DYNAMIC AUDITING

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No. 5 July, 1994

Abstract

In this paper we examine if, in a finite horizon problem, audit policies should be conditioned on the auditing status of the taxpayers or not. For a simple two period model with discrete income levels, we characterize the solution and establish conditions under which a state dependent audit policy is optimal. We also investigate the effects of an increase in the correlation between the income levels. Finally, we examine the case where the income levels are distributed continuously over an interval, and it is optimal to induce truthful reporting in the one-period problem. In this set-up we show that there always exists a state dependent audit policy that payoff dominates a simple repetition of the one period policy.

Keywords - State Dependent Auditing Policy, Discrete Income Distribution, Continuous Income Distribution, Correlated Income Levels, Mis-reporting.

JEL Classification No. - H21, H26.

1 Introduction

This paper addresses the problem of dynamic auditing policies. The basic question is whether auditing rules should be conditioned on the past reports and the auditing status of the taxpayers or not. Information regarding the dynamic properties of actual audit policies are, however, difficult to come by.[1] In this paper, therefore, we opt for a theoretical examination of the problem.

We follow the standard principal-agent paradigm in assuming that the tax department can commit to a auditing policy, not only for the present period, but over the whole planning horizon.[2] We start with a simple two period model, with a discrete, two valued income distribution. Consider a

[1]In the Indian context it has been reported that "the assessing officer pick(s) up the small minority of suspect cases that have acquired a certain amount of permanent notoriety in his charge. In other words, practically the same set of cases are selected each year." (See R. Mohan (1990), pp. 4.) In this case, however, the auditing officers are motivated by a desire to show quick results, rather than by any explicit cost-benefit calculus. (See R. Mohan (1990), pp. 4). Dasgupta *et al* (1992) reports that an examination of 22 scrutiny files in Bangalore and Delhi show some support for the belief that every year the same set of people are selected for scrutiny (pp. 58-59). However, past evasion history appears to have little bearing on the selection of cases. In a field survey it was found that none of the income tax officers mentioned past history as an important reason for the selection of scrutiny cases. (See Dasgupta *et al* (1992) pp. 55).

[2]In this we follow, among others, Reinganum and Wilde (1985) and Border and Sobel (1987). Articles which take the opposite viewpoint, i.e. those which assume that committing to auditing policies is not possible, include Graetz, Reinganum and Wilde (1986). Melumad and Mookherjee (1989) examine how the auditor can implement its full commitment policy if delegation is possible.

set-up where the taxation rates, as well as the penalty rates for tax evasion are exogenously determined by the government. We focus on the problem of the tax department, which determines an audit policy so as to maximize its net revenue. Solving for the optimal two period audit policy, we find that the results depend on whether auditing is optimal in the one-period problem or not. If it is, and if the audit costs are relatively high (in a sense made formal later in the paper), then the optimal dynamic policy is state dependent. Thus, in the second period, the individuals who reported a high income level in the first period, are exempted from auditing.

The basic idea of the dynamic policy is to reduce first period audit costs at the expense of reduced tax collection in the second period. Under this policy a report of high income in the first period is rewarded with an exemption from auditing in the second period. This increases the incentive for truth telling in the first period by the high income group, and, consequently, the audit probability in the first period can be reduced. For high level of audit costs, this reduction in audit costs payoff dominates the loss in revenue from audit exemption in the second period.

We then consider the case where auditing is not optimal in the one period problem. Again, for high levels of audit costs, the auditing policy is state dependent. In the second period, the optimal policy is to always audit those taxpayers who, in the first period, were audited and found to be guilty. In addition, those taxpayers who were not audited at all in the first period, may also be audited.

We also investigate how our results are affected if the income levels in the two periods are correlated. We find that if auditing is optimal in the one period problem, then an increase in correlation makes the state dependent policies less attractive. Otherwise, with an increase in correlation, the state dependent policy becomes more attractive.

Finally, we examine the case where the income levels are distributed continuously over an interval, and it is optimal to audit in the one period problem. We show that there always exists a state dependent policy which pay-off dominates a simple repetition of the one period strategy.

