# Corruption, extortion and evasion

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## Abstract

Corruption, evasion and the abuse of power — and the possibility thereof — are pervasive features of economic activity. A prominent instance is tax collection. This paper examines the implications of corruptibility and the potential abuse of authority for the effects and optimal design of (potentially non-linear) tax collection schemes. Amongst the findings are that: the distributional effects of evasion and corruption are unambiguously regressive under the kinds of schemes usual in practice; and collecting progressive taxes without inducing evasion or corruption may require that inspectors be paid commission on high income reports (but not on low), with the cost of this potentially creating what seems to be a previously-unnoticed trade-off between equity and efficiency.  © 1999 Elsevier Science S.A. All rights reserved.

## 1. Introduction

Tax revenue does not collect itself. Instead its collection invites several forms of dishonesty and malpractice: taxpayers may try to evade their legal liabilities, while

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tax inspectors may solicit bribes in order to connive at such evasion or, more generally, may abuse the authority with which they are entrusted. Firm evidence on the extent of such practices is naturally hard to come by. But anecdotal evidence abounds, and can be stunning.[1] Moreover, any illusion that such practices are limited to developing countries has been dispelled by recent high profile cases in, for example, Italy and the UK. Not least, the Senate Hearings on the Internal Revenue Service (IRS) in autumn 1997 have raised in stark form the potential for abuse that lies in the considerable powers vested in tax collection agencies.

Dishonesty and corruption can make the real effects of the tax system very different from those that the formal tax system would have if honestly implemented. Even when such behaviour does not occur in equilibrium, moreover, the possibility of its occurring must be a central consideration in designing fair and effective tax collection mechanisms. A host of issues arise. How do dishonesty and corruption affect the distributional impact of the tax system? How should potentially corruptible tax inspectors be remunerated? Is it possible to eliminate evasion and corruption without compromising either the revenue raised by the tax system or its distributional effects?

The aim of this paper is to address these and other issues by developing and exploring a model of the encounter between a taxpayer and a tax inspector, both potentially corruptible, within the setting of a very general form of tax collection mechanism; a mechanism that is ultimately a matter for choice by the government. There are three key aspects of the generality that we seek.

The first is that we allow for the possibility of *extortion*: the tax inspector can report, or threaten to the taxpayer that he will report, a taxable income higher than the true. For tax inspectors commonly possess many devices by which they may over-state taxable income: they might disallow or challenge legitimate deductions; they might charge tax on non-taxable incomes; they might simply lie about the taxpayer's characteristics (the floor space of her shop under a presumptive tax system, for example, or the number and age of her dependents). Appeals procedures provide some safeguard against over-assessment, but it is implausible to suppose them sufficiently perfect to preclude it altogether, and indeed the corrupt inspector has an incentive to use intimidatory methods to impede their effectiveness. Practitioners have little doubt as to the prevalence and importance of extortion by tax inspectors. The classic discussion of corruption by Klitgaard (1988) reports the response of Justice Plana, a senior official credited with a

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[1] Surveys in Taiwan, for example, report 94% of interviewees as having been 'led to' bribe corrupt tax administrators and 80% of certified public accountants as admitting to bribing tax officials (Chu, 1990). For India, Mookherjee and Png (1995) — citing Goswami et al. (1990) — report a confidential survey as finding that 76% of all government tax auditors took bribes, and that 68% of taxpayers had paid bribes. Ul Haque and Sahay (1996) report estimates that 20–30% of Nepalese tax revenue has been lost through bribery, and cite a former prime minister of Thailand as reckoning that the elimination of corruption would raise tax revenues by nearly 50%.

successful anti-corruption campaign in the Internal Revenue Service of the Philippines, when asked what he felt to be the most serious form of corruption: 'It was extortion. When you resort to intimidation, when you threaten the taxpayer with a fantastic assessment — that to me is the most serious form of corruption. This practice was fairly extensive and very pernicious.' (Klitgaard, 1988, p. 49).[2]

The second aspect of generality is the remuneration of tax inspectors. We allow a very general reward scheme, comprising a fixed wage and — in particular — a possibly non-linear commission payment on revenues collected.[3] Paying tax inspectors a commission gives them an incentive to resist the evasion of taxes. By the same token, however, it also gives them an incentive to over-state taxes: paying inspectors a commission may thus enhance their ability to extort by rendering credible the threat to over-report the taxpayer's income. Thus this second aspect of generality is closely linked to the first.[4]

The third aspect of generality is that — in order to address distributional issues — we allow for non-linear tax schedules. Such distributional complexities prove to be closely related to the possibility of non-linear commission schedules.

This generality is not pursued for its own sake. It generates what proves a rich framework, with each element generating distinctive and powerful conclusions. Two of these are especially striking:

- for tax schemes of broadly the kind usually observed, the impact of evasion and corruption in tax collection is unambiguously regressive: the richest have most to gain from evading taxes and are least vulnerable to extortion (because it is harder to credibly over-report their incomes); the poor, on the other hand, have few taxes to evade and their incomes can more plausibly be over-reported;
- the honest implementation of progressive taxation requires that the inspector be paid a commission on high income reports (but not on low). Financing that commission, however, requires that the average level of taxation be higher than would otherwise be the case. Costs of implementation — quite distinct from

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[2]The IRS hearings in the US alleged abusive practices that have a similar taste: see, for example, the evidence of Jennifer Long (Finance Committee Press Release, 24th September 1997; http:/ /www.senate.gov/~finance/long.htm).

[3]Increased concern with the extent of evasion and corruption amongst tax collectors has indeed led to suggestions for some form of commission payment: see, for instance, Bagchi et al. (1995).

[4]Some countries, such as Belarus and Senegal, have indeed adopted explicit commission systems for tax inspectors. Reward systems within tax collection agencies may also have implicit commission-like features. As a less structured form of commission, Bird (1992) notes that banks used to collect taxes benefit from the use of these funds over some period; and a firm required to withhold taxes on the wages and salaries it pays will typically find that reporting rather than concealing a given gross wage payment reduces its profit tax liability, akin to a receipt of commission. Not least, it is worth remembering that a central method of tax collection throughout most of recorded history has been tax farming: the extreme form of commission system in which the collector pays the government a fixed fee in return for the right to retain all revenues legitimately collected. There has recently been a revival of interest in the possibilities for this ultimate form of privatisation: see, for example, Stella (1993).

standard incentive effects in the generation of taxable income — thus create a trade-off between equity and efficiency objectives that seems previously to have been unnoticed.

There have of course been many previous studies of dishonesty in taxation. Almost all, however, deal only with evasion by dishonest taxpayers, under the assumption that tax collectors themselves are intrinsically honest.[5] In emphasising collusion between taxpayer and inspector we follow Basu et al. (1992), Besley and McLaren (1993), Chander and Wilde (1992), Carillo (1995a), Flatters and MacLeod (1995) and — with environmental regulation rather than tax collection in mind — Mookherjee and Png (1995). But none of these contains any of the distinctive features just described (except that Mookherjee and Png allow for linear (only) commissions).[6] Closest to the analysis here is Mookherjee (1998),[7] which extends the Mookherjee-Png framework (retaining the linearity restrictions) to raise some of the extortion-related issues addressed here.

There is also of course a large literature on corruption more generally (a recent review being Bardhan (1997)) with key contributions including those of Tirole (1986, 1992) and, on the empirical side, Mauro (1995) and Tanzi and Davoodi (1997). The present analysis has applications in these wider contexts. Recent treatments of collusion within institutions by Kofman and Lawarree (1993), Carillo (1995a,b), and Strausz (1995), for example, preclude extortion of the kind addressed here by arbitrarily assuming that the inspector cannot send a report to the principal that is less favourable to the agent than the truth.[8] Certainly the analytical framework here is open to many other interpretations;[9] the general structure of the problem with which we deal — a principal seeking to extract some payment from an agent and hiring an inspector to uncover and report private

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[5]See for example Border and Sobel (1987), Chander and Wilde (1998), Cowell (1990) and Reinganum and Wilde (1985).

[6]By the same token, we wish to abstract from the issues that these authors focus on: those that arise when the corrupt have corrupt supervisors (Basu et al., 1992; Carillo; 1995a), for example, or the inspector plays the same game over several periods, and so may be discouraged from taking bribes by payment of an efficiency wage and the threat of dismissal (Besley and McLaren, 1993; Flatters and MacLeod, 1995).

[7]We became aware of this paper after circulating earlier versions of the present one.

[8]Extortion has been examined in the contexts — very different from the present — of organised crime (by Konrad and Skaperdas (1995, 1997)) and public procurement (by Mogiliansky (1994) and Auriol (1996)).

[9]One might for example conceive of the principal as the owner of a firm run by the agent, with the former hiring an auditor (the supervisor) to uncover the firm's true profitability, upon which dividend payments can be based, in the knowledge that the manager retains use of funds not distributed and that manager and auditor may collude to misreport profitability. Or the principal might be a landlord, seeking to extract rents from her tenants but unsure of the profitability of their various holdings and to discover this employing a land agent.

information upon which that payment can be based — fits a very wide variety of circumstances in which the possibility of corruption is a key concern.

The rest of the paper is organised as follows. Section 2 sets out the framework of analysis, and Section 3 then addresses a series of positive issues concerning the bargaining equilibrium. Section 4 considers the joint design of optimal tax, remuneration and penalty schedules. Section 5 summarises, and discusses some of our key modelling assumptions.

## 2. The model

As described in Section 1, the aspect of tax collection on which we focus is the encounter between taxpayer and tax inspector. To this end we abstract from some features of the tax collection process that are important in some contexts. In particular, the model we use is most naturally interpreted as one in which all taxpayers will meet an inspector.[10] In practice, such encounters happen only to taxpayers selected for audit. In some cases — as with the US income tax — that audit selection process reflects the application of systematic rules, and there then arise further strategic considerations in the tax collection and design process that we do not address. In many cases, however, audit selection is de facto un-systematic, and one might with little loss think of the taxpayer population we examine as a random draw from a wider universe.[11] Moreover, there are contexts in which all taxpayers are audited: VAT administrations, for example, generally aim to audit all taxpayers within a cycle of a few years; and in some developing countries assessment (for land tax, for instance) is by local figures of authority, taken to have knowledge of each taxpayer's circumstances. The model developed here is not intended as a realistic representation of any actual tax system. Indeed part of the ultimate purpose is to explain why observed systems are not closer to that described here: why it is, for example, that the UK Inland Revenue does not routinely include revenue targets in its performance evaluations. Whilst the model used here is not a full representation of any real tax system, it addresses a feature — an encounter between taxpayer and inspector — that is common to all.

It may be helpful, before turning to its detail, to outline the essence of that model. Discussion of some of the key assumptions is deferred until the final section.

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[10]There are alternatives. One could read the model, for example, as having only one taxpayer encounter an inspector with all non-audited paying some fixed amount of tax (possibly zero).

[11]Though of course the question then remains as to the determination of the tax payments of those not audited.

