992) find that in the presence of corruption, audit probabilities are generally higher, and that higher fines and higher tax rates can reduce expected government revenues. In a related paper, Hindriks, Keen and Muthoo (1999) show that the impact of evasion and corruption can be regressive, and that inducing honesty in the collection of progressive taxes can be costly. A Laffer like behavior of overall tax revenue may arise in the model of Sanyal, Gang and Goswami (2000), while more recently, Bilotkach (2006) considers a tax evasion and bribery game, and Goerke (2008) looks as how tax evasion affects corruption at the tax payer (firm) level.[3]

Two closely related papers are Wane (2000) and Vasina (2003). As in both of these articles, we consider two different remuneration alternatives for the tax officials: A share of the detected evasion (tax farming), and a wage. Wane's tax evader chooses unilaterally the amount to evade, and his model allows for moral hazard and adverse selection.[4] In the current paper the amount of evasion comes from a Nash Equlibrium, and there is moral hazard, but there is no adverse selection. Our model is similar to Vasina (2003) because in his model tax evasion also depends on the inspector's efforts. However, Vasina only considers two levels for the income and two levels for the effort. Therefore, if low effort is exerted, zero evasion is found, and if high effort is exerted, all evasion is found. This means that in Vasina there is no imperfect detection of tax evasion. In my model there is imperfect detection of tax evasion in the sense that the amount of evasion discovered is a continuous function of the level of effort exerted by the tax officials. Unlike these two studies, in this paper we allow for a continuum in both, income and effort.

[3] For a survey of the literature on tax evasion, see Andreoni, Erard and Feinstein (1998) and Slemrod and Yitzhaki (2002). For a survey on corruption, see Jain (2001).

[4] There exists the problem of moral hazard because the exerted effort cannot be observed. There exists the problem of adverse selection because not all potential tax inspectors can be identified as being honest or dishonest.

The rest of the paper is structured as follows. Section 2 explains the behavior of the taxpayer, the honest and corrupt tax auditors, and the interaction among agents. Section 3 presents the baseline parameters and functional forms for the simulation. A sensitivity analysis to policy parameters and the results are presented in Section 4. Section 5 concludes.

2 The Model

The model considers the interaction between two agents. A rational taxpayer that decides how much of her income to report to the tax authority, and a tax official that can be of two different types: corrupt or honest. The taxpayer is confronted with a problem of choice under risk. She knows her income, the tax legislation, the penalties from evading taxes, the probability of being caught evading taxes, and the probability of having a corrupt tax auditor auditing her tax liabilities. The tax auditor shares the same information, but ignores the taxpayer's true level of income.

2.1 The Taxpayer

The taxpayer has a fixed gross income Y, and she has to pay a proportional income tax t on declared income D. There is a fixed probability p of being audited by the tax administration. If caught evading taxes, she has to pay a fine s over the unpaid tax liability discovered by the auditor. If all evasion is found by the auditor, the fine is given by $st(Y\text{-}D)$. Notice that we need $s \geq 1$ for the taxpayer to pay at least the evaded amount $t(Y\text{-}D)$. A standard assumption in the existing tax evasion literature is that when the taxpayer is subject to investigation, the auditor gets to find the true amount of the taxpayer's income Y.[5] However, Feinstein (1991) showed that approximately only one-half of evasion is found when tax reports are inspected. In this paper we allow for the amount of tax evasion found $(Y\text{-}D)$ to be a function of the effort exerted by the tax officials. Let $\varphi(Y,D,a_i)$ be the level of income reveled in the auditing process when auditor i engages effort $0 \leq a_i \leq 1$ for $i = c$ for the corrupt, and $i = h$ for the honest auditor. The model does not necessarily imply that the auditors do not know the true level of income. A more accurate interpretation of the φ function would be that the auditors know the true level of income, but they must exert some effort to legally justify the true level of income given the amount of income the taxpayer has reported.