We then relate our paper to the existing literature on dynamic auditing. Greenberg (1984) examines the problem of tax evasion in an infinite horizon repeated game formulation. He demonstrates that state dependent audit rules can succeed in implementing outcomes that are arbitrarily close to the first best. The basic idea is to penalize repeat offenders with repeated auditing, so as to discourage fraudulent tax reports. Another paper that addresses a similar problem is by Landsberger and Meilijson (1982). They formulate a state contingent audit policy, where the individuals are subjected to varying probabilities of detection depending on whether the taxpayers, following an audit, were found to be honest or not.

Both these papers, however, are in the infinite horizon framework. Moreover, Greenberg (1984) does not allow for a positive rate of discount. Landsberger and Meilijson (1982) do allow for positive discounting, but impose some restrictive assumptions on the tax and the penalty function, as well as on the income distribution. Also, they do not solve for the optimal audit policy. More fundamentally, however, results in infinite horizon models typically convey little information regarding the *optimal* policies in a finite horizon framework.[3] Usually it is possible to impose various extreme penalties in infinite horizon models. These policies often have no counterparts in the finite horizon versions of the problems, and thus provide little insight as regards the finite horizon outcome. Our work thus seeks to extend the existing literature by analyzing the structure of dynamic audit policies under a finite horizon framework.

The rest of the paper is organized as follows. The case where the income is discretely distributed is dealt with in section 1. Section 2 takes up the case where the income is continuously distributed over an interval. Section 4 concludes.

2 The Model : Discrete Income Distribution

We consider a finite horizon model with two periods, denoted period 1 and 2 respectively. The income levels of the population can assume two values, Y_H (for high income) and Y_L (for low income), where $Y_H > Y_L$. Let Δ denote the difference $Y_H - Y_L$. The income levels in the two periods are independently and identically distributed across time, with probability λ for Y_H and $(1-\lambda)$ for Y_L.

The objective of the tax department is to maximize the collection of net

[3] We can mention, as an example, that the structure of optimal contracts in infinite horizon asymmetric information models provide little clue as to the optimal dynamic contracts in finite horizon contracting models.

revenue. To that end it decides on an audit policy which is contingent on the reported income and, perhaps, on the auditing status of the taxpayers. The tax department cannot influence the tax rates or the penalty for tax evasion, which are determined by the government. The taxation rule is proportional. For the high income group, the tax equals tY_H, and for the low income group, the tax equals tY_L, where t denotes the proportional tax rate. The penalty, which is proportional to the evaded tax, equals $ft\Delta$, where f denotes the penalty rate. Let the per unit audit cost be A and the common discount factor for the taxpayers, as well as the tax department be δ, where $0 < \delta < 1$.

To begin with, we consider the one period problem. Let the audit probability be μ, where $0 \leq \mu \leq 1$. Clearly, taxpayers with a high income would report truthfully provided the pay-off from truthful reporting is at least as much as that from reporting Y_L i.e. provided,

$$\begin{aligned} Y_H(1-t) &\geq Y_H - \mu(tY_H + ft\Delta) - (1-\mu)tY_L, \\ \text{or } \mu &\geq \frac{1}{1+f}. \end{aligned}$$

Clearly, the optimal policy is either to audit with probability $\frac{1}{1+f}$, or not at all. If the audit probability equals $\frac{1}{1+f}$, the high income group reports truthfully, but the tax department has to incur the audit costs. For $\mu = 0$, the audit costs are avoided, but only at the expense of lower tax collection from the high income group, who reports Y_L. Comparing the net revenue earned from the two audit policies we find that:

$$\mu = \begin{cases} \frac{1}{1+f}, & \text{if } \lambda t\Delta \geq \mu(1-\lambda)A, \\ 0, & \text{otherwise .} \end{cases}$$

We then consider the two period problem. Let us begin by introducing some notations. Let μ_1 and μ_2 denote the audit probabilities in period 1 and period 2 respectively. Then consider those taxpayers who report Y_L in the second period. We can divide them into four classes depending on their auditing status in the previous period.

H denotes the class of those taxpayers who reported Y_H in the first period.

NA denotes the class of those taxpayers who reported Y_L in the first period, and were not audited.

AA denotes the class of those taxpayers who reported Y_L in the first period, were audited, and found to be reporting truthfully.

AC denotes the class of those taxpayers who reported Y_L in the first period, were audited and found to be mis-reporting.

We then define the audit policies M and N as follows.