## 2.1. Outline

The government, $G$, wishes to raise some revenue, and may (or may not) also have distinct concerns with the levels of tax evasion and/or corruption, and also with the distribution of tax payments across taxpayers of differing incomes. Tax collection is delegated by $G$ to an inspector $I$, who operates within the framework of a set of policy instruments and incentive schemes specified by $G$. It is common knowledge that $I$ is corruptible, in the sense that he pursues his own interest and not necessarily that of $G$: in particular, $I$ is open to bribery. The inspector encounters one of many citizens, $C$. The taxable income $\theta$ of each citizen is her own private information, but its distribution in the population is common knowledge. All citizens are open to the payment (or, conceivably, receipt) of bribes. The encounter between $I$ and $C$ may thus lead to the former receiving a bribe of $B$ from the latter and reporting to $G$ that $C$'s income is $r$, which may differ from her true income $\theta$. This mis-reporting may be in either direction: income may be under-reported, with $C$ and $I$ colluding in the evasion of taxes, or it may be over-reported, corresponding to extortion. The citizen may (at some cost) appeal against the assessment by $I$. If she does not, then the income reported by $I$ is subject to random audit by an honest collector. Both $C$ and $I$ are risk-neutral.

## 2.2. Details

The structure just outlined is modelled as a three-stage game.

### 2.2.1. Stage 1: G announces the tax scheme

The government $G$ announces (and commits itself to) a set of policy instruments $M \equiv \langle T, f_C, f_I, \lambda, \omega \rangle$ comprising: (i) a tax schedule $T : \Gamma \to \Gamma$, where $\Gamma$ denotes the interval $[0, \infty)$ (thus $T(\theta)$ denotes the legal tax liability on income $\theta$), (ii) a penalty schedule $f_i : \Gamma^2 \to \Re$, where $f_i(r, \theta)$ is the monetary fine imposed by $G$ on player $i$ $(i = C, I)$ if income is reported as $r$ but subsequently discovered to be $\theta$, and (iii) a reward scheme for $I$ comprising a fixed wage $\omega \in \Re$ and a commission schedule $\lambda : \Gamma \to [0,1]$. The payment to $I$ for a report $r$ is $\omega + \lambda(r)T(r)$. We refer to any such set of instruments $M$ as a *tax scheme*, and assume that $G$'s choice is restricted to tax schemes that satisfy:

**Assumption 1.** The government can choose only tax schemes such that: (i) $T(\theta) \in [0, \theta]$, $\forall \theta \in \Gamma$, (ii) $f_i(\theta, \theta) = 0$, $i = C, I$, and (iii) $f_i(r, \theta) \geq 0$, $\forall (r, \theta) \in \Gamma^2$.

Assumption A1(i) merely ensures that average tax rates are non-negative and do not exceed 100% (which implies that $T(0) = 0$). A1(ii) means that those discovered to have reported truthfully are neither punished nor rewarded, and A1(iii) that rewards are never paid. Rewarding truthtelling is indeed never optimal in any of

the problems with which we shall be concerned.[12] Knowing the tax scheme and the distribution of citizens' incomes, *I* decides whether or not to participate. If he does not, *I* obtains his reservation payoff, which we normalise to zero. The participation constraint is then that *I*'s expected payoff be non-negative. We restrict attention in the positive part of the analysis to schemes that satisfy this condition, and in the normative part impose the stronger requirement that the ex post payoff to *I* be non-negative.

### 2.2.2. Stage 2: income reporting and appeal

The inspector meets a citizen *C* drawn at random from the population. Before they talk, the citizen's true income $\theta \in \Gamma$ becomes common knowledge between them.[13] They then bargain (talk) according to a *game form* $\Phi$, which has two types of outcome: (i) the players reach an agreement $(m,B) \in \Gamma \times \Re$, with the interpretation that *I* certifies to the government that the true income of *C* is *m*, and *C* pays *I* a bribe of *B*, and (ii) the players fail to reach an agreement and the inspector unilaterally chooses an income report $n \in \Gamma$ — since no agreement has been reached between *I* and *C*, no bribe is paid. With either type of outcome, *I* reports to *G* some income $r \in \Gamma$.[14]

For most of our results we shall need no further restrictions on $\Phi$. By way of illustration, one possible form for $\Phi$ would be that in which: with probability 0.5, player *i* (*i* = *C*,*I*) makes an offer $(m,B)$, which player *j* ($j \neq i$) can either accept or reject; if she rejects then the tax inspector *I* chooses *n* unilaterally.

The citizen is now given an opportunity to appeal against the income *r* reported by *I*. Appeals are always successful, in the sense that *C*'s true income is certain to be revealed and — appeal judges being assumed incorruptible[15] — her liability restored to its correct level. But appealing incurs a fixed cost for *C* of $\alpha \geq 0$. For the most part we shall assume $\alpha$ to be strictly positive, as seems evidently realistic in many tax settings (and as may indeed be optimal, if appeals involve real resource cost, as a means of discouraging frivolous appeals).[16]

We do not allow either *C* or *I* to renege on any agreement $(m,B)$ that is struck,

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[12]This reflects our later assumption that the probability with which the income reported by *I* is audited by an honest inspector is exogenous and fixed.

[13]This is clearly restrictive, but we focus here on other aspects of a problem that is already rather rich. The role of this assumption — and others — is discussed in the concluding section.

[14]It should be noted that *G* cannot control and choose the game form $\Phi$ through which *I* and *C* bargain over the collusive agreement (side-contract). An implication of this observation is that the results from the standard mechanism design/implementation literature with complete information are inapplicable to our problem.

[15]Banerjee (1994) examines what happens when this assumption is violated.

[16]That appealing is costly, and that tax enforcers may exploit this, is again illustrated by the IRS hearings, with one irate taxpayer alleging that in his dealings with them: '...the government extorted $50,000 . . . The government attorneys knew that it was going to cost an additional $50,000 to litigate the case and used it to leverage the IRS' position.' (Evidence of Tom Savage) (Finance Committee Press Release, 24th September 1997; http://www.senate.gov/f̃inance/savage.htm).

though they may have an incentive to do so. The inspector, for example, having perhaps pocketed a bribe in return for condoning understatement of income, would now benefit, if $\lambda T$ is increasing, from raising the income report and so receiving a higher commission. One can also conceive of circumstances in which $C$ would wish to appeal against an income report $m$ to which she had agreed. We preclude such reneging by assuming any agreement struck to be enforceable by some means.[17]

### 2.2.3. Stage 3: audit by an honest inspector

With probability $\pi \in (0,1)$ (and unless it was the subject of appeal at Stage 2, in which case the truth is already known) $I$'s report at Stage 2 is audited by an honest tax collector,[18] and $C$'s true income discovered for sure. We assume $\pi$ to be both exogenous and independent of the income report.

#### 2.2.3.1. Payoffs

The payoffs to $I$ and $C$ depend on the circumstances that materialise. Consider in turn the two kinds of outcomes that the game form $\Phi$ admits. The first is that an agreement is reached, in which case there are again two possibilities. Either there is an audit by an honest superior, in which case payoffs (that of player $i$ being denoted by $P_i$) are

$$P_I = \omega + \lambda(\theta)T(\theta) - f_I(r,\theta) + B \tag{1}$$

$$P_C = \theta - T(\theta) - f_C(r,\theta) - B \tag{2}$$

or there is not such an audit, in which case

$$P_I = \omega + \lambda(r)T(r) + B \tag{3}$$

$$P_C = \theta - T(r) - B . \tag{4}$$

The second type of outcome is that in which no agreement is reached (in which case of course $B = 0$). If $C$ chose to appeal at Stage 2, payoffs are[19]

$$P_I = \omega + \lambda(\theta)T(\theta) - f_I(r,\theta) \tag{5}$$

$$P_C = \theta - T(\theta) - \alpha . \tag{6}$$

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[17]The issue is a familiar one in analyses of collusion, as is our response to it: enforceability might be achieved through reputation effects whose modelling would considerably complicate the analysis. Tirole (1992) suggests that many of the qualitative insights obtained in models which assume that such side-contracts are enforceable might be robust to a relaxation of this assumption.

[18]Corruptible hierarchies are examined by Basu et al. (1992) and Carillo (1995a).

[19]Any compensation paid to $C$ is akin to a reduction of $\alpha$. It should be noted, however, that $C$ cannot be overcompensated.

If $C$ chose not to appeal, then the outcome depends whether or not there turns out to be a random audit of the report made unilaterally by $I$; payoffs are thus as in (1)–(4) above, but with $B = 0$. Weighting the outcomes in (1)–(4) by the probability of audit $\pi$, note for later use that expected payoffs conditional on there being no appeal are:

$$P_I^e(r,B;\theta) \equiv \omega + \pi\lambda(\theta)T(\theta) + (1 - \pi)\lambda(r)T(r) - \pi f_I(r,\theta) + B \qquad (7)$$

$$P_C^e(r,B;\theta) \equiv \theta - \pi T(\theta) - (1 - \pi)T(r) - \pi f_C(r,\theta) - B . \qquad (8)$$

## 2.3. Bargaining equilibrium

Stage 3 of the game being mechanical, we start to solve the game by considering $C$'s decision in Stage 2 as to whether or not to appeal (given that no agreement is reached at Stage 2). Clearly she will not appeal if and only if

$$\theta - T(\theta) - \alpha \leq P_C^e(n,0;\theta) \qquad (9)$$

(our assumption being that when indifferent $C$ does not appeal). At Stage 2, $I$ will bear in mind this possibility of appeal when choosing the unilateral report to make if no agreement is reached. Intuition suggests that it can never be in the interest of the inspector to over-report to such an extent that $C$ will choose to appeal. It is indeed easily verified that: *the citizen does not appeal in any subgame perfect equilibrium (SPE) of the sequential 'disagreement' game that follows if C and I fail to agree at Stage 2.*[20]

Thus, the report that $I$ makes if agreement is not reached at Stage 2 will be such as to maximise his expected payoff in the event of there being no appeal, $P_I^e(r,0;\theta)$, subject to the condition ((9) above) that there will indeed be no appeal. It is assumed throughout that the set of such maximising reports is not empty. Denoting the generic element of the set by $n^*(\theta)$, equilibrium payoffs in the event that $C$ and $I$ do not reach agreement at Stage 2, which we refer to as *disagreement payoffs*, are:

$$d_I = P_I^e(n^*(\theta),0;\theta) \qquad (10)$$

$$d_C = P_C^e(n^*(\theta),0;\theta) . \qquad (11)$$

The other possible outcome at Stage 2 is that $C$ and $I$ reach agreement. It is straightforward to show that an agreement $(m,B)$ is Pareto efficient if and only if $m$ maximises the *surplus*

$$S(\theta,m) \equiv P_I^e(m,B;\theta) + P_C^e(m,B;\theta) \qquad (12)$$

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[20]Proof is available on request.

$$= \theta + \omega - \pi[[1 - \lambda(\theta)]T(\theta) + f(m,\theta)] - (1 - \pi)[1 - \lambda(m)]T(m) \qquad (13)$$

where $f \equiv f_C + f_I$ denotes the collective fine. Note that surplus is independent of the bribe, which simply determines its distribution between $C$ and $I$. We take it that the set of surplus-maximising income reports — with generic element $m*(\theta)$ — is non-empty.