Once the taxpayer is selected to be audited, there exists a fixed probability k that the auditor is corrupt. k can be interpreted as the level of corruption in the tax administration, with k = 0 when there is no corruption and k = 1 when all tax officials are engaged in corrupt activities. When audited by a corrupt official, the taxpayer is able to escape from paying the fine if she pays a lower and also monetary bribe. The bribe rate b is the proportion of the fine that the taxpayer pays the corrupt official in order to escape from paying the full amount of the fine. It is assumed that if the taxpayer decides to under-report her true level of income, she will also be willing to deal with the corrupt tax officials. The total amount of the bribe is $bst(\varphi(Y,D, a_c)\text{-}D)$ with $0 \leq b \leq 1$. The rational taxpayer's behavior conforms the Von

[5] Lee (2001) presents a model where the amount of evasion found depends on the taxpayer's self-insurance.

Neumann-Morgenstern axioms of behavior under uncertainty. She maximizes her expected utility given by:

$$
\begin{aligned}
E[U] &= (1-p)U\left[Y - tD\right] \\
&\quad + p\left\{kU\left[Y - tD - bst\left(\phi(Y,D,a_c) - D\right)\right] + (1-k)U\left[Y - tD - st\left(\phi(Y,D,a_h) - D\right)\right]\right\}
\end{aligned} \tag{1}
$$

For notational convenience define

$$W = Y - tD \tag{2}$$

$$X = Y - tD - bst\left(\phi(Y,D,a_c) - D\right) \tag{3}$$

$$Z = Y - tD - st\left(\phi(Y,D,a_h) - D\right) \tag{4}$$

where W is the level of disposable income resulting when the individual is not audited, X is the level of income resulting when the individual is audited and bribes a corrupt tax auditor, and Z is the level of income when she faces an honest auditor. If both types of auditors exert the same level of effort, we have that the taxpayer will always be better-off if investigated by a corrupt tax auditor $(W > X > Z)$. However, this may not always be the case since different types may have different incentives to work harder towards discovering evasion.

The level of income revealed in the auditing process, φ, has the following properties:

$$\phi(Y,D,0) = D \tag{5}$$

$$\phi(Y,D,1) = Y \tag{6}$$

$$\partial\phi(Y,D,a_i)/\partial a_i > 0 \qquad \text{for} \qquad i = c,h \tag{7}$$

$$\partial^2\phi(Y,D,a_i)/\partial a_i^2 \leq 0 \qquad \text{for} \qquad i = c,h \tag{8}$$

Equation 5 implies that when the auditor makes no effort $(a_i = 0$ for $i = c, h)$ he finds no evasion and the income level revealed is just the one declared by the taxpayer. Equation 6 means that when maximum effort is engaged $(a_i = 1$ for $i = c, h)$ the auditor gets to know the true amount of the taxpayer's income Y. Equation 7 indicates that higher levels of effort will encounter more evasion and equation 8 suggests decreasing marginal productivity of effort. For notational convenience we will just write $\varphi(a_i)$, but we should keep in mind that the φ function depends on Y and D as well.

The first and second-order conditions for the taxpayer are respectively given by:

$$G \equiv \frac{\partial E[U]}{\partial D} = (-t)\left\{ \begin{aligned} &(1-p)U'(W) + pkU'(X)\left[1 + bs\frac{\partial \phi(a_c)}{\partial D} - bs\right] \\ &+ p(1-k)U'(Z)\left[1 + s\frac{\partial \phi(a_h)}{\partial D} - s\right] \end{aligned} \right\} = 0 \tag{9}$$

$$\begin{aligned} J \equiv \frac{\partial^2 E[U]}{\partial D^2} = t^2 &\left\{ \begin{aligned} &(1-p)U''(W) + pkU''(X)\left[1 + bs\frac{\partial \phi(a_c)}{\partial D} - bs\right]^2 \\ &+ p(1-k)U''(Z)\left[1 + s\frac{\partial \phi(a_h)}{\partial D} - s\right]^2 \end{aligned} \right\} \\ &- tps\left\{ kbU'(X)\frac{\partial^2 \phi(a_c)}{\partial D^2} + (1-k)U'(Z)\frac{\partial^2 \phi(a_h)}{\partial D^2} \right\} < 0 \end{aligned} \tag{10}$$

Assuming concavity of the utility function, the second-order condition is unambiguously negative when the second derivative of $\varphi(a_i)$ with respect to D is greater or equal to zero.

