The indirect effects of auditing taxpayers.*

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Abstract

In this paper we focus on the effects of investigations on tax compliance. Results from recent empirical studies suggest that the effects of audits are not only in terms of recovered unpaid tax, but there are also indirect effects in terms of future better compliance and spillover effects on the rest of the community. The evidence suggests that such indirect effects tend to outweigh the direct effect. However, even from a theoretical point of view, it is not clear what may drive these indirect effects. In a very general model we explain the direct and indirect effects of investigations and analyse how different assumptions on taxpayers' motivation towards compliance impact on their response to an increase in the probability of audit.

Keywords: tax evasion, social norm, opportunities to evade, optimal audit rule.

JEL: D81, H26, H30, K42.

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1 Introduction

Tax compliance is a major concern for the tax authority and the fight against tax cheating is a major commitment for all governments. Only limited resources are available to monitor taxpayers' behaviour, and the tax authority faces the difficult decision of how to allocate investigation resources among different groups of taxpayers and among all different manifestations of tax cheating. It is then crucial for the tax authority to understand how taxpayers are affected by audits, in order to design specific and effective audit rules.

The empirical evidence on the impact of audit rates on taxpayers' compliance suggests a positive impact of audits on taxpayers' behaviour, however, it is not very conclusive on its magnitude. As pointed out by Andreoni et al. (1998), who provide an overview of these studies, one major difficulty for the estimation of the effects of audits is endogeneity, in that there are unobserved (at least by the researcher) taxpayers' characteristics that affect both their behaviour and the likelihood of being audited, so that cheating and the probability of being audited are correlated. Some authors have attempted to control for endogenity by using instrumental variables, or two-stage least square regressions. One interesting aspect emerging from some of these studies, mostly based on US data, is the distinction between the direct and indirect effects of investigations. Tauchen et al.(1993), using individual level data from the 1979 Tax Compliance Measurement Program aggregated at district level to match with the audit data, estimate a reported income equation for four audit classes that differ by their total positive income and have non business source: low income (below \$10,000) , middle income (between \$10,000 and \$25,000), middle income (between \$25,000 and \$50,000) and high income (above \$50,000). Their findings suggest that audits stimulate higher income reports for all four groups but the effect is statistically significant only for the highest income group. According to the authors' calculations, the indirect yield from increasing the audit rate for high income wage and salary workers by one percentage point (from the 1979 level of 10.4 to 11.4), would be three times the direct revenue. However, there is no derivation of this result. Dubin et al. (1990), using the IRS budget per return filed and the information documents filed divided by the number of tax returns filed as instrumental variables for the audit probability, investigate the overall role of audits on declared tax. They use state level data for the period 1977-1986, when there was a sharp decline in the audit rate. The authors estimate the *spillover* effects of investigations, which they define as the "...increase in collections from taxpayers, whether or not they are audited, who report more taxes due in response to an increase in the likelihood of an audit". The authors use the estimated reported tax liability per return and total returns filed per capita to calculate, for each year, the predicted value of total reported tax from individual returns that would have been realised if the audit rate had remained constant at its 1977 level over the period

1977-1986. They estimate that maintaining the audit rate at its 1977 value, by 1986 total reported tax would have increased by 15.6 billion dollars. This value is the indirect effect or spillover effect of investigations. The predicted value for the increase in total assessed liability for 1986 from holding the audit rate to its 1977 value is 18.2 billion dollars. The difference between this figure and the predicted value of total reported tax (15.6 billion dollars) gives a direct revenue effect of 2.6 billion. Hence the ratio between indirect and direct effect is 6:1, i.e. the indirect effects of audits produce six out of every seven dollars of additional revenue. Plumley (1996) presents an econometric analysis on the determinants of voluntary compliance, using a very rich dataset by state and year, from 1982 through 1991. The author uses the percentage of the time that an auditor devotes to audits (Direct Examination Time, DET) and the average DET per audit as instruments for the audit rate. The estimation is on the effect of audits on reported Total Income, Total Offsets and Net Income (Total Income minus Offsets), controlling for tax policy measures (e.g. filing threshold, allowed exemptions), burden/opportunity variables (e.g. hours needed to complete a tax return, type of income), IRS enforcement measures (audit rate at the start of the period, information return matching program, non-filer notices, refund offsets and criminal tax convictions), IRS responsiveness (telephone assistance, return preparation services) and taxpayers' demographic and economic characteristics. The findings suggest that audits have a significant compliance effect and the indirect effects of an audit outweigh the direct effect. Plumley obtains an estimate for the ratio between indirect effects and direct effects in a similar way than Dubin et al. and gets a value of 11:1. The only UK study is by Mayston and Martin (1998), on the deterrent effects of VAT assurance visits on VAT non compliance. The authors use cross section data for 48,000 traders across the UK for the year 1996. In their study they calculate the *incremental* deterrent effect, which is the effect on the VAT return declarations that are made by traders who are not the subject of investigation of a one percentage change in investigations. This is estimated from the Net Additional Liability (NAL), i.e. the unpaid tax uncovered by assurance visits, under the assumption that assurance visits represent a sampling process of all traders within the same risk category, so that the NAL of visited traders can be expected to be at the same level for all traders with the same risk characteristics and other parameters (e.g. time since last visit). Their results suggest that a one percent increase in the probability of an audit to all traders induces a 0.55 per cent decrease in non-compliance of traders who haven't been investigated.

A comparison of the findings on the effects of audits on tax compliance from these studies is very difficult as they refer to different levels of data aggregation, to different time periods and different audit programs (random/operational audits). However, a common result is that the indirect effects tend to be much higher than the direct effect.

The fact that taxpayers may be affected by audits even if not directly involved in the assessment seems to be confirmed by surveys and laboratory experiments on taxpayers' attitudes towards non-compliance. Several studies show that individuals' (self-reported) compliance is correlated with their estimate of other individuals' compliance (e.g. Bosco and Mittone, 1997; De Juan et al., 1994; Webley et al., 1988). Torgler (2002) reviews experimental findings on tax compliance, which suggest that there are some interdependencies in individuals' decision of whether or not to evade and their perceptions of other taxpayers' evasion.

An important question we aim to address in this paper is whether we should expect the ratio of the direct over the indirect effects to be equal across different groups of taxpayers. If this is not the case, then there are important implications for the decision on how to optimally allocate investigation resources among different groups of taxpayers. More precisely, if the allocation of investigation resources is merely based on a direct yield:cost ratio from the different audits[1], any indirect effects in terms of better future compliance or spillover effects on the rest of the community are clearly not considered in the decision. If indirect effects tend to be much higher than the direct effects, then the decision will be suboptimal. One problem of focusing on direct yield is that the decision may be in the direction of allocating more resources to increase short-term yields at the expense of reducing the deterrent effect in the short/long run. In order to inform any policy change we need a better understanding of the determinants of these effects and of how these effects may vary across different groups of taxpayers. With this aim we formalise the concepts of direct and indirect effects of investigations, which seem to have been neglected by the theoretical literature. In the standard portfolio models[2] the tax authority sets the probability of detection, the tax rate and the fine rate independently from the taxpayer's decision. There is no interaction between the tax authority and the representative taxpayer and the tax parameters are fixed, chosen independently from taxpayers' behaviour. Later contributions have analysed, by use of game theoretical models, the interaction between taxpayers and the tax authority. The assumption made in those models is that the choice of the tax parameters depends on the extent of evasion, in that taxpayers' decisions have an impact on the tax revenues raised by the Government[3]. However these models consider the overall response of taxpayers to the audit policy, without distinguishing between direct and indirect effects. In a very general model, we derive the rule for the optimal allocation of resources across different groups of taxpayers and

[1]Actual targets for the different interventions to monitor compliance are set on such a ratio, at least in the UK and USA, as this is currently the only available measure of the effects of an audit.

[2]Allingham and Sandmo (1972), Yitzhaki (1974).

[3]See Reinganum and Wilde (1984),(1991), Graetz et al. (1986) and Cremer et al. (1990), Greenberg (1984).

identify the different elements that determine the direct and indirect effects of investigations. We then derive a formula for the ratio between indirect and direct effects. If the ratio were constant across different groups of taxpayers, there wouldn't be any need to know the values of the different components. However, we show that there is no reason to expect the ratio to be constant across different groups of taxpayers. The ratio depends on how intensively a given group of taxpayers is audited, on the effectiveness of investigations and on the behavioural elasticity of taxpayers. The first two factors do indeed vary across taxpayers, hence we can expect the ratio between indirect and direct effects to vary across different groups of taxpayers and fiscalities. This implies that measuring the single components of the ratio is very important for identifying the optimal allocation of investigation resources. For the elasticity of evasion it is very difficult to say whether it should vary or not across groups of taxpayers. The frequency and the effectiveness of investigations are outcomes under the control of the tax authority, whereas the elasticity of evasion is a measure of the taxpayers' behavioural response to audits, very hard to measure. The elasticity we obtain is a population elasticity. This elasticity may capture quite different aspects of individual behaviour. One important aspect, which could explain the existence of indirect effects, is the role of social interactions in a community of taxpayers: individuals who are not directly involved in a tax investigation could still be affected by the audit if their behaviour depends on the other members of the community. The experimental evidence seems to confirm this aspect, but how can we model a situation where the improved compliance by an audited taxpayer may translate in greater compliance at the level of the community? This is the second question we address in this paper. We model social interactions in terms of a non-monetary cost of being investigated, which depends on the number of honest taxpayers in the community. We show that the existence of such a cost can make tax compliance a self-enforcing behaviour, i.e. a social norm, in the relevant community. Moreover, the importance attached to the psychic cost and the impact that a change in the number of honest taxpayers has on the psychic cost are important determinants for overall voluntary compliance as well as for the response to an increase in the audit probability. In particular, the greater the impact of honest taxpayers on the psychic cost and the importance attached to this psychic cost, the greater the number of other taxpayers who will stop evading on the margin for a given increase in the audit rate. This can explain the existence of indirect effects: individuals might be affected by audits even if not directly investigated.