Assuming that the equilibrium outcome at Stage 2 is Pareto efficient and individually rational, it follows that $C$ and $I$ will indeed reach agreement at Stage 2: for (10)–(12) imply $d_I + d_C = S(\theta,n*(\theta)) \leq S(\theta,m*(\theta))$, and hence it is always possible to find a bribe such that $P_i^e(m*(\theta),\theta,B) \geq d_i$ for $i = I,C$. Both players, that is, can fare better than in the disagreement game. Thus, for any $\theta \in \Gamma$, the inspector and the citizen reach agreement at Stage 2 on a surplus-maximising income report $m*(\theta)$. Moreover, $B*(\theta)$ is such that $P_i^e(m*(\theta),B*(\theta);\theta) \geq d_i$ $(i = C,I)$. Although the disagreement payoffs and the possibility of appeal thus have no impact on the income report, they do of course potentially affect the negotiated bribe $B*(\theta)$.

## 3. Positive issues

Continuing the backward induction, the next step would be to characterise $G$'s choice of tax scheme at Stage 1. We postpone this, however, until the next section. Instead we now explore key positive aspects of the bargaining equilibria associated with tax schemes broadly resembling those observed in practice, the wider purpose being to develop some sense of the way in which the structure of the tax scheme affects the outcome of the encounter between $C$ and $I$.

### 3.1. Corruption and tax evasion

The present framework immediately points to a sharp distinction between two kinds of dishonesty: tax evasion (by which we mean under-reporting of income, $m*(\theta) < \theta$) and corruption (meaning the payment of bribes, $B*(\theta) \neq 0$). In previous analyses, which have precluded the threat of over-reporting, these are two sides of a single coin: a bribe is paid to the inspector only in order that he might benefit from, and therefore collude in, under-payment of taxes. Here, in contrast, evasion and corruption are quite different things; and a first task is to establish the precise relationship between them.

Note first that nothing in the specification of the model precludes the possibilities, however unfamiliar, that in equilibrium income will be over-stated and/or bribes paid by the inspector to the citizen. Indeed, one can conceive of circumstances in which the commission payment increases so rapidly with the income report that it becomes worth the inspector's while to bribe the citizen to agree on an over-statement of income. The following establishes, inter alia,

seemingly natural restrictions on the tax scheme which suffice to rule out bargaining equilibria with such properties:

**Proposition 1.** *If both* $\lambda(.)T(.)$ *and* $[1 - \lambda(.)]T(.)$ *are strictly increasing, then for each* $\theta \in \Gamma$: (i) $m^*(\theta) \leq \theta$, (ii) $B^*(\theta) \geq 0$, (iii) $n^*(\theta) \geq \theta$, *and* (iv) $m^*(\theta) < \theta \implies B^*(\theta) > 0$.

**Proof.** See Appendix A.

The intuition is straightforward. The collective payment that $C$ and $I$ make, if not audited, is $[1 - \lambda(m)]T(m)$; if this increases with the income they report then — since detection of any misreport can only increase their collective payment — over-reporting can never maximise their surplus (which is part (i) of the proposition). And if the inspector's commission $\lambda T$ is increasing with the income reported, he will have to receive some bribe in order to be willing to submit an under-report (part (ii)); nor will his threat in the disagreement game involve under-reporting, since with an increasing commission the inspector can do better by reporting truthfully (part (iii)). And to tolerate any evasion of taxes, involving both a loss of commission and potential penalties, the inspector will need to be paid off (part (iv)).

Part (iv) of Proposition 1 indicates that, under the conditions given — and using the terms in the senses defined above — evasion implies corruption.[21] The converse, however, is not true: there exist schemes[22] for which (for some $\theta$) $B^*(\theta) > 0$ even though $m^*(\theta) = \theta$. The reason is clear: a citizen confronted by an inspector willing and able to over-report their liability will be willing to pay a bribe simply to prevent their doing so. Bribes thus emerge not only as a means to share the gains from evasion but also as the manifestation of extortion. This is not merely a theoretical possibility. Jain (1997), for example, speaks of the prevalence in India of a 'No harassment tax', paid to tax officials simply to be assessed expeditiously and correctly.

## 3.2. Evaders as victims

A related implication of the present model is that tax evaders — naturally thought of as villains — may in fact be victims, injured by the power invested in corruptible tax collectors. For it is perfectly possible that the equilibrium payoff to

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[21]Mookherjee and Png (1995) do not obtain the result that evasion implies corruption. This is because, in their model, to reduce evasion the inspector must be motivated to *work* by the prospect of a bribe payment; corruption is needed as an incentive device to combat evasion when the incentive scheme is linear. In our model, on the other hand, a non-linear incentive scheme replicates the incentive effect of bribery.

[22]See footnote 34 below.

the citizen lies below that she would receive if her true income were reported. That is, it may be that for some $\theta$:

$$P_C^e(m^*(\theta),B^*(\theta);\theta) < P_C^e(\theta,0;\theta). \tag{14}$$

In this case we call the type $\theta$ citizen a *victim* of extortion, while if the reverse inequality applies she is an *accomplice* in evasion and corruption.[23] This distinction between victims and accomplices is exactly equivalent to one cast in terms of an *effective surcharge*, $\Sigma$, paid by the taxpayer, defined as the excess of her expected payment of taxes, bribes and fines over her true tax liability: from (8),

$$\Sigma(\theta) \equiv (1 - \pi)[T(m^*(\theta)) - T(\theta)] + \pi f_C(m^*(\theta),\theta) + (1 - \pi)B^*(\theta) \tag{15}$$

with type $\theta$ being a victim (accomplice) iff $\Sigma(\theta) > 0$ ($< 0$). We make further use of this notion of an effective surcharge below.

To identify the precise source of this possibility of the victimised evader, note that a citizen with income $\theta$ cannot be a victim if $n^*(\theta) = \theta$: for her disagreement payoff $d_C$ is then $P_C^e(\theta,0;\theta)$, and since (see Section 2.3 above) $P_C^e(m^*(\theta),B^*(\theta);\theta) \geq d_C$ the inequality in (14) cannot hold. From the definition of $n^*(\theta)$, it is clear that either of two conditions is sufficient for $n^*(\theta) = \theta$. The first is that $\lambda(\theta) = 0$; the second that $\alpha = 0$. Thus victims can emerge in equilibrium only if the inspector is paid, at least in part, on commission: without this, the inspector has no incentive to over-report in the disagreement game. And they can also emerge only if appeals are costly to the taxpayer, who can otherwise neutralise any threat of over-reporting. Extortion thus ultimately arises from the combination of two factors: the incentive that performance-related payment gives the inspector to over-report, and imperfections in the appeal process.

It is possible too to derive some sense of the groups most vulnerable to extortion. Note first that in many contexts there is clearly some upper bound on the level of income that a tax inspector may credibly report. A collector visiting a poor rural village or assessing a presumptive tax on small traders, for example, is likely to beware of inviting suspicion and investigation by reporting implausibly high incomes. Suppose then — just for the present — that there exists some maximal possible level of income (normalised at unity), so that $\Gamma = [0,1]$. Then:

**Proposition 2.** *Under the conditions of Proposition 1, and with $\Gamma = [0,1]$: (i) the*

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[23]Interestingly, the argument that citizens may be more sinned against than sinning has indeed emerged as a line of defence in recent high-profile anti-corruption cases in Italy. Giorgio Armani, for example, ' ... has admitted handing an envelope stuffed with cash to his tax advisor to keep the inspectors at bay. But he said ' ... It is up to the judicial investigators to determine whether I was guilty of corruption or whether I was the subject of extortion.' (*The Independent*, June 8th 1995.)

*richest citizen ($\theta = 1$) can never be a victim, and* (ii) *the poorest citizen ($\theta = 0$) can never be an accomplice.*

**Proof.** Part (i) follows from the discussion after (14) on noting that the constraint $n \leq 1$ imposed on the disagreement game combined with (iii) of Proposition 1 together imply $n^*(1) = 1$. For part (ii), note that the constraint $m \geq 0$ on reported incomes combined with part (i) of Proposition 1 implies that $m^*(0) = 0$. Using this and A1(ii) in (15), the type 0 citizen is an accomplice only if $B^*(0) < 0$, which is precluded by Proposition 1(ii). $\square$

The rich thus enjoy a natural protection against extortion whilst the poor suffer from a natural vulnerability. The richest are protected because their true incomes are so high that they cannot credibly be over-stated by the inspector. The poorest, on the other hand, are vulnerable because their true liabilities are so low that the bribe which the inspector is able to extort by threatening to over-report exceeds any conceivable gain from condoning evasion.

### 3.3. The regressive effects of dishonesty

In practice, fines for tax evasion are almost invariably specified as increasing and convex functions $g_i(u)$ of the amount of tax under-reported,[24] $u \equiv T(\theta) - T(m)$. Such restrictions on the penalty functions $f_i$ may not be optimal, but their pervasiveness in practice makes this an important special case. Consider then:

**Example A.** Any tax scheme satisfying A1 and such that:
 (i) $f_C(m, \theta) = g_C(u)$, with $g_C$ increasing and strictly convex for $u \geq 0$ and zero otherwise.
 (ii) $f_I(m, \theta) = g_I(u)$, with $g_I$ strictly convex, strictly increasing for $u > 0$ and strictly decreasing for $u < 0$.
 (iii) $T$ strictly increasing and strictly convex.
 (iv) $T$, $g_C$ and $g_I$ twice continuously differentiable on the interior of their domains.
 (v) $\lambda(\theta) = \beta$, $\forall \theta \in \Gamma$.

The further and not implausible assumptions have thus been made that: the tax schedule is progressive in the sense of implying an increasing marginal tax rate; the taxpayer pays no fine in the event of over-reporting; fines on the inspector also depend only on the amount of taxes mis-reported; and the commission rate is constant (perhaps zero).

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[24]In the UK, for example, the maximum fine is specified in the Taxes Management Act as 100% of the tax lost, but the Inland Revenue may accept a lesser amount depending, inter alia, on the 'size and gravity' of the offence (*Tolley's Tax Guide, 1992–93*, pp. 121–122).

Suppose too, specialising the example further, that the equilibrium bribe is determined by the familiar 'split-the-difference' outcome, with $C$ and $I$ each receiving their disagreement payoff $d_i$ plus one-half the excess of the maximised surplus $S(m^*(\theta),\theta)$ over the sum of those disagreement payoffs.[25] We assume the split-the-difference form for the remainder of this section, though not, it should be emphasised, anywhere else in the analysis. This leads, when embedded in the general framework of the preceding section, to an equilibrium bribe of

$$B^*(\theta) = \frac{1}{2}(1 - \pi)[[1 + \lambda(n^*(\theta))]T(n^*(\theta)) - [1 + \lambda(m^*(\theta))]T(m^*(\theta))]$$

$$+ \frac{\pi}{2}[f_I(m^*(\theta),\theta) - f_C(m^*(\theta),\theta) + f_C(n^*(\theta),\theta) - f_I(n^*(\theta),\theta)]. \quad (16)$$

Combining the plausible form of tax scheme in Example A with the split-the-difference rule gives a very striking pattern of bribery and effective surcharging:

**Theorem 1.** *For any tax scheme of the form in Example A and with $\Gamma = [0,1]$, if the bribe is given by the split-the-difference rule then there exist $\theta_1$ and $\theta_2$ such that:*
(i) *$B^*(\theta)$ is strictly increasing in $\theta$ on $(0,\theta_1]$, constant on $[\theta_1,\theta_2]$ and strictly decreasing on $[\theta_2,1]$.*
(ii) *$\Sigma(\theta)$ is strictly decreasing on $[0,\theta_1]$ and $[\theta_2,1]$ and constant on $[\theta_1,\theta_2]$, with $\theta_2 = 1$ if $\beta\alpha = 0$.*

**Proof.** See Appendix B.

Part (i) shows the pattern of bribery that emerges in equilibrium to have the general form in Fig. 1, the most notable feature being that the bribe is greater in the middle of the income distribution than at either extreme. Though by no means apparent a priori, this finding that it is the middle classes who pay the biggest bribes has a ready explanation. For the poor, their low incomes and hence low tax liabilities offer little scope for collusive gain from evasion and at the same time limit the extent to which bribes can be extracted from them by the threat of over-reporting (both effects being accentuated by progressivity of the tax schedule). The high incomes of the rich protect them from extortion (as discussed after Proposition 2), and so limit the extent to which they must share with the inspector the gains from evasion. The incomes of the middle classes, however, are both high enough to create sizeable gains from evasion and low enough to leave them wide open to extortion.