2.2 The Tax Auditors

The model is characterized by the existence of two types of tax auditors. The first is an honest auditor who chooses how much effort a_h to engage in finding evasion. The second is a corrupt auditor that chooses how much effort a_c to engage in finding evasion and a bribe rate b to charge the tax evader once evasion is found. The utility functions that they maximize are respectively given by:

$$V_h = U_h\{stg[\phi(a_h) - D(b, a_c, a_h)] + M\} - a_h\omega \tag{11}$$

$$V_c = U_c\{stb[\phi(a_c) - D(b, a_c, a_h)] + M\} - a_c\omega \tag{12}$$

where $U'_i(.) > 0$ for $i = c,h$. M is the amount of income independent from the corruption activity or the auditing process. $0 < \omega < \infty$ is the constant marginal cost of effort in terms of marginal utility of income and $0 \leq g \leq 1$ is an exogenous share that the honest auditor receives from the auditing process. Notice that the taxpayer's declaration D is a function of the auditors' decision variables, so the optimal value of the parameters will depend on the interaction between the agents. The first-order conditions for the auditors are:

$$H_{h,a} \equiv \frac{\partial V_h}{\partial a_h} = U'_h(N_h)sth\left[\frac{\partial \phi(a_h)}{\partial D}\frac{\partial D}{\partial a_h} + \frac{\partial \phi(a_h)}{\partial a_h} - \frac{\partial D}{\partial a_h}\right] - \omega = 0 \tag{13}$$

$$H_{c,a} \equiv \frac{\partial V_c}{\partial a_c} = U'_c(N_c)stb\left[\frac{\partial \phi(a_c)}{\partial D}\frac{\partial D}{\partial a_c} + \frac{\partial \phi(a_c)}{\partial a_c} - \frac{\partial D}{\partial a_c}\right] - \omega = 0 \tag{14}$$

$$H_{c,b} \equiv \frac{\partial V_c}{\partial b} = U'_c(N_c)st\left\{\phi(a_c) - D + b\left[\frac{\partial \phi(a_c)}{\partial D}\frac{\partial D}{\partial b} - \frac{\partial D}{\partial b}\right]\right\} = 0 \qquad (15)$$

where the partial derivatives of D with respect to b, a_h and a_c are given in the appendix, and

$$N_h = stg\left[\phi(a_h) - D(b, a_c, a_h)\right] + M \qquad (16)$$

$$N_c = stb\left[\phi(a_c) - D(b, a_c, a_h)\right] + M \qquad (17)$$

If the taxpayer is audited by the corrupt tax official, the model assumes that the tax official charges an amount equal to $sbt(\varphi(a_c)\text{-}D(b,a_c,a_h))$ and tells the tax administration that no evasion was found.

An interesting extension to this model would be to follow Wane (2000) and Acconcia, D'Amato and Martina (2003) and include monitoring of the tax auditor behavior. Wane considers the possibility of an *additional* audit that monitors the auditor's behavior. This audit finds whether corruption occurred or not, and reveals the true level of income. Acconcia, D'Amato and Martina (2003) consider a game between tax auditors and corruption monitorers (who are assumed to be incorruptible). While this would make the model more realistic, it needs to be implemented with additional assumptions, namely, that the second audit costlessly reveals the true level of income. This means that at some point there has to be technology that is not corruptible.

2.3 The Equilibrium

The Bayesian Nash Equilibrium values of the endogenous variables, D, b, a_h and a_c, for a simultaneous-move game under a common rationality setting is obtained by solving the system of non-linear equations 9, 13, 14, and 15. We will focus on this Nash Equilibrium throughout the paper. This is the same Equlibrium as if we allow the tax officials to move first. However, notice that if the taxpayer moves first and the tax auditor decides the bribe rate b once evasion is found, there will be a second Bayesian Nash Equilibrium if the auditor charges a bribe rate b = 1. This equilibrium is not credible because it relies on the myopic behavior of the taxpayer. With a non-myopic taxpayer, she will forecast this b = 1 behavior and will report her tax liabilities as if there were no corruption, even when $k \neq 0$ because she does not get any benefit from being audited by a corrupt official. In this case corruption plays no role on compliance levels. The only difference is that when audited by an honest official, the fine goes to the tax administration, while when audited by a corrupt official, the bribe (equal to the fine) goes to the corrupt inspector.