In the following section we derive a formalisation of the concepts of direct and indirect effect and separate out the different elements characterising the two concepts. Section 3 presents some simulations on the policy implications when different groups of taxpayers evade different amounts of tax and have different elasticity of evasion. The question we examine is whether it is always optimal to focus more resources on the group with the higher elasticity of evasion. In section 4 we compare the standard portfolio approach to the case of social psychic cost for being invetigated and show the impact of a rise in the audit rate on aggregate evasion. Finally section 5 concludes.

2 The indirect and direct effects of investigations

In this section we analyse the effects of an increase in the frequency of detection and derive an expression for the direct and indirect effects. We model the optimal allocation of investigation resources across different categories of taxpayers, when the enforcement agency has a fixed budget to carry out investigations. To reflect actual behaviour from the enforcement agency the model assumes that the enforcement agency's objective function is to minimise the tax gap, defined as the amount of evasion which is not recovered through investigations[4].

Let N_k be the number of taxpayers of type k, and E_k the average amount of evasion carried out by taxpayers of that type. The probability of being audited for taxpayers of type k is p_k. The total number of investigations carried out on taxpayers of type k is $I_k = p_k N_k$. We define the ratio of the average amount recovered per investigation of taxpayers of type k to the average amount of evasion per taxpayer of type k as θ_k[5]. The cost of carrying out such an investigation is c_k. We assume taxpayers differ in the frequency with which they are investigated and in each group their behaviour depends solely on the frequency of audit with which the group is targeted, via the function $E_k(p_k)$. There are m different types of taxpayer. We measure the responsiveness of taxpayers of type k to the audit rule in terms of the elasticity of evasion: $\varepsilon_k = -\frac{dE_k}{dp_k}\frac{p_k}{E_k}$.

We should note few points before proceeding.

- In the behavioural relationship adopted above we are not assuming that taxpayers necessarily correctly perceive the true frequency with which their group is inspected, just that there is some relationship between the actual frequency of inspection, the perceived frequency of investigation and behaviour. We are not modelling these

[4] This is the actual target (*Public Service Agreement target*) for HM Revenue and Customs.

[5] There are two factors bearing on the value of θ for any given group. First, for a variety of reasons the tax authority would not necessarily expect to recover in any particular investigation the full amount of tax that is actually evaded, which would suggest $\theta < 1$. On the other hand there may be a great deal of targeting of resources within group k so that investigations are devoted to the high end of the spectrum, in which case we could have $\theta > 1$. Also, if the enforcement agency is carrying out an investigation over multiple years, it might well be the case that $\theta > 1$. Which value of θ will apply in any circumstance depends on the heterogeneity of the group and the extent to which investigations are targeted on high yield or affect a long period of time. If the group is pretty homogeneous or if taxpayers are selected more or less at random, we would expect $\theta < 1$.

more fundamental relationships, but we just adopt a reduced form that relates behaviour ultimately to the actual frequency of inspection. So the elasticity defined above confounds two elasticities: the sensitivity of evasion behaviour to the perceived frequency of inspection and the sensitivity of the perceived probability of inspection to the actual frequency of inspection. It is important to distinguish between the two elasticities as they measure different aspects of the individual response to audits. They may also take very different values: an individual may be very sensitive to the perceived odds of being investigated, but the actual probability and perceived probability may be matched very poorly. Or the opposite might occur. Hence the weak response to investigations which emerges from some of the empirical studies using individual level data, could be compatible with a high sensitivity of evasion behaviour to perceived probability if perceive probabilities do not adjust precisely to a change in actual probabilities. Alternatively, a low response to audits could be due to a low sensitivity to perceived probability, even if the match between actual and perceived probability is perfect.

- It is also important to recognise that the elasticity defined above measures the average behavioural response of taxpayers in the same group. It is a population elasticity rather than an individual elasticity. This has two implications. First, this allows for considerable heterogeneity of individual sensitivity within the group. Secondly this is consistent with the possibility that taxpayer behaviour might not be based on a purely individualistic calculus but might be affected by the proportion of taxpayers within the group who are compliant, thus reflecting some kind of social norm at work. The advantage of very reduced form specification of individual behaviour that we have employed is that it is consistent with a wide range of deeper structural models.

- In principal behaviour will depend on many factors other than the probability of investigation. It will also depend on: the likelihood of the investigations being effective - and hence on θ_k; the likelihood that, if effective, a penalty will be imposed. Since here we are mainly interested in the allocation of investigation resources we do not consider these other behavioural factors, but recognise their presence through the fact that the elasticity can vary across groups.

- On the other hand we are not allowing for the possibility that the behaviour of taxpayers of type k depends on the frequency with which other groups are investigated - as might be the case if people's perceived probability of being investigated depends on what they hear from taxpayers in other groups about their experience.

- In this setting we focus purely on the number of investigations carried out. There is also an issue of the quality of investigations. What we might expect is that there is a quality continuum to investigations, and that higher quality investigations *(i)* require more resources C; *(ii)* recover a higher fraction of evasion θ, and, possibly, *(iii)* have a bigger impact on taxpayer behaviour, ε. It would be interesting to investigate what could be said about the optimal quality of investigations balancing off all these considerations. However, for the purposes of this paper, the assumption we make is that the quality of investigations - and hence C, θ, ε - is fixed, possibly because managers have already chosen the optimal quality. We are not ignoring quality and assuming that it is the cheapest, lowest cost type of investigation that should be pursued. So, once again, the reduced form model employed here is consistent with a deeper structural account of there being a spectrum of investigation technologies.

The total expected amount of evasion by taxpayers in group k is $N_k E_k$, while, if they are inspected with frequency p_k, then the total expected compliance yield from investigations will be $N_k p_k \theta_k E_k$. So the total tax gap from group k will be:

$$G_k = N_k E_k \{1 - p_k \theta_k\} \tag{1}$$

The cost of investigating taxpayers in group k is $c_k p_k N_k$. The objective of the enforcement agency is to select the frequency of an audit for each group of taxpayers in order to minimise the tax gap, subject to the constraint that only a limited amount of resources (C) can be devoted to investigations:

$$\min_{p_k} \sum_{k=1}^{m} \{N_k E_k [1 - p_k \theta_k]\} \qquad s.t. \sum_{k=1}^{m} c_k p_k N_k \leq C \tag{2}$$

The first order condition for an interior solution is:

$$N_k \left\{ \frac{dE_k}{dp_k} [1 - p_k \theta_k] - \theta_k E_k \right\} - \lambda N_k c_k = 0 \tag{3}$$

where λ is the Lagrange multiplier on the resource constraint, representing the marginal reduction in the tax gap that could be brought about by an additional unit of resources for investigations.

With a bit of re-arranging we can re-write (3) as:

$$\frac{E_k\theta_k - \varepsilon_k E_k\theta_k + \frac{\varepsilon_k E_k}{p_k}}{c_k} = \lambda \tag{4}$$

Equation (4) characterises the optimal allocation of investigation resources. The expression on the left hand side represents the ratio of the marginal reduction in the payment/tax gap brought about by a unit increase in the frequency of inspections for group k, to the marginal cost of a unit increase in the frequency of inspections for group k.

An optimal allocation of resources implies that the marginal benefit:cost ratio should be the same across groups of taxpayers. This common marginal benefit:cost ratio will measure the marginal benefit of increasing resources available for investigation by 1 unit. Equation (4) also tells us that the optimal allocation of resources is independent of the size of the population of taxpayers in group k. It is the average yield for taxpayers in group k that matters not total yield.

We are interested in the expression for the marginal reduction in the payment gap (MRPG), the numerator of equation (4). We can write this as:

$$MRPG_k = E_k\theta_k - \varepsilon_k E_k\theta_k + \frac{\varepsilon_k E_k}{p_k} \tag{5}$$

Equation (5) allows us to explain the direct and indirect effects of investigations. The expression shows that there are three effects to be considered.

The first term of equation (5) represents the immediate yield brought in from an extra investigation. If one extra investigation is carried out, since each investigation is expected to yield $E_k\theta_k$ on average, then this is what the enforcement agency expects to get from the extra investigation.

