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Corruption in tax administration

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We extend the game-theoretic model of Graetz, Reinganum and Wilde (1986) to allow for corruption in tax administration. In the presence of corruption audit rates are generally higher than in its absence. In fact, in the presence of corruption it is possible to sustain equilibria in which all returns are audited. Moreover, when some auditors accept bribes it is possible for increases in the fine rate or the tax rate to reduce expected government revenue.

1. Introduction

In recent years a large literature on corruption has developed, building initially on Becker (1968) and, later, Rose-Ackerman (1978). While specific models are relatively idiosyncratic, the literature has grown along two essentially independent lines. One line emphasizes the efficiency aspects of corruption, especially in underdeveloped countries [Krueger (1974), Bhagwati (1982), Beck and Maher (1986)]. The other line analyzes the consequences of various corruption deterrence schemes [Lui (1986), Cadot (1987)].

At the same time a large literature on tax evasion has developed, again building on Becker (1968), via Allingham and Sandmo (1972) and Srinivasan (1973). This literature now includes a number of principal–agent models [Reinganum and Wilde (1985), Border and Sobel (1987), Mookherjee and P'ng (1989), Melamud and Mookherjee (1989), Chander and Wilde (1992)] and game-theoretic models [Graetz, Reinganum and Wilde (1986), Reinganum and Wilde (1986), Beck and Jung (1989), Beck, Davis and Jung (1989)].

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The integration of these two literatures, i.e. the development of models of tax evasion that incorporate the possibility of corruption in tax administration, is an obvious and important research goal. Indeed, a small literature exists, initiated by Virmani (1987) and Chu (1990). Chu cites a survey undertaken by the city government of Taipei in 1981 in which 94 percent of the taxpayers polled reported being 'led to' paying bribes to corrupt tax administrators. In his own survey, Chu found that 46 of 54 C.P.A.s interviewed admitted paying bribes to tax administrators (6 more refused to answer). Acharya and associates (1986) report that in India approximately 50 percent of legally reportable income goes untaxed, while a confidential survey by the Policy Group (1985) concluded that approximately three-quarters of all Indian tax auditors accept bribes [cited by Goswami, Sanyal and Gang (1990)].

In this paper we extend the game-theoretic model of Graetz, Reinganum and Wilde (1986) to allow for corruption in tax administration.[1] When some taxpayers are willing to pay bribes and some auditors are willing to accept bribes, the tax agency is more likely to forgo auditing altogether than when no taxpayers offer bribes or no auditors accept bribes. On the other hand, given that some auditing takes place, the possibility of corruption generally leads to a higher audit rate than when it is absent. In fact, in the presence of corruption it is possible to sustain equilibria in which all returns are audited. Moreover, when some auditors accept bribes it is possible for increases in the fine rate or the tax rate to reduce expected government revenue.

The paper is organized as follows. Section 2 briefly reviews the Graetz, Reinganum and Wilde model, and section 3 introduces corruption into that model. Section 4 defines equilibria for the model with corruption and establishes existence. Section 5 provides comparative statics results and section 6 a brief conclusion.

2. The G–R–W model

In the model specified by Graetz, Reinganum and Wilde (1986), hereafter referred to as G–R–W, there are two possible income levels, I_L and I_H, where $0<I_L<I_H$. Income is random and independently distributed across taxpayers; the probability that a given taxpayer has high income is q and the probability that he or she has low income is $1-q$. Taxpayers are restricted to reporting only I_L or I_H. Thus, taxpayers with true income I_L will always report I_L; taxpayers with true income I_H may have an incentive to report

[1]For a recent principal–agent model of corruption in tax administration see Kim and Park (1990). Besley and McLaren (1990) and Mookherjee and P'ng (1991) analyze the role of wage incentives in nonstrategic models of corruption in tax administration and environmental protection, respectively.

I_L.[2] The taxes associated with low and high income are T_L and T_H, respectively, where $0 < T_L < T_H$. The fine for underreporting is F, where $F > 0$.[3]

If a taxpayer reports low income, the tax agency may wish to conduct an audit. An audit costs c, where $T_H - T_L + F > c > 0$.[4] Audits are perfect in the sense that a taxpayer with true income I_H who reports I_L is discovered to have true income I_H with certainty if audited.

Let α be the probability that a taxpayer with high income reports low income, and let β be the probability that a low income report is audited. Assume all agents are risk neutral, taxpayers maximize expected income, and the tax agency maximizes expected revenue net of audit costs. If $c > q(T_H - T_L + F)$, then the unique Nash equilibrium is $\alpha^* = 1$, $\beta^* = 0$. If $c \leqq q(T_H - T_L + F)$, then the unique Nash equilibrium is

$$\alpha^* = (1-q)c/q(T_H - T_L + F - c),$$

$$\beta^* = (T_H - T_L)/(T_H - T_L + F).$$

3. The G–R–W model with corruption

Suppose that auditors can suppress the results of audits and thus shield taxpayers who incorrectly report I_L instead of I_H from both the additional tax due, $T_H - T_L$, and the fine for underreporting, F. But suppose further that if the auditor shields an evader, there is some chance that the auditor and evader will be caught, in which case both suffer additional costs. A substantially enriched version of the G–R–W model results, in which some auditors take bribes and some do not, while some taxpayers offer bribes and others do not. To specify this enriched model, we introduce the following additional notation:

γ = the share of additional tax plus penalty $(T_H - T_L + F)$ that goes to the auditor as a bribe;
K_A = the (private) cost to a tax auditor if caught taking a bribe;
K_T = the (private) cost to an evader if caught paying a bribe;
p = the probability that the auditor and evader are caught exchanging a bribe.

[2] G–R–W (1986) assume that some proportion of taxpayers, ρ, always report honestly, the 'habitual compliers'. In this paper we ignore this group and assume that all taxpayers act strategically when it is in their interest to do so.

[3] This specification can easily be modified to allow proportional taxes and fines; see G–R–W (1986) and section 5 below.

[4] If $c \geqq T_H - T_L + F$, then it never pays the tax agency to audit a low income report, even if it were known ex ante to come from a taxpayer with high income. Thus the assumption that $T_H - T_L + F > c$ is needed to allow for the possibility of some auditing in equilibrium.

We refer to K_A and K_T as 'bribery penalty costs' and to p as the 'bribery detection probability'.