3 Calibration and Benchmark Parameters

Because of the complexity of the first-order conditions, we will use simulations to obtain an interpretation and to analyze the predictions of the model. In this section we explain how the model will be calibrated to an economy with income tax that has relatively large corruption and tax evasion levels. To make the problem more tractable for the interpretation of the compliance levels, we define the Compliance Coefficient as $C.C.$= (Declared Income)/(Total Income) = D/Y. Notice that 1 - $C.C.$ is the tax evasion rate. Moreover, notice that given that the auditors and the tax payer are representative agents, the payoff for the revenue service will be proportional to the Compliance Coefficient. That is, given that the goal of the revenue service is to collect taxes, not collect fines or minimize the salaries of the employees.

3.1 Agents' Utility and Revealed Level of Income

To model the agents' preferences we assume that the utility function for both agents, taxpayer and auditors, is given by the Constant Relative Risk Aversion (CRRA) utility $U(Y)=(Y^{1-\beta})/(1-\beta)$. This utility function was also used in tax evasion models in Bernasconi (1998) and Esteller-Moré (2003). The taxpayer has a constant relative risk aversion given by β. Moreover, the individual is risk averse as long as $\beta > 0$, and higher values of β imply higher individual's risk aversion. A reasonable parameter for β is 1.8, which was used in tax evasion models in Bernasconi (1998) and Esteller-Moré (2003). This value was estimated by Karni and Schmeider (1990) and Epstein (1992). The only difference between the taxpayer's utility function and the auditors' utility function is that the auditors have an additional cost of effort $a_i\omega$ for $i = c,h$ that directly reduces utility levels, as equations 11 and 12 show.

In addition to the agents' utilities, we need the technology to determine how much income is revealed during the auditing process. This is given by the φ function described in section 2.1, which models the amount of evasion found as a function of the true level of income, the declared income, and the level of effort exerted by the tax auditor. Equations 5 through 8 show the desirable properties for the φ function. Given these properties, the functional form that we will use in the simulations is:

$$\phi(Y,D,a_i) = D + \left(\frac{Y-D}{1-\lambda/2}\right)\cdot a_i - \frac{\lambda}{2}\left(\frac{Y-D}{1-\lambda/2}\right)\cdot a_i^2 \qquad \text{for} \quad i = c,h \tag{18}$$

where $0 \leq \lambda \leq 1$ is a measure of the concavity of the φ function. When $\lambda = 0$, we have constant productivity of effort. In addition to complying with properties 5 through 8, this φ function guarantees that the second-order condition in equation 10 is unambiguously negative, as required.

3.2 Audit Probability, Tax Rate, Fines, and Corruption Levels

One common problem faced by models based on Allingham and Sandmo (1972) is that they require an excess risk aversion to explain the observed compliance levels. Bernasconi (1998) argues that the empirical evidence can be explained by the distinction of orders of risk aversion. He explains that individuals do not have a clear idea of the audit probabilities and they overestimate small probabilities and underestimate large probabilities. To model this behavior he proposes using Expected Utility with Rank Dependent Probabilities (EURDP) in tax evasion problems based on Allingham and Sandmo (1972). We adopt the same EURDP and use the transformation proposed in Bernasconi (1998) to work with a perceived audit probability.[6] This means that if the actual audit probability is 0.705%, the perceived audit probability is 10%. We will use a perceived audit probability of p = 10% for the simulations.

For the tax rate we use t = 25%, and for the fine, s = 2, which implies a 100% fine over unpaid tax liabilities. Finally, for the corruption levels, Chu (1990) mentions that in a survey undertaken by the city government of Taipei in 1981, 94% of the taxpayers polled reported being 'led to' paying bribes to a corrupt tax administrator. Cited in Sanyal, Gang and Goswami (2000), The Police Group (1985) suggests that at least 76% of all Indian tax auditors are corrupt. These evidence points that the probability of encountering a corrupt tax official can be high. We use a value of s = 0.4.