The second and third terms of equation (5) represent the behavioural response of all taxpayers to an increase in the frequency of audit. A reduction in the average amount of evasion by all taxpayers in group k , means that all investigations (and not just the additional one) will find that the amount brought in from each investigation is now a bit lower. This effect is measured by the term $\varepsilon_k E_k\theta_k$. However a reduction in the average amount of evasion also means that the tax gap is reduced. The term $\frac{\varepsilon_k E_k}{p_k}$ captures the (absolute) reduction in the average amount of evasion brought about by a unit increase in the frequency of investigations. It is inversely proportional to the frequency with which the group is investigated. The smaller the number of investigations that the enforcement agency currently carries out, the greater will be the percentage increase that one additional investigation will represent. This is the *compliance* effect of an increase on investigations[6]. So which of these are the direct effect and which the indirect effect? There are two

[6] We should note that here we are ignoring any timing issue, which is likely to affect the direct and the

possibilities. We can interpret the direct effect as the effect on yield, and hence consider the first two terms in equation (5) as the direct effect, or, and we believe this is more appropriate to reflect what we mean by direct and indirect effects, we can consider the direct effect as the immediate yield from investigations and the indirect effect as the behavioural impact of the actions of the tax authority. In this case the first term of equation (5) represents the direct effect and the second and third terms the indirect effect.

In the next subsection we derive the ratio between indirect and direct effects following from each of these two interpretations and consider how this analysis can help in clarifying the apparently contradicting figures emerging from the empirical studies we mentioned above.

2.1 The ratio between indirect and direct effects

For the calculation of the ratio between indirect and direct effects the simplest understanding would be to say that the direct effect is just the immediate yield brought in from an extra investigation, while the indirect effect is the effect of this activity on changing behaviour and hence compliance. So the ratio is :

$$R_{k1} = \frac{\varepsilon_k}{p_k \theta_k} \tag{6}$$

But this ignores the second term in equation (5). If we include the second term and say that the direct effect is about the effect of investigations on yield, whereas the indirect effect is about the effect on compliance, the ratio becomes:

$$R_{k2} = \frac{\frac{\varepsilon_k E_k}{p_k}}{E_k \theta_k - \varepsilon_k E_k \theta_k} = \frac{\varepsilon_k}{p_k \theta_k (1 - \varepsilon_k)} \tag{7}$$

Notice that because, compared to the first ratio, we have made the direct effect smaller and kept the indirect effect the same, we have $R_{k2} > R_{k1}$

On the other hand, if we say that the indirect effect is all about the behavioural impact of the enforcement agency actions, then we should consider the second and third terms of equation (5) as the indirect effect, in which case we get a third measure:

$$R_{k3} = \frac{-\varepsilon_k E_k \theta_k + \frac{\varepsilon_k E_k}{p_k}}{E_k \theta_k} = \varepsilon_k \left(\frac{1}{p_k \theta_k} - 1 \right) \tag{8}$$

effect in a different way, in that the behavioural response to an increase in the frequency of investigations is going to be observed later than the direct effect on the discovered evasion. For simplicity here we only consider one period, thereby modelling a steady state.

Because, relative to the first measure, we have now made the indirect effect smaller and kept the direct effect the same we have $R_{k1} > R_{k3}$[7]. As already anticipated our view is that the third ratio is the closest to capturing the spirit of what we mean by the direct and indirect effects.

The most important point is that, whatever the definition one adopts, there is absolutely no reason to think that this ratio is constant across fiscal areas. Indeed there is absolutely no reason to think that this ratio is going to be constant across different taxpayer groups within a fiscal area. For even if we thought that the behavioural elasticity, ε, was relatively constant across groups, the ratio depends on an operational/resource decision - how intensively to investigate taxpayers, p, and on the operational effectiveness of fraud investigations, θ, both of which will certainly vary both across and within fiscal areas. It's worth noting that a high ratio is consistent with a low behavioural response, if the coverage rate is sufficiently low.

What are the implications of this analysis on the allocation of resources across different groups of taxpayers?

3 Allocating investigation resources between two groups with different evasion elasticities: a simulation.

We consider two groups of taxpayers, 1 and 2. We assume that, for individuals in group 1, the entry condition for evasion is more restrictive than for individuals in group 2, hence average evasion is higher in group 2, $E_2 > E_1$.

In this setting the programme of the enforcement agency is:

$$\min_{p_1,p_2} N_1E_1(p_1)(1-p_1\theta_1) + N_2E_2(p_2)(1-p_2\theta_2)$$

$$s.t \quad C_1N_1p_1 + C_2N_2p_2 \leq C$$

The first order conditions are:

$$\frac{E_1\theta_1 - \varepsilon_1E_1\theta_1 + \frac{\varepsilon_1E_1}{p_1}}{C_1} = \lambda \tag{9}$$

[7] We derive these ratios under the assumption that the tax authority does not have enough information on how taxpayers differ in one group and hence cannot target specific taxpayers. This implies that the audit is random within a given group. However, as we show in the Appendix, under some general conditions, the above expressions are not greatly affected, even if we allow for the possibility that the tax authority can target investigation resources and select, within a given group, those taxpayers with higher expected evasion.

$$\frac{E_2\theta_2 - \varepsilon_2 E_2\theta_2 + \frac{\varepsilon_2 E_2}{p_2}}{C_2} = \lambda \tag{10}$$

The solution depends on the values of the parameters. In what follows we run two simulations, each with three scenarios with different parameter values. Table 1 presents our first simulation. For convenience we define group 1 as "individuals" and group 2 as "corporations". In the first scenario we assume that both groups have the same elasticity of evasion, ε, and the average amount of evasion in both groups, E, is observed and is substantially higher for corporations (100 times higher than for individuals). We derive the optimal probability of an audit, p, under the assumption that the functional form for the average evasion is $E_i = \alpha_i p_i^{-\varepsilon_i}$. The optimal coverage rate for individuals is 0.6% and for corporations 18.9%. This gives an aggregate enforcement resource allocation of £56m to individuals and £944m to corporations.

In scenario 2 we assume a much smaller value of the elasticity of evasion for corporations (0.1 instead of 0.5). This could be due to the fact that companies attach less importance to the social norm. All other parameters are the same as in scenario 1. The change to the allocation compared to scenario 1 is slight. The values for the audit probabilities are 0.7% for individuals and 18.7% for corporations and the allocation is £66m and £934m.

In scenario 3, where the evasion elasticity for corporations is reduced to 0.01, there is still little change. Over 93% of total resources are still allocated to corporations. This is because average evasion for corporations is so high relative to individuals that the direct effect of investigations always dominates the combined direct and indirect effects for individuals and most resources are optimally allocated to investigate corporations.

Simulation 1							
		Scenario1		Scenario2		Scenario3	
		Same epsilon		Corp less elastic		Corp much less elastic	
		Indivs	Corps	Indivs	Corps	Indivs	Corps
Assumptions	**N (million)**	9	1	9	1	9	1
	c	1000	5000	1000	5000	1000	5000
	theta	5	3	5	3	5	3
	elasticity of evasion	0.5	0.5	0.5	0.1	0.5	0.01
Choice var	**p**	**0.006214**	**0.188815**	**0.007355**	**0.18676**	**0.007708**	**0.1861248**
Dependent var	**E**	500	50000	460	50055	449	50007
Lagrangian term	**direct**	2500	150000	2298	150164	2245	150022
	2nd term	-1250	-75000	-1149	-15016	-1122	-1500
	3rd term	40231	132405	31241	26802	29119	2687
	indirect	38981	57405.02	30092	11785	27997	1187
	total	41481	207405	32390	161949	30242	151208
	lambda	41.481	41.481	32.38987	32.38987	30.24161	30.241613
Constraint	**Resource all. (m)**	**56**	**944**	**66**	**934**	**69**	**931**
	budget (m)	1000		1000		1000	

Table 1 - Simulation 1: optimal allocation of investigation resources within two groups of taxpayers with different elasticities of evasion.

In the second simulation, which is represented in table 2, the value of average evasion for corporations is reduced from 50,000 to 5,000 (only 10 times higher than for individuals). The elasticities and all the other parameter values in each scenario are the same as in our first simulation. In this case the share of the total resources allocated to corporations decreases from 54% to 38% from scenario 1 to scenario 2, and further to 23% in scenario 3. The greater indirect effect of investigations for individuals plays now a major role for the marginal reduction in the payment gap and the optimal allocation of resources is such that more resources are devoted to investigate individuals than corporations.

Simulation 2									
		Scenario1			Scenario2			Scenario3	
		Same epsilon			Corp less elastic			Corp much less elastic	
		Indivs	Corps		Indivs	Corps		Indivs	Corps
Assumptions	**N (million)**	9	1		9	1		9	1
	c	1000	5000		1000	5000		1000	5000
	theta	5	3		5	3		5	3
	epsilon	0.5	0.5		0.5	0.1		0.5	0.01
Choice var	**p**	**0.051179**	**0.107878**		**0.069283**	**0.075291**		**0.085776**	**0.0456034**
Dependent var	**E**	500	5000		430	5183		386	5043
Lagrangian ter	**direct**	2500	15000		2149	15549		1931	15130
	2nd term	-1250	-7500		-1074	-1555		-966	-151
	3rd term	4885	23174		3101	6884		2251	1106
	indirect	3635	15674		2027	5329		1286	955
	total	6135	30674		4176	20878		3217	16084
	lambda	6.13485	6.13485		4.175678	4.175678		3.216861	3.2168609
Constraint	**Resource all. (m)**	**461**	**539**		**624**	**376**		**772**	**228**
	budget (m)	1000			1000			1000	

Table 2 - Simulation 2: optimal allocation of investigation resources between two groups of taxpayers with different elasticitity of evasion.