We also introduce the following additional assumptions.

Assumption 1. K_T is independent of the amount of tax evaded or the level of the bribe. It is distributed across taxpayers according to c.d.f. $G_T(\cdot)$ with associated density function $g_T(\cdot)$.[5]

Assumption 2. K_A is independent of the total amount of tax evasion known to the auditor or the total level of bribes accepted by the auditor. Rather, it is incurred once for each time that the auditor is discovered to have shielded an evader. It is distributed across auditors according to c.d.f. $G_A(\cdot)$ with associated density function $g_A(\cdot)$.

Assumption 3. γ is exogenous.[6]

Assumption 4. p is independent of the total amount of tax evasion known to the auditor or the total of bribes accepted. Rather, it is a risk to which the evader and auditor are exposed each time the auditor shields an evader. It is the same for all auditors.[7]

Assumption 5. Auditors are risk neutral and maximize expected income.

These assumptions imply that bribery is an all-or-nothing decision in this model – when an auditor discovers an evader, the auditor reports either all evasion or none. In the latter case the auditor gains $\gamma(T_H - T_L + F)$ if he or she is not discovered shielding the evader or loses K_A if he or she is

[5]Bribery penalty costs for taxpayers may consist of social stigma as well as loss of income. The introduction of stigma costs into models of tax evasion seemingly is due to Benjamini and Maital (1985). The idea is further developed by Gordon (1989). Taxpayers caught evading taxes but not paying bribes may also suffer such costs, but they generally are lower than for taxpayers caught evading taxes and paying bribes since in many countries tax evasion is a socially accepted phenomenon but bribe-paying is not. Furthermore, criminal penalties are generally more likely to be imposed for bribe-paying than for tax evasion. In any event, the basic qualitative features of the model remain intact even if all taxpayers are willing to pay bribes, i.e. even if $G_T(0)=1$ (see section 5).

[6]For models in which γ is determined by a bargaining process see Virmani (1987), Besley and McLaren (1990), and Goswani, Sanyal and Gang (1990). The latter cite a study by the Policy Group (1985) in which it is estimated that γ is approximately 20 percent in India.

[7]The bribery detection probability is also independent across taxpayers in the sense that if an auditor is discovered to have accepted a bribe from one taxpayer, this has no effect on the likelihood that he or she will be discovered to have received a bribe from another taxpayer. Since not all taxpayers necessarily are willing to pay bribes in our model, while it is more likely, it is not automatic that an auditor who accepts a bribe from one taxpayer will receive a bribe from another taxpayer. We therefore make the analytically convenient assumption that bribery detection probabilities are independent across taxpayers.

discovered shielding the evader. Thus, an auditor with bribery penalty cost K_A will accept a bribe if and only if

$$\gamma(T_H - T_L + F)(1-p) > pK_A;^{8} \tag{1}$$

i.e. the auditor will accept a bribe if and only if $K_A < K_A^*$, where

$$K_A^* = \gamma\Delta(1-p)/p \tag{2}$$

and

$$\Delta = T_H - T_L + F. \tag{3}$$

Assumption 6. Taxpayers are risk neutral. They minimize expected tax-related costs, and are indifferent whether these costs are taxes, bribes, fines, or bribery penalty costs.[9]

Suppose a taxpayer with bribery penalty cost K_T observes high income but reports low income. If the taxpayer is audited by an auditor with bribery penalty cost K_A such that $K_A < K_A^*$ – that is, by an auditor who accepts bribes – but does not offer a bribe, then the taxpayer suffers total costs of $T_H + F$. If the taxpayer does offer a bribe, he or she suffers expected costs of $T_L + (1-p)\gamma\Delta + p(\Delta + K_T)$. Thus the taxpayer offers a bribe if and only if

$$T_H + F > T_L + (1-p)\gamma\Delta + p(\Delta + K_T);^{10} \tag{4}$$

i.e. the taxpayer offers a bribe if and only if $K_T < K_T^*$, where

$$K_T^* = (1-\gamma)\Delta(1-p)/p. \tag{5}$$

Taxpayers' payoff functions differ depending on whether they are willing to offer bribes; on whether $K_T < K_T^*$. This motivates the following definition.

Definition 1. A taxpayer is an *honest evader* if $K_T \geqq K_T^*$ and a *dishonest evader* if $K_T < K_T^*$.

Let α^H be the probability that an honest evader with high income reports low income and let $\alpha^D(K_T)$ be the probability that a dishonest evader with bribery penalty cost K_T and high income reports low income. Let β be the probability that a low income report is audited. Since the tax agency cannot

[8]We resolve indifference in favor of not taking a bribe.

[9]Given risk neutrality, minimizing expected tax-related costs is equivalent to maximizing expected utility which, in this case, reduces to maximizing expected income.

[10]We resolve indifference in favor of not offering a bribe.

distinguish ex ante between taxpayers except with respect to their self-reported income, β is the same for all taxpayers. Finally, let $C^{H}(\alpha^{H},\beta)$ be the cost function for an honest evader with high income and $C^{D}[\alpha^{D}(K_T),\beta;K_T]$ be the cost function for a dishonest evader with bribery penalty cost K_T and high income. Then

$$C^{H}(\alpha^{H},\beta)=\alpha^{H}[\beta(T_H+F)+(1-\beta)T_L]+(1-\alpha^{H})T_H$$
$$=\alpha^{H}[\beta\Delta-(T_H-T_L)]+T_H \tag{6}$$

and

$$C^{D}[\alpha^{D}(K_T),\beta;K_T]=\alpha^{D}(K_T)[\beta\{G_A^*[T_L+(1-p)\gamma\Delta+p(\Delta+K_T)$$
$$+(1-G_A^*)(T_H+F)\}+(1-\beta)T_L]+[1-\alpha^{D}(K_T)]T_H \tag{7}$$

$$=\alpha^{D}(K_T)[\beta\Delta-(T_H-T_L)]$$
$$+T_H-\alpha^{D}(K_T)\beta G_A^*[\Delta(1-p)(1-\gamma)-pK_T], \tag{8}$$

where $G_A^*\equiv G_A(K_A^*)$.

