Tax amnesties, plea bargains and the optimal enforcement policy

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ABSTRACT. This paper develops a model of tax enforcement in which the tax agency is allowed to make pre-audit settlement offers to taxpayers. Settlements can either take the form of public amnesties or individual plea bargains. In this model, pre-audit settlements allow the agency to overcome its limited control over the enforcement parameters (the agency takes the tax and penalty levels as given) and to increase its net revenue. Public amnesties prove to be superior to individual plea bargains, since they allow the agency to extract from taxpayers, not only the prospective defence cost, but also the risk premium associated with the sampling procedure.

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49. Christians should be taught that the Pope's pardons are useful, if they do not put their trust in them; but most harmful, if through them they lose the fear of God. Martin Luther, "The Ninety-five Theses," Wittemberg, 1517.

1. Introduction

One of the major concerns raised by the repeated use of "pardons", is that they may eventually remove any restraint on individuals' behaviour and encourage repeated violations. In the context of tax enforcement, the question is whether grace programmes may eventually encourage evasion and reduce the government's net revenue.

In this paper, we analyse the short and long-run implications of amnesties for income tax evaders, and of plea bargaining with the tax agency. Amnesties considered are a form of pre-audit settlement: those who accept the settlement offer are granted immunity from prosecution. Like plea bargains, amnesties represent an attempt by the agency to reduce its audit expenditure after the crime has been committed, when there is no longer any need to provide incentives to comply. Plea bargains differs from general amnesties in that they are available only to taxpayers already selected for investigation.

It has long been recognized in the literature on pre-trial negotiation that after the infraction has been committed, a settlement provides a Pareto improvement, as it allows the parties to avoid the costs associated with the trial. The problem with settlements, however, is that when they take place, the prosecuting party has imperfect information on the defendant's type, and cannot distinguish the guilty defendant from the innocent one. This allows the guilty defendant to reap an informational rent, and makes crime more attractive. In the context of taxation, the introduction of a settlement stage is likely to produce a loss in tax revenue and one might conjecture that this leads to a reduction in the agency's overall payoff.

We investigate this problem by developing a model in which the tax agency and the taxpayers rationally choose their strategies and have correct expectations on the opponent's play ("rational expectations"). This allows one to shed some light on the effects of amnesties and plea bargains on the enforcement policy and to provide an answer to the question of whether it would be advisable to prevent the agency from using them as policy tools.

The main assumption of this paper is that the agency has limited control over the enforcement policy: it has full control over the audit policy, but assumes that the tax and penalty levels as pre-determined by a superior authority.

The starting point for our analysis is a model of tax enforcement where no negotiations between the tax agency and the taxpayers can take place. The only policy tool

controlled by the agency is the audit rate. Taxpayers have concave utility functions and may either have high or low incomes. The optimal policy has here a very simple nature: to audit low income reports with a probability just sufficient to discourage evasion.

This basic model is then contrasted with a more complex model in which the agency can make use of amnesties after taxpayers have reported their incomes. The game between the agency and the taxpayers will be characterized by the following move order: 1. the agency selects the audit rates for each level of income reported, 2. taxpayers file their income returns and pay the appropriate taxes, 3. the agency offers an amnesty with an appropriate participation fee, 4. taxpayers decide whether to participate in the amnesty or not. Taxpayers who take part in the amnesty are granted immunity from prosecution, while the others are subject to the audit rates decided by the agency at the outset.

In offering the amnesty, the agency acts as a monopolist which provides insurance against audits. It is assumed that all taxpayers are interested in getting this insurance irrespective of whether they have evaded or not, because audits impose a defence cost on auditees which is not refunded by the state (nor can it be covered by private insurance). Evaders, however, are willing to pay more to avoid the audit risk because they face a larger net payment if they are audited. Depending on the level of the participation fee, the amnesty will either be accepted by the whole population or only by evaders. When the participation fee is low ("pooling amnesty"), the amnesty functions as a "sale" in the enforcement policy: evaders are able to get away with their infractions at low cost. In this case, the agency collects an amnesty revenue proportional to the defence cost and the risk premium of taxpayers, and incurs no audit costs. When the participation fee is large ("screening amnesty"), evaders do not benefit from any discount in the expected penalties, and the amnesty serves the purpose of separating evaders from compliant taxpayers. In this case, the amnesty allows the agency to save on the audit expenditure and to extract the prospective net payment (fine+taxes evaded+defence cost) and the risk premium from evaders.

The optimal amnesty fee is decided by the agency on the basis of its belief about the evasion rate, and is dependent upon the expected yield of audits. At the equilibrium, the amnesty fee will be low with positive probability and this provides taxpayers with ex-ante incentives to evade. It will be noted that large audit rates increase the audit threat, but also increase the expected audit expenditure, making a low amnesty fee more likely. The optimal enforcement policy will then have to face a trade-off between the incentive to raise a large amnesty revenue and the need to provide incentives to comply.

Due to the complexity of the game, an explicit expression of the optimal *audit cum amnesty* policy can be derived only for two special cases: in the first, taxpayers

are risk-neutral, while in the second, the defence cost to taxpayers is negligible. These two cases provide powerful insights into the nature of the optimal policy. They show that the enforcement policy retains its deterrent value only if the amnesty fee is randomly chosen and if taxpayers incur the risk that the fee is larger than the statutory tax. It will be seen that the amnesty policy allows the agency to extract additional resources from taxpayers, the amount of which depends positively on the prospective defence costs to taxpayers and their risk premia. The possibility of extracting the defence cost by means of a settlement provides the agency with the incentive to engage in opportunistic behaviour ("**extortionary effect**") and raise the audit rate for low income reports to its maximum levels. The agency deliberately inflates the prospective defence cost to taxpayers in order to extract it at the settlement stage.

When taxpayers are highly averse to risk, however, a countering factor may come into play, namely, the need to create some uncertainty in the sampling stage in order to increase the risk associated with the decision to evade. By bounding the audit rate away from one, the agency produces a specific "audit selection" risk which it can then provide insurance against. This factor provides the agency with an incentive to reduce the audit rate and, consequently, to reduce the net payment of high income taxpayers. In turn, the reduction of the actual tax differential produces an increase in net revenue ("**Laffer curve effect**").

Contrary to amnesties, plea bargains take place after taxpayers have been picked out for investigations and do not provide insurance against the "audit selection" risk. Here, the Laffer curve effect does not apply and the agency does not have any incentive to bound the audit rate away from one. The optimal enforcement policy with plea bargains will generally coincide with the optimal enforcement policy with amnesties and risk neutrality: the audit rate for low reports will be equal to one, so that all taxpayers reporting a low income will be selected for an investigation and offered a settlement. The maximum net revenue that the agency can obtain through plea bargains will prove to be less than that obtained through public amnesties, as the latter only allows the agency to gain from the extraction of the risk premium associated with the uncertainty of selection.

The model developed in this paper follows the so called "principal-agent" approach to tax enforcement pioneered by Reinganum and Wilde (1986). The main feature of this approach is that the agency is assumed to be able to commit itself to the optimal audit policy and to act as a *Stackelberg leader.*[1] The contribution of this paper rests

[1] Other important contributions to this approach can be found in the work of Scotchmer (1987), Border and Sobel (1987), Mookherjee and Png (1989) and Sanchez and Sobel (1993). Melumad and Mookherjee (1989) develop an interesting model in which the government achieves the "precommitment" solution by delegating authority over the enforcement policy to a manager and by providing her with the appropriate incentive scheme.

in the analysis of amnesties and plea bargains as policy tools to be coupled with the use of audits. The agency announces the audit rates (chooses the audit technology) at the outset, but chooses the terms of the settlement *after* taxpayers have reported their incomes. In this sense, settlements represent a form of "renegotiation" of the enforcement policy, which takes place after the crime (if any) has been committed. One of the results from the literature on renegotiation is that it cannot increase the principal's payoff (to see this, it is sufficient to apply the revelation principle).[2] In this paper, instead, renegotiation increases the net revenue to the tax agency, since the agency does not have full control over the enforcement parameters (it cannot modify the tax and penalty rates). Amnesties allow the agency to surmount the inflexibility of the tax code (which is less flexible to contingent variation in the economic system), and to produce an efficiency gain.