In table 3 we consider how the optimal allocation of resources varies with the budget available to conduct investigations. The analysis is based on the parameters for simulation 2, scenario 2, gradually increasing the enforcement agency's budget constraint, from £1m to £5,000m. Initially most of the enforcement resources are put into individuals. For a budget of £1m, 95% of the resources are devoted to individuals and for a budget of £100m, still 87.4% of the resources go into individuals. However, owing to the strong deterrent effect of investigations, the average level of evasion for the individuals quickly decreases and it becomes advantageous to switch resources to companies, primarily in order to obtain the direct yield. For a budget of £ 2,500m there is a switch in the audit probability and resources from individuals to corporations.

Simulation 3							
	budget	p-indiv	p-corp	Res all.-indiv	Res all-corp	E-indiv	E-corp
	m	%	%	%	%	m	m
Scenario 2	*5000*	11.37	*79.5*	*20.5*	*79.5*	*335*	*4095*
Budget growth path	1	0.01	0.001	95	5	11010	12655
	10	0.11	0.01	**94.1**	5.9	3498	9887
	100	0.97	0.25	**87.4**	12.6	1148	7282
	1000	6.93	7.53	**62.4**	37.6	430	5183
	2500	9.94	32.1	**35.8**	**64.2**	359	4483
	5000	11.37	79.54	20.5	79.5	335	4095

Table 3 - Optimal allocation of investigation resources for different values of the enforcement agency's budget constraint.

We have considered the optimal allocation of investigation resources between two groups of taxpayers, one group where tax compliance assumes the characteristics of a social norm and the other group with no such considerations. The findings from our simulations suggest that the decision how to optimally allocate investigation resources depends on the average evasion and on the elasticity of evasion in each group. The higher the average evasion in one group, the more substantial the direct effect of investigations and the more resources should be allocated to that group. In fact the direct effect tends to outweigh the combined direct and indirect effect in the other group. In this case the elasticity of evasion has less of a role in the decision on how to target different groups of taxpayers. As the difference in the direct effect across groups of taxpayers gets smaller, evasion elasticities assume a more important role. The results also show that there are diminishing returns from investigations. If the audit probability is very low, the indirect effect is very high and the decrease in tax evasion induced by a rise in the audit rate is quite substantial. But as the audit rate keeps on increasing the marginal reduction in tax evasion gets smaller and smaller. This implies that as more resources become available for investigations, they shouldn't be constantly focused on the group where initially the marginal reduction in the payment gap was greater.

4 Taxpayers' response to an increase in the frequency of audits in the presence of a social psychic cost of being investigated

Many studies have shown the importance of preference heterogeneity, also in the area of tax compliance (Gächter, 2006). Several experiments indicate that some subjects are conditional cooperators, some are free-riders and some are compliant independently of any activities within the group or external interventions changing the parameters of the experiment. Frey (1997) shows that there are taxpayers who do not even search for ways to cheat at taxes. Ellfers (2000) argues that not everyone with "an inclination to dodge his taxes is able to translate his intention into actions". Frey and Torgler (2004), using data from the European Values Survey, perform a multivariate analysis across 30 countries and provide evidence on the relevance of conditional cooperation for tax morale. They show a positive correlation between people's tax morale (measured by a question whether cheating on tax is justified if you have the chance) and people's perceptions of how many others cheat on taxes. This is confirmed by Gächter (2006), who presents evidence from four lab experiments suggesting that people are less likely to cheat on their taxes or to commit benefit fraud if they have the impression that others behave honestly.

In this second part of the paper we are interested in analysing how the behavioural response to an increase in the probability of an audit is affected by the presence of social interactions, which we model in terms of a non-monetary social cost of being investigated.

We compare two settings: one in which tax compliance is simply an opportunistic behaviour, based on purely monetary considerations, which is the same approach as the standard portfolio model. We then consider the case where there is a psychic cost or reputational loss of being investigated, which assumes the characteristics of a social stigma, the magnitude of which depends on the behaviour of the other taxpayers. The greater the number of honest taxpayers the greater the social stigma of being investigated and hence the less inclined a single individual will be to cheat on his taxes. We analyse the effect of an increase in the frequency of investigations on the overall compliance in both cases.

In the analysis that follows we make the following assumptions:

- Risk neutrality. We analyse the taxpayer decision as a two-step decision: the taxpayer first decides whether or not to evade, by comparing the utility of non-evasion with the expected utility of evasion and then chooses the optimal amount of evasion. It can be shown that the decision whether or not to engage in tax evasion is not affected by the degree of risk aversion: tax evasion will be chosen whenever the probability of being detected is below a certain threshold, determined by the value of the fine and tax rate[8]. The degree of risk aversion affects the decision how much to evade. An increase in the probability of an audit will decrease the amount of evasion and will also induce some taxpayers to stop evading. As we shall consider, different assumptions on taxpayers' motivations will imply different entry conditions for evasion and these will also affect the impact of a change in the probability of detection, irrespective of the degree of risk aversion. Hence our results are not qualitatively affected by the assumption of risk aversion, which we make to keep notation simple and to focus on the effects of non monetary considerations and social interactions rather than attitudes towards risk.

- Audits are 100% successful: once an individual is investigated, any tax evasion that was taking place is detected, i.e. the probability of receiving an audit/investigation corresponds to the probability of being detected. This is the common assumption in the theoretical models on tax evasion.

- We keep the assumptions we made in section 2 and do not model taxpayers' perceptions of being audited: we just adopt a reduced form that relates individual behaviour to the actual frequency of investigations. Moreover, in terms of the model in section 2, we examine the behaviour of individuals belonging to the same group k and assume that only the probability of being investigated in group k (p_k) matters, i.e. audits rates in other groups do not have any spillover effects across groups.

4.1 Selfish calculus.

We first consider the setting of the standard portfolio model, where the taxpayer decides whether or not to evade on the basis of a selfish and purely monetary calculus.

4.1.1 Individual behaviour

We first focus our analysis at the individual level.

We define the utility from non evading for an individual with income y and facing a tax rate t as:

[8] This condition ensures that the expected utility from evasion is greater than the utility from non evasion. In an income-state dependent diagram this condition implies that the slope of the indifference curve at a point along the 45 degree line, $\frac{-(1-p)}{p}$, is more negative than the slope of the budget constraint $-(\frac{t-f}{t})$as in Allingham and Sandmo (1972) or $(1-f)$ as in Yitzhaki (1973) - so that the point of tangency between the indifference curve and the budget constraint must lie below the 45 degree line, thus implying a positive amount of evasion.

$$U^{NE} = y(1-t) \tag{11}$$

Let e, $0 \leq e \leq 1$, be the individual's opportunity to evade, i.e. the proportion of income that can potentially be hidden and $\widetilde{e}$, $0 \leq \widetilde{e} \leq e$, the actual proportion of income evaded. An individual is investigated with probability p, $0 < p < 1$, and in case of evasion he/she will need to pay back the taxes due and a monetary fine $F > 0$ on the amount of evaded income, $\widetilde{e}$ (as in Allingham and Sandmo, 1972). Hence the utility from evading is:

$$U^E = p[y(1-t) - F\widetilde{e}y] + (1-p)[(y - \widetilde{e}y)(1-t) + \widetilde{e}y] = y(1-t) + \widetilde{e}y[t(1-p) - pF] \tag{12}$$

An individual is willing to evade if $U^E > U^{NE}$. Hence tax evasion will occur whenever if $\widetilde{e}[t(1-p) - pF] > 0$. If $t(1-p) - pF > 0$ the expected financial gain from evading one extra unit of income is positive and the taxpayer will always evade to the maximum amount, so $\widetilde{e} = e$[9]. The expression $t(1-p) - pF$ is decreasing in F, so that there will be an $\overline{F}$ such that $t(1-p) - p\overline{F} = 0$. For this particular value of the fine rate the individual will be indifferent between evasion and non evasion. Hence, $\overline{F} = \frac{t(1-p)}{p}$ defines the critical value above which an individual will opt for full compliance, as, above $\overline{F}$, $t(1-p) - p\overline{F} < 0$ and tax evasion is not profitable on the margin. If taxpayers face the same tax parameters there will be a unique value of $\overline{F}$ above which *everybody* will evade, even if their income differs. Note, also, that the only way to affect the decision whether or not to evade is to vary $\overline{F}$. In this case, in fact, opportunities to evade are not affected by any of the tax parameters. Above $\overline{F}$ tax evasion will occur whenever $e > 0$[10].

4.2 Non-pecuniary loss for being investigated.

The act of being caught evading may imply some loss in reputation, or some psychic cost for feeling guilty or ashamed. This non pecuniary cost is very likely to differ across individuals: the loss of reputation for being caught evading may be higher for a corporation than for an individual or for a person with a high public profile. Similarly, the feeling of guilt or shame may be quite personal and differ across individuals, regardless of their occupation. We make the assumption that this loss in reputation or psychic cost depends on the number of people in the community who evade. The idea being that the larger the

[9]We should note that here both the probability of detection p and the fine rate F are fixed and do not depend on the amount of evasion. In reality both the frequency of an audit and the fine rate are positively related to the amount of concealed income. This may imply that tax evaders do not evade to the maximum extent of their possibilities.