Policy M: In the first period, those who report a low level of income Y_L, are audited with probability $\frac{1-\lambda\delta}{1+f}$. In period 2, the taxpayers belonging to H, are exempted from auditing. The rest of the taxpayers are audited with probability $\frac{1}{1+f}$. Thus policy M involves,

$$\begin{aligned}
\mu_1 &= \frac{1-\lambda\delta}{1+f}, \\
\mu_2 &= \begin{cases} 0, & \text{for H,} \\ \frac{1}{1+f}, & \text{for NA, AA and AC.} \end{cases}
\end{aligned} \tag{1}$$

Policy N: In both period 1 and 2 those who report a low level of income are audited with probability $\frac{1}{1+f}$. Thus policy N involves,

$$\begin{aligned}\mu_1 &= \frac{1}{1+f},\\ \mu_2 &= \frac{1}{1+f}.\end{aligned} \tag{2}$$

Proposition 1 below characterizes the optimal audit policy for relatively low audit costs, so that auditing is optimal in the one period problem.

Proposition 1. *Consider the case where $\lambda t\Delta \geq \mu(1-\lambda)A$ i.e. in the one period problem it is optimal to audit and induce truthful reporting. Then the optimal audit strategy is either policy M or policy N. If $\mu(1-\lambda)A > \lambda t\Delta - \mu(1-\lambda)A$, then policy M is optimal, otherwise it is optimal to adopt policy N.*

Proof. First observe that the optimal strategy must involve truthful reporting by the high income group in period 1, because any strategy which involves mis-reporting in the first period is dominated by the repetition of the one period strategy i.e. by policy N.

Next, we argue that in the second period, it is optimal to audit the taxpayers belonging to NA, AA and AC with probability $\mu_2 = \frac{1}{1+f}$. It is clear that in the second period, for any taxpayer who reports Y_L, the audit probability should be either $\frac{1}{1+f}$ or 0. Suppose that for taxpayers belonging to AA, second period audit probabilities are zero. Consider the alternative strategy where the second period audit probability for AA is $\frac{1}{1+f}$. This would lead to an increased revenue in period 2. Also the period 1 incentives are not affected because in the first period the low income group was going to report Y_L anyway. Next consider the case where the second period audit probabilities are 0 for the group AC. In the alternative strategy where $\mu_2 = \frac{1}{1+f}$ for AC, second period revenues will not be affected as there will be no mis-reporting in equilibrium. However, since there is a greater incentive for truthful reporting in period 1, first period audit frequency can be reduced. The first period audit frequency must be strictly positive because the high income group would be lying otherwise. If $\mu_2 = 0$ for the taxpayers belonging to NA, then an identical change in the policy means that the second period pay-offs would increase and the audit frequency in period 1 can be reduced.

From the above, it is clear that for any alternative scheme, the second period audit probabilities must take the following form: $\mu_2 = 0$ for H and $\mu_2 = \frac{1}{1+f}$ for AA, NA and AC.

The required audit frequency in period 1 can be calculated by equating the high income group's pay-off from truthful reporting and mis-reporting. Pay-off from truthful reporting is $Y_H(1-t)+\delta[\lambda(Y_H - tY_L)+(1-\lambda)tY_L]$ and pay-off from mis-reporting is $Y_H - \mu_1(tY_H + ft\Delta) - (1-\mu_1)tY_L + \delta[\lambda Y_H(1-t)+(1-\lambda)Y_L(1-t)]$.

Equating the pay-offs for the two cases, we obtain

$$\mu_1 = \frac{1-\lambda\delta}{1+f}. \tag{3}$$

This is nothing but policy M. Under this policy the high income group is going to report truthfully in the first period. The first period gain in pay-off through reduced auditing is $(1-\lambda)(\mu - \mu_1)A$. The loss in pay-off through not auditing H is equal to $\delta\lambda\{\lambda t\Delta - (1-\lambda)A\}$. Thus the tax department opts for policy M provided,

$$\begin{aligned}(1-\lambda)(\mu-\mu_1)A &> \delta\lambda\{\lambda t\Delta-(1-\lambda)A\},\\ \text{i.e. } \mu(1-\lambda)A &> \lambda t\Delta-\mu(1-\lambda)A. \qquad (4)\end{aligned}$$

■

The basic idea of the alternative scheme is to reduce first period audit costs at the expense of reduced tax collection in period 2. A report of Y_H in period 1 is rewarded with an exemption from auditing in period 2. This increases the incentive fo truth telling in period 1 by the high income group. Consequently, the audit probability in period 1 can be reduced. Hence we have that the first period audit probability, $\frac{1-\lambda\delta}{1+f}$, is less than $\frac{1}{1+f}$, the audit probability for the one period problem. Whether this trade-off is profitable for the tax department depends on the parameter values.

