AUDIT HIERARCHY IN A CORRUPT ADMINISTRATION

Amal Sanyal

August 1998
Contents

1. Introduction .............................. 1
2. Truth-revealing encounter for a single-period or the short-run .............................. 1
3. Sustainability of Truth Revealing Equilibria ........................................ 4
4. Designing a Sustainable Truth-Revealing Equilibrium .................................. 5
5. Concluding Observations .............................................................................. 7

References ......................................................................................................... 9
1. Introduction

Recently there have been a number of theoretical contributions to the analysis of supervisory hierarchies. Bac (1996, 1996a) and Bag (1997) have analysed a model of monitoring a corruptible agent by a second agent within a principal agent framework. Earlier Chander and Wilde (1992) had analysed income tax evasion with corrupt auditors under a team of super-auditors.

In a corrupt environment however superauditors or supermonitors themselves are (potentially) corrupt, and need either an incentive to cooperate or to be monitored by another layer. Thus there is no a priori reason to expect that super-auditing would necessarily produce a higher payoff for the principal or, if it does, then, a single tier of superauditing is optimal. Modeling the problem with only one level of superauditors appears ad hoc unless it is shown that it generates the best payoff for the principal. Two obvious questions arise: (a) is a hierarchy necessary for revealing private information? and (b) is there an optimal level of hierarchy that generates the best payoff for the principal?

The present work addresses both issues in the context of income tax evasion. About the first it proves a rather strong result, namely that if rewards are related to the evasion detected by an auditor, then (i) no level of hierarchy, however large, can sustain truth-revealing in the long run, while (ii) no hierarchy is necessary in the short run. About the second issue we claim that (i) truth revealing equilibria can be sustained by tying up rewards to tax collection; and, (ii) there exists a level of hierarchy that maximises government’s net revenue. Bribe chains have been formally analysed earlier in Basu, Bhattacharya and Mishra (1992). Our analysis reinforces an important conclusion of that paper that a small reward can stop a large leak through bribes in a bribe chain, because individuals in a chain generally get a small fraction of total bribes. These results contradict the claim by Gangopadhyay, Goswami, and Sanyal (1991) that auditing with only one level of superauditors can generate truth-revealing equilibria. We argue that long-run aspects of the problem were not properly addressed in their argument.
2. Truth-revealing encounter for a single-period or the short-run

Assume:

(1) There are \( m \) levels of audit.

(2) Let \( p_l \) denote the probability that a taxpayer is audited, \( p_2 \) that a level 1 auditor is audited, \( \ldots \), and \( p_m \) that the \((m-1)\) level auditor is audited, \( 0 \leq p_l \leq 1 \).

(3) Let \( f_2 \) denote the proportional fine rate for first level auditors, \( f_3 \) that for the second level, \( \ldots \), and \( f_m \) that for the \((m-1)\)th level auditors. For symmetry of notation, we denote by \( f_i \) the tax plus fine \((= t + F)\) to be levied on taxpayers if caught cheating.

(4) The highest, ie the \( m \)th level is not monitored. Instead they are offered a reward \( R > 0 \), proportional to the amount of dishonest reporting of their immediate lower level auditors that they can find out.

(5) Auditors at all levels are potentially corrupt.

(6) Auditors and taxpayers act honestly if they are indifferent between cheating and honest action.

(7) All agents are risk neutral.

(8) In potential bribe negotiations gains or losses of agents are described by possible fines and rewards alone. There is no hidden asymmetry of bargaining positions of any agent.

(9) The proportional tax rate \( t \) is fixed by fiscal authorities, while the revenue administration can choose audit probabilities, \( p_i \) \((i = 1, 2, \ldots, m)\), fine rates \( f_i \) \((i = 1, 2, \ldots, m)\), and the reward rate \( R \). They thus have to choose \((2m + 1)\) variables.