Tax amnesties have recently attracted some attention in the theoretical literature. Andreoni (1991) and Malik and Schwab (1991), among others, have studied amnesties for income tax evaders. Their models, however, relate to programmes that allow taxpayers to revise their income returns without offering immunity from prosecution. Hence, their amnesties do not provide taxpayers with insurance against audits, but rather against their own miscalculations in the optimal tax return and against temporary liquidity constraints. Tax amnesties of this kind have been popular in the US, whereas the amnesties considered here have been popular in Italy, the Philippines and Columbia, and are similar to standard "voluntary disclosure schemes" used to unearth illegal wealth, which have been recently implemented in India, Argentina and Belgium. [3]

The other theme of this paper, plea bargaining, has received a much wider attention in the literature. We will not try to survey the immense literature on pre-trial negotiations here [see Cooter and Rubinfeld (1989)]. Very little, however, has been written on the effects of plea bargaining on the incentives to commit crime and the optimal enforcement policy. An interesting contribution to this topic is the recent work of Reinganum (1993), who develops an integrated model of plea bargaining, criminal choice and crime detection. Her article differs from mine in many substan-

[2]Renegotiation has been thoroughly studied in the literature on optimal contracts. In that context, renegotiation proves to increase the payoff of the principal only if it occurs after some new pieces of non-verifiable information have become available to the parties. On this, see Hart and Moore (1988), Huberman and Kahn (1988), Fudenberg and Tirole (1990), Hermalin and Katz (1991) and Aghion, Dewatripont and Rey (1994).

[3]IRS (1987), however, shows that 2/3 of the revenue collected through the amnesty programmes implemented in the US stemmed from so-called "accounts receivable," that is tax deficiencies which were known to the agency. This means that these programmes essentially acted as the "plea bargains" studied in this paper. For an overview of amnesty programmes recently offered in different countries see Olivella (1994), Uchitelle (1989) and Franzoni (1995).

tial respects, among which are the timing of the moves and the side making the settlement offer (in her model, the settlement offer comes form the defendant).

Chu (1990) develops a model of plea bargaining with the tax agency in which taxpayers who report an income level above a fixed threshold are automatically guaranteed immunity from legal prosecution. In Chu's model the use of this sort of *minimum tax* allows the agency to correct an inefficiency in the enforcement policy (audit rates are not conditioned on the income report) and increases social welfare. [[In contrast to Chu's model, it is assumed here that plea bargaining takes place *after* taxpayers have reported their incomes and that the terms of the deal depend on the agency's belief that it is dealing with an evader.]]

It is important to note that the results of this model are not specific to tax enforcement and are applicable to many other monitoring games, such as those related to the general enforcement of law, the regulation of a monopolist with unknown costs, and the regulation of externalities.

The paper has the following structure. In section 2, a basic enforcement model is developed in which neither amnesties nor plea bargains can take place. In section 3, tax amnesties are introduced and analyzed. In section 4 and 5, the optimal enforcement policy with amnesties is derived for two special cases: in the first taxpayers are risk-neutral, in the second the defence cost imposed on taxpayers by an audit is negligible. Section 6 deals with plea bargaining and section 7 provides some final remarks.

2. Enforcement with no settlements

The starting point of our analysis is a simple enforcement model where amnesties and plea bargains are not feasible. Consider a population of taxpayers with different liabilities: a fraction p of them has taxable income y_0, and the rest y_1, with $y_0 < y_1$. The statutory liabilities of type-0 and type-1 are, respectively, T_0 and T_1, with $T_0 < T_1$. Since taxes are paid on reported incomes, there is an incentive for type-1 to misreport his income and evade $T_1 - T_0$. In order to prevent this, the tax agency can perform costly audits. Audits are assumed to be perfect, in the sense that they always reveal the real income of the auditee. Convicted evaders are subject to a penalty F. An important assumption is that T_0, T_1 and F are determined by an upper-level institution and cannot be modified by the agency. They are not necessarily optimally chosen, and this will have important implications for the amnesty policy. It is assumed that audits impose, simply in being carried out, a defence cost s on the auditee, which is not refunded by the state.[4] This cost is associated with the nuisance of an on-site investigation and with the legal expenditure borne in making one's own case before

[4] This assumption is in line with the institutional arrangements of most countries.

the courts. The defence cost applies only to taxpayers reporting a low income, since taxpayers reporting a high income cannot possibly be evaders.[5]

Let a_0 and a_1 be the audit rates for low and high income returns respectively. The payoffs to type-1 are:

$$\begin{cases} EU_{1H} = u(y_1 - T_1), & \text{if he reports "high,"} \\ EU_{1L}(a_0) = (1-a_0)\,u(y_1 - T_0) + a_0 u(y_1 - T_1 - F - s), & \text{if he reports "low,"} \end{cases}$$

with $u' > 0, u'' \leq 0$.

Let α_0 be the audit probability for low reports which leaves a taxpayer with high income indifferent between reporting "high" and "low,"

$$\alpha_0 \equiv \frac{u(y_1 - T_0) - u(y_1 - T_1)}{u(y_1 - T_0) - u(y_1 - T_1 - F - s)}.$$

A taxpayer with high income evades only if $a_0 \leq \alpha_0$. Since there is no reward for over-reporting, we expect the low-income type to choose the "low" return. This is true for each possible combination of a_0 and a_1 only if the defence cost is not too large. We therefore assume that $s < T_1 - T_0$. Under this condition, a low-income taxpayer always reports his true income and gets expected utility

$$EU_{0L}(a_0) = (1-a_0)\,u(y_0 - T_0) + a_0\,u(y_0 - T_0 - s).$$

Let us turn to the problem of the agency. It has to choose the audit rates a_0 and a_1 that maximize the expected net revenue, i.e. tax revenue minus audit expenditure plus recovered taxes and fines. The agency is assumed to be able to commit itself to the optimal audit strategy. In other words, the audit programme (audit technology) is decided by the agency at the beginning of the period taking into account the reaction of the taxpayers.[6] Since only high-income taxpayers report a high income, a_1 can be optimally set equal to zero: $a_1^* = 0$.

Let $\beta = \beta(a_0)$ be the probability that type-1 evades and let c be the cost of an audit to the agency. The net revenue is then

$$\begin{aligned} R(a_0) = {} & pT_0 + (1-p)\,T_1 - \beta(a_0)(1-p)(T_1 - T_0) \\ & + a_0(1-p)\,\beta(a_0)\,f - [p + (1-p)\,\beta(a_0)]\,ca_0, \end{aligned}$$

[5]In theory, the defence cost could also apply to taxpayers reporting a high income. This would simply amplify the "extortionary" behaviour of the agency brought about by the amnesty policy.

[6]It is important to note that the agency commits itself to the audit rates and not to the "number" of audits per income class. If that were the case, the agency might lose control over taxpayers' expectations (and behaviour) and multiple equilibria might arise. Given the number of audits for the low report, for instance, we might have an equilibrium in which all taxpayers report a low income, and the audit rate is consequently small, and another one in which only poor taxpayers report a low income, and the audit rate is consequently large. In both cases, taxpayers' choices would be rational. A similar problem would arise when the amnesty is offered.

where $f \equiv T_1 - T_0 + F$ is the additional payment to the state of a caught evader. The net revenue is constituted by the statutory taxes minus the taxes evaded plus the fines and taxes recovered through audits minus the audit expenditure.

Since high-income taxpayers evade only if $a_0 \leq \alpha_0$, we have

$$\begin{cases} R^{-}(a_0) = pT_0 + (1-p)T_0 + a_0[(1-p)f - c], & \text{for } a_0 < \alpha_0, \\ R(a_0) \in [R^{-}(\alpha_0), R^{+}(\alpha_0)], & \text{for } a_0 = \alpha_0, \\ R^{+}(a_0) = pT_0 + (1-p)T_1 - pca_0, & \text{for } a_0 > \alpha_0. \end{cases} \tag{1}$$

The agency has an incentive to audit low reports only if the cost of an audit does not exceed its net revenue. Note that for $a_0 < \alpha_0$, the net yield of each audit is $(1-p)f - c$, which is assumed to be positive.

ASSUMPTION 1. *The audit cost is not prohibitive:* $c < (1-p)f$.

This assumption guarantees that the net yield of an audit is positive when all high-income taxpayers evade.

From equation 1 we obtain

$$R^{+}(a_0) > R^{-}(a_0) \Longleftrightarrow a_0 < \frac{T_1 - T_0}{f - c}.$$

Since $u'' \leq 0$, we have

$$\alpha_0 = \frac{u(y_1 - T_0) - u(y_1 - T_1)}{u(y_1 - T_0) - u(y_1 - T_1 - F - s)} \leq \frac{T_1 - T_0}{f + s} < \frac{T_1 - T_0}{f - c},$$

and thus $R(\alpha_0)^{+} > R(\alpha_0)^{-}$. It is easy to see that the maximum revenue is reached at $a_0^{*} = \alpha_0^{+}$, that is at $\lim_{\epsilon \to 0}(\alpha_0 + \epsilon)$.

We have thus proved the following result.

Proposition 1. *If negotiations cannot take place between the agency and taxpayers, the optimal enforcement policy is characterized by the following audit rates*

$$\begin{cases} a_1^{*} = 0 \\ a_0^{*} = \dfrac{u(y_1 - T_0) - u(y_1 - T_1)}{u(y_1 - T_0) - u(y_1 - T_1 - F - s)}. \end{cases}$$

In a world where settlements between the agency and the taxpayers cannot take place, the enforcement policy takes a simple form: no audits for high reports and audits at a rate just sufficient to discourage evasion for low reports. Note that here

audits play a purely deterrent role: at the equilibrium, nobody evades and only honest taxpayers are audited.