A decrease in t or Δ increases the attractiveness of the state dependent policy vis-a-vis the repetition policy, as does an increase in A. Both these changes increase the potential gains from reduced auditing, wh e reducing the cost of tax losses in period 2, both of which increase the relative attractiveness of the state dependent policy.

In the above analysis, we assume that the penalty for tax evasion do not increase if the offense is repeated. We then briefly consider the case where $f_R > f$, where f_R is the penalty rate in case of repeated tax evasion.[4] We find that this makes no difference to our analysis. A higher penalty for repeat offenses allows a lower audit rate for AC in

[4]In Australia, for example, filing of fraudulent tax returns are penalized at differential rates depending on past conviction records. For providing false or misleading i rmation,

period 2. In equilibrium however, there is going to be no mis-reporting, thus the lower audit costs do not matter.

We then consider the case where $\lambda t\Delta < \mu(1-\lambda)A$ i.e. in the one period case it is optimal not to audit. To begin with, we define three audit policies A, B and C. We are going to show that the optimal policy, in this case, must be one of the above three.

Policy A: In period 1 those who report a low level of income are audited with probability $\frac{1-\lambda\delta}{1+f}$. In period 2, the taxpayers belonging to NA and AC are audited with probability $\frac{1}{1+f}$. The rest of the taxpayers are not be audited. So under policy A we have:

$$\begin{aligned} \mu_1 &= \frac{1-\lambda\delta}{1+f}, \\ \mu_2 &= \begin{cases} \frac{1}{1+f}, & \text{for NA and AC,} \\ 0, & \text{otherwise.} \end{cases} \end{aligned} \tag{5}$$

Policy B: In period 1 those who report a low level of income are audited with probability $\frac{1}{1+f+\lambda\delta}$. In period 2, the taxpayers belonging to AC are audited with probability $\frac{1}{1+f}$. The rest of the taxpayers not audited at all. Thus policy B involves:

$$\begin{aligned} \mu_1 &= \frac{1}{1+f+\lambda\delta}, \\ \mu_2 &= \begin{cases} \frac{1}{1+f}, & \text{for AC,} \\ 0, & \text{otherwise.} \end{cases} \end{aligned} \tag{6}$$

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first offenders are penalized upto a maximum of 2000 Australian dollars, while repeat offenders may be penalized upto a maximum of 4000 Australian dollars. Similar differential rates exist in New Zealand as well. (See National Tax Research Center (1987)).

Policy C: Audit probabilities are zero in both the first and the second period. Thus under policy C we have that:

$$\begin{aligned} \mu_1 &= 0, \\ \mu_2 &= 0. \end{aligned} \tag{7}$$

Proposition 2 below characterizes the optimal policy in the case where audit costs are high, in the sense that auditing is not optimal in the one period problem.

Proposition 2. *Consider the case where $\lambda t\Delta < \mu(1-\lambda)A$ i.e. in the one period case it is optimal not to audit. The optimal policy can only be one of the three, policy A, B or C. Depending on the net revenue any one of the three might be optimal.*

Proof. Observe that any alternative scheme must involve truthful reporting in the first period. Otherwise, a repetition of the one period strategy, i.e. policy C, would dominate that scheme. This implies that for any alternative scheme there cannot be a zero level of auditing in period 1. Because, then we would have mis-reporting in the first period.

Since any alternative scheme must involve truthful reporting in the first period, it is optimal to audit taxpayers belonging to AC with probability $\frac{1}{1+f}$ for AC. As the equilibrium does not involve any mis-reporting, this does not lead to any loss of revenues in the second period, while the incentive for truthful reporting in the first period is enhanced.