Consider an auditor at the \( m \)th (highest level), and suppose she has detected false clearance given by an auditor at \((m-1)\) level involving amount \( Z \). A bribe negotiation between the two ensues. If \( b_m \) denotes the proportional bribe rate between these two agents, then gains upon successful negotiation of the \( m \)th level auditor is \((b_m - R)Z\), while that of the \((m-1)\) level auditor is \((f_m - b_m)Z\). Assuming symmetrical bargaining positions, a Nash bargaining solution sets \( b_m \) so that it maximises the product \((b_m - R)(f_m - b_m)Z^2\). This gives

\[
b_m = \frac{(f_m + R)}{2} \quad (1)
\]

Set

\[
f_m = R \quad (2)
\]
This makes $b_m = f_m$, which implies, from Assumption 6, that $(m-1)$ level auditors would pay fines rather than bribe their superiors if caught cheating.

Consider the similar game between an $(m-1)$ level and an $(m-2)$ level auditor. Because $(m-1)$ auditors will pay fines rather than bribe when caught, the game maximises $(f_{m-1} - b_{m-1})(b_{m-1} - p_m f_m)/2$ and yields

$$b_{m-1} = (f_{m-1} + p_m f_m) / 2 \quad (3)$$

Set

$$f_{m-1} = p_m f_m \quad (4)$$

This makes $b_{m-1} = f_{m-1}$, which implies, that $(m-2)$ level auditors would pay fines rather than bribe their superiors if caught cheating.

Following the same line of reasoning we have in general

$$b_i = (f_i + p_{i+1} f_{i+1}) / 2 \text{ for } i = 2 \text{ to } (m-1) \quad (5)$$

In general set

$$f_i = p_{i+1} f_{i+1} \quad (6)$$

This makes $b_i = f_i$, which implies, that $(i-1)$ level auditors would pay fines rather than bribe their superiors if caught cheating. In particular for $i = 2$, it implies that level $I$ (the lowest level) auditors would also pay fines rather than bribe those at level 2 if caught.

Now consider the bribe negotiation between an errant tax payer and a level $I$ auditor. It maximises $(f_1 - b_1)(b_1 - p_2 f_2)/2$ and yields $b_1 = (f_1 + p_2 f_2) / 2$. Set

$$f_1 = p_2 f_2 \quad (7)$$

This makes $b_1 = f_1$, which implies, that taxpayers would also pay fines rather than bribe level $I$ auditors if caught cheating.
Finally set

\[ p_i = t / f_i \]  \hspace{1cm} (8) \]

This makes tax paying and fine paying indifferent options for taxpayers leading to truth revealing, given assumption 6.

Equations (2) to (8) can be used to provide the following \((m + 1)\) conditions:

\[ f_m = R \]  \hspace{1cm} (9) \\
\[ f_{m-1} = p_m R \]  \hspace{1cm} (10) \\
\[ f_{m-2} = p_{m-1} p_m R \]  \hspace{1cm} (11) \\
\[ f_i = p_2 p_3 p_4 \ldots \ldots p_{m-1} p_m R, \]  \hspace{1cm} (12) \\
and, \[ f_1 = t / p_i \]  \hspace{1cm} (13)

Since the revenue administration has to choose \((2m + 1)\) variables, which are constrained by the \((m + 1)\) relations (9) to (13), they have only \(m\) degrees of freedom left. Without any loss of generality, we will assume that the administration chooses \(m\) audit probabilities \(p_i\).

By construction, any choice of \(p_i\) \((i = 1, 2, \ldots , m)\) along with the constraints (9) to (13) produces a truth-revealing equilibrium. Tax-payers find bribing no better than paying fines. But expected fine payment equals taxes constraining them to remain truthful. Because they are truthful, no bribes are generated. Auditors at level 1 cannot encourage evasion by tax-payers by offering to take a smaller bribe (than the Nash equilibrium rate) because they, when caught, will have to pay either a bribe or a fine equal to the Nash equilibrium rate. Nor can their superiors ease the situation by offering to take a lower bribe for same reasons, and so on upwards.