The net revenue under the optimal policy is

$$R^* = pT_0 + (1-p)T_1 - pca_0. \tag{2}$$

The agency collects the statutory taxes in full and spends a certain amount in audits. The audit expenditure is smaller if the unit cost of an audit c and the fraction of low-income taxpayers p are smaller, and if the sanction F and the risk aversion of taxpayers are larger (since a_0 is smaller when F is larger and the taxpayers are more averse to risk).

3. The optimal amnesty

In this section, we consider the possibility that the agency offers an amnesty after taxpayers have reported their incomes. Taxpayers who pay the amnesty fee are granted immunity from legal prosecution. The amnesty is equivalent to an offer of insurance against audits and cannot be provided by the private sector. It is assumed that, at this stage, the agency has all the bargaining power and that it is able to make a take-it-or-leave-it settlement offer. In theory, the offer could contain a set of standard insurance contracts characterized by different degrees of coverage and premiums. In our case, it is clear that it is in the interest of the agency to avoid the audit cost, and thus to provide full coverage. The space of the relevant contracts will then contain only two simple offers, providing full insurance at different premiums (amnesty fees). Taxpayers who reject the offer are subject to the risk of being audited.

The game between agency and taxpayers is now characterized by the following move order:

1. the tax agency selects the audit rates,
2. taxpayers report their incomes and pay their taxes,
3. the agency decides the amnesty fee,
4. taxpayers choose whether to participate in the amnesty or not.

The solution to the game is the Perfect Bayesian Equilibrium. This solution requires strategies to be optimal given the beliefs of the agents and beliefs to be obtained from equilibrium strategies and observed actions using Bayes' rule.

It is convenient to begin the analysis from the last stage. Let us assume that high-income taxpayers have evaded with probability β, that the audit rates are set to a_0 and a_1, and that this is common knowledge. The agency can make two amnesty offers: one for the taxpayers who have reported low incomes and one for those who have reported high incomes. However, since only type-1 reports a high income, audits do not represent a threat to "high" reporters, and the optimal settlement offer for these individuals has a zero amount, $q_H = 0$.

Consider now the amnesty offer for the taxpayers who have reported a low income. Clearly, type-1 (the evader) is willing to pay more than type-0 to avoid the audit risk, since in case of an audit he also has to pay the taxes evaded and the fine ($T_1 - T_0 + F = f$). The amounts that the two types of taxpayer are willing to pay are:

$$\begin{cases} q_{L0}(a_0) = a_0 s + RP_0(s, a_0), & \text{the willingness to pay of type-0,} \\ q_{L1}(a_0) = a_0(f+s) + RP_1(f+s, a_0), & \text{the willingness to pay of type-1.} \end{cases}$$

The amount that each type is willing to pay to avoid the audit risk is equal to the amount that a risk-neutral taxpayer would be willing to pay, $a_0 s$ and $a_0(f+s)$, respectively, plus the risk-premium associated with the risk of losing s and $f+s$, respectively, with probability a_0.

After taxpayers have submitted their income returns and paid the appropriate taxes, the agency will choose the optimal amnesty fee for low reports from among: $\{q_{L0}(a_0), q_{L1}(a_0), q_\infty\}$, where $q_\infty > q_{L1}(a_0)$ is a fee so large that nobody accepts it.

At this stage, the agency's belief that a taxpayer who has reported "low" is an evader is

$$v = \frac{\beta(1-p)}{\beta(1-p)+p}.$$

The agency will select the amnesty fee that maximizes its payoff. The (continuation) expected net revenues associated with the different fee levels are

$$\begin{cases} R_{L0} = q_{L0}(a_0), \\ R_{L1} = v\, q_{L1}(a_0) - (1-v)ca_0, \\ R_\infty = va_0 f - ca_0. \end{cases}$$

Note that the tax payments are not part of the continuation net revenue since they occur in a previous stage. The nature of the amnesty programme will vary according to the level of the fee q_L.

The first type of amnesty (*pooling amnesty*) has such a low fee, q_{L0}, that everybody accepts it. The advantage of this amnesty is to completely cut back the audit expenditure.

The second type of amnesty (*screening amnesty*) has a larger fee, q_{L1}, and is aimed only at evaders. A fraction $1-v$ of potential participants prefers not to take part in the programme and chooses to bear the risk of an audit.[7]

The last possibility for the agency is to post an amnesty fee so large as to discourage everybody from taking part in the programme (*no amnesty*).

[7] The fact that settlements can operate as screening devices was emphasized first by Grossman and Katz (1983).

We have

$$R_{L1} - R_{\infty} = v\left[a_0 s + RP_1\left(f + s, a_0\right) + ca_0\right] \geq 0,$$

which indicates that a screening amnesty dominates the no-amnesty policy: the amnesty allows the agency to extract the expected defence cost and the risk premium from the taxpayers who accept it, and to save on the audit expenditure. Note that the previous inequality is strict only if $v > 0$, so that it is still possible that the no-amnesty policy is optimal when $v = 0$. Yet, if $v = 0$, $R_{L0} - R_{\infty} = a_0 s + RP_0\left(s, a_0\right) + ca_0 > 0$, and a 'pooling' amnesty proves superior. This definitely shows that calling an amnesty is always the optimal choice for the agency.

Proposition 2. *If $a_0 > 0$, the tax agency will always find it profitable to offer an amnesty after taxpayers have reported their incomes.*

This result shows that after income returns have been submitted, the agency is better off negotiating the enforcement policy with taxpayers rather than independently carrying out random audits.[8] Ideally, the agency would prefer to exempt only honest taxpayers, who yield a negative net audit revenue, from audits. However, it cannot do this because it has imperfect information on taxpayers' type.

What we have called 'screening amnesty' does not represent an extraordinary concession to taxpayers. Evaders do not get any special benefit: they can only choose between paying a (large) amnesty fee and bearing the audit risk. Both options provide them with the same expected utility. With a 'pooling amnesty', however, evaders manage to avoid the audit risk at a price lower than the price they are actually willing to pay. The amnesty fee, in fact, is low enough to also attract honest taxpayers, who want to avoid the risk of having to bear the cost of defence in the event of an audit.

If we compare the revenues associated with the pooling and screening amnesty, we get

$$R_{L1} > R_{L0} \iff v > \frac{q_{L0}\left(a_0\right) + ca_0}{q_{L1}\left(a_0\right) + ca_0}$$

$$\iff \beta > \bar{\beta}(a_0) \equiv \frac{p}{1-p}\,\frac{ca_0 + q_{L0}\left(a_0\right)}{q_{L1}\left(a_0\right) - q_{L0}\left(a_0\right)}.$$

A screening amnesty is preferable only if the agency believes that high-income taxpayers have evaded with probability greater than $\bar{\beta}\left(a_0\right)$. In some cases, $\bar{\beta}\left(a_0\right)$ can be greater than one, and a pooling amnesty is optimal irrespective of the level of β. This amounts to saying that a pooling amnesty is preferable to a screening one even if all

[8] In contrast to the literature on optimal contracts, in our case the initial contract (audit policy) cannot be "renegotiation-proof." The audit policy will always be renegotiated.

high-income taxpayers have evaded with probability one. This possibility is likely to arise when the number of high-income taxpayers is relatively small or the social cost of an audit $(c+s)$ is particularly large:

$$\bar{\beta}(a_0) > 1 \iff p(c+s)\,a_0 > (1-p)\left[fa_0 + RP_1(f+s, a_0) - RP_0(s, a_0)\right].$$

It is not possible to establish whether $\bar{\beta}(a_0)$ is greater or less than 1 without imposing some restrictions on the model. In the following, we consider two special cases.

Lemma 3. .
1. If the defence cost for taxpayers is negligible, $s \to 0$, then $\bar{\beta}(a_0) < 1$ for all $a_0 > 0$.
2. If taxpayers are risk neutral, then $\bar{\beta}(a_0) \leq 1$ if and only if $c + s \leq \frac{1-p}{p} f$.

Proof. In the first case, we have $\bar{\beta}(a_0) < 1 \iff pca_0 < (1-p)\left[fa_0 + RP_1(f, a_0)\right]$. By Assumption 1, $c < (1-p)f$ and the inequality is satisfied for all $a_0 > 0$.

In the second case, the result stems directly from the fact that $q_{L0} = sa_0$ and $q_{L1}(a_0) = (s+f)\,a_0$. □

We can now turn to the taxpayers' problem. They choose the income return that maximizes their expected utility on the basis of their expectations about the terms of the amnesty. At the equilibrium, these expectations have to be correct ("rational").