[10]Whenever $e > 0$, $U^E > U^{NE}$, and an invidual will engage in tax evasion.

number of evaders in a community the lower the psychic cost of being caught. So, the total loss in case of detection is[11]:

$$f_i = F + \lambda_i C(1 - \mu)$$

where F is the monetary fine rate, as decided by the fiscal authority, $\lambda_i > 0$ is the importance attached by individual i to the non-pecuniary loss of being caught and $C(1-\mu)$ is the non-pecuniary cost of being caught, with μ being the proportion of evaders in the community. We assume $C'(\cdot) > 0$, to reflect the fact that the larger the proportion of honest taxpayers in the community, the larger the psychic cost of being caught. In our model, the interdependency between taxpayers is captured by the social stigma of being investigated. If there is a sufficiently high proportion of honest taxpayers in the community, the expected loss in reputation can be so substantial to deter tax evasion even if the expected monetary gain is positive. As we shall see, tax compliance may become in this case a self-enforcing behaviour, i.e. a social norm. Other authors have considered the interdependency between taxpayers. Gordon (1989) considers the case of a social stigma attached to the act of evading taxes, which is suffered irrespective of being detected: making a truthful declaration to the tax authority has a moral connotation and the higher the number of other honest taxpayers, the higher the social stigma of evading taxes. Myles and Naylor (1996) capture the influence of social interactions in the taxpayers' decision whether or not to evade in the framework of the social custom and conformity approach. In their model a social custom utility is derived when taxes are paid honestly, but is lost if evasion is chosen. Individuals also get an extra utility from conforming with the standard pattern of social behaviour. Hence the utility from non-evasion includes two extra arguments that were neglected in the standard portfolio model: a fixed gain from following the social custom and an extra gain from conforming to the other honest taxpayers, which depends on the number of honest taxpayers. Like in Gordon (1989), Myles and Naylor assume that there is a moral dimension in the act of behaving honestly. A truthful declaration brings non-monetary gains (or equally, tax evasion causes a non-pecuniary cost).

Our approach differs from both Gordon (1989) and Myles and Naylor (1996). In our model the moral connotation attached to tax compliance is less strong: it is only in case of detection that the individual suffers an extra psychic cost. The loss of reputation is not linked to the act of evading, but rather to the act of being caught. There is not necessary a personal conviction that paying taxes honestly is morally right, i.e. there

[11]Note that this non pecuniary cost is suffered in case of detection only, to reflect feelings of guilt or shame of prosecution with regard to the other members of the community and it is not a private cost incurred regardless of being investigated.

isn't a personal moral cost of evading. The psychic cost is rather due to the fact of being discovered evading, it is more a reputational cost than a personal moral cost. In line with the empirical evidence we mentioned above, suggesting that people's perceptions of how many others individuals cheat on taxes are important determinant for individual behaviour, we assume that this psychic cost is decreasing with the perceived number of cheaters in the community.

4.2.1 Individual behaviour

We normalise income to 1, to make notation simpler. For a single individual i, the utility from non evasion is

$$U_i^{NE} = (1 - t) \tag{13}$$

and the utility from evasion is:

$$U_i^E = p[(1-t) - f_i\widetilde{e_i}] + (1-p)[(1-\widetilde{e_i})(1-t) + \widetilde{e_i}] = (1-t) + \widetilde{e_i}[t(1-p) - pf_i] \tag{14}$$

The net expected total gain from evading one extra unit of income includes monetary and non-monetary considerations and becomes $t(1-p) - p(F + \lambda_i C(1-\mu))$, which is increasing in μ. As in the purely monetary fine case we considered above, there will be a threshold level $\overline{f_i}$ such that $t(1-p) - p(\overline{f_i}) = 0$,above which an individual will opt for full compliance. We shall assume that from a monetary point of view, evasion is always worth it, i.e. $F < \frac{t(1-p)}{p}$ and there is always an opportunity to evade, i.e. $\widetilde{e_i} > 0$, so that an individual would evade the proportion of income equal to his/her opportunity of evasion. Given that the expected total gain from evading one extra unit of income is increasing in μ, there will be a unique $\overline{\mu}$ such that the net expected marginal gain of tax evasion is zero, i.e. $t(1-p) - p(F + \lambda_i C(1-\overline{\mu})) = 0$. For given tax parameters and a given value attached to the importance of the reputational loss or psychic cost of being audited, values of $\mu > \overline{\mu}$ willl induce tax evasion, as for $\mu > \overline{\mu}$ the net expected marginal gain of tax evasion becomes positive.

We first notice that the threshold level $\overline{f}$ will vary across individuals depending on λ_i. This implies that it will be possible to observe some individuals opting for evasion and others being fully compliant even if they face the same tax parameters. A mixed equilibrium of evaders and non-evaders will be possible.

In figure 1 we represent the individual's decision whether or not to evade.

We represent the total fine $f = F + \lambda_i C(1-\mu)$ on the vertical axis, as a function of the proportion of evaders in the community, which is represented on the horizontal axis.

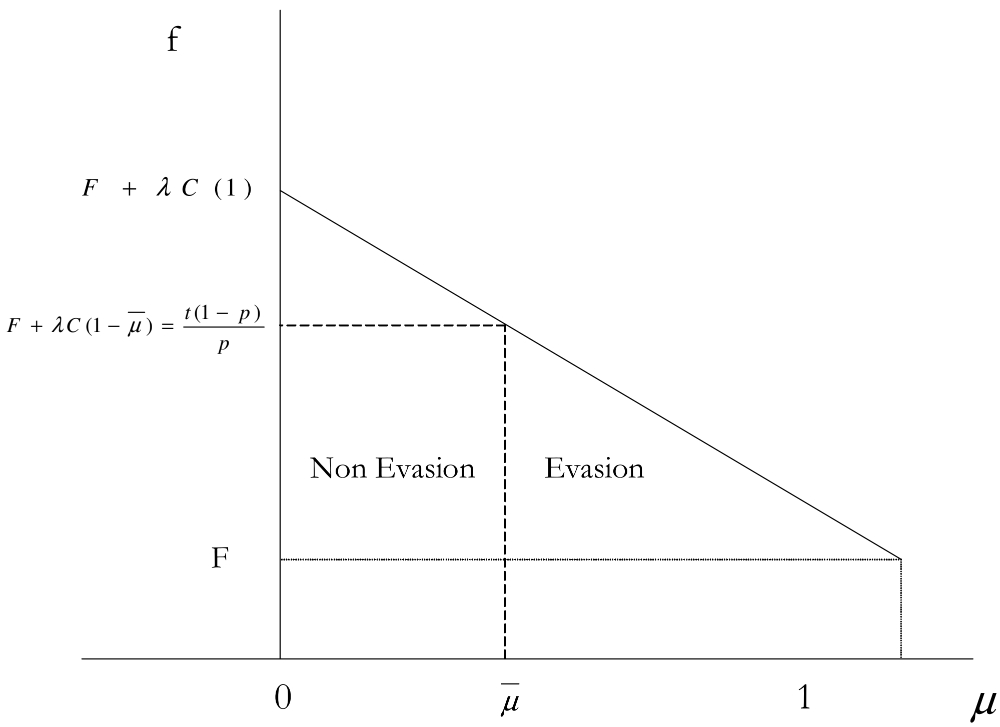

Figure 1: Tax evasion decision when there is a psychic cost of being caught

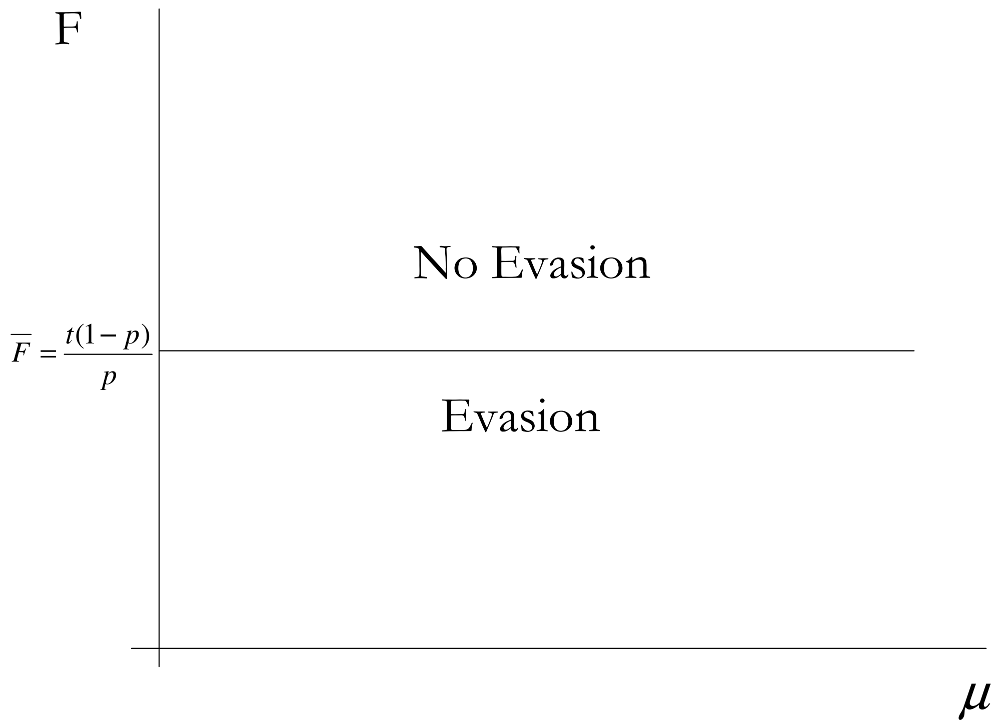

Figure 2: Tax evasion decision with a pure monetary cost of being detected.