Also observe that for taxpayers belonging to H, the optimal solution must involve a zero level of auditing. Suppose to the contrary that the audit probability is $\frac{1}{1+f}$. If taxpayers belonging to H are not audited at all, then the second period revenues for the tax department would increase. Moreover, the incentive to report truthfully in period 1 would increase and thus the first period audit probability can be reduced.

For taxpayers belonging to AA as well, the alternative scheme must involve no auditing, as this does not affect the incentives for truthful reporting in any way, and is also superior from the viewpoint of the second period revenues.

Thus there are two possible alternative audit strategies:

(i) $\mu_2 = \frac{1}{1+f}$ for AC and NA, and $\mu_2 = 0$ otherwise, and

(ii) $\mu_2 = \frac{1}{1+f}$ for AC and $\mu_2 = 0$ otherwise.

Notice that case (i) and case (ii) correspond to policy A and B respectively. We consider the two cases by turns.

Case (i). Denote the first period audit probability in this case by μ''. The pay-off from truthful reporting is $Y_H(1-t)+\delta\{\lambda(Y_H-tY_L)+(1-\lambda)Y_L(1-t)\}$ and the pay-off from mis-reporting is $Y_H - \mu''(tY_H + ft\Delta) - (1-\mu'')tY_L + \delta\{\lambda Y_H(1-t) + (1-\lambda)Y_L(1-t)\}$.

Equating the pay-offs we find that,

$$\mu'' = \frac{1-\lambda\delta}{1+f}.$$

The tax department's gain compared to the repetition strategy is $\lambda t\Delta - \mu''(1-\lambda)A$. However in the second period the tax department makes losses by auditing the NA an amount equal to $\delta(1-\lambda)(1-\mu'')\{A(1-\lambda)\mu - \lambda t\Delta\}$.

Thus there is a net gain compared to the repetition strategy provided,

$$\lambda t\Delta - \mu''(1-\lambda)A > \delta(1-\lambda)(1-\mu'')\{A(1-\lambda)\mu - \lambda t\Delta\}. \qquad (8)$$

Case (ii). Let us denote the first period pay-off in this case by μ'. Pay-off from truthful reporting is $Y_H(1-t) + \delta\{\lambda(Y_H - tY_L) + (1-\lambda)Y_L(1-t)\}$ and pay-off from reporting falsely is $Y_H - \mu'(tY_H + ft\Delta) - (1-\mu')tY_L + \delta\{\lambda\mu' Y_H(1-t) + \lambda(1-\mu')(Y_H - tY_L) + (1-\lambda)Y_L(1-t)\}$.

Equating the two pay-offs we obtain that,

$$\mu' = \frac{1}{1+f+\lambda\delta}.$$

Clearly, the tax department's gain in period 1 is $\lambda t\Delta - \mu'(1-\lambda)A$ which is the gain from honest reporting minus the cost of auditing the those who report a low level of income. In period 2, there is no change in the pay-off as under this policy there is no mis-reporting in the first period. Thus there is a net gain provided,

$$\lambda t\Delta - \mu'(1-\lambda)A > 0. \tag{9}$$

Thus depending on which of the three schemes yield a greater pay-off the tax department will choose its strategy. ■

In both policy A and policy B the basic idea is to induce truthful reporting by the high income group in period 1, at the cost of incurring losses in period 2 through auditing. Through a threat of auditing in the second period, truthful reporting in the first period can be induced with a lower level of auditing compared to that in the one period problem. Recall that $\mu_1 = \frac{1-\lambda\delta}{1+f}$ in policy A and $\mu_1 = \frac{1}{1+f+\lambda\delta}$ in policy B. Thus, under both policy A and B, μ_1 is lower compared to that for the one period problem. In policy A both the NA and the AC are threatened with auditing in the second period, whereas policy B involves auditing the AC alone in the second period. Consequently the second period losses would be greater for policy A. As a compensation the audit probability for policy A would be lower in the first period as the incentive for truthful reporting is greater in policy A. Which of the three policies are selected would depend on their net revenue earning potential.

Any parametric change that increases the tax revenue and hence increase the value of truthful reporting in the first period, e.g. increases in Δ or t, would increase the attractiveness of both policy A and B. While on the other hand, an increase in A would reduce the attractiveness of these schemes since it increases the cost of auditing in period 1, as well as in period 2.