3.3 Benchmark Equilibrium

To get the benchmark Bayesian Nash Equilibrium of the model we have to solve the system of four non-linear equations 9, 13, 14, and 15. This will give us the equilibrium income, D^e, the bribe rate, b^e, and the level of effort exerted by the honest auditor, a_h^e, and by the corrupt auditor, a_c^e. A summary of the parameters values used in the calibration along with the benchmark equilibrium is presented in Table 1. In the benchmark equilibrium, the declared income is 80.98, which implies a Compliance Coefficient of 0.81 and a tax evasion rate of 19.02%. The equilibrium bribe rate b^e is 7.88% which means that for every dollar of fine, the corrupt auditor keeps 7.88 cents. The benefit for the tax evader from encountering a corrupt tax official is 92.12 cents for every dollar of fine. The calculated effort levels are a_c^e = 0.88 and a_h^e = 0.79 for the corrupt and the honest auditors, respectively.[7] This means that the corrupt auditor works harder towards finding evasion because of the additional benefits from keeping a share of the evasion fine for himself.

[6] *EURDP* considers the possibility that indifference curves be kinked at the certainty point implying that reporting the true level of income can be optimal. The weighting function used in Bernasconi (1998) and obtained by Camerer and Ho (1994) is $f(p)=1-(1-p)^{\gamma}/[p^{\gamma}+(1-p)^{\gamma}]^{1/\gamma}$, where γ = 0.56.

[7] The Gauss code used to solve the model is available from the author upon request. The code uses the library *NLSYS Version 3.1.2*. The algorithm used is line search and the jacobian is calculated using forward difference.

Table 1: Calibration values and benchmark equilibrium

Parameter	Value	Description
Calibration values		
p	10%	Audit probability
Y	100	Income
β	1.8	Relative risk aversion
M	30	Auditor's income
t	25%	Tax rate
s	3	Fine
k	0.4	Corruption
λ	1	Concavity of φ
g	0.1	Share of evasion to auditors
ω	0.012	Marginal cost of effort
Benchmark equilibrium		
$C.C.^e$	80.98%	Compliance Coefficient
b^e	7.88%	Bribe rate
a_c^e	0.88	Effort exerted by corrupt auditor
a_h^e	0.79	Effort exerted by honest auditor