The total fine is decreasing in the proportion of evaders. There will exist a $\overline{\mu}$ such that $f = \overline{f}$ and hence such $t(1-p) - p(F + \lambda_i C(1-\mu)) = 0$. At this point the individual will be indifferent between cheating and honestly declare his/her taxes. Above $\overline{\mu}$, the total expected cost of being detected will be lower than the expected gain of evading and the individual will be willing to evade. Hence $\overline{\mu}$ represents the critical proportion of tax evaders above which an individual would consider to evade.

If we compare this to the situation of the monetary fixed fine, we can see that the tax authority has now more tools to discourage tax evasion. In the case of a pure monetary fine, tax evasion could be discouraged only by altering the tax parameters and setting the fine rate above $\overline{F} = \frac{t(1-p)}{p}$, as illustrated in figure 2. When there is a psychic cost of being apprehended, the tax authority can discourage tax evasion by setting a lower monetary fine, as the fine and the psychic cost are substitutes in deterring tax evasion. If the government could implement policies to affect the psychic cost, for example by implementing educational programs to enhance the importance of the reputational loss (λ_i), it could have more margin to combat tax evasion.

4.2.2 The community

In our model opportunities to evade are exogenous, in that they are not affected by the tax parameters and the psychic cost. Given that we assume $\widetilde{e_i} > 0$, opportunities to evade only affect the total amount of evasion and not the number of evaders[12]. In what follows we concentrate on the total number of evaders rather than total evasion, so that we can simplify notation. Our results are not affected by the distribution of opportunities to evade across the population of taxpayers. We assume taxpayers differ in the importance attached to the non pecuniary fine for being audited λ_i. The density function for λ is $h(\lambda)$ and we assume it is continuous and that the support of $h(\lambda)$ is $[0, +\infty[$. As we have already defined $\overline{f}$ is the threshold level of the fine below which tax evasion is profitable. For given tax parameters and a given critical proportion of evaders, some individuals will have λ_i such that they will be above $\overline{f}$ and some will be below $\overline{f}$. The distribution of $h(\lambda)$ will determine how many individuals evade. We denote the value of λ_i such that $f = \overline{f}$ as $\overline{\lambda} = \frac{t(1-p)-pF}{pC(1-\overline{\mu})}$.

Let

$$m(\mu; F, p, t) = \int_0^{\overline{\lambda}(t,p,F,\overline{\mu})} h(\lambda)d\lambda = H\left(\overline{\lambda}(\cdot)\right) \tag{15}$$

be the proportion of taxpayers in the community that are willing to evade. Notice that

$$\frac{\delta m}{\delta \mu} = \left[\frac{\delta \overline{\lambda}}{\delta \mu} h(\overline{\lambda})\right] \geq 0 \tag{16}$$

since $\frac{\delta \overline{\lambda}}{\delta \mu} = -[t(1-p) - pF][pC(1-\mu)]^{-2}[pC\prime(1-\mu)(-1)] > 0$. Notice that

$$m(1; F, p, t) = \int_0^{\infty} h(\lambda)d\lambda \tag{17}$$

which is independent of λ, though, for $\mu < 1$ an increase in λ will make the entry condition for evasion more restrictive, hence will lower m. The equilibrium value of μ, $\widehat{\mu}$, is given by

$$\widehat{\mu} = m(\widehat{\mu}; F, p, t) = H\left(\overline{\lambda}(\widehat{\mu})\right) \tag{18}$$

It occurs when the distribution of the importance attached to the psychic cost is such that, if every individual faces the same proportion of evaders $\widehat{\mu}$, the actual proportion of evaders in the whole economy, $m(\widehat{\mu}; F, p, t)$, will be just $\widehat{\mu}$, i.e. $\widehat{\mu}$ is a fixed point for $m(\widehat{\mu}; \cdot)$. In other words, an equilibrium in the whole community occurs when, given the

[12] In fact, if $\widetilde{e_i} > 0$, the entry condition for tax evasion is not affected by opportunities to evade.

actual proportion of tax evaders in the population, no one has an incentive to switch from evasion to non-evasion, or vice versa.

We now check what types of equilibria there might exist.

a) Zero evasion equilibrium

It is easily seen that an equilibrium with zero evasion will not be possible as:

if $\widehat{\mu} = 0$, then $\overline{\lambda}(0) = \frac{t(1-p)-pF}{pC(1)} > 0$. Hence $H(0) > 0.\widehat{\mu} = 0$ cannot be an equilibrium.

b) Full evasion equilibrium

if $\widehat{\mu} = 1$, then $\overline{\lambda}(1) = \frac{t(1-p)-pF}{pC(0)}$. Unless $C(0) = 0$, $\overline{\lambda}(1) \neq +\infty$. Hence $H(1) < 1$. $\widehat{\mu} = 1$ cannot be an equilibrium, unless $C(0) = 0$.

c) Interior equilibria

As $H(\overline{\lambda}(\mu))$ is increasing in μ, the existence of at least one interior equilibrium is guaranteed. The interior equilibrium will be unique if $m" \geqq 0$. Note that:

$$m" \approx 2CC'^2H' - C^2HC" + FC'^2H" \tag{19}$$

Hence, if $C" \leq 0$ and $H" \geqq 0$, or if $C" \geqq 0$ and $H" \leq 0$, but the last two terms on the right hand side of equation 19 are not too negative, then $m" \geqq 0$, and there will be a unique interior equilibrium, if $C(0) \neq 0$.

The existence of multiple equilibria depends on the shape of the psychic cost function (C' , $C"$) and on the distribution of the importance attached to the psychological cost of being audited ($H(\overline{\lambda})$, H', $H"$).

In what follows we focus on a unique interior equilibrium and consider the comparative statics for a change in the audit rate. We make the assumption that $C(0) \neq 0$ and that $m'' \geqq 0$. Results are however valid for any locally stable interior equilibrium. The equilibrium is represented in figure 3 for $m'' \geqq 0$.

The function $m(\mu)$ is represented by the schedule AB. The equilibrium occurs at the intersection of AB with the 45° line $(\widehat{\mu})$.

An increase in λ implies, for $\mu \neq 1$, a more restrictive entry condition for tax evasion, i.e. for a given observed proportion of evaders, there will be less taxpayers willing to evade than before. This lowers the equilibrium number of tax evaders, m. Hence an increase in λ pivots the schedule AB down through the point B. In figure 3 the schedule $A'B$ represents the function $m(\mu)$ for a higher λ. The new equilibrium implies a lower proportion of evaders. So the more important is the reputational loss of being investigated, λ, the smaller the number of individuals who evade tax.

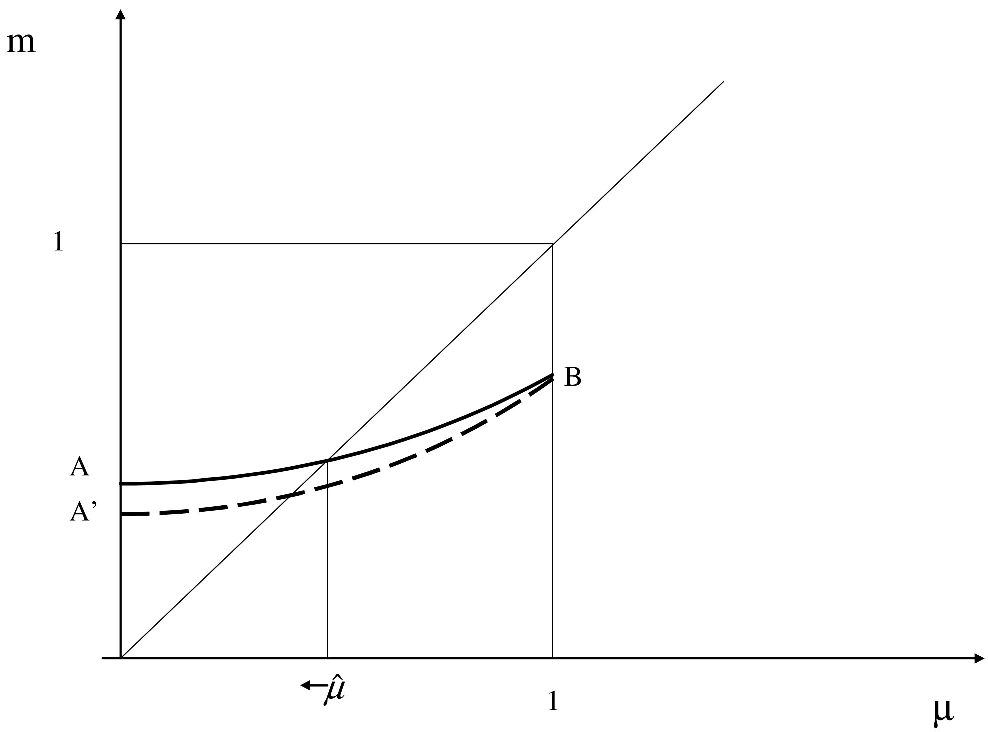

Figure 3: An interior equilibrium of tax evaders

Effect of an increase in the probability of detection on overall evasion. We want to know how the number of evaders is affected by the probability of detection.