As we know, type-0 has little choice: he is bound to report "low" and get utility $EU_{0L}(a_0)$ independently of the level of the amnesty fee. Type-1, instead, will choose between a "high" and "low" report on the basis of the expected amnesty fee. In particular, he will choose to evade either because a_0 is below the 'deterrence' threshold or, when this is not the case, because there are good chances that the amnesty fee will be low.

Let λ be the probability of a pooling amnesty (low amnesty fee). A high income taxpayer chooses to evade if

$$(1-\lambda)u(y_1 - T_0 - q_{L1}(a_0)) + \lambda u(y_1 - T_0 - q_{L0}(a_0)) > u(y_1 - T_1),$$

that is, if

$$\lambda > \bar{\lambda}(a_0) \equiv \frac{u(y_1 - T_1) - EU_{1L}(a_0)}{u(y_1 - T_0 - q_{L0}(a_0)) - EU_{1L}(a_0)}.$$

Type-1 prefers to evade if a pooling amnesty is offered with probability greater than $\bar{\lambda}(a_0)$. Note that $\bar{\lambda}(a_0) \geq 0$ if and only if $u(y_1 - T_1) \geq EU_{1L}(a_0)$, that is, if and only if $a_0 \geq \alpha_0$. It can be easily seen that $\bar{\lambda}(a_0) \leq 1$ for all $a_0 \geq 0$.

These considerations allow us to characterize the equilibrium of the game. Note that a_1 is irrelevant to the solution of the game since the agency cannot extract any amount form taxpayers reporting a high income. Let us concentrate on the optimal amnesty fee for those who have reported "low".

Suppose that $a_0 < \alpha_0$. Then, high-income taxpayers will find it profitable to evade irrespective of the amnesty terms. Given $\beta = 1$, the agency will choose $q_L = q_{LI}(a_0)$ if $\bar{\beta}(a_0) \leq 1$, and $q_L = q_{LG}(a_0)$ otherwise.

Suppose now that $a_0 > \alpha_0$. In this case, high-income taxpayers evade only if the expected probability of a pooling amnesty (low fee) is sufficiently large, i.e. if $\lambda \geq \bar{\lambda}(a_0)$. On the other hand, the agency will choose a pooling amnesty either because the social cost of an audit is relatively large, $\bar{\beta}(a_0) > 1$, or because the evasion rate is low, $\beta \leq \bar{\beta}(a_0) \leq 1$. It is clear that at the equilibrium, the pooling amnesty has to be offered with positive probability: if this were not the case, high-income taxpayers would all choose to comply, and this would render the pooling amnesty superior. For the same reason, the evasion probability has to be positive: if all high-income taxpayers complied, a pooling amnesty would be offered and evasion would be profitable. It is then easy to see that there can be only two types of equilibria. If $\bar{\beta}(a_0) < 1$, high-income taxpayers evade with probability $\beta = \bar{\beta}(a_0)$, so as to make the agency indifferent between a pooling and a screening amnesty, and the agency sets $\lambda = \bar{\lambda}(a_0)$, so as not to punish nor reward evasion. If $\bar{\beta}(a_0) > 1$, the agency is bound to offer a pooling amnesty and high-income taxpayers evade with probability one.

The previous arguments are summarized by the following proposition.

Proposition 4. *Given a_0 and a_1, the equilibrium of the game between taxpayers and the tax agency is as follows.*

Let $a_0 < \alpha_0$. Type-1 evades with probability one and the amnesty is screening if $\bar{\beta}(a_0) < 1$, and pooling otherwise.

Let $a_0 = \alpha_0$. If $\bar{\beta}(\alpha_0) \leq 1$, type-1 evades with probability $\beta \in [\bar{\beta}(\alpha_0), 1]$ and the amnesty is screening. If $\bar{\beta}(\alpha_0) > 1$, type-1 evades with probability one and the amnesty is pooling.

Let $a_0 > \alpha_0$. If $\bar{\beta}(a_0) \leq 1$, type-1 evades with probability $\bar{\beta}(a_0)$ and the amnesty is pooling with probability $\bar{\lambda}(a_0)$. If $\bar{\beta}(a_0) > 1$, type-1 evades with probability one and the amnesty is pooling.

For $a_0 = \alpha_0$, the game admits of a multiplicity of equilibria characterized by different equilibrium evasion probabilities β. They all yield the same payoff to the agency and the taxpayers.

As shown by Proposition 4, the nature of the equilibrium depends on the level of the audit rates and on whether the social cost of an audit is relatively small. If the

social cost of an audit is large, $\bar{\beta}(a_0) > 1$, then the amnesty has a fee sufficiently low to be accepted by everybody irrespective of high-income taxpayers' rate of evasion. If the social cost of an audit is small, $\bar{\beta}(a_0) \leq 1$, then the amnesty has a large fee if the audit rate a_0 is small, while it has a random fee if a_0 is large. In the latter case, the uncertainty about the amnesty fee transforms evasion into a costly gamble: with probability $\bar{\lambda}(a_0)$ the amnesty fee is less than the tax differential $T_1 - T_0$, with probability $1 - \bar{\lambda}(a_0)$ the amnesty fee is greater than the tax differential. Note that pooling amnesties ("sales") are more likely when the audit rate is larger.

The previous result fully characterizes the equilibrium of the game between the agency and the taxpayers. The problem of the agency is to choose a_0 so as to maximize the expected revenue, with the knowledge that an amnesty will be offered after taxpayers have reported their incomes. As we have seen, the nature of the continuation equilibrium varies according to whether $\bar{\beta}(a_0)$ is greater or less than one. Without imposing restrictions on the model we do not know which of the two is true, and we cannot derive the optimal audit policy. However, before we proceed to the analysis of the special cases, we can compare the net revenue obtained using the amnesty tool with that obtained without it.

Proposition 5. *The use of the amnesty tool allows the agency to obtain a net revenue as large as that obtained without it.*

Proof. To prove this result we need to find a combination of a_0 and a_1 such that the net revenue is at least as great as the no-amnesty revenue. Take $a_1 = 0$ and $a_0 = \alpha_0^-$.[9] Type-1 will then choose to evade with certainty: $\beta = 1$. The optimal amnesty fee will depend on whether $\bar{\beta}(\alpha_0)$ is less or greater than one. If the agency sets $q_L = q_{L1}(\alpha_0)$, the net revenue is

$$\bar{R} = pT_0 + (1-p)T_0 + (1-p)\,q_{L1}(\alpha_0) - pc\alpha_0.$$

Consider now the difference between $\bar{R}$ and the (maximum) no-amnesty revenue (eq. 2)

$$\bar{R} - R^{NA} = -(1-p)(T_1 - T_0) + (1-p)\,q_{L1}(\alpha_0),$$

so that

$$\bar{R} - R^{NA} \geq 0 \Longleftrightarrow q_{L1}(\alpha_0) - (T_1 - T_0) \geq 0.$$

Note that at $a_0 = \alpha_0$, type-1 is indifferent between "reporting high and paying T_1" and "reporting low and paying $T_0 + q_{L1}(\alpha_0)$;" which implies that $q_{L1}(\alpha_0) = T_1 - T_0$.

[9] In view of the fact that the net revenue (with the amnesty) is the same at α_0^- and α_0^+, we could also choose α_0^+, which is the optimal rate when amnesties are not feasible. α_0^- provides us with a shorter proof.

Hence, if $q_L = q_{L1}(\alpha_0)$, the net revenue obtained by using the amnesty and the net revenue obtained without it are equal. Note however that $q_L = q_{L1}(\alpha_0)$ is the optimal choice only if $\bar{\beta}(\alpha_0) \leq 1$: if this is not the case, the agency sets $q_L = q_{L0}(\alpha_0)$ and earns a larger net revenue. □

When amnesties are available, the agency can always find *an* audit policy (the optimal policy with no-amnesties) that yields a revenue as large as the no-amnesty revenue. The revenue obtained using the *optimal* audit policy can therefore be even larger. This is definitely greater than the no-amnesty revenue if $\bar{\beta}(\alpha_0) > 1$, i.e. if the social cost of an audit is relatively large. In this case, the amnesty allows the agency to gain additional revenue even if it does not engage in opportunistic behaviour and does not raise the audit rate. Although the introduction of the amnesty tool has the effect of boosting evasion, the net revenue does not decrease; the amnesty revenue and the reduction in audit expenditure compensate for the loss in tax intake.

In the following section, we analyze some special cases in detail and show how the net revenue is affected by the configuration of the parameters of the model.

4. Optimal enforcement policy with amnesties and risk-neutral taxpayers

The simplest and probably most instructive case is that of risk neutral taxpayers. Since this case will also turn out to be relevant for the analysis of plea bargaining, we shall study it in detail. Under risk neutrality, the analysis is noticeably simplified by the fact that the willingness of taxpayers to pay can be explicitly computed. We have $q_{L0}(a_0) = sa_0$ and $q_{L1}(a_0) = (f+s)\,a_0$, and thus

$$\bar{\beta} = \frac{p}{1-p}\frac{s+c}{f}, \qquad \bar{\lambda}(a_0) = \frac{a_0(f+s) - (T_1 - T_0)}{a_0 f}.$$

The solution of the game depends on whether $\bar{\beta}$ is greater or less than one, i.e. on whether $c+s$ is greater or less than $\frac{1-p}{p} f$ (lemma 1).