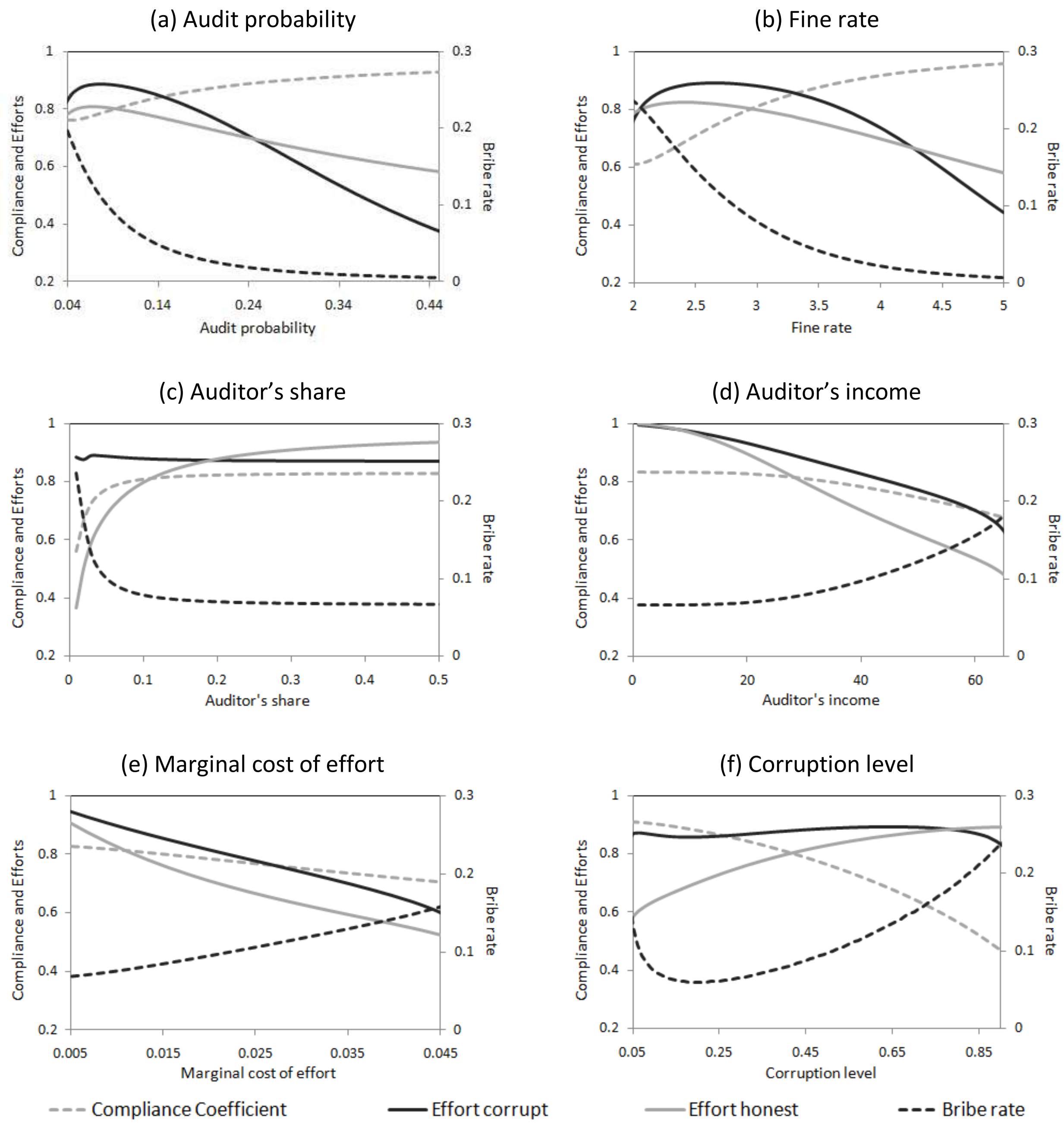
4 Sensitivity to Policy Parameters

The most common policy parameters to deter tax evasion are the audit probability and the fine. In this model the tax administration has five policy parameters under its control. Besides the two traditional audit probability and fine rate, the tax administration can modify the share g of the evasion fine given to the auditors, the auditors' level of income M and to some extent, the marginal cost of effort ω. In this section we analyze the effect of a change in each of these parameters and the corruption levels k on the four endogenous variables of the model. The results are shown in the six panels of Figure 1.

4.1 Audit Probability and the Fine Rate

Panel (a) in Figure 1 shows the equilibrium Compliance Coefficient, $C.C.$, the bribe rate, b, and the exerted efforts by the honest auditor a_h and the corrupt auditor a_c for different audit probabilities. As in Allingham and Sandmo (1972), increasing the number of tax inspections increases compliance levels. Starting at p = 10%, increasing the audit probability has a negative impact on the levels of effort exerted by both types of auditors. Moreover, the bribe for the corrupt official also decreases. For low audit probabilities, evasion levels will be large, meaning that the benefit from finding evasion is also large. In this case corrupt tax official will work harder towards discovering evasion. However, for larger audit probabilities evasion levels will be lower, decreasing the incentives for finding evasion. Hence, for sufficiently large audit probabilities, honest official work harder than corrupt officials. As compliance level increases due to higher audit probabilities, both types of auditors will work less because finding evasion is not as profitable as before.

Figure 1. Reponses to policy parameters.



The effect of the fine rate s on the endogenous variables is shown in Panel (b), Figure 1. Higher fine rates increase compliance levels. Consistent with Allingham and Sandmo (1972), the audit probability and the fine rate are found to be substitute policy parameters, indicating that by increasing any of these two, we can obtain lower evasion levels. As in the previous case, for low values of s the corrupt auditors work harder, while honest auditors work harder for higher values of the fine.