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[25]The split-the-difference rule can be rationalised in several ways. In the symmetric ultimatum bargaining game described above, (16) will be the unique subgame perfect equilibrium bribe. Other game forms $\Phi$ will also generate (as a unique equilibrium) the split-the-difference rule (see, for example, Muthoo (1999)).
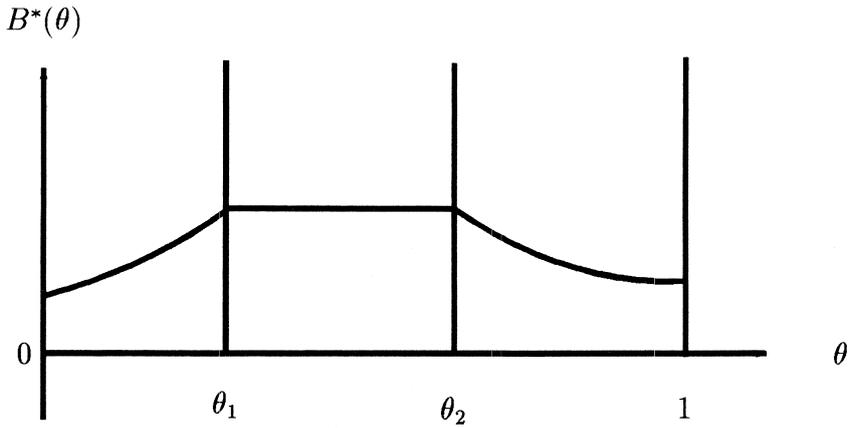
$B^*(\theta)$



Fig. 1. The equilibrium bribe under conditions of Theorem 1.

Part (ii) of the Proposition shows the effective surcharge $\Sigma$ to have the general shape shown in Fig. 2: strictly decreasing at the extremes and constant in between.[26] This is perhaps as one would expect at the top, given the decreasing
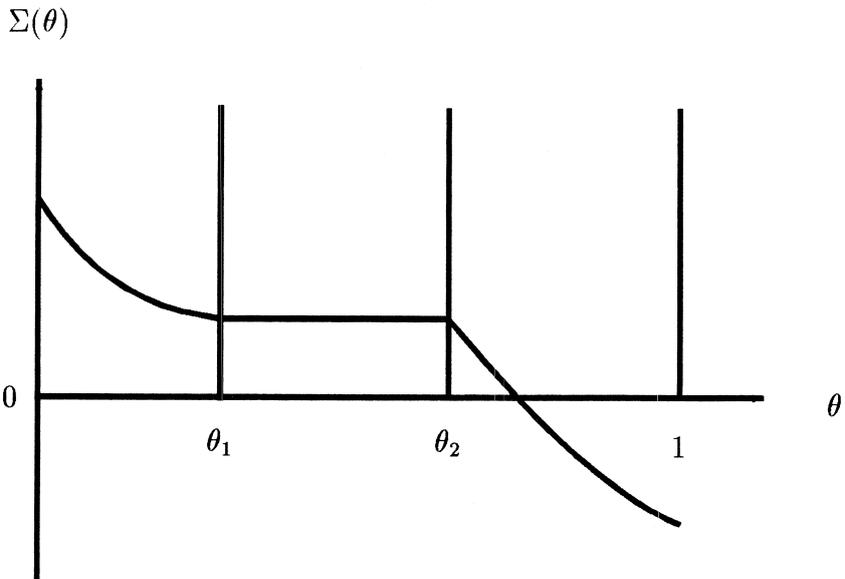
$\Sigma(\theta)$



Fig. 2. The effective surcharge under conditions of Theorem 1.

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[26]As drawn, $\Sigma$ becomes negative above $\theta_2$; it might, however, become negative below $\theta_1$.

bribe displayed in part (i): the rich are less vulnerable to extortion and also have more to gain by evading tax. That the effective surcharge also falls at low levels of income despite an increasing bribe reflects a growing opportunity to evade as income reaches deeper into the range of a progressive system: increased gains from evasion more than offset the larger bribes that must be paid.

The implications for the distributional consequences of equilibrium evasion and corruption are very powerful: part (ii) shows that their effect is equivalent, so far as the taxpayer is concerned, to adding to the statutory tax schedule an effective surcharge that decreases with income in the manner illustrated. Such a surcharge is inherently regressive, implying[27] that the distribution of expected net incomes — net, that is, of taxes, bribes and fines — is unambiguously less equal (in the Lorenz sense) than the distribution of income net only of legal tax liabilities. Tax schemes similar to those often observed thus have the feature that the impact of evasion and corruption are unambiguously regressive.[28]

## 3.4. Fighting corruption and evasion

A central concern in discussions of corruption and evasion, is how best to combat them. To this end, and as a source of intuition for the subsequent analysis of optimal policy, we briefly consider some comparative statics.[29] Consider first the penalty structure. Mookherjee and Png (1995) find that increasing the penalties on corrupt inspectors actually increases the bribe: inspectors demand a higher payment to collude in misleading the government. Focusing on the other side of the encounter, Chander and Wilde (1992) show — in a rather different setting involving asymmetries of information between $I$ and $C$ — that increasing penalties on $C$ can also lead to an increase in the equilibrium bribe: the citizen needs to offer a higher bribe in order to ensure that the inspector colludes in evasion. Here, however, an important distinction emerges between penalties levied in the event of over- and under-reporting. For brevity, we focus on the significance of this for the impact of penalties on the inspector:[30]

**Proposition 3.** *Consider any tax scheme M satisfying the conditions of Proposition 1, for which T, λ and $f_i$ are differentiable and for which fines are strictly increasing in the extent of misreporting (so that $\nabla_m f_i(m,\theta) < 0$ ( $>0$ ) as $m <$ ( $>$ )θ). Suppose too that the bribe is given by the split-the-difference rule. Then:*

[27]By for example, Proposition 3 of Jakobsson (1976).

[28]Note that this is true, moreover, even if — because either the commission rate or the cost of appeal is zero — there is no prospect of extortion: this would simply imply $\theta_2 = 1$, eliminating the upper range in the figures. The regressivity result, in particular, would remain entirely clear-cut.

[29]For the rest of the paper, we revert to our assumption that $\Gamma = [0,\infty)$.

[30]Converse remarks apply to penalties on the taxpayer.

 (i) *a multiplicative increase in the fine on I in the event of under-reporting at all*
     $\theta \in \Gamma$ *has an ambiguous effect on* $B^*(\theta)$, $\forall \theta \in \Gamma$;
(ii) *a multiplicative increase in the fine on I in the event of over-reporting at all*
     $\theta \in \Gamma$ *reduces* $B^*(\theta)$ *for all* $\theta$.

**Proof.** See Appendix C.

   The ambiguity in part (i) reflects counter-acting effects. First, an increase in the penalty on *I* for under-reporting makes the inspector more reluctant to under-report income, which favors an increase in the bribe; this gives the Mookherjee-Png result. But at the same time $m^*(\theta)$ increases, tending to decrease the bribe and so making the overall effect ambiguous. Part (ii) shows that increasing the penalty on *I* for over-reporting, on the other hand, unambiguously reduces the bribe. Thus it is over-reporting by *I* that needs to be penalised heavily to discourage corruption, since it is this that reduces *I*'s disagreement payoff. The instinct of Justice Plana cited in Section 1 — that the control of corruption requires that extortion be especially heavily punished — is thus borne out.
   Turning to the effects of paying higher commissions, one finds:

**Proposition 4.** *Under the conditions of Proposition 3, a multiplicative increase in the commission schedule:*
  (i) *strictly increases* $m^*(\theta)$ *for all* $\theta$ *such that* $m^*(\theta) > 0$,
 (ii) *strictly reduces the government's net revenue, and*
(iii) *has an ambiguous effect on equilibrium bribes.*

**Proof.** See Appendix D.

   This confirms the intuition of Section 1: giving the inspector an interest in a high income report tends to reduce the extent of evasion (since by Proposition 1 $m^*(\theta) \leq \theta$). Part (ii) indicates, however, that the consequent increase in the government's revenue is more than offset by the increased cost of the commission itself. This is best thought of as an envelope result: a small increase in *m* has no effect on surplus, and hence also no effect on net revenues (the increased payment of taxes being exactly offset by reduced receipts from fines); thus only the direct cost of the higher commission remains.
   What of the impact of commission payments on corruption? In a different context, Mookherjee and Png (1995) show that increasing the commission rate (which they assume to be constant) leads to a higher bribe (at all $\theta$); the intuition being that a higher commission rate increases the disagreement payoff to the inspector. In the present setting, however, the impact is ambiguous. This is at first sight surprising, since the possibility of over-reporting that is allowed here means that an increase in the commission rate increases still further the inspector's disagreement payoff, and to that extent reinforces the tendency for the bribe to

increase. But there is also another effect at work: the increase in reported income $m^*$. The result of Mookherjee and Png (1995) relates to circumstances in which the report remains unchanged at a corner solution implied by linear penalties; thus the only way that the inspector can realise any benefit from his improved disagreement payoff is by an increased bribe. Here, however, he may also benefit from the increased commission payment associated with the higher income report.

## 4. Optimal tax schemes

Continuing the backward induction begun in Section 2 we arrive now at Stage 1 of the game: the government's choice of tax scheme. Thus $G$ selects the tax schedule $T$, reward system $\langle \omega, \lambda \rangle$ and penalty functions $f_i$ ($i = C, I$). The government's choice will depend, of course, on its objectives. Four likely concerns come to mind: the revenue raised, the extent of evasion, the degree of corruption and the overall distributional impact of the tax scheme. To bring out the distinctive implications of each, we consider first the case in which $G$ cares only about revenue and then, in turn, add in each of the other concerns. Before doing so, we introduce one further restriction. The design problem in this model is trivial if penalties are unbounded. We therefore now restrict attention to schemes that satisfy the limited liability constraints in:

**Assumption 2.** For any $\theta \in \Gamma$ and any $r \in \Gamma$: (i) $f_I(r, \theta) \leq \omega + \lambda(\theta)T(\theta)$, and (ii) $f_C(r, \theta) \leq \theta - T(\theta)$.