Suppose first that $c + s < \frac{1-p}{p} f$, so that $\bar{\beta} < 1$ for all $a_0 \geq 0$. The agency's problem is to select the audit rate a_0 that maximize the net revenue (a_1 does not affect the net revenue and can be set to any level).

The game between the agency and taxpayers has the following nature. For $a_0 < \alpha_0$, high income taxpayers evade with certainty and the agency offers a screening amnesty with fee $q_L = (f+s)a_0$. Only evaders take part in the amnesty. For $a_0 = \alpha_0$, high-income taxpayers evade with probability $\beta \in [\bar{\beta}, 1]$ and the agency offers a screening amnesty with fee $q_L = (f+s)\,\alpha_0$. For $a_0 > \alpha_0$, high-income taxpayers evade with probability $\bar{\beta}$, the amnesty for the low reports has fee $q_L = sa_0$ with probability $\bar{\lambda}(a_0)$ and fee $q_L = (f+s)a_0$ with probability $1 - \bar{\lambda}(a_0)$.

This allows us to calculate the net revenue as a function of a_0. Upon simplification, we get

$$R(a_0) = \begin{cases} pT_0 + (1-p)T_0 + (1-p)(f+s)a_0 - pca_0, & \text{for} \quad a_0 < \alpha_0, \\ pT_0 + (1-p)T_1 - (1-p)\bar{\beta}(T_1 - T_0) + \left(p + (1-p)\bar{\beta}\right)a_0 s, & \text{for} \quad a_0 \geq \alpha_0, \end{cases}$$

so that

$$\frac{\partial R}{\partial a_0} = \begin{cases} (1-p)(f+s) - pc > 0, & \text{for } a_0 < \alpha_0, \\ \left[p + (1-p)\bar{\beta}\right]s > 0, & \text{for } a_0 > \alpha_0. \end{cases}$$

The optimal choice of a_0 is therefore $a_0^* = 1$.

Let us turn now to the case where $c + s > \frac{1-p}{p} f$. In this case, the audit costs are so large that a pooling amnesty is preferable irrespective of the evasion rate. High income taxpayers will then find it profitable to evade with probability one. The net revenue becomes

$$R(a_0) = pT_0 + (1-p)T_0 + sa_0.$$

The optimal audit rate is again $a_0^* = 1$. The following proposition summarizes the previous results.

Proposition 6. *If taxpayers are risk neutral, the optimal enforcement policy is the following:*
1. If $c + s < \frac{1-p}{p} f$ (small social cost of an audit), then the agency chooses $a_0^* = 1$. As a consequence, high-income taxpayers evade with probability $\bar{\beta} = \frac{p}{1-p}\frac{s+c}{f}$, and the amnesty fee for those who have reported a low income is $q_L = s$ with probability $\bar{\lambda} = \frac{F}{F+T_1-T_0}$ and $q_L = s + f$ with probability $1 - \bar{\lambda} = \frac{T_1-T_0}{F+T_1-T_0}$.
2. If $c + s > \frac{1-p}{p} f$ (large social cost of an audit), then the agency chooses $a_0^* = 1$. All taxpayers report a low income and the amnesty fee is $q_L = s$.

Note how the introduction of the settlement stage radically modifies the enforcement policy. The possibility of extracting the defence cost from taxpayers at the settlement stage encourages opportunistic behaviour on the side of the agency: the audit threat is raised to its maximum level and large settlement amounts are collected. This can be labelled as the "extortionary effect," since it leads the agency to deliberately increase the risk it provides insurance against.[10] Despite the increase in the audit rate, the audit expenditure does not increase, since only a fraction of

[10] This behaviour resembles that of criminal rackets, which make sure that an "accident" occurs to people who do not accept their protection.

the population (those who do not participate in the amnesty) is subject to the audit programme.

If the social cost of an audit is low (case 1), the amnesty fee is randomly chosen: with probability $\bar{\lambda}$ it is equal to the prospective defence costs to auditees, with the complementary probability it is equal to the defence cost plus the expected payment of evaders (taxes evaded and penalty).

If the social cost of an audit is high (case 2), the amnesty fee is equal to the defence cost and everybody participates in the programme. Here, high and low income taxpayers end up paying the same amount to the agency, and the tax system becomes uniformly lump-sum.

When the participation fee is low, $q_L = s$, the amnesty has the effect of a "sale," since evaders can get away with their infraction at a small cost. If the enforcement game were independently repeated over time, sales would occur at random interval of an average length of $1/\bar{\lambda} = \frac{F+T_1-T_0}{F}$ in case 1, while they would occur in every period in case 2.

The net revenue associated with the optimal amnesty policy is

$$R^A = \begin{cases} pT_0 + (1-p)T_1 + \frac{p}{T_1-T_0+F}\left[s(F+s) - c(T_1-T_0-s)\right], & if \quad c+s \leq \frac{1-p}{p}f, \\ pT_0 + (1-p)T_0 + s, & if \quad c+s > \frac{1-p}{p}f. \end{cases} \tag{3}$$

It can be established that the net revenue is increasing in the penalty F and the defence cost s, and decreasing in the audit cost c when $c+s < \frac{1-p}{p}f$, and that it is increasing in s when $c+s > \frac{1-p}{p}f$.

We can compare the net revenue expression just obtained with that relative to the no-amnesty policy (eq. 2).

For the case with $c+s \leq \frac{1-p}{p}f$, we get

$$R^A - R^{NA} = \left(p + (1-p)\bar{\beta}\right)(1-\alpha_0)\,s > 0.$$

The additional revenue associated with the use of the amnesty is proportional to the defence cost s. It is actually equal to the increase in the (threatened) defence expenditure associated with the increase in the audit rate times the probability of a low report. It is easy to see that if the defence cost was negligible, or if the audit rate was not raised above the optimal no-amnesty level, the introduction of the amnesty would not produce an increase in the net revenue.

For the case with $c+s > \frac{1-p}{p}f$, we have

$$R^A - R^{NA} = s + pc\alpha_0 - (1-p)(T_1 - T_0) > 0.$$

Here, the additional revenue is simply equal to the defence cost plus the saving in audit expenditure minus the loss in tax revenue due to evasion. The additional revenue is larger, if the defence cost s and the audit cost c are larger.

It can be seen that the extortionary behaviour allows the agency to extract additional resources from taxpayers only because audited taxpayers are not refunded their defence cost. Noticeably, the revenue increase produced by the amnesty policy could be alternatively obtained by an ex-ante (compulsory) insurance against the defence expenditure.

Finally, it is important to note that settlements allows the two parties to avoid the inefficiency of the audit procedure, which imposes costs on both of them (c and s). Yet, when the social cost of an audit is small, a settlement is not always agreed upon between tax agency and taxpayers: with probability $1-\bar{\lambda}$ the amnesty is screening, and a fraction p of taxpayers rejects it. This implies that amnesties may fail to eliminate the inefficiency of the enforcement policy. In addition, since the audit rate α_0 is raised to its maximum level, it is possible that inefficiency may actually be increased.

It is interesting to assess the efficiency implications of amnesties by comparing the amount of resources 'wasted' under the amnesty policy and the no-amnesty policy of section 2. In this way, we can also ascertain whether the increased revenue associated with the amnesty policy stems from a reduction of inefficiency or simply from larger transfers from taxpayers.

Consider the no-amnesty policy first. At the equilibrium, the net payment of a high-income taxpayer is $\tau_1 = T_1$, and that of a low-income taxpayer is $\tau_0 = T_0 + s\alpha_0$, since he bears the audit risk. The amount of resources 'wasted' by the enforcement policy is then

$$W^{NA} = p\tau_0 + (1-p)\tau_1 - R = p\alpha_0\,(c+s) = p\,(T_1 - T_0)\,\frac{c+s}{f+s}.$$

Consider now the amnesty policy. If $c + s < \frac{1-p}{p} f$, the net payment of a high-income taxpayers is $\tau_1 = T_1$, and that of a low-income taxpayer is $\tau_0 = T_0 + s$. The amount of resources wasted is then

$$W^{A} = p\tau_0 + (1-p)\tau_1 - R = p(1-\bar{\lambda})(c+s) = p\frac{c+s}{f}\,(T_1 - T_0 - s)\,.$$

We have therefore that

$$W^{A} < W^{NA} \Longleftrightarrow p\left(1-\bar{\lambda}\right)(c+s) < p\alpha_0\,(c+s) \Longleftrightarrow \left(1 - \tfrac{f+s-T_1+T_0}{f}\right) < \tfrac{T_1-T_0}{f+s}$$

$$\Longleftrightarrow \tfrac{T_1-T_0-s}{f} < \tfrac{T_1-T_0}{f+s} \Longleftrightarrow s + f > T_1 - T_0,$$

which is verified. Therefore, social waste is less when amnesties are used. The reason for this is that under the amnesty policy audits are more rarely carried out (only when the amnesty is not pooling). This does not mean that the high-income taxpayer gets a larger payoff: the reduction in the actual audit probability is compensated by the fact that those who report a low income always have to pay an amnesty fee of amount at least s. The reduction in the actual tax differential and the concomitant reduction in the actual audit probability are, in the end, the source of the efficiency gain. Note that the one who is damaged by the use of amnesties is the low income taxpayer, who faces a larger audit probability and a larger expected defence cost.