Notice first of all that an increase in p decreases $\overline{\lambda}$ for all values of μ and so shifts the schedule AB down, thus lowering $\widehat{\mu}$, i.e. $\frac{\delta\widehat{\mu}}{\delta p} < 0$. Formally we have:

$$\frac{\delta\widehat{\mu}}{\delta p} = \frac{\frac{\delta m}{\delta p}}{1 - \frac{\delta m}{\delta\widehat{\mu}}} \tag{20}$$

An increase in p causes the marginal individuals to stop evading; this lowers the proportion who evade, which in turns reduces evasion - and so on.

By differentiating (5) with respect to the p, we get that the impact of a change in the probability of audit is:

$$\frac{\delta m}{\delta p} = h(\overline{\lambda})\frac{\delta\overline{\lambda}}{\delta p} + h(\overline{\lambda})\frac{\delta\overline{\lambda}}{\delta\widehat{\mu}}\frac{\delta\widehat{\mu}}{\delta p} \tag{21}$$

Notice that the first effect is due to the fact that an increase in the probability of detection makes the entry condition for evasion more restrictive and hence lowers the critical level of importance of the psychic cost: those on the margin will stop evading. The second argument is the additional effect arising because of taxpayer's interpendencies. As the number of those on the margin stop evading, the magnitude of the psychic cost increases and this discourages even more people to continue evading. We know that $\frac{\delta\overline{\lambda}}{\delta\mu} \geqslant 0$ and that $\frac{\delta\overline{\lambda}}{\delta\widehat{\mu}} = \frac{[t(1-p)-pF]C'(1-\widehat{\mu})}{p[C(1-\widehat{\mu})]^2}$. Hence the change in $\overline{\lambda}$ due to a change in the equilibrium number of evaders $(\widehat{\mu})$ is positively related to the marginal psychic cost of being audited. The greater $C'(\cdot)$, the greater the additional second effect due to social interdependencies, captured in this model by the psychic cost of being investigated.

In figure 4 we decompose the effect of a rise in the audit rate in the two effects described above. The line AB represents equilibrium proportion of evaders when there is a psychic cost attached to being audited, which is an increasing function of the number of honest taxpayers. For simplicity we assume that $m' > 0$ and $m" = 0$. The initial equilibrium is at point $\widehat{\mu}$. The line CC represents the same equilibrium but when there is a fixed psychic cost of being investigated. In this case $\frac{\delta\overline{\lambda}}{\delta\widehat{\mu}} = 0$. If the initial equilibrium is $\widehat{\mu}$, a rise in the audit rate will shift both lines parallel downwards. The movement from $\widehat{\mu}$ to $\widehat{\mu}'_C$ represents the first effect of equation (21), i.e. the decrease in the number of evaders due to an increase in the expected fine, which makes the entry condition for evasion more restricitive. The movement from $\widehat{\mu}'_C$ to $\widehat{\mu}'_{AB}$ represents the second term in the right hand side of equation (21) and it is the extra effect of a rise in the audit rate due to the social norm. Notice that the magnitude of this second effect depends on the slope of the line AB, which is determined by $C\prime$, the marginal cost of reputation , i.e. the impact of a

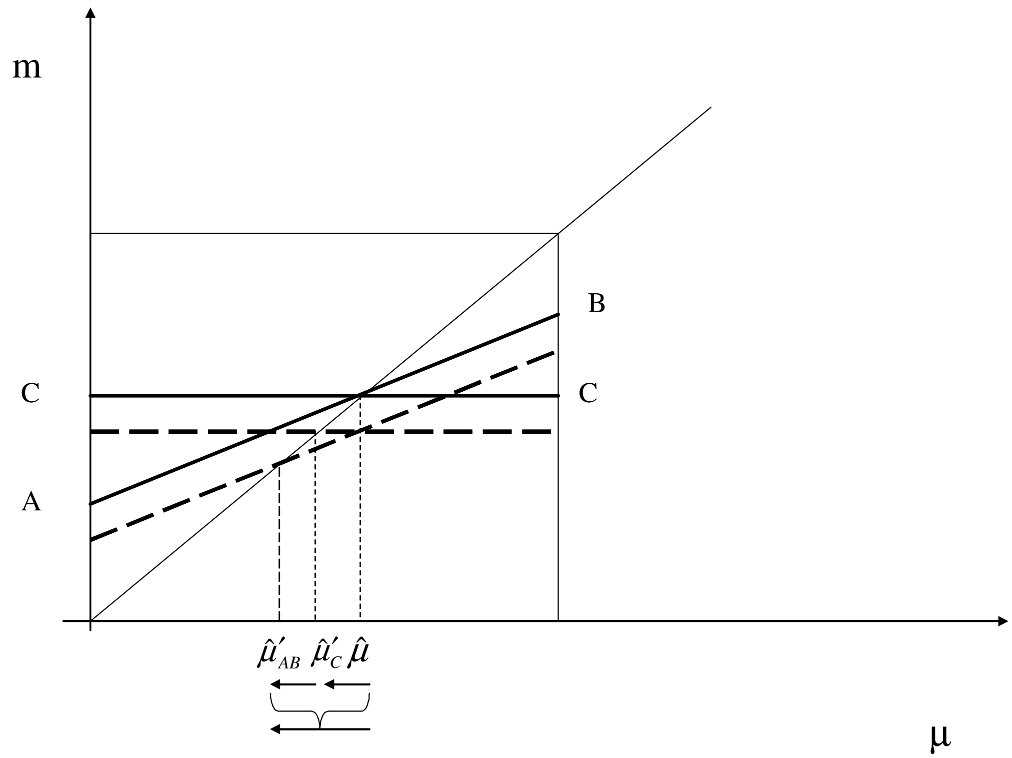

Figure 4: Decomposition of the impact of an increase in hte frequency of audit on the number of evaders

change in the number of honest taxpayers in the community on the psychic cost of being investigated..

In conclusion, if people suffer a psychic cost and this is increasing in the number of other taxpayers being honest, then an increase in p will cause the fraction of the population who evade to fall, and this will give an extra reason for people to stop evading over and above the normal deterrence effects. Moreover, the greater the marginal psychic cost, the greater will be the fall in the proportion who evade. But, in addition, the more weight that people give to this effect, the more this will cause people on the margin to stop evading[13]. We are able to explain the presence of indirect effects: even if taxpayers are not directly subject to an investigation, an increase in the probability of being detected has indirect effects on the rest of the population. Moreover, tax compliance is self-enforcing behaviour and hence assumes the characteristics of a social norm. The stability of such a social

[13]We should note that this analysis applies when there is a unique, locally stable equilibrium. In the presence of multiple equilibria we wouldn't be able to use our comparative statics as an increase in the probability of detection would shift the density function down and some initial equilibria might disappear, causing a jump to a different equilibrium.

norm will depend on the type of equilibria, and hence on how the importance attached to the moral or reputational loss of being apprehended is distributed in the community and on the shape of the psychic cost function.

If the importance attached to the social norm varies across taxpayers, an important issue is how this would affect the allocation of investigation resources. How could the enforcement agency take advantage of the greater behavioural response, i.e. the greater indirect effect, of taxpayers sensitive to the social norm? Would this necessarily imply to put more resources where the social norm argument is more compelling?

In the next section we consider two groups of taxpayers, where tax compliance is regarded as a social norm to a different extent and, by use of simulations, show the implications for the optimal allocation of investigation resources.

5 Conclusion

In this paper we have focused on the effects of investigations on tax compliance.

We decompose the elements of the direct and indirect effects in quite a general model and show that the ratio of the two depends on the behavioural elasticity, on how intensively a given group of taxpayers is investigated and on the operational effectiveness of investigations. The intensity and the operational effectiveness of investigations do indeed vary across fiscal areas and also across different groups of taxpayers within the same fiscal area. Hence there is no reason to expect the ratio to be constant across different groups of taxpayers or different fiscalities. It then becomes important to estimate the different components of the ratio between the indirect and direct effects to have some insights on how the impact of audits differ across different groups of taxpayers. We investigate how different assumptions on the motivations driving taxpayers' behaviour may affect the elasticity of evasion. In particular we compare a setting where taxpayers decide whether or not to be honest with no regard for the behaviour of other taxpayers to a situation where the decision is interdependent and tax compliance is a social norm.

Our results suggest that if tax compliance is a social norm in the relevant community this has important implications on the impact of an increase in the coverage rate on voluntary compliance. At the aggregate level of the community of taxpayers, we can expect a higher response to a change in the allocation of audit resources than in the absence of a social norm. Essentially, social norms introduce a multiplier effect: generating greater compliance through a deterrent effect causes even more people to become compliant through the social norm. The magnitude of the impact of audits on aggregate behaviour will therefore be higher the greater the importance attached to the social norm. Note that we gave a less strong moral connotation to tax compliance than Myels and Naylor (1996) approach: tax evasion causes a loss in reputation (social stigma) only if investigated. Yet, we did make an assumption on individuals' preferences. However, there is another possibility to explain tax compliance as a social norm, withough invoking any special preferences and hence functional forms for the utility function. Tax evasion is, by its nature, a risky activity. While in the standard theoretical models an individual is assumed to know the probability of being caught, in reality he does not, and rather makes his compliance decision on the basis of perceptions of such a probability. The amount of evasion undertaken by one's predecessors or peer group may convey information on the uncertainty (risk) of the environment. In particular an individual may observe how many of his peers are evading and are caught and accordingly update his prior beliefs on the probability of being caught. In such a context individuals would care about the relative amount of evasion in their community, not because of moral considerations, or altruism, but just because they are trying to extract information about the environment. The number of evaders would enter the argument of the (perception of the) probability of being audited and not the utility function, so that specific preferences are not imposed to explain the social custom. Yet, it would still be the case that tax compliance is self-enforcing behaviour: the greater the number of compliant taxpayers, the more willing an individual is to be compliant. And an increase in the audit rate would still have a multiplier effect.