A2(i) requires that $I$ receive at least his reservation utility (normalised, recall, at zero) even if audited, irrespective of which citizen he encounters and the income he reports. A2(ii) requires that $C$ not need to draw on any other resources to meet her liabilities if audited, again irrespective of the income reported. A tax scheme is henceforth called *admissible* iff it satisfies A1 and A2, and the set of such schemes is denoted by $\Omega$. Note that A1 and A2 imply that $E_\theta[P_I^e(m^*(\theta), B^*(\theta); \theta)] \geq 0$ so that $I$'s participation constraint is satisfied. Moreover, since $T(0) = 0$ and $f_I \geq 0$, A2(i) implies that $\omega \geq 0$. Pure tax farming is thus precluded.

### 4.1. Maximising revenue and minimising evasion

Suppose first that the government's sole concern is to maximise (any increasing function of) its expected revenue, which is

$$P_G^*(M) \equiv E_\theta[(1 - \pi)[1 - \lambda(m^*(\theta))]T(m^*(\theta))$$
$$+ \pi[[1 - \lambda(\theta)]T(\theta) + f_C(m^*(\theta), \theta) + f_I(m^*(\theta), \theta)]] - \omega. \qquad (17)$$

Such behaviour can be rationalised in several ways: $G$ might be a leviathan; or $G$

may be benevolently providing a public good that citizens value more highly, at the margin, than their private incomes; or, as we shall prove later, $G$ may ultimately be pursuing a Rawlsian maximin objective. In any event, revenue maximisation proves a useful benchmark, which we shall very soon be tempering by other concerns.

For there are, in general, many revenue-maximising tax schemes. Suppose then that $G$ is also averse to tax evasion; we do not model the reason for this, though it seems clear that evasion is widely seen as costly not only in terms of its direct impact on tax revenues but also, and perhaps more fundamentally, in jeopardising the perceived integrity and legitimacy of the tax system. The question then immediately arises as to whether it is possible for $G$ to eliminate evasion without compromising its revenue objective. This in turn is essentially the question of whether the revelation principle applies in our framework, despite the restrictions imposed on in A1–A2, so that attention can be confined to schemes that induce truthful reporting. Denoting by $\Omega^{ep} \subseteq \Omega$ the set of admissible schemes that are *evasion-proof* in the sense that

$$S(\theta,\theta) \geq S(m,\theta), \quad \forall \theta \in \Gamma, \quad \forall m \neq \theta (m \in \Gamma) \tag{18}$$

the following shows that it does indeed apply:[31]

**Lemma 1.** *For any tax scheme $M \in \Omega$ there exists $M' \in \Omega^{ep}$ such that $P_G^*(M) = P_G^*(M')$.*

Any tax scheme that maximises revenue over the evasion-proof set $\Omega^{ep}$ thus also maximises revenue over the wider set $\Omega$: $G$ can eliminate evasion without foregoing any revenue. The class of schemes that are both revenue-maximising and evasion-proof is of obvious importance. The following provides a complete characterisation:

**Theorem 2.** *An admissible tax scheme is revenue-maximising and evasion-proof if and only if it has the features:* (a) $\pi\theta = [1 - \lambda(\theta)]T(\theta)$, *for all* $\theta \in \Gamma$, (b) $\omega = 0$, *and* (c) $f(r,\theta) \geq (1 - \pi)(\theta - r)$, $\forall r,\theta \in \Gamma$ *such that* $r < \theta$. *The expected revenue raised by any such scheme is* $\pi\theta^e$, *where* $\theta^e$ *denotes the expected value of* $\theta$.

**Proof.** See Appendix E.

The proof is somewhat involved, but the underlying reasoning is quite straightforward. Take the necessity part. Suppose first that $G$ has decided to set the maximal penalties allowed by the limited liability condition A2. If $C$ and $I$ are

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[31]The proof of Lemma 1 is available on request.

discovered on audit to have misreported they then pay to $G$ a total amount (net of remuneration to $I$) of $T + f_I + f_C - \omega - \lambda T$; which is equal, given maximal penalties, to $\theta$. Their collective payment on a truthful report, $[1 - \lambda(\theta)]T(\theta)$, can thus be raised only to equality with their expected loss if they were to mis-report, which is $\pi\theta$: at any higher level they would make a lesser expected payment by reporting some $m < \theta$. This establishes the necessity of the condition in (a). And $G$'s net receipts from a truthful report, $[1 - \lambda(\theta)]T(\theta) - \omega$, are then maximised by setting $\omega = 0$ (which is condition (b)), in which case the maximised value of expected revenue (from (a)) is $\pi\theta^e$. Finally, it is readily checked that when (a) is satisfied truthful reporting requires that penalties satisfy (c). Verifying sufficiency is routine.

Several conclusions follow from Theorem 2. Part (a) implies that the two requirements of revenue maximisation and evasion-proofness place very few additional restrictions on either tax or commission schedules when each is considered in isolation.[32] Using A1, for example, part (a) of the Theorem implies that the average tax rate $T(\theta)/\theta$ be no less than the probability of audit $\pi$, and the commission rate no greater than $1 - \pi$. What Theorem 2 does very substantially restrict, however, is the relationship between $T$ and $\lambda$. In particular, part (a) implies that it is perfectly possible for $G$ to raise the maximum feasible revenue by implementing a tax schedule that is progressive (in the sense that the average tax rate rises with income); but only if it also sets a reward structure such that the commission rate $\lambda$ also increases with the income reported. By the same token, a constant commission rate is optimal only if tax liabilities are proportional to income. Intuitively, a progressive tax schedule means that the tax saved by any under-statement of income is greater at higher incomes; and an increasing commission rate is then needed to counter the consequently greater temptation to

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[32]Proposition 4(ii) might suggest that the revenue-maximising commission rate is zero. For it might lead one to suspect that given any mechanism with a positive commission rate, expected revenue could be increased — albeit at the cost of inducing some evasion — by a small reduction in the commission rate. This would appear to contradict Theorem 2. Notice, however, that condition (c) of Theorem 2 (combined with A1(ii)) implies that in any admissible tax scheme that is revenue-maximising and evasion-proof, the collective fine $f(m,\theta)$ is not differentiable in $m$ at $m = \theta$. Hence, such a tax scheme does not satisfy the hypotheses of Proposition 4, which require, in particular, that the collective fine be differentiable in $m$ at $m = \theta$ — which, in turn, implies (combined with the monotonicity assumptions) that the derivative of $f$ with respect to $m$ at $\theta$ is zero. It should be noted that the proof of Proposition 4(ii) is based on the envelope argument, which requires, in particular, that $S$ be differentiable in $m$ at $m = \theta$ — and this would not be true if $f$ is not differentiable in $m$ at $m = \theta$. Hence, any tax scheme considered in Proposition 4 is not an admissible, revenue-maximising and evasion-proof tax scheme — and no admissible, revenue-maximising and evasion-proof tax scheme satisfies the conditions of Proposition 4. In fact, it can be shown (proofs available on request) that if $G$ has to choose a tax scheme from the class of tax schemes that satisfy the conditions of Proposition 4, then: (i) the evasion-proofness requirement implies that the commission rate equals one, and the maximal revenue raised is zero, and (ii) revenue is maximised through a *non* evasion-proof tax scheme, in which the commission rate is zero.

evade taxes, which it does by raising the cost to the inspector, in foregone commission, of conniving in an under-statement of income.

Part (a) also reveals the key role played in the model by the parameter $\pi$: it is the strength of the constraint on dishonesty inherent in the wider economic environment that ultimately determines how much revenue the government can raise.

Part (b) of the theorem indicates that the fixed wage component of remuneration is set at its lowest possible level: any excess of $I$'s expected payment over his reservation utility must come entirely from commission payments.

Part (c) has two useful implications. One is that it is only the collective fine — not its allocation between $C$ and $I$ — that matters for evasion-proofness and revenue-maximisation. The other, more striking, is that the achievement of these objectives does not require that penalties be set at their maximum feasible levels. Indeed these penalties can take a very simple form: it is enough that they be proportional to the extent of understatement, with the factor of proportionality being greater the less effective is the audit check.

Combining these observations, Theorem 2 points to two sets of circumstances in which commission payments may have a role and — consequently, given part (b) — the inspector optimally paid more than his reservation utility level. One (from part (a)) is that in which, for some reason, the preferred tax schedule has a non-constant marginal rate (because, for example, the preferred schedule is progressive). The other is that in which, for some reason, fines on the citizen cannot be set at levels that satisfy part (c): for then, given A2(i) and part (b), (c) can be satisfied only if commissions are non-zero. In both of these cases, the payment to $I$ of an 'efficiency wage' — though here, since $\omega = 0$, the surplus comes not from the fixed wage but from the commission — serves to provide scope for punishment that counteracts incentives to dishonesty, whether created by non-linearities in the tax schedule (which we consider in some detail below) or restrictions on the penalties that can be imposed on $C$.

## 4.2. Corruption-aversion

Suppose now that the government's concerns extend beyond the revenue it raises and the extent of tax evasion to include also — again for reasons that we do not model, but seem evident enough in practice[33] — the degree of corruption in tax collection. As emphasised earlier, the possibility of extortion means that corruption is conceptually quite distinct from evasion: the threat of over-reporting may enable $I$ to extract a bribe merely to report the truth. Thus there certainly exist schemes which belong to the revenue-maximising, evasion-proof class $\Omega^{ep}$

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[33]Nalebuff (1998), for example, argues powerfully for such an aversion to corruption per se.

characterised in Theorem 2 but are not corruption-proof (in the sense that it is not the case that $B*(\theta) = 0$, $\forall \theta \in \Gamma$).[34]

Are there then any evasion-proof and revenue-maximising schemes that are also corruption-proof? The further requirement imposed by corruption-proofness, it can be shown,[35] is that $n*(\theta) = \theta$ $\forall \theta \in \Gamma$. This is as intuition would suggest: if there is no prospect of evasion then bribes can arise only in connection with extortion, to prevent which it is necessary to remove any incentive for $I$ to over-report. If appeals are costless (so that $\alpha = 0$), corruption-proofness follows immediately. The more interesting and relevant case, we have argued, is surely that in which $\alpha > 0$. Eliminating extortion is then a matter of ensuring that the gains to $I$ from a disagreement outcome in which $C$'s income is over-reported — which depend on the commission received on the associated tax payments — are outweighed by the penalties $I$ incurs if the over-report is discovered. More precisely, denote by $N*(\theta)$ the set of income reports that would not be appealed by a citizen with income $\theta$; that is, recalling (9),

$$N*(\theta) \equiv \{n \in \Gamma | (1 - \pi)T(n) + \pi f_C(n,\theta) \leq (1 - \pi)T(\theta) + \alpha\}. \qquad (19)$$

Then it will never be in $I$'s interest to over-report if and only if $P_I^e(\theta,0;\theta) \geq P_I^e(n,0;\theta)$ for all $n \in N*(\theta)$; which, using (7), is the condition

$$(1 - \pi)[\lambda(n)T(n) - \lambda(\theta)T(\theta)] \leq \pi f_I(n,\theta), \qquad (20)$$

so that the expected gain in commission is less than the increase in the expected penalty paid by $I$. Clearly then:

**Lemma 2.** *An admissible tax scheme is evasion-proof, corruption-proof and revenue-maximising if and only if the conditions of Theorem 2 hold and (d) for any $\theta \in \Gamma$, condition (20) holds $\forall n \in N*(\theta)$.*

There is one obvious way of satisfying these conditions. For the incentive to over-report can be removed by simply paying no commission. Using this in Theorem 2 leads one to:

**Corollary 1.** *The following tax scheme is evasion-proof, corruption-proof and revenue-maximising:*
 (i) *$T(\theta) = \pi\theta$, $\forall \theta \in \Gamma$,*
 (ii) *$\lambda(\theta) = 0$, $\forall \theta \in \Gamma$,*

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[34]Consider, for example, the tax scheme with $T(\theta) = t\theta$ for some $t \in (\pi,1]$, $\lambda(\theta) = 1 - \pi/t$ and satisfying (b) and (c) of Theorem 2. By Theorem 2, this is revenue-maximising and evasion-proof. But it can also be shown to imply $B*(\theta) > 0, \forall \theta \in [0,\hat{\theta}]$ where $\hat{\theta} \equiv \min\{\alpha/\pi, 1 - \pi\}$. (Proof available on request).