If $c + s > \frac{1-p}{p} f$, we have $\tau_1 = \tau_0 = T_0 + s$, so that

$$W^A = p\tau_0 + (1-p)\tau_1 - R = 0.$$

There is no inefficiency when amnesties are used and the social costs of the audit is large. Here, all cases are settled and no audits are performed. All taxpayers make the same payment and the enforcement policy implements a uniform lump-sum taxation system. In this case, we have again

$$W^A < W^{NA}.$$

The introduction of the amnesty tool reduces social waste by bringing down to zero the probability that audits a actually carried out. Audits here remain a pure threat for those not accepting the amnesty offer. Note, again, that only the low-income taxpayer is damaged by this policy.

Proposition 7. *Under risk neutrality, the introduction of the amnesty as a policy tool reduces the probability that audits are carried out and reduces the amount of resources wasted by the enforcement system.*

As we have seen, the reduction of social waste is due to a definite factor, namely the reduction of the actual tax differential. Low income taxpayers end up paying more, while high income taxpayers either pay the same amount as they would with the no-amnesty policy (when the amnesty fee is randomly chosen), or pay less (when the fee is low with certainty).

5. Optimal enforcement policy with amnesties and risk-averse taxpayers

In this section, we investigate the nature of the optimal enforcement policy when amnesties are feasible and taxpayers are risk-averse. Here, in addition to expected audit expenses, an amnesty allows the agency to extract the risk premium from

taxpayers. Since the taxpayers' risk premium is larger if the uncertainty associated with the sampling process is larger, the agency has an incentive to move away from the policy of extensive auditing and increase the uncertainty associated with the selection procedure. This produces a shift in the uncertainty associated with the enforcement policy from the amnesty (random amnesty fee) to the sampling stage (random selection of taxpayers for auditing). Intuition then suggests that the optimal audit rate will be further away from one if the risk premium the agency can reap through the amnesty is larger, i.e. if taxpayers are more averse to risk.

It is not possible to obtain general results in this direction without making specific assumptions on the shape of the taxpayers' utility function. Yet, it is possible to fully characterize the optimal enforcement policy for a limiting case, in which the defence cost for auditees tends to zero. The proof of this result can be found in the appendix.

Proposition 8. *If taxpayers are risk averse and if the defence cost is negligible* $(s = 0)$, *the optimal enforcement policy takes the following shape. Let* $\bar{q}'_{L1} = q'_{L1}(\alpha_0)$ *and* $\bar{\beta} = \frac{p}{1-p}\frac{c\alpha_0}{q_{L1}(\alpha_0)}$. *We have:*
1. If $c < \frac{1-p}{p}\bar{q}'_{L1}$, *then* $a_0^* = \alpha_0$. *High-income taxpayers evade with probability* $\beta \in [\bar{\beta}, 1]$ *and the amnesty fee for low reports is* $q_L = q_{L1}(\alpha_0)$ *(screening amnesty). The expected net revenue is the same as that of the no-amnesty policy.*
2. If $c > \frac{1-p}{p}\bar{q}'_{L1}$, *then* $a_0^* \in [0, \alpha_0]$. *High-income taxpayers evade with probability* $\beta = 1$ *and the amnesty fee for low reports is* $q_L = q_{L1}(\alpha_0)$ *(screening amnesty). The net revenue is greater than that of the no-amnesty policy.*

At the equilibrium, the evasion rate is always sufficiently large to discourage the use of a pooling amnesty. If taxpayers are moderately averse to risk or the audit cost small (case 1), the agency sets a_0 to the level which leaves high-income taxpayers indifferent between evading and not. Those who evade are offered a screening settlement of amount $q_L = T_1 - T_0$, which they accept. This allows the agency to recover the tax revenue lost due to evasion. Hence, the introduction of the settlement stage does not affect the expected net revenue.

If taxpayers are highly averse to risk or the audit cost is large (case 2), the agency sets a_0 to a low level. High-income taxpayers evade with probability one and the amnesty fee is $q_{L1}(a_0) < T_1 - T_0$. Due to the low audit rate, the agency incurs a small audit expenditure. The reduction in audit expenditure plus the amnesty intake more than compensate for the loss in the tax revenue. In this case, the net payment of high-income taxpayers is reduced from T_1 to $T_0 + q_{L1}(a_0)$. This is an interesting case in which the amnesty allows the agency to efficiently modify the tax levels decided by the superior authority. Note that in order to do so, the agency does not fix in advance a reduced amnesty fee payable by taxpayers in lieu of the statutory tax. Instead, the

agency modifies the actual payment of the taxpayers by means of the audit rate: a small audit rate implies a small expected punishment and, hence, a small amnesty fee. The policy of reducing the audit rate may increase the net revenue to the agency, and this is the case when the statutory tax for high income taxpayers, T_1, is "too large." Here, a sort of "**Laffer curve effect**" applies: a reduction in the actual tax level allows the agency to reduce the audit expenditure and to gain from the increased selection risk borne by taxpayers. The incentive to evade is reduced, and the agency can reduce the amount of resources needed to refrain agents from noncompliance by an amount which outweighs the loss in the tax intake.

The optimal enforcement policy emerging from the last proposition differs from that derived under risk-neutrality. In that case, the agency had a strong incentive to raise the audit rates in order to increase the expected defence costs to taxpayers, which it could then extract (extortionary effect). That sort of policy places all risk for taxpayers in the amnesty stage (random fee) as opposed to the sampling stage. With risk-aversion, the optimal policy is likely to take a different nature: the agency has to strike a balance between the gains associated with the extraction of the defence cost (extortionary effect) and those associated with the extraction of the risk premium (Laffer curve effect). It is therefore natural to expect that with a small defence cost, the optimal policy will depend more on the second factor. As Proposition 8 shows, if the defence cost is negligible, the optimal audit rate for low reports cannot be greater than α_0. Also, the optimal audit rate is smaller and the net revenue larger, if taxpayers are more averse to risk.

The results obtained for the two special cases (risk neutrality and zero defence costs) provide us with a clear picture of the optimal enforcement policy at two extremes. It is sensible to think that, in the general case, the optimal policy will lie somewhere in between the policies derived for the special cases. Computations run on the general case, with a positive defence cost and risk averse taxpayers, confirm this intuition. In particular, they show that the optimal audit rate a_0 (and the probability of a pooling amnesty) is larger if the defence cost s is larger and if taxpayers are less averse to risk.

Finally, note that since amnesties reduce the social waste when the "extortionary effect" alone applies and $a_0^* = 1$, they will reduce it *a fortiori* when the "Laffer curve effect" comes into play and $a_0^* < 1$.

6. Optimal enforcement policy with plea bargains

One of the main differences between amnesties and individual plea bargains is that the former address all criminals (taxpayers), whereas the latter are accessible only to

criminals already selected for investigations.[11] In many countries, tax inspectors can negotiate the level of the penalty with taxpayers and offer considerable "discounts" to those who confess their infraction. It is clear that if plea bargaining already takes place at individual level, there is no need to have public amnesties. In this section, we analyze the impact of individual plea bargaining on the optimal enforcement policy and compare it with the optimal amnesty policy. In order to do so, we take a very simple view of plea bargaining and assume that negotiations take place when the agency is still uninformed about taxpayers' real income and that all the bargaining power rests in the hands of the agency. The move sequence is the following:

1. the agency selects the audit rates a_0 and a_1;
2. taxpayers choose their income reports and pay their taxes;
3. random samples of taxpayers are selected for auditing;
4. selected taxpayers are invited to settle their case;
5. taxpayers decide whether to accept the settlement offer or not.

It is assumed that the agency makes a "take-it-or-leave-it" settlement offer to taxpayers selected for investigations and that those who reject it are invariably subject to an audit.

It is easy to see that the plea bargaining game is very similar to the amnesty game. The main difference lies in the fact that amnesties are offered before taxpayers are selected for investigation and thus operate as social insurance against the audit-selection risk. In that case, the optimal policy has to solve a difficult risk allocation problem for the incentive to extract the defence cost from taxpayers (by means of large audit rates) is countered by the incentive to raise the uncertainty in the selection procedure (keeping the audit samples at a less than 100% size). Under risk neutrality, this problem does not emerge because the sampling uncertainty does not produce a risk premium which can be seized. Something similar happens here: since risk-premium extraction is not at stake, the optimal enforcement policy will take a simple form, which will reveal itself to be the same as the optimal policy with amnesties and risk neutrality.