Modelling how people form their perceptions about the probability of being investigated would not only help explaining the emergence of tax compliance as a social custom, but it would also allow to distinguish the two components of the individual elasticity of evasion we mentioned above: the sensitivity of evasion behaviour to the perceived frequency of inspections and the sensitivity of the perceived probability of inspection to the actual frequency of inspection.

In analysing the optimal allocation of resources among different groups of taxpayers, we assumed that in each group taxpayers are only affected by the probability of being investigated in their group. But there may be some spillover effects: an increase in the coverage rate in one group could be observed in another group and this could alter the perception of being investigated also in this group and increase their voluntary compliance. These are possible extensions of our analysis.

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6 Appendix

Allocating investigation resources: the targeting case.

In section 3 we assumed a random audit within a specific group of taxpayers. The tax authority did not have any information of how evasion differs across taxpayers within the same group, so that was not able to distinguish marginal evasion from average evasion withing the same group of taxpayers.

We now suppose that the tax authority has some information about taxpayers that enables it to distinguish the *expected* amount of evasion that one type of taxpayer might be involved in relative to another.

More precisely, assume that the actual amount of evasion, e_{jk}, in which the j-*th* taxpayer in group k is involved given by:

$$e_{jk} = \phi_k(x_j, p_k) + \xi_k \tag{22}$$

where x_j is a vector of observable individual characteristics and $\xi_k$is a random variable with zero mean. We assume that the tax authorities have a risk-profiling model that enables to observe for any given taxpayer the expected amount of evasion

$$\overline{e}_{jk} = \phi_k(x_j, p_k) \tag{23}$$

For simplicity, assume that the effectiveness of investigations is independent of taxpayer type and is given once again by the constant θ_k.

Since behaviour depends solely on the fraction of people investigated - and not their identity - in order to minimise the tax gap the tax authority will obviously want to target those taxpayers with highest expected evasion.

To understand the implications of this, for expositional simplicity, we assume that x is a scalar and that the distribution of x in the k-*th* group is given by the density function $l_k(x)$. We also assume that $\phi(x,p)$ is a strictly increasing function of x.

This implies that if a fraction p_k of taxpayers in group k are investigated these will be all taxpayers for whom $x \geq \underline{x}_k$, where $\underline{x}_k$ is defined by

$$\int_{\underline{x}_k}^{\infty} l_k(x)dx = p_k \tag{24}$$

For later purposes notice that

$$-l(\underline{x}_k)\frac{d\underline{x}_k}{dp_k} = 1 \tag{25}$$

As before let $E_k(p_k) = \int_0^{\infty} \phi_k(x_j, p_k)l(x)dx$ be the average amount of evasion in group

k, and let

$$E_k^t(p_k) = \frac{\int_{\underline{x}_k}^{\infty} \phi_k(x, p_k) l_k(x) dx}{p_k} \tag{26}$$

be the average amount of evasion amongst the sub-group of group k who are targeted for investigations. Obviously, $E_k < E_k^t$.

Also let $E_k^m = \phi_k(\underline{x}_k, p_k)$ be the expected evasion of the marginal taxpayer who is targeted for investigation. Obviously $E_k^m < E_k^t$.

Since tax authorities typically only investigate a very small fraction of taxpayers, we would normally expect that $E_k < E_k^m$, and so $E_k < E_k^t$.

Finally let $\varepsilon_k = -\frac{dE_k}{dp_k}\frac{p_k}{E_k}$ be the sensitivity of taxpayer behaviour to the probability of investigation for the k-th group of taxpayers as a whole, and $\varepsilon_k^t = -\frac{dE_k^t}{dp_k}\frac{p_k}{E_k^t}$ be the sensitivity of the sub-group of taxpayers who are targeted for investigation.

The payment/tax gap of the k-th group of taxpayers is

$$G_k = N_k \left[E_k - \theta_k \int_{\underline{x}_k}^{\infty} \phi_k(x, p_k) l_k(x) dx \right] \tag{27}$$

An alternative way of writing this is

$$G_k = N_k [E_k - \theta_k p_k E_k^t] \tag{28}$$

From (38) we get:

$$MRPG_k = -\frac{1}{N_k}\frac{dG_k}{dp_k} = \theta_k \phi_k(\underline{x}_k, p_k) + \frac{E_k \varepsilon_k}{p_k} - \theta_k \int_{\underline{x}_k}^{\infty} \left[-\frac{\delta \phi_k}{\delta p_k} \right] l_k(x) dx \tag{29}$$

From (37) it is straightforward to show that

$$\int_{\underline{x}_k}^{\infty} \left[-\frac{\delta \phi_k}{\delta p_k} \right] l_k(x) dx = E_k^t \varepsilon_k^t + (E_k^m - E_k^t) \tag{30}$$

Substitute (41) into (40) and we get:

$$MRPG_k = \theta_k E_k^m + \frac{E_k \varepsilon_k}{p_k} - \theta_k \left[E_k^t \varepsilon_k^t + (E_k^m - E_k^t) \right] \tag{31}$$

But notice that we can re-write this as:

$$MRPG_k = \theta_k E_k^t - \theta_k E_k^t \varepsilon_k^t + \frac{E_k \varepsilon_k}{p_k} \tag{32}$$

which is the formula one would get from (39).

The formula in (43) is very similar to that in (5).

The question is what we can say from this about the ratio of the indirect to the direct effect of investigation activity. This depends on what one means by the direct and indirect effect - the average or marginal effect of the tax authority activity.

If we defined the direct effect as $\theta_k E_k^t$ - i.e. the *average* yield form an investigation - then, from (43), the formula for the ratio of the indirect effect to the direct effect would be:

$$R_{3k} = \varepsilon_k \left[\frac{E_k}{E_k^t} \frac{1}{p_k \theta_k} - \frac{\varepsilon_k^t}{\varepsilon_k} \right] \tag{33}$$

If the tax authority were unable to target investigation resources then we would have $E_k = E_k^t$; $\varepsilon_k = \varepsilon_k^t$ and (44) would collapse to (8).

If the tax authority were able to target,but there were no reason to think that the behavioural response of targeted taxpayers was significantly different from non-targeted taxpayers, then we would have $E_k < E_k^t$; $\varepsilon_k \approx \varepsilon_k^t$ and so we would have

$$R_{3k} \approx \varepsilon_k \left[\frac{E_k}{E_k^t} \frac{1}{p_k \theta_k} - \frac{\varepsilon_k^t}{\varepsilon_k} \right] < \varepsilon_k \left[\frac{1}{p_k \theta_k} - 1 \right] \tag{34}$$

and so, as we might expect, targeting gives a lower ratio of the indirect to the direct effect.

However this approach would be very odd since the direct doesn't reflect the fact that the tax authority is targeting resources and so, if given extra resources, would deploy those on the marginal taxpayer. So if we define the direct effect as $\theta_k E_k^m$ - i.e. the *marginal* yield per investigation - then, from (42), the ratio of the indirect effect to the direct effect is:

$$R_{3k} = \varepsilon_k \frac{E_k^t}{E_k^m} \left[\frac{E_k}{E_k^t} \frac{1}{p_k \theta_k} - \frac{\varepsilon_k^t}{\varepsilon_k} \right] + \left[\frac{E_k^t}{E_k^m} - 1 \right] \tag{35}$$

If we compare (46) with (44) then we see that the expression on the RHS of (46) is larger than the expression on RHS of (44) - which is not surprising since the MRPG is the same and, in (46) we are using as denominator the marginal direct effect which is smaller than the average, which is denominator in (44). This shows up in two ways. First of all we have to multiply (44) by $\frac{E_k^t}{E_k^m} > 1$ - which is a re-scaling effect to reflect the different denominators - but then we have to add $\left(\frac{E_k^t}{E_k^m} - 1 \right) > 0$.

If the coverage rate is very low then we would expect the marginal and average values to be very similar, so, the values we get in (44) and (46) are likely to be very similar.

Once again, if the tax authority were unable to target investigation resources then we would have $E_k = E_k^t$; $\varepsilon_k = \varepsilon_k^t$ and (46) would collapse to (8).

If the tax authority were able to target, but there were no reason to think that the behavioural response of targeted taxpayers was significantly different from non-targeted taxpayers, then we would have $E_k < E_k^m < E_k^t$; $\varepsilon_k \approx \varepsilon_k^t$ and so we would have

$$R_{3k} \approx \varepsilon_k \frac{E_k^t}{E_k^m}\left[\frac{E_k}{E_k^t}\frac{1}{p_k\theta_k} - 1\right] + \left[\frac{E_k^t}{E_k^m} - 1\right] \tag{36}$$

What this suggests is that in many circumstances the ratio of the indirect effect to the direct effect could be well approximated by

$$R_{3k} \approx \varepsilon_k \left[\frac{E_k}{E_k^t}\frac{1}{p_k\theta_k} - 1\right] \tag{37}$$

which is just a mild adjustment to the original formula in (8).