[35]The proof is available on request.

(iii)  $\omega = 0$, *and*

(iv)  $f_I(r,\theta) = 0$ *and* $f_C(r,\theta) = (1 - \pi)(\theta - r)$ $\forall r,\theta \in \Gamma$ *such that* $r < \theta$.

This is a very simple scheme, involving a proportional tax schedule (with average and marginal rate equal to the probability of random audit) and a fixed wage system for inspectors. A government that likes revenue and dislikes evasion and corruption can thus do no better than set a proportional tax and pay its collectors a fixed wage. The tax scheme in Corollary 1 looks very much like the kind of straightforward tax arrangements often recommended by tax policy analysts, especially for developing countries. The rationale, however, is typically in terms of such considerations as administrative ease and the avoidance of creating arbitrage opportunities. The rationale provided here is entirely different: it is that one can preclude extortion by paying no commission to inspectors, but then any progressivity in the tax structure invites evasion and corruption.[36]

There may though be tax schemes other than that in Corollary 1 which maximise revenue without inducing evasion or corruption. The following establishes a striking necessary condition: any such scheme must possess the features of that in Corollary 1 in the lower part of the income distribution:

**Proposition 5.** *It is necessary for an admissible scheme to be evasion-proof, revenue-maximising and corruption-proof that:*

$$T(\theta) = \pi\theta, \quad \forall \theta < \alpha/(1 - \pi) \tag{21}$$

$$\lambda(\theta) = 0, \quad \forall \theta < \alpha/(1 - \pi). \tag{22}$$

**Proof.** See Appendix F.

At least in the lower reaches of the income distribution, the tax must thus be a simple proportional one and the commission rate must be zero. This result derives from the implication of A2(i) that $f_I(n,0) = 0$. For the inspector then has nothing to lose in attempting to extort from the poorest individual, who can then be protected from 'small' over-reports — her ability to appeal protecting her from 'large' over-reports — only by removing any incentive for $I$ to misreport in this range; which requires paying no commission. That the tax must be a proportional one then follows from the linkage between the shape of $T$ and $\lambda$ discussed after Theorem 2. The sharpness of Proposition 5 clearly reflects the strength of the limited liability condition A2. More broadly, however, the result points again to the potential vulnerability of the poor to extortion: those with low taxable income have little to offer the corrupt inspector in terms of sharing gains from tax evasion,

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[36]As a referee notes, we should emphasise that the result in Corollary 1 hinges on the assumption that the tax inspector learns the citizen's true income costlessly.

since they have little tax to avoid; paying inspectors a commission at low income reports then does little to combat evasion but does create the possibility of extortion. The lesson, it seems, is that the payment of commission on low income reports can be especially dangerous.

While corruption-proofness thus rules out progressive taxation in the lower part of the income distribution, the preceding results leave open the possibility that it may be possible to achieve progressivity over some upper range of the income distribution, without damaging revenues or creating evasion or corruption, so long as an appropriate commission is paid on these higher income reports. The following verifies that this is indeed the case so long only as the collective fine on $I$ and $C$ exceeds a lower bound:

**Proposition 6.** *It is sufficient for an admissible scheme to be revenue-maximising, evasion-proof and corruption-proof that the conditions of Theorem 2 hold and*[37]
  (e) *The tax and commission schedules satisfy:*

$$T(\theta) = \pi\theta, \quad \forall \theta < \alpha/\pi(1 - \pi) \tag{23}$$

$$\lambda(\theta) = 0, \quad \forall \theta < \alpha/\pi(1 - \pi), and \tag{24}$$

(f) *for any $\theta \in \Gamma$ and $r \neq \theta$ such that $r \geq \alpha/\pi(1 - \pi)$,*

$$f(r,\theta) > \alpha/\pi - (1 - \pi)(r - \theta). \tag{25}$$

**Proof.** See Appendix G.

Interestingly, the lower bound on the collective fine in (f) not only admits less than maximal penalties but actually decreases with the extent of any over-report. To see why this is, and more generally how it is that this lower bound suffices, note first that the condition can also be written as

$$\pi f(r,\theta) + (1 - \pi)\pi(r - \theta) > \alpha. \tag{26}$$

The left of (26) reflects two kinds of punishment that arise from any over-report: the explicit penalty $f(r,\theta)$ and — recalling condition (a) of Theorem 2 — the implicit penalty in the form of an increase in the collective payment $(1 - \lambda)T$ made to the government. The condition in (f) is that this expected punishment exceeds the cost of appealing: intuitively, it must then be the case that either the punishment is so great that the inspector will choose never to over-report or/and the cost of appealing so low that $C$ will indeed choose to appeal. And this condition may hold even if the fine $f(r,\theta)$ decreases with the extent of over-

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[37]Note that the sufficient condition in (e) differs from the necessary condition of Proposition 5 in requiring zero commission over a wider interval. If attention is restricted to continuous $T$, however, condition (e) also becomes necessary. The proof of this is available on request.

reporting because the implicit component of the punishment automatically increases with $r$.

Proposition 6 points the way to the construction of many tax schemes that are evasion-proof, corruption-proof, revenue-maximising and — in contrast to the simple proportional tax of Corollary 1 above — progressive in the upper reaches. Consider, for example, the class of tax schemes described in:

**Example B.** A tax scheme with $\omega = 0$, satisfying (f) of Proposition 6 and:

$$\text{(i)} \quad T(\theta) = \begin{cases} \theta - \alpha/\pi & \theta \geq \hat{\theta} \\ \pi\theta & \theta < \hat{\theta} \end{cases} \tag{27}$$

$$\text{(ii)} \quad \lambda(\theta) = \begin{cases} [(1 - \pi)\pi\theta - \alpha]/(\pi\theta - \alpha) & \theta \geq \hat{\theta} \\ 0 & \theta < \hat{\theta} \end{cases} \tag{28}$$

where $\hat{\theta} \equiv \alpha/\pi(1 - \pi)$.

This, it is easily checked, satisfies all the conditions of Proposition 6. And it involves a progressive tax schedule, with the average rate strictly increasing at incomes above $\hat{\theta}$, honestly implemented by a scheme involving less than maximal penalties and positive commissions in the progressive range.

There are thus many evasion-proof, corruption-proof revenue-maximising schemes for $G$ to choose from. Since these schemes differ in the progressivity of the tax schedule $T$, distributional concerns in tax design come to the fore again, and it is to these that we now turn.

## 4.3. Distributional considerations

Consider then the comparison, from the perspective of a government with some distributional concerns, between the schemes in Corollary 1 and Example B. They raise the same revenue, and both are evasion-proof and corruption-proof. But the distribution of net incomes implied by the tax scheme in Corollary 1 is unambiguously less equal (in the Lorenz sense) than that implied by the tax scheme in Example B.[38] It might therefore seem that any government with distributional concerns will prefer the latter. But not so. For notice that since expected commission payments are strictly positive under the scheme in Example B but zero under that in Corollary 1, the fact that the two schemes raise the same

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[38]Assuming, that is, that $\hat{\theta} < 1$: otherwise the two schemes are identical.

revenue for the government implies that the average tax burden is actually higher under the scheme in Example B. Honest implementation of the progressive scheme requires a costly commission system that taxpayers themselves must ultimately pay for. Indeed comparing tax payments under the two schemes it can be seen that no taxpayer strictly prefers the progressive tax in Example B to the proportional tax in Corollary 1: the only people who gain from progressivity are the inspectors, who must be paid more than their reservation value in order to implement it. Any distributionally concerned government then needs to trade off the attractions of a progressive tax system — an equity gain in having a more equal distribution of net incomes — against the higher average level of taxation — and hence lower average net income — that it involves. Though the scheme in Example B is no more than an illustration, the implication may be of some importance: potential evasion and corruption in the tax collection process mean that there are costs involved in the honest implementation of progressive taxation of a kind quite different from the incentive effects on taxpayers usually emphasised.

   The discussion so far has taken it that the primary purpose of taxation is to raise revenue, and indeed by restricting taxes $T(\theta)$ to be non-negative we have precluded purely redistributive taxation. Consider now the opposite extreme, in which taxes are levied *only* in order to redistribute. More precisely, consider the set of redistributive tax schemes defined by a net tax schedule of the form $\tau(\theta) = T(\theta) - b(\theta)$, where $b(\theta) \geq 0 \ \forall \theta \in \Gamma$, $E_\theta[\tau(\theta)] = 0$ and $T$ forms part of an admissible tax scheme as defined after A2 above (but with A2(ii) now amended to reflect the possible receipt of benefit).[39] Suppose too that the government pursues the extreme Rawlsian maximin objective of maximising the net income of the worst-off individual. Our final result shows that such a government, if it confines itself to evasion-proof and corruption-proof schemes[40] can be thought of as optimally proceeding in two steps: first it implements a revenue-maximising tax scheme of exactly the sort considered above, and then it distributes the proceeds as a poll subsidy:[41]

**Proposition 7.** *An admissible evasion-proof and corruption-proof redistributive tax scheme maximises the net income of the poorest citizen if the net tax schedule is of the form $\tau^*(\theta) = T^*(\theta) - b$, where $T^*$ forms part of an admissible corruption-proof and revenue-maximising tax scheme and $b = E_\theta[T^*(\theta)] = \pi\theta^e$.*

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[39]More precisely, in the remainder of this section we replace A2(ii) of the text by the condition A2(ii)*: $f_c(r,\theta) \leq \theta - T(\theta) + b(\theta) - b(0), \forall r, \theta \in \Gamma$. Admissibility is now to be interpreted in terms of A2(ii)*.

[40]These features are assumed rather than proved because of such possibilities as that $G$ might wish to arrange matters so that $I$ finds it optimal to pay a bribe to a citizen with $\theta = 0$.

[41]The proof of Proposition 7 is available on request.

The bulk of the analysis above thus applies not only to the revenue-maximising government but also, at an opposite extreme, the Rawlsian one.

## 5. Summary and concluding remarks

The two most fundamental results are those emphasized in Section 1:

- The impact of evasion and corruption is unambiguously regressive under tax schemes of broadly the kind often observed. For the poor have little to gain from evading taxes and are at the same time vulnerable to over-reporting of their incomes; for the rich, the converse is true.
- Inducing honesty in the collection of progressive taxes can be costly, implying an additional source of inefficiency associated with the pursuit of equity goals. Intuitively, the government can levy progressive taxes without reducing its own payoff by creating countervailing incentives in the form of commissions: the parties are tempted to understate income to evade progressive taxes, and tempted to overstate income to raise the commission payments. Arranging an appropriate balance between the two, however, incurs a real resource cost.