Let us solve the game starting from the last stage, where taxpayers have to choose whether to accept the deal or not. Take a taxpayer with high income who has reported "low" and has been selected for investigations. He will accept a settlement of amount $\hat{q}$ only if

$$u\left(y_1 - T_0 - \hat{q}\right) \leq u\left(y_1 - T_1 - F - s\right),$$

[11] Leonard and Zeckhauser (1987) point out some additional features peculiar to amnesties: 1. the relatively small difference in the terms available, 2. their publicity, 3. their importance in signaling changes in the enforcement policy, 4. their inclusion of elements of pardon and redemption.

i.e., only if

$$\hat{q} \leq f + s.$$

The willingness of an evader to pay is then $\hat{q}_{L1} = f + s$. Compliant taxpayers will instead be willing to pay only $\hat{q} = s$ to avoid the audit. These values can be obtained from the formulae of the previous sections by letting the audit rate go to 1. For $a_0 = 1$, all taxpayers (reporting a low income) are selected for investigations and the two procedures (amnesties vs plea bargaining) are indistinguishable.

Let us turn now to the settlement stage and consider the optimal settlement offer for those who have reported a low income. The agency will optimally choose one of the following amounts

$$\begin{cases} \hat{q}_{L0} = s, & \text{the willingness to pay of type-0,} \\ \hat{q}_{L1} = f + s, & \text{the willingness to pay of type-1,} \\ \hat{q}_{\infty} > \hat{q}_{L1}, & \text{an amount so large that nobody accepts it.} \end{cases}$$

The optimal amount is derived from the comparison of the continuation revenues:

$$\begin{cases} \hat{R}_{L0} = s, \\ \hat{R}_{L1} = v(f + s) - (1 - v)c, \\ \hat{R}_{\infty} = vf - c. \end{cases}$$

If the inspector limits his request to s (*pooling settlement*), the case is settled with certainty and she gains s. If she raises her request to $f + s$ (*screening settlement*), the case is settled only with probability v (the probability of evasion given a low report). Finally, if she asks for an amount greater than $f + s$, the case is not settled and the audit takes place with certainty. It is easy to see that, as in the amnesty case, $\hat{q}_{\infty}$ can never be an optimal offer. The optimal settlement amount will then be chosen between $\hat{q}_{L1}$ and $\hat{q}_{L0}$:

$$\hat{R}_{L1} > \hat{R}_{L0} \iff v > \frac{s + c}{f + s + c}$$

$$\iff \beta > \hat{\beta} \equiv \frac{p}{1 - p} \frac{c + s}{f}.$$

The optimal settlement is of the screening type only if β is greater than $\hat{\beta}$. The threshold $\hat{\beta}$ is equal to the threshold $\bar{\beta}$ derived for the optimal amnesty under the assumption of risk neutrality. We therefore have that $\hat{\beta} \leq 1 \iff c + s \leq \frac{1-p}{p} f$. Clearly, the optimal settlement amount for those who report a high-income is always $q_H = 0$.

Let $\hat{\lambda}$ be the probability that a pooling settlement is offered to those who have reported a low income. Taxpayers with a high income choose to evade only if

$$(1-a_0)\,u(y_1-T_0)+a_0\left[\hat{\lambda}\,u(y_1-T_0-s)+\left(1-\hat{\lambda}\right)u(y_1-T_0-f-s)\right]\geq u(y_1-T_1),$$

that is, only if

$$\lambda\geq\hat{\lambda}(a_0)\equiv\frac{u(y_1-T_1)-EU_{1L}(a_0)}{[(1-a_0)\,u(y_1-T_0)+a_0u(y_1-T_0-s)]-EU_{1L}(a_0)}.$$

It can be easily established that $\hat{\lambda}(a_0)>0$ if and only if $a_0>\alpha_0$, and that $\hat{\lambda}(a_0)\leq 1$ for all $a_0\geq 0$. High-income taxpayers evade either because a_0 is small, $a_0<\alpha_0$, or because the probability of a pooling settlement is sufficiently large, $\lambda>\hat{\lambda}(a_0)$.

The threshold value just obtained differs from that obtained for the amnesty policy since individual settlements take place after samples are taken and do not remove the selection-risk on taxpayers' side. It is interesting to ascertain which type of deal (amnesty vs settlement) yields the largest expected payoff to evaders. This will in general depend on the shape of the utility function and on how risk aversion is affected by the income level. The following result can be easily established.

Lemma 9. *If utility functions display decreasing absolute risk aversion, then evaders gain more from a pooling settlement than a pooling amnesty.*

Proof. An evader's expected payoff is $u(y_1-T_0-\hat{q}_{L0}(a_0))$ with a pooling amnesty and $V(a_0)\equiv[(1-a_0)\,u(y_1-T_0)+a_0u(y_1-T_0-s)]$ with a pooling settlement. Let $y_1-T_0-x(a_0)$ be the certainty equivalent of $V(a_0)$: $u(y_1-T_0-x(a_0))=V(a_0)$. Hence, $V(a_0)\geq u(y_1-T_0-\hat{q}_{L0}(a_0))$ if and only if $x(a_0)\leq\hat{q}_{L0}(a_0)$. Note that $x(a_0)$ and $\hat{q}_{L0}(a_0)$ represent, respectively, the amounts that a high-income and a low-income taxpayer are willing to give up to avoid the same risk. $x(a_0)$ and $\hat{q}_{L0}(a_0)$ are then equal to a_0s plus the risk premium for each type. With DARA, the risk premium is decreasing in income, and therefore $x(a_0)\leq\hat{q}_{L0}(a_0)$. □

Since the deal is made at a price acceptable to the low-income taxpayer, the high income taxpayer is worse off when the deal includes selection-risk coverage if the low-income taxpayer is more risk-averse than himself. As a consequence, when utility functions display DARA, a smaller probability of a pooling settlement provides the same incentive to evade as a larger probability of a pooling amnesty: $\hat{\lambda}(a_0)\leq\bar{\lambda}(a_0)$. It is also clear that if taxpayers are risk neutral, settlements and amnesties are equivalent, and that $\hat{\lambda}(a_0)=\bar{\lambda}(a_0)$ for $a_0=0,1$.

We can now proceed in the analysis of the settlement game. Note that a_1 can be optimally set to 0. According to the same arguments used for the amnesty game, the equilibrium must be as follows.

For $a_0 < \alpha_0$, high income taxpayers evade with probability one. The settlement is screening if $c + s < \frac{1-p}{p} f$, and is pooling otherwise.

For $a_0 = \alpha_0$, we have two possible cases. If $c + s < \frac{1-p}{p} f$, high income taxpayers evade with probability $\beta \in [\hat{\beta}, 1]$ and the settlement is screening. Otherwise, they evade with probability one and the settlement is pooling.

For $a_0 > \alpha_0$, we again have two possible cases. If $c + s < \frac{1-p}{p} f$, high income taxpayers evades with probability $\hat{\beta}$ and the settlement is pooling with probability $\hat{\lambda}(a_0)$. Otherwise, they evade with probability one and the settlement is pooling.

We can finally derive the optimal audit rates. It can now be easily seen that the net revenue expression for the settlement policy is the same as that of the amnesty policy under risk neutrality.

We have

$$\hat{R}(a_0) = \begin{cases} pT_0 + (1-p)T_0 + (1-p)a_0(f+s) - pca_0, & \text{for} \quad a_0 < \alpha_0, \\ pT_0 + (1-p)T_1 - (1-p)\bar{\beta}(T_1 - T_0) + a_0\left(p + (1-p)\bar{\beta}\right)s, & \text{for} \quad a_0 \geq \alpha_0. \end{cases}$$

which is the same as the expression derived in section 4. The optimal audit rate is again $a_0^* = 1$. Since risk-premium extraction is not at stake, the optimal policy is to use the audit threat to its maximum extent and choose a unitary audit rate. All taxpayers reporting a low income are included in the audit sample and invited to settle.

Proposition 10. *If plea bargaining is allowed to take place after taxpayers have been selected for auditing, the optimal enforcement policy is the same as that obtained for the amnesty policy with risk neutral taxpayers (see proposition 6).*

In view of this result, the comparative statics results obtained in section 4 apply here. In particular, the net revenue will be larger if the fine F and the defence cost s are larger and if the audit cost c is smaller. Also, the gain in the net revenue due to the introduction of a settlement stage depends positively on the defence cost s. Finally, the settlement policy reduces the probability that an audit is carried out and reduces social waste.

The plea bargains policy may be now compared with the amnesty policy. In view of the last result, this task turns out to be particularly easy.