Definition 2. A *best response for an honest evader*, noted by $\phi^{H}(\beta)$, is a value of α^{H} that minimizes $C^{H}(\alpha^{H},\beta)$. A *best response for a dishonest evader*, denoted by $\phi^{D}(\beta,K_T)$, is a value of $\alpha^{D}(K_T)$ that minimizes $C^{D}[\alpha^{D}(K_T),\beta;K_T]$.

The following proposition results immediately from the linearity of C^{H} in α^{H} and C^{D} in $\alpha^{D}(K_T)$.

Proposition 1. The best response for honest evaders is

$$\phi^{H}(\beta)=\begin{cases}0, & \text{if } \beta\Delta>T_H-T_L,\\ \in[0,1], & \text{if } \beta\Delta=T_H-T_L,\\ 1, & \text{if } \beta\Delta<T_H-T_L.\end{cases}$$

The best response for a dishonest evader is

$$\phi^{D}(\beta;K_T)=\begin{cases}0, & \text{if } \beta\Delta>T_H-T_L+\beta G_A^*[\Delta(1-p)(1-\gamma)-pK_T],\\ \in[0,1], & \text{if } \beta\Delta=T_H-T_L+\beta G_A^*[\Delta(1-p)(1-\gamma)-pK_T],\\ 1, & \text{if } \beta\Delta<T_H-T_L+\beta G_A^*[\Delta(1-p)(1-\gamma)-pK_T].\end{cases}$$

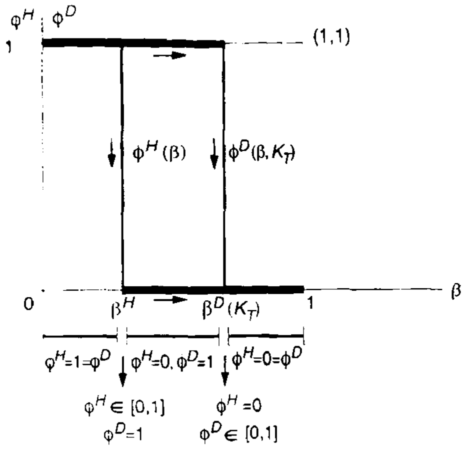

Fig. 1. The best response functions $\phi^{\mathrm{H}}(\beta)$ and $\phi^{\mathrm{D}}(\beta, K_{\mathrm{T}})$.

In the analysis that follows, it is useful to specify those audit probabilities that make honest evaders and dishonest evaders indifferent between reporting low income and high income when they observe high income. Thus, using Proposition 1 and obvious notation, we define

$$\beta^{\mathrm{H}} = (T_{\mathrm{H}} - T_{\mathrm{L}})/\Delta \tag{9}$$

and

$$\beta^{\mathrm{D}}(K_{\mathrm{T}}) = (T_{\mathrm{H}} - T_{\mathrm{L}})/\{\Delta - G_{\mathrm{A}}^{*}[\Delta(1-p)(1-\gamma) - pK_{\mathrm{T}}]\}. \tag{10}$$

The relationship between β^{H}, $\beta^{\mathrm{D}}(K_{\mathrm{T}})$, and K_{T} is also immediate.

Proposition 2. $\beta^{\mathrm{D}}(K_{\mathrm{T}}) > \beta^{\mathrm{H}}$ *for all* $K_{\mathrm{T}} < K_{\mathrm{T}}^{*}$; $\beta^{\mathrm{D}}(K_{\mathrm{T}}^{*}) = \beta^{\mathrm{H}}$; *and* $\mathrm{d}\beta^{\mathrm{D}}(K_{\mathrm{T}})/\mathrm{d}K_{\mathrm{T}} < 0$.

Proposition 2 implies that $\phi^{\mathrm{D}}(\beta; K_{\mathrm{T}}) \geqq \phi^{\mathrm{H}}(\beta)$ for all $\beta \in [0,1]$ and $K_{\mathrm{T}} < K_{\mathrm{T}}^{*}$. In other words, dishonest evaders are more likely than honest evaders to report low income when they observe high income. Fig. 1 illustrates the best response functions $\phi^{\mathrm{H}}(\beta)$ and $\phi^{\mathrm{D}}(\beta; K_{\mathrm{T}})$ for a single value of K_{T} such that $K_{\mathrm{T}} < K_{\mathrm{T}}^{*}$.

We assume that the audit rate is determined at an administrative level above the individual auditor, but we distinguish between two types of tax agencies, naive and sophisticated. We denote the audit rates of the two types of tax agencies by β^{N} and β^{S}, respectively.

Definition 3. A *naive tax agency* presumes that all auditors are honest. A *sophisticated tax agency* recognizes the presence of corruption.

Assumption 7. Tax agencies are risk neutral. They maximize expected revenue net of audit costs, ignoring bribery penalty costs but not under-reporting penalties.[11]

Since naive tax agencies ignore the possibility of bribery, Assumption 7 implies that they maximize

$$\begin{aligned}\pi^{\mathrm{N}}(\alpha^{\mathrm{H}},\beta^{\mathrm{N}}) &= \beta^{\mathrm{N}}[\mu^{\mathrm{N}}(T_{\mathrm{H}}+F)+(1-\mu^{\mathrm{N}})T_{\mathrm{L}}-c]+(1-\beta^{\mathrm{N}})T_{\mathrm{L}} \\ &= \beta^{\mathrm{N}}(\mu^{\mathrm{N}}\Delta-c)+T_{\mathrm{L}},\end{aligned} \tag{11}$$

where μ^{N} is the probability that a low income report comes from a taxpayer with high income, in this case presuming that no bribes are offered or accepted. In other words, following Bayes' Law:

$$\mu^{\mathrm{N}}=\alpha^{\mathrm{H}}q/(\alpha^{\mathrm{H}}q+1-q). \tag{12}$$

Sophisticated tax agencies face a more complex problem since each dishonest evader can follow his or her own strategy with respect to reporting low versus high income when high income is observed (depending on the dishonest evader's bribery penalty cost). Let $\alpha^{\mathrm{D}}(K_{\mathrm{T}})$ be an arbitrary set of such strategies for dishonest evaders; that is, let $\alpha^{\mathrm{D}}(K_{\mathrm{T}})$ be the probability that a dishonest evader with bribery penalty cost K_{T} reports low income when high income is observed.