We should now remark that the value of \(m\) is of no consequence in this model (see below for a scheme where it matters). In particular, if \(m = 1\), then \(f_i = t / p_i\), \(R = f_i\) and any feasible \(p_i\) ensures truth-revealing equilibrium. In view of positive marginal cost of additional audit levels, \(m = 1\) is optimal.
3. Sustainability of Truth Revealing Equilibria

It is easy to doubt the sustainability of this scheme over a period of time. In truth-revealing equilibrium no tax-payer cheats, no auditor at levels 1 to \((m-1)\) misreports, and thus auditors at \(m\) level get no reward either. Income of \(m\) level auditors is lower than in cheating equilibrium. If the audit exercises are not just single period encounters, then \(m\) level auditors can increase their payoff through encouraging cheating and extracting bribes over repeated encounters. The only requirement for a cheating equilibrium to reappear is that the \(m\) level auditors ignore the reward. This seems eminently plausible. By convincing subordinates at level \((m-1)\) that they are willing to accept a bribe \(b_m < R = f_m\), they can make it feasible for the latter to take bribes from the \((m-2)\) level and so on down the hierarchy to the first level of auditors, inducing a cheating equilibrium. Since payoffs for auditors at all levels, and that of tax-payers are higher in any such cheating equilibrium, they are expected to co-operate.

For example, suppose \(m\) level auditors offer to accept \(b_m = q. f_m\), \(0 < q < 1\). Then using the difference equation (5) and the restriction (6), we can see that:

\[
\begin{align*}
    b_m &= f_m q \\
    b_{m-1} &= f_{m-1} (1 + q)/2 \\
    b_{m-2} &= f_{m} (3 + q)/4 \\
    \cdots \\
    b_1 &= f_1 \left(2^{m-1} - 1 + q\right)/2^{m-1}
\end{align*}
\]

implying that auditors at all level are better off than in truth-revealing equilibrium.

Also since \(b_l = f_l \left(2^{m-1} - 1 + q\right)/2^{m-1} < f_l = t/p_l\), tax-payers too are better off.
4. Designing a Sustainable Truth-revealing Equilibrium

One possible way out is to remove the incentive of \( m \) level auditors to defect from truth-revealing equilibrium by offering a share of income returned rather than cheating detected. The share is calculated as what they would have got in a cheating equilibrium. This should make \( m \) level indifferent between a cheating and a truth-revealing equilibrium, which given assumption 6, would ensure they refuse bribes. Unable to bribe, \((m-1)\) level would take a bribe from below if they can afford the fine when caught. Audit probabilities and fine rates are to be so set as to make this option unaffordable. Thus they would refuse bribes from below, and so on down to level 1. Finally taxpayers are to face an audit probability that makes expected fines equal to taxes.

In equilibrium \( m \) level has no incentive to undermine it. But unless they offer to take bribes, neither lower level auditors nor taxpayers can undermine it. The strategy is to concede a share to the top level to flush out the share held at other levels and by taxpayers.

Accordingly we now set \( R = 0 \), and the reward is replaced by an offer of share \( s \) (to be determined below) of the income reported in each \( m \) level auditor’s area. Additionally, to deter the possibility of cheating and then paying fines when caught, we impose \((m-1)\) restrictions:

\[
p_{f_i} = b_{i-1}
\]

for \( i = 2 \) to \( m \).

For taxpayers we similarly impose:

\[
p_{f_1} = t
\]

Starting from \( m \) level now,

\[
b_m = f_m / 2
\]
and in general

\[ b_i = (f_i + p_{i+1}b_{i+1}). \]  

(17)

Using equation (17) and restrictions (14), we can work out \( b_i \)'s in terms of \( f_i \)'s. Thus:

\[ b_{m-1} = (f_{m-1} + p_mb_m) / 2 = f_{m-1} / 2 + pmf_m / 4 = f_{m-1} / 2 + b_{m-1} / 4. \]

Therefore,

\[ b_{m-1} = (2/3)f_{m-1} \]  

(18)

By similar manipulation we have

\[ b_{m-2} = (3/4)f_{m-2} \]  

(19)

and in general,

\[ b_i = [(m-i+1) / (m-i+2)] f_i \quad \text{for} \quad i = 1 \text{ to } m \]  

(20)