4.2 Auditor's Share, Income, and Marginal Cost of Effort

Figure 1, Panel (c) shows the equilibrium of the endogenous variables as the auditor's share of evasion fine changes. As we would expected, higher shares g make the honest auditor work harder. The effort exerted by the corrupt tax auditor raises for relatively low values of g, but it is unresponsive to changes in g for relatively higher values of the auditor's share. Relatively small shares appear to be enough to make auditors engage in high effort levels. Moreover, this also appears to determine the shape of the compliance coefficient schedule; increasing the share when it's already high has a negligible effect on the levels of effort exerted by the auditors and on the compliance levels. When $g = 0$, the only source of income for the honest auditors is M; hence, they will not have any incentives to find evasion and will exert zero effort. Therefore, as g approaches zero, the honest auditors decrease their effort to work, the bribe rate approaches to one, and only corrupt auditors will be discovering evasion and keeping compliance levels above zero. In cases where the tax administration does not offer incentives towards discovering evasion in the form of g, the findings in the model will still hold if we motivate the existence of a non-monetary compensation that replaces the role of g. Honest auditors may be self motivated, or there may exist some peer pressure to work.

The schedules of the model's endogenous variables as the level of income M changes are depicted in Panel (d), Figure 1. Higher income levels decrease the marginal utility of income. Hence, the marginal benefit from finding evasion is lower. As the level of income increases, auditors exert less effort towards finding evasion and the compliance coefficient drops. This shows that when aiming at reducing evasion levels using different inspectors' remuneration alternatives, it is more effective to increase the share g of evasion found in the auditing process than to increase level of income M. For low values of M, both types of inspectors work equally hard. However, when the level of M rises, the effort exerted by the honest official drops faster because the corrupt official receives the additional incentive of higher evasion levels. This higher evasion levels make corruption activities more profitable. Moreover, part of the drop in compliance when M is larger is absorbed by the fact that corrupt auditors now charge higher bribes, making the effective fine sb larger if audited by a corrupt inspector.

Even though the tax administration does not have direct control over the marginal cost of effort ω, it may still have various ways of affecting it. The tax administration can hire more productive inspectors, who have lower costs of finding evasion. Moreover, it can provide additional training to existing auditors, or implement more sophisticated techniques in the auditing process, making finding evasion less costly (e.g., better computers, specialized software). All these potential improvements in the inspection process can be summarized in one variable, the marginal cost of effort ω. The effect of changes in ω on the endogenous variables of the model is presented in Panel (e). Decreasing the marginal cost of effort makes both types of auditors more efficient in their inspection activities. With lower costs, both types exert higher levels of effort, which in turn increases the compliance coefficient. When ω = 0, both auditors will exert the maximum effort, $a_c = a_h = 1$, and if audited, all evasion will be found, $\varphi = Y$.

An interesting possibility, considered in Vasina (2003), is that the negotiation of the bribe occurs at the start of the audit and *prior* to the expenditure of any effort by the corrupt auditor. This means that the tax evader confesses of her tax evasion after knowing she will be audited by a corrupt official, and most importantly, before any tax evasion is found. The idea is that this can potentially increase the net gains for the taxpayer and the auditor, because it avoids the costly effort on the part of the auditor. We do not consider this possibility formally. However, intuitively there will be a multiple equilibria in which the ex-ante bribe can take any values within a range, $b_{min} \leq b^e \leq b_{max}$. If the ex-ante negotiated bribe is below b_{min}, the auditor will not accept and will go for the audit in search for evasion. Moreover, if it is above b_{max}, then the tax payer will not accept and will opt for the auditor to exert the effort.

4.3 Corruption Level

To see how the corruption level in the tax administration affects the equilibrium, Panel (f) shows the schedules of the endogenous variables as k changes. When the proportion of corrupt tax officials is larger, taxpayers find evasion as a suitable option because getting caught by an honest official is less likely. Hence, evasion increases and finding it is easier and more profitable for the auditors. For the honest tax official who cannot change the share g, working harder is always a good alternative with higher evasion levels. However, for the corrupt officials who also chooses the bribe rate, the response is not that simple. On the one hand, he shares the same effect as the honest official; higher evasion levels (as k increases) give him incentives to work harder. However, on the other hand, with higher evasion levels the equilibrium bribe is also larger. Higher bribe rates already give him a relatively high income, which translates into a low marginal utility of income and less incentives to work harder. This is the case because his marginal utility of income should be proportional to the marginal cost of effort (see equation 14).