Honest evaders never offer bribes and thus can, without loss of generality, be treated symmetrically with respect to the decision to report low income when high income is observed. Let α^{H} be an arbitrary such strategy for honest evaders; that is, let α^{H} be the probability that an honest evader reports low income when high income is observed. Then sophisticated tax agencies maximize

$$\begin{aligned}\pi^{\mathrm{S}}(\alpha^{\mathrm{H}},\alpha^{\mathrm{D}},\beta^{\mathrm{S}}) &= \beta^{\mathrm{S}}\{\mu^{\mathrm{SD}}[G_{\mathrm{A}}^{*}(T_{\mathrm{L}}+p\Delta)+(1-G_{\mathrm{A}}^{*})(T_{\mathrm{H}}+F)] \\ &\qquad +\mu^{\mathrm{SH}}(T_{\mathrm{H}}+F)+(1-\mu^{\mathrm{SD}}-\mu^{\mathrm{SH}})T_{\mathrm{L}}-c\}+(1-\beta^{\mathrm{S}})T_{\mathrm{L}} \\ &= \beta^{\mathrm{S}}[\mu^{\mathrm{SD}}\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})+\mu^{\mathrm{SH}}\Delta-c]+T_{\mathrm{L}},\end{aligned} \tag{13}$$

[11] We assume that tax agencies ignore bribery penalty costs when they set audit rates since these costs may consist to a substantial degree of elements that are not transfers to tax agencies. See footnote 5 for additional comments on bribery penalty costs.

where μ^{SD} and μ^{SH} are the respective probabilities that a low income report comes from a dishonest evader with high income and an honest evader with high income.[12] In other words, again following Bayes' Law:

$$\mu^{SD}=q\int_0^{K_T^*}\alpha^D(K_T)g_T(K_T)\,dK_T\Bigg/\left[q\int_0^{K_T^*}\alpha^D(K_T)g_T(K_T)\,dK_T+q(1-G_T^*)\alpha^H+1-q\right], \tag{14}$$

$$\mu^{SH}=q(1-G_T^*)\alpha^H\Bigg/\left[q\int_0^{K_T^*}\alpha^D(K_T)g_T(K_T)\,dK_T+q(1-G_T^*)\alpha^H+1-q\right], \tag{15}$$

where $G_T^*=G_T(K_T^*)$.[13]

Definition 4. A *best response for a naive tax agency*, denoted by $\psi^N(\alpha^H)$, is a value of β^N that maximizes $\pi^N(\alpha^H,\beta^N)$. A *best response for a sophisticated tax agency*, denoted by $\psi^S(\alpha^H,\alpha^D)$, is a value of β^S that maximizes $\pi^S(\alpha^H,\alpha^D,\beta^S)$.

The linearity of ψ^N in α^H and ψ^S in μ^{SD} and μ^{SH} yields the next proposition.

Proposition 3. The best response for a naive tax agency is

$$\psi^N(\alpha^H)=\begin{cases}0, & \text{if } \alpha^H<(1-q)c/q(\Delta-c),\\ \in[0,1], & \text{if } \alpha^H=(1-q)c/q(\Delta-c),\\ 1, & \text{if } \alpha^H>(1-q)c/q(\Delta-c).\end{cases}$$

The best response for a sophisticated tax agency is

$$\psi^S(\alpha^H,\alpha^D)=\begin{cases}0, & \text{if } \mu^{SD}\Delta(1-G_A^*+pG_A^*)+\mu^{SH}\Delta-c<0,\\ \in[0,1], & \text{if } \mu^{SD}\Delta(1-G_A^*+pG_A^*)+\mu^{SH}\Delta-c=0,\\ 1, & \text{if } \mu^{SD}\Delta(1-G_A^*+pG_A^*)+\mu^{SH}\Delta-c>0,\end{cases}$$

where μ^{SD} and μ^{SH} are given in (14) *and* (15).

If we substitute from (14) and (15) for μ^{SD} and μ^{SH} in the definition of ψ^S given in Proposition 3, the condition for indifference between auditing and not auditing becomes

[12] Where convenient notationally, we suppress the dependence of α^D on K_T.

[13] We assume that monitoring of auditors is costless, or at least that the costs of monitoring auditors are not sensitive to α^H, $\alpha^D(K_T)$, or β.

$$q[\Delta(1-G_A^*+pG_A^*)-c]\int_0^{K_T^*}\alpha^D(K_T)g_T(K_T)\,dK_T$$

$$+\alpha^H q(1-G_T^*)(\Delta-c)=c(1-q). \tag{16}$$

4. Equilibrium in the G–R–W model with corruption

We have defined two types of tax agencies, naive and sophisticated. We now define separate equilibria for each.

Definition 5. A *naive equilibrium* is a pair $(\bar{\alpha}^H, \bar{\beta}^N)$ such that $\bar{\alpha}^H=\phi^H(\bar{\beta}^N)$ and $\bar{\beta}^N=\psi^N(\bar{\alpha}^H)$. A *sophisticated equilibrium* is a triple $(\hat{\alpha}^H, \hat{\alpha}^D(K_T), \hat{\beta}^S)$ such that $\hat{\alpha}^H=\phi^H(\hat{\beta}^S)$, $\hat{\alpha}^D(K_T)=\phi^D(\hat{\beta}^S;K_T)$, and $\hat{\beta}^S=\psi^S(\hat{\alpha}^H,\hat{\alpha}^D)$.

The existence of a unique naive equilibrium follows exactly as in G–R–W.

Proposition 4. There exists a unique naive equilibrium. It is one of two types.

(a) *If $c>q\Delta$, then $\bar{\alpha}^H=1$ and $\bar{\beta}^N=0$. The associated value of α^D is* 1.

(b) *If $c\leqq q\Delta$, then $\bar{\alpha}^H=(1-q)c/q(\Delta-c)$ and $\bar{\beta}^N=(T_H-T_L)/\Delta\equiv\beta^H$. The associated value of α^D is* 1.

In the first type of naive equilibrium, which obtains when audit costs are high, there is no auditing and both honest evaders and dishonest evaders always report low income. In the second type of naive equilibrium, which obtains when audit costs are low, auditing is random as is the decision by honest evaders to report low income when they observe high income. In this equilibrium dishonest evaders always report low income.