Corollary 11. *The expected net revenue to the agency is larger when it makes use of public amnesties rather than individual plea bargains.*

Proof. Under the amnesty regime, the agency can always set $a_0 = 1$. In this case there is no difference between an amnesty and the individual negotiation of settlements (all taxpayers are selected for investigations). Therefore, the amnesty policy can always guarantee the agency with a net revenue as large as the maximum revenue obtained with plea bargains. □

This result is essentially due to the fact that individual plea bargains do not affect the risk involved in the evasion choice and cannot be used to reduce an excessive tax differential.

Note that the difference between the maximum revenues in the amnesty and the plea bargaining regimes is larger if the optimal audit rates under the amnesty regime are smaller, and in particular, if taxpayers are more averse to risk and if the defence cost s is smaller.

In assessing the policy implication of our result, one has to bear in mind that our depiction of plea bargaining rests on some simplifying assumptions that may not obtain in reality. In particular, the following factors need to be taken in consideration.

- First, when individual plea bargaining takes place, nothing can guarantee that all the bargaining power remains in the hands of the agency. If this is not the case, a part of the 'social surplus' will be netted by taxpayers at the settlement stage. It is hard to tell how the solution of the game would be affected by this factor without making specific assumptions about the negotiation process. Note, however, that all possible settlement processes must provide evaders with an informational rent (unless all defendants are audited). This is sufficient to induce a positive evasion rate at the equilibrium.

- Second, plea bargaining may take place after investigations have started and some information has been gathered by the agency. In this case, the outcome of the game will depend on the actual shape of the investigation process and whether the agency can acquire evidence damaging to evaders at a low cost. Also, individual deals may allow the agency to use information it can have access to, which is either nonverifiable or legally irrelevant, but informative (e.g., "all your friends are evaders and therefore your are likely to be an evader"). The use of this sort of information would produce a noticeable efficiency gain in the enforcement policy. This would also be true for the case in which the agency has full control over all policy parameters.[12] It is questionable, however, whether this would be desirable within a broader view which takes individual rights and procedural integrity into consideration.

[12]See footnote 2.

- Finally, since plea bargaining takes place at a "private" level, it gives rise to the possibility of corruption. Inspectors may be tempted to bias the settlement offer and exchange a low settlement amount for private compensation. A comprehensive analysis of this case will have to take into account the anti-corruption devices used by the government. It is clear, however, that if these devices were not effective, plea bargaining would have disastrous effects on the net revenue.[13]

The first and the third factors tend to accentuate the superiority of public amnesties with respect to individual plea bargains, while the second suggests that the outcome of this comparison may depend on the features of the process of discovery.

7. Final remarks

The analysis of this paper shows that when the agency has limited control over the enforcement parameters, perfectly anticipated pre-audit settlements may allow the agency to gain additional resources. By means of these settlements, the agency can correct some imperfections in the enforcement system, like the lack of insurance against the defence expenditure and an excessive tax differential. In a first-best world, in which all enforcement parameters are optimally chosen, tax amnesties and plea bargains cannot produce an increase in the tax revenue (the revelation principle applies). In this sense, they represent second best instruments, which can be used when major reforms of the tax system are not feasible.[14] Also, they can be deemed as short term adjustment tools (amnesties in particular), which allow the government to accommodate temporary changes in economic variables (e.g. changes in income) without altering the tax code.

It is no surprise to find that amnesties are abundantly used in countries in which the enforcement system suffers from major structural problems. In these contexts, amnesties can be viewed not only as an indication of an inability of the enforcer to commit, but also as attempts to overcome the structural rigidity which gives rise to problems. The problem is, however, that the unlimited use of these second best tools allows the state to capitalize on its own inefficiency and provides an excuse to indefinitely delay any thorough-going reform of the enforcement system.

8. Appendix

Proof of Proposition 8.

[13]This is the reason why, for instance, plea bargains with the tax agency have been ruled out in the USA in the early fifties and in Italy at the beginning of the seventies.

[14]In reference to the initial quotation, one can think of indulgences as a clever way of surmounting the theological prohibition of the direct sale of the right to sin.

If $s = 0$, an honest taxpayer is willing to accept the settlement offer only if $q = 0$. From Lemma 3 we know that $\bar{\beta}(a_0) < 1$ for all $a_0 > 0$: when the probability of evasion is sufficiently large, the agency prefers to screen between taxpayers.

Consider now the problem of the choice of the optimal audit rate.

If $a_0 < \alpha_0$, type-1 evades with certainty and the agency offers $q_L = q_{L1}(a_0)$. The net revenue is

$$R_0(a_0) = pT_0 + (1-p)T_0 + (1-p)q_{L1}(a_0) - pca_0, \qquad \text{for } a_0 < \alpha_0,$$

with

$$\begin{aligned} R_0'(a_0) &= (1-p)q_{L1}'(a_0) - pc, \\ R_0''(a_0) &= (1-p)q_{L1}''(a_0) < 0. \end{aligned}$$

R_0 reaches its maximum at $a_0 = \alpha_0$ if $(1-p)q_{L1}'(\alpha_0) \geq pc$, and at $\hat{a}_0 = \{a_0 : R_0'(a_0) = 0\}$ otherwise.

If $a_0 > \alpha_0$, type-1 evades with probability $\beta = \bar{\beta}(a_0)$ and the agency sets $q_L(a_0) = 0$ with probability $\bar{\lambda}(a_0)$ and $q_L = q_{L1}(a_0)$ with probability $1 - \bar{\lambda}(a_0)$. The net revenue is

$$\begin{aligned} R_1(a_0) &= pT_0 + (1-p)T_1 - (1-p)\bar{\beta}(a_0)(T_1 - T_0) + \\ &\quad + (1-p)\bar{\beta}(a_0)\, q_{L1}(a_0) - pca_0 = \qquad \text{for } a_0 > \alpha_0, \\ &= pT_0 + (1-p)T_1 - (1-p)\bar{\beta}(a_0)(T_1 - T_0), \end{aligned}$$

with

$$\bar{\beta}(a_0) = \frac{p}{1-p}\frac{ca_0}{q_{L1}(a_0)}.$$

Upon simplification we get

$$\begin{aligned} R_1'(a_0) &= \bar{\beta}'(a_0)(1-p)(q_{L1}(a_0) - T_1 + T_0) + (1-p)\bar{\beta}(a_0)q_{L1}'(a_0) - pc \\ &= -(1-p)(T_1 - T_0)\bar{\beta}'(a_0). \end{aligned}$$

Since $q_{L1} = T_1 - T_0$ at $a_0 = \alpha_0$, we have

$$\begin{aligned} R_1'(\alpha_0) < 0 &\iff (1-p)\bar{\beta}(\alpha_0)q_{L1}'(\alpha_0) - pc < 0, \\ &\iff (1-p)\frac{p}{1-p}\frac{c\alpha_0}{q_{L1}(\alpha_0)}q_{L1}'(\alpha_0) - pc < 0, \\ &\iff q_{L1}'(\alpha_0) < \frac{q_{L1}(\alpha_0)}{\alpha_0}. \end{aligned}$$

The last inequality is satisfied since $q_{L1}(0) = 0$, and $q_{L1}'(a_0) > 0$, $q_{L1}''(a_0) < 0$ for all $a_0 \in (0,1)$.

We can now use this piece of information to derive the sign of $R_1'(a_0)$ for all $a_0 > \alpha_0$ Note, in fact, that (omitting subscripts and arguments)

$$R_1' = 0 \Longleftrightarrow \bar{\beta}' = \frac{p}{1-p} c \frac{q - aq'}{q^2} = 0,$$

and

$$\begin{aligned} R_1'' &= -(1-p)(T_1 - T_0)\bar{\beta}'' = \\ &= -(1-p)(T_1 - T_0)\frac{p}{1-p} c \frac{(q' - aq'' - q')q^2 - (q - aq')2qq'}{q^4}, \end{aligned}$$

so that, whenever $R_1' = 0$,

$$R_1'' = -(1-p)(T_1 - T_0)\frac{p}{1-p} c \frac{-aq''}{q^2} < 0.$$

This proves that R_1 is quasi-concave and that its critical points must all be local maxima. If R_1 is declining at $a_0 = \alpha_0$, then it will be declining for all points to the r.h.s. of α_0, since it has no (critical) minima. We can then be sure that $a_0^* \notin (\alpha_0, 1]$.

The optimal audit rate is therefore the following:

1. If $(1-p)q_{L1}'(\alpha_0) < pc$, then a_0^* is the only value of $a_0 \in (0, \alpha_0)$ such that $R^{0\prime}(a_0) = 0$;

2. If $(1-p)q_{L1}'(\alpha_0) \geq pc$, then $a_0^* = \alpha_0$.

In the first case the net revenue to the agency exceeds the no-amnesty revenue since $a_0^* \neq \alpha_0$ (see the proof of proposition 5).

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