In a cheating equilibrium the bribe extracted by some \( j \) th auditor at level \( i \) is \( p_1 p_2 ... p_i b_i Y^j \) if \( Y^j \) denotes income of taxpayers under the jurisdiction of this auditor via the chain of subauditors. Total bribe accruing to the \( k \) th auditor at level \( m \) is \( p_1 p_2 ... p_m b_m Y^{mk} \). We now set:

\[ s = p_1 p_2 ... p_m b_m \]

\[ = (t/f_1) (b_1/f_2) (b_2/f_3) (b_3/f_4) ...(b_{m-1}/f_m) (f_m/2) \]

\[ = t(b_1/f_1) (b_2/f_2) (b_3/f_3) ...(b_{m-1}/f_{m-1}) (1/2) \]

\[ = t [m/(m+1)] [(m-1)/m] [(m-2)/(m-1)] ... [2/3](1/2) \]

\[ = [t / (m+1)] \]

Thus in addition to salary (which may be zero), each \( m \) level auditor is offered a share \( s = [t / (m+1)] \) of the total income reported in her or his area of jurisdiction.

Given this additional feature, auditors at level \( m \) are assured of the same income in a truth-revealing and a cheating equilibrium. By assumption (6) they should report honestly. An auditor at level \( (m-1) \) would then take a bribe only if it is affordable to pay fines when caught.
This possibility being closed by (14), they would not take a bribe from \((m-2)\) level and so on down the line.

In this structure, too, the value of \(m\) is evidently not important for truth revealing as such. However it is important for government’s net revenue. Writing \(\pi\) for net revenue,

\[
\pi = (1-s)y - \pi_1 N c_1 - \pi_1 \pi_2 N c_2 - \ldots - \pi_1 \pi_2 \ldots \pi_m N c_m
\]

\[
= \frac{m}{(m+1))y - \pi_1 N c_1 - \pi_1 \pi_2 N c_2 - \ldots - \pi_1 \pi_2 \ldots \pi_m N c_m
\]

\(y\) is total income of all tax-payers, \(N\) the number of tax-payers and \(c_i\) unit audit cost at level \(i\).

Suppose the number of audit levels is increased from \(i\) to \(i+1\), and \(r_{i+1}\) denotes the resulting change in \(\pi\). Then we have:

\[
r_{i+1} = y/(i+1)(i+2) - \pi_1 \pi_2 \ldots \pi_{i+1} N c_{i+1}
\]

The first expression on the right hand side is the increase in the government’s share of tax revenue, which is positive but is decreasing in \(i\). The second expression is the increase in the cost of adding another layer of auditing. The optimum value of \(m\) can be found out by noting that net revenue increases as long as

\[
ty/(i+1)(i+2) > \pi_1 \pi_2 \ldots \pi_{i+1} N c_{i+1}
\]
5. **Concluding Observations**

We can summarise the conclusions in the following five propositions:

1. No hierarchy is necessary for truth-revealing equilibrium for one-shot encounters.
2. No hierarchy level however large can sustain truth revealing in repeated encounters if rewards are related to detection of evasion.
3. If rewards are related to tax collection, it is possible to design sustainable truth-revealing equilibria.
4. In such schemes, the number of levels is not important for truth revealing.
5. Number of levels is important for the net revenue of the government.

The basic intuition behind these results is quite simple. If rewards are linked to detection, then auditors are rewarded only as long as taxpayers evade taxes. If auditors take the reward seriously then their short-run payoff is maximised by reporting all evaders. But taxpayers soon learn that auditors refuse bribes and start returning income honestly, stopping the possibility of rewards for auditors. Thus auditors develop an incentive to undermine the scheme by taking bribes at rates that make tax evasion feasible, ie they ignore the reward scheme altogether.

The situation changes radically when the government offers auditors a share of tax. If the share is calculated to be no less than auditors' share in cheating equilibria, auditors are no worse off when they enforce a truth-revealing equilibrium. The government’s objective would then be to reduce the share offered to auditors, and this is achieved by increasing the number of levels in the audit hierarchy. Because in a cheating equilibrium, the share of evaded income accruing to an auditor falls as she is further away from the tax payer, it costs the government less to compensate a higher layer of auditors. This reinforces the observations made in Basu, Bhattacharyya and Mishra (1992) that a small reward can stop a large leak through bribes in a bribe chain, because individuals in a chain get only a fraction of total bribes. Of course, as we have argued, this consideration has to be weighed against the additional cost of another layer of auditors and auditing.
References