Next we consider the case where the income levels in the two periods are correlated. If an individual has an income Y_i in period 1 then we assume that with probability α his income is going to be Y_i in period 2 and with probability $(1-\alpha)$ nature is going to select according to the distribution $\lambda, (1-\lambda)$. Therefore α can be taken to be a parameter of correlation. For $\alpha = 0$ we have zero correlation and for $\alpha = 1$ we have perfect correlation.

In this set-up we ask the following question. Will the pay-offs from the state dependent strategies increase or decrease when there is an increase in the correlation between the two periods? The pay-offs from the repetition strategies are, of course, not affected by this change. We find the answer depends on whether, in the one period problem, it is optimal to audit or not.

Clearly, the probability of income being high in the second period when it was high in the first period is given by $\lambda_\alpha = \alpha + \lambda(1-\alpha)$ and the probability of the income being low when it was high previously is $1-\lambda_\alpha = (1-\lambda)(1-\alpha)$.

First we consider the case where it is optimal to audit in the one period problem. Arguing as before we can show that the only possible optimal scheme must be of the form policy M. Again equating the pay-offs from truthful reporting and mis-reporting we find that,

$$\mu_1(\alpha) = \frac{1 - \delta\lambda_\alpha}{1 + f}.$$

Obviously, $\frac{\partial \mu_1(\alpha)}{\partial \alpha} = -\frac{\delta(1-\lambda)}{1+f} < 0$.

Calculating the tax department's gain we find that it would choose policy M provided,

$$(1 - \lambda)\lambda_\alpha \mu A > \lambda[\lambda_\alpha t\Delta - (1 - \lambda_\alpha)A].$$

Collecting terms we find that the gain equals $\lambda A + \lambda_\alpha[-A\lambda - \lambda t\Delta - A\mu(1 - \lambda)]$. Since the term within brackets is negative, the net gain from the state dependent policy decreases with an increase in correlation.

Next we consider the case where $\lambda t\Delta < \mu(1 - \lambda)A$ i.e. auditing is not optimal in the one period problem. Here we restrict attention to the case where it is optimal to follow policy B. Comparing the pay-offs from truthful reporting and [illegible]ing we find that,

$$\mu'(\alpha) = \frac{1}{1 + f + \delta\lambda_\alpha}.$$

Clearly, $\frac{\partial \mu'(\alpha)}{\partial \alpha} = -\frac{\delta(1-\lambda)}{(1+f+\delta\lambda_\alpha)^2} < 0$.

In this case the excess pay-off from this policy over the repetition policy equals $\lambda t\Delta - \mu'(\alpha)(1 - \lambda)A$ which is always positive.

The above arguments can be summarized in Proposition 3.

Proposition 3. *(i) Suppose that auditing is optimal in the one period problem, and that in the two period case, it is optimal to follow policy M.*

Then an increase in the correlation between the periods makes the state dependent strategy less attractive i.e. there is a fall in the expected pay-off from the state dependent strategy.

(ii) Suppose that auditing is not optimal in the one period problem, and that, in the two period case, it is optimal to follow policy B. Then an increase in α makes policy B more attractive i.e. it leads to an increase in the pay-off from the state dependent strategy.

The intuition is as follows. In the case of Proposition 3(i), the idea is to make the truthful reporting of Y_H in period 1 more attractive. The incentive comes from exempting taxpayers belonging to H from auditing in period 2. An increase in correlation have two effects. First, this increases the magnitude of the loss from tax exemption. Secondly, the required audit intensity in the first period would be reduced. In equilibrium, the first effect dominates the second, so that policy M becomes less attractive. In the case of Proposition 3(ii), the alternative scheme relies on threatening to audit AC i.e. those who lied and were caught. This leads to a reduction in the period 1 audit frequency. Since, in equilibrium, mis-reporting do not take place, the threat is never implemented. An increase in correlation, however, leads to a reduction in the first period audit probability, making policy B more attractive.

3 Continuous Income Distribution

In this section we consider the case where the income level is distributed continuously over the interval $[\underline{Y}, \overline{Y}]$ according to the distribution $F(y)$. Assume that the density function is $f(y)$.