Two types of sophisticated equilibria, analogous to the two types of naive equilibria, also exist. But a third and fourth type of sophisticated equilibrium in which $\hat{\beta}^S>\beta^H$ can also exist. These equilibria have the property that some dishonest evaders always report low income when high income is observed while other dishonest evaders always report high income when high income is observed. In fact, only one type of dishonest evader is indifferent. We denote the bribery penalty cost of this type by $H(\hat{\beta}^S)$. Using $\phi^D(\beta;K_T)$ from Proposition 1:

$$H(\hat{\beta}^S)=K_T^*-[\hat{\beta}^S\Delta-(T_H-T_L)]/\hat{\beta}^S pG_A^*. \tag{17}$$

Proposition 5. There exists a unique sophisticated equilibrium. It is one of four types.

(a) *If $c>q\Delta[1-G_T^*G_A^*(1-p)]$, then $\hat{\alpha}^H=1=\hat{\alpha}^D(K_T)$ for all $K_T<K_T^*$ and* $\hat{\beta}^S=0$.

(b) *If* $q\Delta[1-G_T^*G_A^*(1-p)] \geqq c \geqq qG_T^*\Delta(1-G_A^*+pG_A^*)/(1-q+qG_T^*)$, *then* $\hat{\alpha}^H = [c(1-q+qG_T^*) - qG_T^*\Delta(1-G_A^*+pG_A^*)]/q(1-G_T^*)(\Delta-c), \hat{\alpha}^D(K_T)=1$ *for all* $K_T < K_T^*$, *and* $\hat{\beta}^S = (T_H - T_L)/\Delta$.

(c) *If* $qG_T^*\Delta(1-G_A^*+pG_A^*)/(1-q+qG_T^*) > c > qG_T^*[K_T^*-(F/pG_A^*)]\Delta(1-G_A^*+pG_A^*)/\{1-q+qG_T^*[K_T^*-(F/pG_A^*)]\}$, *then* $\hat{\alpha}^H = 0$.

$$\alpha^D(K_T) = \begin{cases} 0, & \text{if } K_T > H(\hat{\beta}^S), \\ \in [0,1], & \text{if } K_T = H(\hat{\beta}^S), \\ 1, & \text{if } K_T < H(\hat{\beta}^S), \end{cases}$$

and $\hat{\beta}^S$ *solves* $G_T[H(\hat{\beta}^S)] = c(1-q)/q[\Delta(1-G_A^*+pG_A^*)-c]$.

(d) *If* $qG_T^*[K_T^*-(F/pG_A^*)]\Delta(1-G_A^*+pG_A^*)/\{1-q+qG_T^*[K_T^*-(F/pG_A^*)]\} \geqq c$, *then* $\hat{\alpha}^H = 0$,

$$\hat{\alpha}^D(K_T) = \begin{cases} 0, & \text{if } K_T > K_T^*-(F/pG_A^*), \\ \in [0,1], & \text{if } K_T = K_T^*-(F/pG_A^*), \\ 1, & \text{if } K_T < K_T^*-(F/pG_A^*), \end{cases}$$

and $\hat{\beta}^S = 1$.

Proof. (a) It is clear from fig. 1 that if $\hat{\beta}^S = 0$, then $\hat{\alpha}^H = 1 = \hat{\alpha}^D(K_T)$. In this case $\mu^{SD} = qG_T^*$ and $\mu^{SH} = q(1-G_T^*)$. Thus $\hat{\beta}^S = 0$ requires (from Proposition 3) that

$$qG_T^*\Delta(1-G_A^*+pG_A^*) + q(1-G_T^*)\Delta - c < 0,$$

which reduces to $c > q\Delta[1-G_T^*G_A^*(1-p)]$. With $\hat{\beta}^S = 0$, Proposition 1 implies immediately that $\hat{\alpha}^H = 1 = \hat{\alpha}^D(K_T)$.

(b) Consider $\hat{\beta}^S = \beta^H$. Fig. 1 then indicates that $\hat{\alpha}^H \in [0,1]$ and $\hat{\alpha}^D(K_T) = 1$ for all $K_T < K_T^*$ are the only possible values for $\hat{\alpha}^H$ and $\hat{\alpha}^D(K_T)$. In this case

$$\mu^{SD} = qG_T^*/[qG_T^* + q(1-G_T^*)\hat{\alpha}^H + 1 - q]$$

and

$$\mu^{SH} = q(1-G_T^*)\hat{\alpha}^H/[qG_T^* + q(1-G_T^*)\hat{\alpha}^H + 1 - q].$$

Thus $\hat{\beta}^S = \beta^H \equiv (T_H - T_L)\Delta$ requires (from Proposition 3) that

$$qG_T^*\Delta(1-G_A^*+pG_A^*) + q(1-G_T^*)\hat{\alpha}^H\Delta - c[qG_T^* + q(1-G_T^*)\hat{\alpha}^H + 1 - q] = 0$$

or

$$\hat{\alpha}^{\mathrm{H}}=[c(1-q+qG_{\mathrm{T}}^{*})-qG_{\mathrm{T}}^{*}\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})]/q(1-G_{\mathrm{T}}^{*})(\Delta-c).$$

That $\hat{\alpha}^{\mathrm{D}}(K_{\mathrm{T}})=1$ for all $K_{\mathrm{T}}<K_{\mathrm{T}}^{*}$ follows directly from Proposition 1 when $\hat{\beta}^{\mathrm{S}}=(T_{\mathrm{H}}-T_{\mathrm{L}})/\Delta$. It remains to guarantee that $\hat{\alpha}^{\mathrm{H}}\in[0,1]$. But $\hat{\alpha}^{\mathrm{H}}\leqq 1$ reduces to

$$q\Delta[1-G_{\mathrm{T}}^{*}G_{\mathrm{A}}^{*}(1-p)]\geqq c$$

and $\hat{\alpha}^{\mathrm{H}}\geqq 0$ reduces to

$$c\geqq qG_{\mathrm{T}}^{*}\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})/(1-q+qG_{\mathrm{T}}^{*}).$$

(c) Consider a sophisticated equilibrium with $1>\hat{\beta}^{\mathrm{S}}>\beta^{\mathrm{H}}$. Then it must be that $\hat{\alpha}^{\mathrm{H}}=0$. Furthermore, by the definition of $H(\hat{\beta}^{\mathrm{S}})$ given in (17), $\hat{\alpha}^{\mathrm{D}}(K_{\mathrm{T}})$ must take the form stated in the proposition. In this case

$$\mu^{\mathrm{SD}}=qG_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]/\{qG_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]+1-q\}$$

and

$$\mu^{\mathrm{SH}}=0.$$

Thus $\hat{\beta}^{\mathrm{S}}\in(\hat{\beta}^{\mathrm{H}},1)$ requires (from Proposition 3) that

$$qG_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c\{qG_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]+1-q\}=0.$$