An interesting point in Panel (f) is the non-monotonicity of the bribe. When k is low, meaning that there is a small probability that the tax payer will encounter a corrupt auditor, the corrupt auditor can hold a relatively large bribe rate b. This is because this will unlikely discourage taxpayers from evading. However, as the probability of having a corrupt auditor increases, a high bribe has a greater weight to discourage compliance; hence, the optimal bribe rate decreases. This is what happens for k below 0.2. For higher corruption levels, evasion is already high and higher bribe rates are optimal because they will unlikely discourage taxpayer to evade. This explains the increase in b as k increases for already high levels of k.

Even though k is not directly under the tax administration control, there are some actions that can be taken to reduce corruption in the administration. When $\omega \to 0$ and $k \to 0$ we are back to the Allingham and Sandmo (1972) and Yitzhaki (1974) model.

5 Conclusion

This paper is initially an extension of the classic Allingham and Sandmo (1972) and Yitzhaki (1974) tax evasion model, where we include the interaction between the taxpayer and a potentially corrupt tax inspector. A standard assumption in the tax evasion literature is that the tax auditors get to know the true level of the taxpayers' taxable income during an inspection. However, Feinstein (1991) has empirically shown that only about half of the evasion is detected in an audit. To be able account for this imperfect detection and to analyze different remuneration alternatives for the tax officials, the model considers that the amount of evasion found depends on a costly effort exerted by the auditors.

Because of the complexity of the first-order conditions that govern the interaction among the agents, the implications from the model were obtained using simulations. The existence of corruption in a tax administration has the following two main implications. First, taxpayers lower their reported income because corruption gives them the opportunity to encounter a corrupt official and bribe him in order to escape from paying higher evasion fines. Second, corrupt tax officials find in corruption additional incentives to work harder due to the opportunity of receiving bribes. Consistent with previous literature, the model predicts a positive effect of both, fines and audit probabilities on compliance. Higher compliance can be achieved by giving tax inspectors a share of the evasion discovered, but increasing their lump-sum income will reduce compliance. Finally, higher compliance can as well be accomplished by decreasing inspectors' cost of finding evasion.

Appendix

From the Implicit Function Theorem: $\partial D/\partial b = -\dfrac{\partial G/\partial b}{\partial G/\partial D}$, $\partial D/\partial a_h = -\dfrac{\partial G/\partial a_h}{\partial G/\partial D}$, and $\partial D/\partial a_c = -\dfrac{\partial G/\partial a_c}{\partial G/\partial D}$. G is given in equation 9 and

$$\frac{\partial G}{\partial b} = -tpks\left\{U''(X)\left[1+sb\left(\frac{\partial\phi(a_c)}{\partial D}-1\right)\right]\left(\phi(a_c)-D\right)+U'(X)\left[\frac{\partial\phi(a_c)}{\partial D}-1\right]\right\}$$

$$\frac{\partial G}{\partial a_c} = -tpksb\left\{U''(X)\left[1+sb\left(\frac{\partial\phi(a_c)}{\partial D}-1\right)\right]\left(\frac{\partial\phi(a_c)}{\partial a_c}\right)+U'(X)\left[\frac{\partial^2\phi(a_c)}{\partial D^2}\frac{\partial D}{\partial a_c}\right]\right\}$$

$$\frac{\partial G}{\partial a_h} = -tp(1-k)s\left\{U''(Z)\left[1+s\left(\frac{\partial\phi(a_h)}{\partial D}-1\right)\right]\left(\frac{\partial\phi(a_h)}{\partial a_h}\right)+U'(Z)\left[\frac{\partial^2\phi(a_h)}{\partial D^2}\frac{\partial D}{\partial a_h}\right]\right\}$$

$$\frac{\partial G}{\partial D} = t^2 \left\{ \begin{array}{l} (1-p)U''(W) + pk\left\{U''(X)\left[1+sb\left(\frac{\partial(a_c)}{\partial D}-1\right)\right]^2 - \frac{sb}{t}U'(X)\left[\frac{\partial^2\phi(a_c)}{\partial D^2}\right]\right\} \\ + p(1-k)\left\{U''(Z)\left[1+s\left(\frac{\partial(a_h)}{\partial D}-1\right)\right]^2 - \frac{s}{t}U'(Z)\left[\frac{\partial^2\phi(a_h)}{\partial D^2}\right]\right\} \end{array} \right\}$$

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