Other points also deserve some emphasis:

- Since the poor are the most vulnerable to extortion, paying tax inspectors commission on low income reports — lending strength to their threat to over-report — runs an especially large risk of inducing abuse and corruption.
- While heavy penalties on inspectors caught conniving in the evasion of taxes may simply lead them to ask for and receive larger bribes, heavy penalties for extortion reduce bribe-taking and may have a key role to play in combating corruption. Corruption and evasion can be eliminated, however, and at no revenue cost, without setting penalties at their maximum feasible levels.
- A government that is concerned only to maximise revenue — or which has a Rawlsian maximin objective — and is averse to both evasion and corruption can do no better than set a proportional tax schedule and pay inspectors a fixed wage (with penalties proportional to extent of mis-reporting); can do no better, that is, than set something resembling a simple flat tax. The reason is nothing to do with incentive effects on taxpayers' effort or administrative simplicity: it is as a means of ensuring honesty in collection.
- It is the threat of extortion which leads to low-powered incentives. There are two opposing forces at work here. On one hand, since collusion defeats the effectiveness of tax instruments in raising revenue and impairs the deterrent effect of penalties, it is desirable to provide high-powered incentives to the inspector (in the form of a commission payment to resist the temptation to

collude with the taxpayer). On the other hand, to deter the inspector from abusing his discretionary power through the threat of extortion, it is desirable to have low-powered incentives. In the present context, the latter effect dominates, in the sense that there is never any strict gain from paying positive commissions.[42]

Evasion and corruption are complex matters, and the analysis has abstracted from many aspects that may be important in practice. Some of these simplifying assumptions (such as the absence of any systematic audit selection process) were discussed in the text. We conclude by considering some of the others.

One such is the assumption that the probability of corruption being detected (the parameter $\pi$) is exogenous, and independent of the income report. We think of $\pi$ as describing the degree of intrinsic honesty in the system. It plays a key role in the analysis; it is this, for instance, which determines the maximum amount of revenue that the government can raise. As Klitgaard (1988) emphasizes, it is this degree of intrinsic honesty that ultimately determines the likelihood that corruption will be detected. In the short-run it is hard for the government to affect this variable very significantly: hence the approach taken here. Doubtless there are ways in which governments can have some affect on the probability of an illicit deal between taxpayer and inspector being discovered: it could increase the number of audits double-checked, or seek over time to develop an elite core of incorruptible inspectors. Formally, one can certainly extend the analysis to allow $\pi$ to be varied by the government, at some cost. But this adds little of real interest. A more substantive question is whether efforts to detect dishonesty — the work of the incorruptible elite team, for instance — should be concentrated on low income reports (as the work of Chander and Wilde (1998), for example, would seem to suggest): the appropriate policy is not clear, since although such a focus of effort would reduce the incentive to underreport income — the effect emphasised in the previous literature on optimal auditing — it would also exacerbate the risk of extortion.

Second, in assuming that the taxpayer's true taxable income becomes known to the inspector without effort on the part of the latter we preclude an obvious incentive argument for commission payments. The analysis shows that even without this moral hazard dimension some commission payment is needed to implement progressive taxes honestly. The need to motivate inspectors in discovering underlying income will only reinforce this effect. Now, however, commission payments may have an even stronger effect in promoting extortion: not only do they lend credibility to the inspector's threat to over-report (as here),

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[42]It should be noted that although in much of the principal-agent theory (as, for example, surveyed in Hart and Holmstrom (1987)) it is optimal to provide the agent with high-powered, complex, incentive schemes, in some principal-agent contexts — such as in the context of multi-task environments (see Holmstrom and Milgrom, 1991) — it is optimal to provide low-powered, simple, incentive schemes.

they also provide the inspector with an incentive to acquire information that strengthens his position in bargaining with the taxpayer.

Third, there may in practice be restrictions on acceptable penalties that constrain the government more tightly than we have allowed here; and it may then be optimal for the government to tolerate some degree of evasion and corruption. Suppose, for example — here we take an extreme case, for clarity — that small misreports cannot be penalised. Then the only way to preclude evasion altogether is by paying the inspector entirely on commission. But since one can also show — along the lines of Theorem 2 — that $\omega$ must be set to zero, the government would then raise no revenue. To collect any revenue, it must tolerate evasion, which in turn opens the way to the payment of bribes.[43]

## Appendix A. Proof of Proposition 1

To show that $m*(\theta) \leq \theta$, note from (12) that, using A.1,

$$S(\theta,\theta) - S(m,\theta) = (1 - \pi)[[1 - \lambda(m)]T(m) - [1 - \lambda(\theta)]T(\theta)] + \pi f(m,\theta).$$
(A.1)

Combining (A.1) with the hypothesis that $[1 - \lambda(.)]T(.)$ is strictly increasing implies that no $m > \theta$ can maximise $S(m,\theta)$. To show that $n*(\theta) \geq \theta$, note from (7), using (A.1),

$$P_I^e(n,0;\theta) - P_I^e(\theta,0;\theta) = (1 - \pi)[\lambda(n)T(n) - \lambda(\theta)T(\theta)] - \pi f_I(n,\theta). \quad \text{(A.2)}$$

Combining (A.1) with the hypothesis that $\lambda(.)T(.)$ is strictly increasing then implies that $\forall n < \theta$, $P_I^e(n,0;\theta) < P_I^e(\theta,0;\theta)$. Since $n = \theta$ satisfies (9), we have the desired conclusion. We now show that $B*(\theta) \geq 0$. Since $P_I^e(m*(\theta),B*(\theta);\theta) \geq d_I$, and

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[43]Details of these results are available on request.

since $n = \theta$ satisfies (9) (which implies $d_I \geq P_I^e(\theta,0;\theta)$), we have $P_I^e(m^*(\theta),B^*(\theta);\theta) \geq P_I^e(\theta,0;\theta)$. Consequently,

$$B^*(\theta) \geq (1 - \pi)[\lambda(\theta)T(\theta) - \lambda(m^*(\theta))T(m^*(\theta))] + \pi f_I(m^*(\theta),\theta). \tag{A.3}$$

Combining (A.1) with the hypothesis that $\lambda(.)T(.)$ is strictly increasing thus implies (since we have already shown that $m^*(\theta) \leq \theta$) that $B^*(\theta) \geq 0$. Part (iv) of the proposition follows immediately from (A.3), since $\lambda(.)T(.)$ is strictly increasing. $\square$

## Appendix B. Proof of Theorem 1

We first establish:

**Lemma A.** *For any tax scheme of the form in Example A:*

$$m^*(\theta) = \begin{cases} 0 & \forall \theta \in [0,\theta_1] \\ T^{-1}[T(\theta) - u^*] & \forall \theta \in [\theta_1,1] \end{cases} \tag{B.1}$$

$$n^*(\theta) = \begin{cases} T^{-1}[T(\theta) - v^*] & \forall \theta \in [0,\theta_2] \\ 1 & \forall \theta \in [\theta_2,1] \end{cases} \tag{B.2}$$

*where $\theta_1 \equiv T^{-1}(u^*)$, $\theta_2 \equiv T^{-1}(v^* + T(1))$, $\theta_1 < \theta_2$ and $u^* > 0$ and $v^* \leq 0$ are both independent of $\theta$. Moreover, $v^* = 0$ if $\beta\alpha = 0$.*

**Proof.** Consider first the optimal report $m^*(\theta)$. Unconstrained maximisation of the surplus $S$ in (13) gives the necessary condition

$$- \pi g'[T(\theta) - T(m)] + (1 - \pi)(1 - \beta) = 0, \tag{B.3}$$

the prime indicating differentiation and $g \equiv g_C + g_I$. This implies an amount of under-reporting $T(\theta) - T(m^*(\theta)) \equiv u^* > 0$ that is independent of true income $\theta$. Recognising that the report $m$ is constrained to be non-negative, it is then clear that there will exist some critical income level $\theta_1$ such that those above under-report by $u^*$ whilst those below report $m = 0$ and thus under-report by the full amount of their true liability. Hence (B.1).

Consider next the disagreement report $n^*(\theta)$. From (9) and $P_I^e(n,0;\theta)$ and leaving aside the constraint that $n \in \Gamma$, the outcome of the disagreement game is readily seen to solve

$$\min_v [\pi g_I(v) + (1 - \pi)\beta v] \text{ s.t. } \pi g_C(v) - (1 - \pi)v \leq \alpha \tag{B.4}$$

where $v \equiv T(\theta) - T(n)$. The solution $v^*$ being independent of $\theta$ and non-positive (by feasibility of the choice $v = 0$), the result follows. $\square$

To establish the theorem itself, define $z(\theta) \equiv 2B^*(\theta)$ and consider three sub-intervals of $\Gamma$:

(a) For $\theta \in [0, \theta_1]$, using Lemma A in (15) and (16) gives:

$$z(\theta) = (1 - \pi)(1 + \beta)[-v^* + T(\theta)]$$
$$+ \pi[g_I(T(\theta)) - g_C(T(\theta)) + g_C(v^*) - g_I(v^*)] \tag{B.5}$$

$$\Sigma(\theta) = -(1 - \pi)T(\theta) + \pi g_C(T(\theta)) + (1 - \pi)B^*(\theta). \tag{B.6}$$

Differentiating (B.5):

$$z'(\theta) = T'(\theta)[(1 - \pi)(1 + \beta) + \pi\{g'_I(T(\theta)) - g'_C(T(\theta))\}]. \tag{B.7}$$

Since $m^*(\theta) = 0$ for any $\theta \in [0, \theta_1]$, it follows that $\nabla_m S(0, \theta) \leq 0$. That is,

$$(1 - \pi)(1 - \beta) > \pi g'(T(\theta)) \tag{B.8}$$

Using (B.8) in (B.7), the assumption that (for $i = C, I$) $g'_i(u) > 0$ for $u > 0$ implies $z' > 0$. Turning to $\Sigma$, differentiating (B.6) and using (B.7) gives

$$\Sigma' = T'(\theta)\left[-(1 - \pi) + \frac{1}{2}[(1 - \pi)(1 + \beta) + \pi g'(T(\theta))]\right] \tag{B.9}$$

Substituting for $g'(T(\theta))$ from (B.8) gives $\Sigma' < 0$.

(b) For $\theta \in [\theta_1, \theta_2]$, it is immediate from Lemma A that both $B^*$ and $\Sigma$ are independent of $\theta$.