To begin with we consider the one period problem. Arguing as before it is easy to see that the tax department's policy is as follows:

$$\mu = \begin{cases} \frac{1}{1+f}, & \text{if } t\int_{\underline{Y}}^{\overline{Y}} y dF(y) - \overline{\mu} A \geq t\underline{Y}, \\ 0, & \text{otherwise,} \end{cases}$$

where $\overline{\mu} = \frac{1}{1+f}$.

We then turn our attention to the two period problem. Let us assume that the audit costs are not too high in the sense that, in the one period problem, it is optimal to induce honest reporting. We demonstrate that there always exists a state dependent policy which pay-off dominates a simple repetition of the one period strategy.

The basic idea of Proposition 4 is as follows. We partition the interval into two sub-intervals E and F, where E= $[\underline{Y}, Y']$ and F= $[Y', \overline{Y}]$. Taxpayers belonging to F who, in period 1, were audited and found to be honest, are exempted from auditing in the second period. The rest of the taxpayers would be audited with probability $\frac{1}{1+f}$. This provides an incentive for truthful reporting in period 1 among the taxpayers in income class F. Hence, in period 1, a lesser degree of auditing would do. We compare the pay-off from this policy with the pay-off that accrues from simply repeating the one period strategy. It is observed that in the limit, as Y' is taken close enough to $\overline{Y}$, the state dependent strategy pay-off dominates the repetition strategy.

Proposition 4. *If $\int[y(1-t)-\overline{\mu}A]dF(y) \geq 0$, then there exists some state dependent strategy which pay-off dominates a simple repetition of the one period strategy.*

Proof. Partition the interval into two sub-intervals E and F, where E= $[\underline{Y}, Y']$ and F= $[Y', \overline{Y}]$. Define $\Delta' = \overline{Y} - Y'$. Consider the following strategy: In period 1 the taxpayers belonging to E and F are audited with with probability $\frac{1}{1+f}$ and $\frac{\Delta'}{\Delta'(1+f)+\delta\int(x-\underline{Y})dF(x)}$, respectively. Let $\mu' = \frac{\Delta'}{\Delta'(1+f)+\delta\int(x-\underline{Y})dF(x)}$. In the second period the strategy is as follows: Taxpayers belonging to F are exempted from auditing provided they were audited and found to be honest in the first period. The rest of the taxpayers are audited with probability $\frac{1}{1+f}$.

The first period audit probability for F is obtained by equating the pay-off from truthful reporting with that from reporting Y' for the income level $\overline{Y}$. The pay-off from truthful reporting is $\overline{Y}(1-t)+\delta(\int xdF(x)-\mu' t\underline{Y}-(1-\mu')t\int xdF(x))$ and the pay-off from mis-reporting Y' is $\overline{Y}-\mu'(t\overline{Y}+ft\Delta')-(1-\mu')tY'+\delta\int x(1-t)dF(x)$.

This implies that those with income $\overline{Y}$ are not going to under-report. It can be verified that for any lower income level also mis-reporting will not occur.

Calculating the tax department's gain from this scheme, as compared to a repetition of the one period scheme, we find that, in period 1 there is a gain of $(1-F(Y'))(\overline{\mu}-\mu')A$. In the second period however, there is a loss of $\delta\mu'(1 - F(Y'))[\int[x(1-t) - \overline{\mu}A]dF(x)]$. Thus the net gain equals $(1 - F(Y'))[(\overline{\mu} - \mu')A - \delta\mu' Z]$, where $Z = \int[x(1-t) - \overline{\mu}A]dF(x)$. Hence there is a positive gain provided,

$$(\overline{\mu} - \mu')A > \delta\mu' Z. \tag{10}$$

Substituting for $\overline{\mu}$ and μ', and manipulating, the left hand side of equation (10) reduces to $\frac{\delta\mu'\overline{\mu}Ax}{\Delta'}$, where $X = \int(x - \underline{Y})dF(x)$. Thus equation (12) simplifies to

$$\overline{\mu}AX > \Delta' Z. \tag{11}$$

Clearly, for Δ' small enough, equation (11) is satisfied. ∎

At a first glance, Proposition 4 appears to contradict our analysis in the previous section where we argued that the optimality of state dependent strategies depends on the parameter values. A closer inspection, however, resolves this apparent paradox. Notice that in Proposition 1, a state dependent strategy is optimal if $\mu(1-\lambda)A > \lambda t\Delta - \mu(1-\lambda)A$. This condition is clearly satisfied if, *ceteris paribus*, λ is low enough. In Proposition 4, we essentially manipulate the partition to ensure that the size of group F is small enough. This is the analogue of the condition in the discrete case that λ is low enough, and thus Proposition 4 goes through.