In other words, $\hat{\beta}^{\mathrm{S}}$ must solve

$$G_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]=c(1-q)/q[\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c]. \tag{18}$$

Notice that $\mathrm{d}H(\hat{\beta}^{\mathrm{S}})/\mathrm{d}\hat{\beta}^{\mathrm{S}}=-(T_{\mathrm{H}}-T_{\mathrm{L}})/(\hat{\beta}^{\mathrm{S}})^{2}pG_{\mathrm{A}}^{*}<0$. Furthermore, $G_{\mathrm{T}}(\cdot)$ is a c.d.f., so $G_{\mathrm{T}}[H(\hat{\beta}^{\mathrm{S}})]$ is decreasing in $\hat{\beta}^{\mathrm{S}}$. Also, $H(\beta^{\mathrm{H}})=K_{\mathrm{T}}^{*}$ so that $G_{\mathrm{T}}[H(\beta^{\mathrm{H}})]=G_{T*}$. Thus a necessary condition for (18) to have an interior solution is

$$G_{\mathrm{T}}^{*}>c(1-q)/q[\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c]$$

or

$$qG_{\mathrm{T}}^{*}\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})/(1-q+qG_{\mathrm{T}}^{*})>c.$$

Next, observe that $H(1)=K_{\mathrm{T}}^{*}-(F/pG_{\mathrm{A}}^{*})$. This value could be negative, in which case $G_{\mathrm{T}}[H(1)]=0$, or it could be positive. No simple necessary and sufficient condition relates $G_{\mathrm{T}}(H(1)]$ to $c(1-q)/q[\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c]$. In other words, all we can say is that given (18), a unique $\hat{\beta}^{\mathrm{S}}\in(\beta^{\mathrm{H}},1)$ exists if and only if $G_{\mathrm{T}}[K_{\mathrm{T}}^{*}-(F/pG_{\mathrm{A}}^{*})]<c(1-q)/q[\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c]$.

(d) The argument for the fourth type of sophisticated equilibrium follows directly from that for the third. If $G_T[H(1)] > c(1-q)/q[\Delta(1-G_A^*+pG_A^*)-c]$, then β^S obtains a corner solution at 1.

Finally, the proof is complete once we observe that no sophisticated equilibria with $\hat{\beta}^S \in (0, \beta^H)$ are possible [except under the unique parameter configuration $qG_T^*\Delta(1-G_A^*+pG_A^*)+q(1-G_T^*)\Delta-c=0$, which we ignore]. Q.E.D.

5. Comparative statics

In order to simplify the comparative statics, we make the following assumption about the distribution of taxpayer bribery penalty costs.

Assumption 8. $G_T(\cdot)$ has all its mass concentrated on two costs, K_H and K_D, where $0 < K_D < K_T^* < K_H$. The probability that $K_T = K_D$ is r and the probability that $K_T = K_H$ is $1-r$.

The significance of Assumption 8 is that all dishonest evaders have the same bribery penalty cost and thus can be treated symmetrically. Thus we have the following version of Proposition 5.

Proposition 6. Under Assumption 8 there exists a unique sophisticated equilibrium. It is one of four types.

(a) *If* $c > q\Delta[1-rG_A^*(1-p)]$, *then* $\hat{\alpha}^H = 1 = \hat{\alpha}^D$ *and* $\hat{\beta}^S = 0$.

(b) *If* $q\Delta[1-rG_A^*(1-p)] \geqq c \geqq qr\Delta(1-G_A^*+pG_A^*)/(1-q+qr)$, *then* $\hat{\alpha}^H = [c(1-q+qr)-qr\Delta(1-G_A^*+pG_A^*)]/q(1-r)(\Delta-c)$, $\hat{\alpha}^D = 1$, *and* $\hat{\beta}^S = (T_H - T_L)/\Delta$.

(c) *If* $qr\Delta(1-G_A^*+pG_A^*)/(1-q+qr) > c$ *and* $K_D \geqq K_T^* - (F/pG_A^*)$, *then* $\hat{\alpha}^H = 0$, $\hat{\alpha}^D = c(1-q)/qr[\Delta(1-G_A^*+pG_A^*)-c]$, *and* $\hat{\beta}^S = (T_H - T_L)/[\Delta - pG_A^*(K_T^* - K_D)]$.

(d) *If* $qr\Delta(1-G_A^*+pG_A^*)/(1-q+qr) > c$ *and* $K_D < K_T^* - (F/pG_A^*)$, *then* $\hat{\alpha}^H = 0$, $\hat{\alpha}^D = 1$, and $\hat{\beta}^S = 1$.

Proof. Parts (a) and (b) follow directly from the proof of Proposition 5 when $G_T^* = r$. Part (c) follows from two conditions. First, from Proposition 1, dishonest evaders are indifferent between reporting low income and reporting high income when high income is observed if and only if

$$\hat{\beta}^S \Delta = T_H - T_L + \hat{\beta}^S G_A^*[\Delta(1-p)(1-\gamma) - pK_D].$$

This gives $\hat{\beta}^S$. That $K_T^* - (F/pG_A^*) < K_D$ guarantees that $\hat{\beta}^S < 1$. Second, from Proposition 3, the tax agency is indifferent between auditing and not auditing a low income report if and only if

$$q[\Delta(1-G_A^*+pG_A^*)-c]\hat{\alpha}^D r = c(1-q).$$

This gives $\hat{\alpha}^{\mathrm{D}}$. Part (d) follows from similar considerations, where we observe that $\hat{\alpha}^{\mathrm{D}}=1$ requires that $K_{\mathrm{D}} \leqq K_{\mathrm{T}}^{*}-(F/pG_{\mathrm{A}}^{*})$ and $\hat{\beta}^{\mathrm{S}}=1$ requires that $qr\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})/(1-q+qr)>c$. Q.E.D.

A variety of comparative statics can be calculated, but we are interested in the effects of taxes and fines on compliance, auditing, and expected revenue for sophisticated equilibria in which $\hat{\beta}^{\mathrm{S}} \in (0,1)$. The next proposition gives expected revenue for cases (b) and (c) of Proposition 6.