(c) For $\theta \in [\theta_2, 1]$, Lemma A implies (recalling that $g_C(u) = 0$ for $u \leq 0$)

$$z(\theta) = (1 - \pi)(1 + \beta)[u^* + T(1) - T(\theta)]$$
$$+ \pi[g_I(u^*) - g_C(u^*) - g_I(T(\theta) - T(1))] \tag{B.10}$$

$$\Sigma(\theta) = -(1 - \pi)u^* + \pi g_C(u^*) + (1 - \pi)B^*(\theta). \tag{B.11}$$

Establishing that $z(\theta)$ is strictly decreasing over this range will thus also establish that $\Sigma$ is decreasing. Differentiating in (B.10) gives

$$z'(\theta) = T'(\theta)[-(1 - \pi)(1 + \beta) - \pi g'_I(v)] \tag{B.12}$$

where $v = T(\theta) - T(1)$. Note next that it is necessary for the minimisation problem in (B.4) augmented by the binding constraint $v = T(\theta) - T(1)$ that

$$\pi g'_I(v) + (1 - \pi)\beta - \mu_1(1 - \pi) - \mu_2 = 0, \tag{B.13}$$

where $\mu_1 \geq 0$ is the multiplier on the no-appeal constraint in (B.4) and $\mu_2 > 0$ that for the constraint directly on $v$. Using (B.13) in (B.12) gives $z'/T' = -(1 - \pi)(1 + \mu_1) - \mu_2 < 0$. $\square$

## Appendix C. Proof of Proposition 3

For part (i), introduce a parameter $\zeta$ such that the fines on the inspector are now

$$f_I(m,\theta,\zeta) = \begin{cases} \zeta f_I(m,\theta), & \forall m < \theta \\ f_I(m,\theta), & \forall m \geq \theta \end{cases} \qquad (C.1)$$

By a similar argument to that given in the proof to Proposition 4 below, one finds that $\nabla_\zeta m^*(\theta,\zeta) > 0$. Since Proposition 1 applies, so that $n^*(\theta) \geq \theta$, it is easily seen from $P_I^e(n,0;\theta)$ and (9) that $n^*(\theta)$ is independent of $\zeta$. The ambiguity of the effect of an increase in $\zeta$ is straightforward to establish by differentiating in (16) and evaluating at $\zeta = 1$, and then considering the following two cases. If $\pi$ is sufficiently small, then an increase in $\zeta$ decreases $B^*(\theta)$. But if $\pi$ is sufficiently large, $f_I$ sufficiently small and $f_I$ is relatively flatter than $f_C$, in the sense that for any $m < \theta$ $\nabla_m f_C(m,\theta) < \nabla_m f_I(m,\theta)$ $(<0)$, then an increase in $\zeta$ increases the equilibrium bribe.

For part (ii), suppose now that the parameter $\zeta$ applies to $f_I$ in the event $m \geq \theta$. In this case $m^*$ is easily seen to be independent of $\zeta$, and it then follows from (7)–(8) (using the split-the-difference rule) that it is enough to show that increasing $\zeta$ reduces $d_I - d_C$. Given, from Proposition 1, that $n^* \geq \theta$ it is clear from (10) that $d_I$ is strictly decreasing in $\zeta$. From (11) and (A.1), $d_C$ is non-increasing in $n^*$; and that $\nabla_\zeta n^* \leq 0$ follows on considering the only two possibilities: either the no-appeal constraint (9) bites, in which case $n^*$ cannot strictly increase with $\zeta$ (the critical value of $n$ at which $C$ appeals being unaffected by $\zeta$); or $n^*$ is characterised by an interior solution, in which case routine comparative statics give $\nabla_\zeta n^* < 0$ $\square$.

## Appendix D. Proof of Proposition 4

Define $\lambda(\theta) = \gamma h(\theta)$, where $\gamma \in (0,1)$ and $h(\theta) \in (0,1)$. If $m^*(\theta) > 0$, then it must be the case that $\nabla_m S(m^*(\theta),\theta) = 0$ and $\nabla_{mm} S(m^*(\theta),\theta) < 0$. Hence the sign of $\nabla_\gamma m^*(\theta;\gamma)$ is the same as the sign of $\nabla_{m\gamma} S(m^*(\theta),\theta;\gamma)$. $\lambda(.)T(.)$ strictly increasing implies that the latter sign is strictly positive, and hence Proposition 4(i) follows. If $m^*(\theta) = 0$, then it is trivial to show that $\nabla_\gamma m^*(\theta;\gamma) \geq 0$.

We now establish part (ii). Notice that the payoff to the government from type $\theta$ is, in fact, $\theta - S(m^*(\theta,\gamma);\gamma)$. Differentiating this w.r.t $\gamma$, it follows — since $\nabla_\gamma S(m^*(\theta);\gamma) > 0$ and $\nabla_m S(m^*(\theta,\gamma);\gamma)\nabla_\gamma m^*(\theta,\gamma) = 0$ — that if $m^*(\theta,\gamma) > 0$, then that derivative is strictly negative. If, on the other hand, $m^*(\theta) = 0$, then either $\nabla_m S(m^*(\theta;\gamma) = 0$ or $< 0$. In the latter case $\nabla_\gamma m^*(\theta;\gamma) = 0$, since $\nabla_m S(0,\theta;\gamma)$ is continuous in $\gamma$. In either case, therefore, the desired derivative is strictly negative (since $\nabla_\gamma S(m^*(\theta);\gamma) > 0$). Hence, part (ii) follows.

We now show that the effect on the bribe $B^*(\theta)$ is ambiguous. Note first that (in

obvious notation) $n^*(\theta;\gamma)$ is non-decreasing in $\gamma$, for $n^*$ is either at a corner solution for the constrained maximisation of $P_I^e(n,0;\theta)$, in which case it is independent of $\gamma$, or it is characterised by an interior solution to the maximisation of $P_I^e(n,0;\theta)$, in which case it is easily seen to be strictly increasing in $\gamma$. The ambiguity of the effect of an increase in $\gamma$ is straightforward to establish by differentiating in (16) and then considering the following two cases, in both of which one assumes $\pi$ to take a sufficiently high value. If $f_C$ is relatively flatter than $f_I$, in the sense that (i) for any $m < \theta$ $\nabla_m f_I(m,\theta) < \nabla_m f_C(m,\theta)$ ($< 0$), and (ii) for any $m > \theta$ $\nabla_m f_I(m,\theta) > \nabla_m f_C(m,\theta)$ ($> 0$), then an increase in $\gamma$ strictly decreases the equilibrium bribe. While if $f_I$ is relatively flatter than $f_C$, then the reverse is the case.

## Appendix E. Proof of Theorem 2

*Necessity*. Using conditions (i) and (ii) in (13), the evasion-proofness requirement (18) (that $S(m,\theta) \geq S(\theta,\theta)$, $\forall m \neq \theta$) reduces to condition (iii). Conditions (i) and (ii), together with evasion-proofness, also imply that $G$'s expected revenue is $\pi\theta^e$.

It thus suffices to show that any evasion-proof, revenue-maximising admissible tax scheme satisfies (i) and (ii). And for this, we now argue, it is enough to show that (i) and (ii) are satisfied by any such scheme that also involves penalties that are maximal in the sense of being the largest consistent with the limited liability restriction in (A.2): that is, for any $\theta,r \in \Gamma$ such that $r \neq \theta$, $f_I(r,\theta) = \omega + \lambda(\theta)T(\theta))$ and $f_c(r,\theta) = \theta - T(\theta)$. For consider some evasion-proof revenue-maximising scheme $M$ that does not involve maximal penalties. Let $M'$ be the scheme identical to $M$ in every aspect except that in $M'$ penalties are maximal. It is trivial to verify that $M'$ is evasion-proof (because $M$ is).[44] This implies that $M'$ generates the same, maximal, expected revenue as $M$. Thus $M'$ is evasion-proof, revenue-maximising, and has maximal penalties. If then $M'$ satisfies conditions (i) and (ii), so too — being identical in every respect except the penalties $f_i$ — does the original scheme $M$.

Suppose then that penalties are maximal. The evasion-proofness conditions (18) then become the requirement that for any $\theta, m \in \Gamma$ such that $m \neq \theta$,

$$(1 - \pi)[1 - \lambda(m)]T(m) \geq [1 - \lambda(\theta)]T(\theta) - \pi(\omega + \theta) . \tag{E.1}$$

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[44]Let $S(m,\theta;M)$ and $S(m,\theta;M')$ denote the surplus function associated respectively with tax schemes $M$ and $M'$. Since $M$ is evasion proof, $S(\theta,\theta;M) \geq S(m,\theta;M)$ for all $m \neq \theta$. Furthermore, since the commission and tax schedules in $M$ and $M'$ are identical, $S(\theta,\theta;M) = S(\theta,\theta;M')$. Hence, $S(\theta,\theta;M') \geq S(m,\theta;M)$ for all $m \neq \theta$. Since the penalties in $M'$ are maximal, and otherwise $M$ and $M'$ are identical, it follows that $S(m,\theta;M) \geq S(m,\theta;M')$ for all $m \neq \theta$. Hence, $M'$ satisfies (18).

Since, by (A.1), $T(m)[1 - \lambda(m)] \geq 0$ $\forall m \in \Gamma$ and $T(0)[1 - \lambda(0)] = 0$, this implies (and is implied by)

$$\pi(\omega + \theta) \geq [1 - \lambda(\theta)]T(\theta).$$

Maximising the state's expected revenue then requires setting the right of this latter inequality to its maximum level, i.e.:

$$\pi(\omega + \theta) = [1 - \lambda(\theta)]T(\theta). \tag{E.2}$$

The state's expected revenue then becomes $E_\theta[\pi\theta - (1 - \pi)\omega]$ which, since $\omega \geq 0$, is maximised by setting $\omega = 0$; which is condition (ii). Condition (i) then follows from (E.2).

*Sufficiency.* Conditions (i) and (ii) are readily seen to imply that the evasion-proofness conditions (18) are satisfied; and, with (ii), to generate expected revenue equal to the maximal value of $\pi\theta^e$. □

## Appendix F. Proof of Proposition 5

Note first that since $T(0) = 0$ and (from A2(i)) $f_I(r,0) = 0$ for all $r \in \Gamma$, for $\theta = 0$ condition (20) reduces to $\lambda(n)T(n) \leq 0$ for all $n \in N^*(0)$. Suppose then that there exists $\hat{n} \in (0, \alpha/(1 - \pi))$ such that $\lambda(\hat{n}) > 0$. Since $T(0) = 0$, $T(\hat{n}) \leq \hat{n}$ and (from A2(i)) $f_C(\hat{n},0) = 0$, one finds from (19) that $\hat{n} \in N^*(0)$. But since (from Theorem 2) $T(r) > 0$ for all $r > 0$, it then also follows that $\lambda(\hat{n})T(\hat{n}) > 0$, and thus (20) is violated. □

## Appendix G. Proof of Proposition 6

Given Theorem 2, we need to show that such a tax scheme is corruption-proof. Fix an arbitrary $\theta \in \Gamma$. First note that (24) implies that for any $n \in N^*(\theta)$ — where $N^*(\theta)$ is defined in (19) — such that $n < \alpha/\pi(1 - \pi)$, inequality 20 is satisfied — which means that the inspector prefers to report the truth than $n$. Now fix any $n \geq \alpha/\pi(1 - \pi)$. Inequality (25) implies (using condition (i) of Theorem 2) that $A + B > 0$, where

$$A = (1 - \pi)[T(n) - T(\theta)] + \pi f_C(n,\theta) - \alpha$$

$$B = (1 - \pi)[\lambda(\theta)T(\theta) - \lambda(n)T(n)] + \pi f_I(n,\theta) .$$

Thus, either $A > 0$ or $B > 0$. We now note that the citizen appeals against the report $n$ if and only if $A > 0$, and the inspector prefers to report the truth than $n$ if and only if $B \geq 0$. Hence, since if $A > 0$ then $n \notin N^*(\theta)$, it follows that $n^*(\theta) = \theta$. The desired conclusion follows immediately, because, as noted above, any

evasion-proof tax scheme is corruption-proof if and only if $n^*(\theta) = \theta$ for all $\theta \in \Gamma.$ □

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