4 Conclusion

This paper seeks to throw some light on the structure of dynamic audit policies. We find that there are two different incentives for pursuing a state dependent audit policy. If audit costs are not very high, so that auditing is optimal in the one period problem, then the state dependent audit policy essentially serves to reduce first period audit costs, by rewarding the truthful and high income taxpayers with a zero audit level in the second period. Thus, even in the absence of any informational asymmetry, something akin to a reputational effect may operate. The high income taxpayers may report truthfully in the first period, so as to build up a reputation and then, later on, take advantage of it by reporting falsely. If, however, audit costs are high, then the motivation for state dependent strategies lies in inducing truthful reporting in the first period, at the cost of incurring losses in the second period. Thus, somewhat paradoxically, the state dependent policies follow what we can call a 'carrots' strategy if audit costs are low, while in the presence of high audit costs, state dependent policies follow a 'sticks' strategy. This difference in the incentives also serves to explain why an increase in correlation between the income levels affect the incentives for state dependent policies differently in the two regimes. Consider the case where audit costs are not very high. If correlation increases, then, under the optimal state dependent strategy, the number of second-period-taxpayers belonging to H increases. Hence providing incentives for truthful reporting in the first period becomes more costly. We then consider the case where audit costs are relatively high and it is optimal to employ policy B. Then, as correlation increases, mis-reporting in the first period becomes more costly in terms of income foregone in the second period, hence the result.

We then notice that our analysis in section 3 suggests that, from a revenue point of view, state dependent audit policies make sense in most cases. At this point, however, a word of caution is in order. Scotchmer (1986) argues that inequities may arise if the auditor is able to divide the taxpayers into various income classes. Since the argument in Proposition 4 relies on dividing the income interval into two classes, the critique made in Scotchmer (1986) clearly applies to this policy as well. Thus, when looked at from a larger perspective, there is a need to balance the revenue objective against equity considerations when setting the audit policy.

Finally, notice that in this paper we strive for transparency, rather than generality of the results. Not surprisingly, one can think of several directions in which the model can be generalized. Let us mention, briefly, just two of them. First, one may want to solve for the case when there are more than two periods. Clearly, the analysis can quickly become very messy as, with the passage of time, the possible audit classes proliferate. One possible way of simplifying the analysis would be to assume that information regarding only the previous period is available, so that audit strategies can only be conditioned on the immediate past. Such an assumption clearly makes sense in the developing countries, where the information storage and retrieval systems are not very well developed.[5] Another contributing factor could be the policy of frequent transfer among tax officials. In India, for example,

[5]In case of India we can provide, as corroborating evidence, some selective quotes from Dasgupta *et al* (1992): (a) "In all ranges visited, especially in Bombay, space availability for storage of files, cupboard etc. were inadequate. Likewise availability of stationery and supplies was below requirement." (See pp. 27). (b) "Files examined by us, in almost all cases, were physically appalling." (See pp. 28). (c) "$\cdots$, since the file issue registrar is not properly maintained, files often cannot be traced." (See pp. 28).

it has been claimed that frequent transfers imply that "DCs, AOs, inspectors and other staff have little chance to familiarize themselves with local conditions and, therefore, cannot bring local experience to bear in making assessments."[6] One may also want to generalize the discrete model to the case where there are n types, rather than only two. We do not formally analyse either of these possibilities. It is our conjecture, however, that in both cases, results which are qualitatively similar to those developed earlier, should go through. Clearly, of course, the problem of dynamic audit policies is not very well understood and should repay further work.

Acknowledgement : I am grateful to Dilip Mookherjee for suggesting that I look into this problem. I would also like to thank Dilip Mookherjee and Arindam Dasgupta for their helpful comments.

[6]See Dasgupta *et al* (1992), pp. 114. Dasgupta *et al* (1992) also claim that in India, "..., the average duration of posting per office (of an income tax officer) was approximately 17 months". (See pp. 35).

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