Proposition 7. Under Assumption 8, per taxpayer expected revenue in a sophisticated equilibrium (ER) takes the following values.

(a) *If* $q\Delta[1-rG_{\mathrm{A}}^{*}(1-p)] \geqq c \geqq qr\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})/(1-q+qr)$, *then*

$$ER = T_{\mathrm{L}}+(T_{\mathrm{H}}-T_{\mathrm{L}})\{q\Delta[1-rG_{\mathrm{A}}^{*}(1-p)]-c\}/(\Delta-c).$$

(b) *If* $qr(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})/(1-q+qr)>c$ *and* $K_{\mathrm{D}}>K_{\mathrm{T}}^{*}-(F/pG_{\mathrm{A}}^{*})$, *then*

$$ER = T_{\mathrm{L}}+(T_{\mathrm{H}}-T_{\mathrm{L}})[q\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c]/[\Delta(1-G_{\mathrm{A}}^{*}+pG_{\mathrm{A}}^{*})-c].$$

Even if one assumes that taxes and fines are proportional, i.e. that $T_{\mathrm{L}}=tI_{\mathrm{L}}$, $T_{\mathrm{H}}=tI_{\mathrm{H}}$, and $F=ft(I_{\mathrm{H}}-I_{\mathrm{L}})$, where $0<t<1$ and $f>0$, unlike the original G–R–W model, this model yields comparative statics results that are complex and generally of ambiguous sign. This is because the percentage of auditors who potentially accept bribes, G_{A}^{*}, depends on both the tax rate and the fine rate. Thus, the effects of increases in these parameters on under-reporting, the audit rate, and expected revenue generally depend on the sign of a term that involves the factor $G_{\mathrm{A}}^{*}+g_{\mathrm{A}}^{*}K_{\mathrm{A}}^{*}$. For example,

$$\frac{\partial \hat{\alpha}^{\mathrm{H}}}{\partial t} = \frac{\Delta\{qr\Delta g_{\mathrm{A}}^{*}K_{\mathrm{A}}^{*}(1-p)-c[1-q+qr(1-p)(G_{\mathrm{A}}^{*}+g_{\mathrm{A}}^{*}K_{\mathrm{A}}^{*})]\}}{q(1-r)t(\Delta-c)^{2}}.$$

Thus an increase in the tax rate decreases the likelihood that an honest evader reports low income when high income is observed, increasing the audit rate (or leaves it unchanged) and increases expected revenue. However, if $g_{\mathrm{A}}^{*}K_{\mathrm{A}}^{*}$ is large enough, it is possible that an increase in the tax rate increases the likelihood that an honest evader reports low income when high income is observed, and decreases expected revenue. Similarly, an increase in the fine rate generally decreases the likelihood that an honest evader reports low income when high income is observed, decreases the audit rate and increases expected revenue, although if $g_{\mathrm{A}}^{*}K_{\mathrm{A}}^{*}$ is large enough, then the opposite effects are possible. The possibility of comparative statics results that differ from the analogous results in the G–R–W model arises because increases in the tax rate or the fine rate cause increases in the likelihood that an auditor will accept a bribe, mitigating the extent to which such increases reduce the costs of reporting low income when high income is observed.[14]

6. Conclusion

Several immediate properties of the equilibria described in Propositions 4 and 5 are of interest.

(1) A sophisticated tax agency is more likely to forgo auditing altogether than a naive tax agency. In the former case $\hat{\beta}^S>0$ if and only if $c<q\Delta[1-G_T^*G_A^*(1-p)]$, while in the latter case $\bar{\beta}^N>0$ if and only if $c<q\Delta$. As long as $G_T^*>0$ and $G_A^*>0$, the first constraint is more restrictive than the second constraint. Indeed, as all evaders become dishonest and all auditors become bribable, $\hat{\beta}^S>0$ if and only if $c<q\Delta p$. If the bribery detection probability is small enough, this constraint is unlikely to be satisfied.

(2) On the other hand, given that some auditing takes place, a sophisticated tax agency will set a higher audit rate than a naive tax agency whenever $c<qG_T^*\Delta(1-G_A^*+pG_A^*)/(1-q+qG_T^*)$.

(3) When $G_T^*=0$, so that all evaders are honest – no taxpayers are willing to pay bribes – then the naive equilibria and sophisticated equilibria coincide, and are the same as in the G–R–W model. However, when $G_A^*=0$ a similar affect fails to arise. That is, as the percentage of bribable auditors goes to zero, there are discontinuities in the equilibrium correspondences for both naive and sophisticated equilibria. This can be seen in the case of naive equilibria where the value of α^D is always 1 – dishonest evaders always strictly prefer to report low income when high income is observed as long as there is some chance, however small, of being audited by a bribable auditor. But when there are no bribable auditors, dishonest evaders act like honest evaders, and the naive equilibria coincide with the equilibria of the G–R–W model.

Similarly, as long as $G_A^*>0$, no matter how small it is, there exist sophisticated equilibria in which $\hat{\beta}^S>\beta^H$. In particular, these occur whenever $G_T^*>0$ and $qG_T^*\Delta/(1-q+qG_T^*)>c$. Furthermore, for sophisticated equilibria in which $\hat{\alpha}^H\in[0,1]$, $\hat{\alpha}^D(K_T)=1$ for all $K_T<K_T^*$ and $\hat{\beta}^S=\beta^H$ [Proposition 5, part (b)]:

$$\lim_{G_A^*\to 0}\hat{\alpha}^H=[c(1-q+qG_T^*)-qG_T^*\Delta]/q(1-G_T^*)(\Delta-c)<(1-q)c/q(\Delta-c)=\bar{\alpha}^H.$$

The point here is that there is a fundamental asymmetry between bribe-

[14]These results hold for cases (b) and (d) of Proposition 6 [see Chander and Wilde (1990) for details]. The presence of the mitigating effect of course depends on the existence of taxpayers who are willing to pay bribes, i.e. on $r>0$. In fact, if r is low enough, cases (b), (c), or (d) of Proposition 6 never arise.

paying taxpayers and bribe-accepting auditors. As the percentage of bribe-paying taxpayers falls toward zero, the performance of the tax system improves continuously, until it achieves the level of the no-corruption system. But as the percentage of bribe-accepting auditors falls toward zero, even though the performance of the tax system improves continuously, it is bounded away from the level of the no-corruption system.

(4) In the presence of corruption it is possible to sustain sophisticated equilibria in which $\hat{\beta}^S = 1$. This can never occur in the G–R–W model since in that model if $\beta = 1$, no taxpayer would report low income when high income is observed, in which case $\beta = 1$ cannot be optimal.

Only one of these properties requires further comment, the asymmetry between bribe-paying taxpayers and bribe-accepting auditors. This asymmetry arises because in the presence of some bribe-accepting auditors, no matter how few, taxpayers with low enough bribery penalty costs who observe high income prefer reporting low income instead of high income when they would otherwise be indifferent. One question is whether this kind of result is robust to generalizations of the G–R–W model such as that analyzed by Reinganum and Wilde (1986). Another question concerns whether similar results obtain in other models of law enforcement which involve analogous asymmetries, such as that between drug users and drug dealers.

The comparative statics results of the model are also significant. In particular, the possibility that an increase in the tax rate or the fine rate could actually decrease government revenue is an important feature of the G–R–W model with corruption. While such a possibility is perhaps an exception rather than the norm, the response of government revenue to an increase in either tax rate or the fine rate will be less in the presence of corruption than in its absence, even if it is not negative.

These results were obtained in the context of some relatively strong assumptions, such as lump-sum bribery penalty costs, independence between size of the bribe and the likelihood of bribery detection, and a constant likelihood of bribery detection. However, the basic result of the paper – that one of the major social costs of corruption is its tendency to defeat the effectiveness of government policy instruments, both in terms of the government's ability to raise revenue directly and its ability to enforce tax laws – is undoubtedly insensitive to weakening these assumptions. Indeed, both Virmani (1987) and Chu (1990) obtain similar comparative statics results in models of tax evasion and corruption which use a substantially different combination of assumptions. While we obtain sharper results with respect to the tax agency and the asymmetry between bribe-paying taxpayers and bribe-accepting auditors, all these analyses point to the important role of anti-corruption policies in countries where both tax evasion and corruption are substantial.

References

Acharya, S. and associates (with contributions by R.J. Chelliah), 1986, Aspects of the black economy in India (NIPFP, New Delhi).

Allingham, M.G. and A. Sandmo, 1972, Income tax evasion: A theoretical analysis, Journal of Public Economics 1, 323–338.

Beck, P.J. and W.O. Jung, 1989, Taxpayers' reporting decisions and auditing under information asymmetry, The Accounting Review 64, 468–487.

Beck, P.J. and M.W. Maher, 1986, A comparison of bribery and bidding in thin markets, Economics Letters 20, 1–5.

Beck, P.J., J.S. Davis and W.O. Jung, 1989, The role of tax practitioners in tax reporting: A signalling game, Unpublished manuscript, University of Illinois.

Becker, G.S., 1968, Crime and punishment: An economic approach, Journal of Political Economy 76, 169–217.

Benjamini, Y. and S. Maital, 1985, Optimal tax evasion and optimal tax evasion policy, in: W. Gartner and A. Wenig, eds., The economics of the shadow economy (Springer-Verlag, Berlin).

Besley, T. and J. McLaren, 1990, Tax compliance and corruption deterrence: The role of wage incentives, Unpublished manuscript, Princeton University.

Bhagwati, J., 1982, Directly unproductive, profit-seeking (DUP) activities, Journal of Political Economy 90, 988–1002.

Border, K.C. and J. Sobel, 1987, Samurai accountant: A theory of auditing and plunder, Review of Economic Studies 54, 524–540.

Cadot, O., 1987, Corruption as a gamble, Journal of Public Economics 33, 223–244.

Chander, P. and L. Wilde, 1990, Corruption in tax administration, Unpublished manuscript, California Institute of Technology, Pasadena.

Chander, P. and L. Wilde, 1992, A general characterization of optimal income taxation and enforcement, Social Science Working Paper 791, California Institute of Technology, Pasadena.

Chu, C.Y.C., 1990, Income tax evasion with venal tax officials – the case of developing countries, Public Finance.

Gordon, J.P.F., 1989, Individual morality and reputation costs as deterrents to tax evasion, European Economic Review 33, 797–805.

Goswami, O., A. Sanyal and I.N. Gang, 1990, Corrupt auditors: How they affect tax collection, Unpublished manuscript, Indian Statistical Institute, New Delhi.

Graetz, M.J., J.F. Reinganum and L.L. Wilde, 1986, The tax compliance game: Toward an interactive theory of law enforcement, Journal of Law, Economics and Organization 22, 1–32.

Kim, S.T. and J.H. Park, 1990, Tax evasion and bribery, Manuscript, Department of Economics, Chongju University.

Krueger, A.O., 1974, The political economy of the rent-seeking society, American Economic Review 64, 291–303.

Lui, F.T., 1986, A dynamic model of corruption deterrence, Journal of Public Economics 31, 215–236.

Melamad, N. and D. Mookherhee, 1989, Delegation as commitment: The case of income tax audits, Rand Journal of Economics 20, 139–163.

Mookherjee, D. and I. P'ng, 1989, Optimal auditing, insurance, and redistribution, Quarterly Journal of Economics 103, 399–415.

Mookherjee, D. and I. P'ng, 1991, Corruptible supervisors and law enforcers: How should they be compensated?, Business Economics, Working paper no. 90-23, University of California at Los Angeles.

Policy Group, The, 1985, Estimates of tax collection and evasion in response to the 1985–86 budget, Confidential memo, New Delhi, India.

Reinganum, J.R. and L.L. Wilde, 1985, Income tax compliance in a principal–agent framework, Journal of Public Economics 26, 1–18.

Reinganum, J.R. and L.L. Wilde, 1986, Equilibrium verification and reporting policies in a model of tax compliance, International Economic Review 27, 739–760.

Rose-Ackerman, S., 1978, Corruption, a study in political economy (Academic Press, New York).

Srinivasan, T.N., 1973, Tax evasion: A model, Journal of Public Economics 2, 339–346.

Virmani, A., 1987, Tax evasion, corruption and administration: Monitoring the people's agents under symmetric dishonesty, Mimeo. (Development Research Department, The World Bank, Washington, DC).