Tax Evasion with a Conscience*

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Abstract

How do moral concerns affect fraud and detection, and in particular tax compliance and the need for audits? We propose answers by exploring a psychological $2 \times 1 \times 2 \times 1$ inspection game which incorporates belief-dependent taxpayer guilt, unawareness, and third-party audience effects. Novel conclusions are drawn regarding whose behavior is affected by moral concerns (it's the authority's more than the citizen's) and regarding policy, in particular fines vs. jail, the role of information campaigns, and the use of a principle of public access whereby tax returns are made public information.

Keywords: Tax evasion; Guilt; Inspection game; Policy

JEL classification: C72; D91; H26; H83

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1 Introduction

Tax evasion can cause loss of revenue, unfair outcomes, and spillover disrespect of law. Yet, if people are honest, to some degree, the problems may be alleviated relative to what classical theory (e.g. Allingham and Sandmo 1972) suggests.[1] Some scholars argued that "moral sentiments" are crucial for understanding compliance,[2] while others (e.g., Kleven et al., 2011) suggested that the overall impact is small. A complicating aspect is that if taxpayers are conscientious this may reduce the need for inspections. It may be difficult to disentangle cause and effect by studying data. Behavioral theory can provide an illuminating complement, accounting for tax morale while endogenizing compliance and inspection behavior.

Battigalli and Dufwenberg (2007) (B&D) model how guilt shapes players' motivation and outcomes in games, based on a close reading of relevant psychology including recent experimental work by behavioral economists. The approach builds on the framework of so-called psychological game theory (Geanakoplos et al., 1989; Battigalli and Dufwenberg, 2009), in which players' utilities depend on beliefs (about beliefs) about choices and not only on which end node is reached (as in standard games). We make a first pass at applying B&D's model to explore tax compliance. The setting we consider is highly stylized, yet rich enough to explore how taxpayer guilt shapes the interaction. We explore a 4-player $2 \times 1 \times 2 \times 1$ inspection game. The active players are a citizen and a tax authority, while the passive players are, respectively, the citizen's alter ego who would be unaware of a tax rule and an observing neighbor. While these additional players cannot actively choose, they are crucial to the psychological analysis via their beliefs.

Guilt, to a degree, mitigates the problems of tax evasion though in a perhaps unexpected way. Which interacting party's behavior is most affected by the presence of taxpayer guilt? It may seem intuitive that it would be the

[1] See, e.g., Andreoni et al. (1998), Slemrod (2019), and Alm (2019) for excellent surveys.

[2] Already Allingham and Sandmo (1972) discussed the possibility of social stigma in case of detected evasion. Erard and Feinstein (1994) is an early contribution modelling the impact of guilt and shame. See Luttmer and Singhal (2014) for a more recent contribution on the role of tax morale.

taxpayer, but in much of our analyses the degree of tax evasion is insensitive to the degree of guilt aversion. Instead, the inspection rate of the tax authority is affected. It would be a mistake to portray this as a failure of guilt sentiments to reign in tax fraud. Much less inspection will be needed when an equilibrium is played, and this may involve huge savings of public funds.

We also reach novel conclusions about policy that lack counterpart had guilt not been considered. This concerns fine-vs.-jail punishments, campaigns to raise tax law awareness, and whether to make tax returns public information. Some of the insight hinge crucially on aspects idiosyncratic to psychological game theory. For example, conclusions depend on information structure *across end nodes*. This could never happen in standard games. To get a feel, compare private vs. public tax returns. These schemes provide different information to tax payers' *neighbors*. Neighbors make no choices, yet our taxpayer cares about *their inferences* whether or not evasion occurs. Whether tax returns are private or public is then critical.

Following B&D, we explore two forms of moral anguish. Under "simple guilt" an evading taxpayer cares about the extent to which he *actually* hurts fellow citizens relative to what they expect. Under "guilt-from-blame" he rather worries about others' impressions regarding his *intentions* to cause such harm. Our analysis contrasts these forms of bad conscience with each other, and either with a classical world with no remorse.

Our paper joins an emerging literature on behavioral analysis of tax compliance. E.g., Hashimzade et al. (2013) review models that include psychological aspects like regret, ambiguity aversion and prospect theory in a tax-evasion setting, and both Engström et al. (2015) and Rees-Jones (2018) find empirical evidence of loss aversion being decisive to tax compliance. Hence, psychological mechanisms play an important role and important insights could be gained by including them in the tax-evasion setting. We are the first to incorporate different notions of taxpayer guilt in a psychological game theory setting. Although we set up a rather stylized model of a strategic interaction between taxpayer and tax authority, it gives us several novel insights.

Throughout, we emphasize and focus on a tax evasion scenario. However, we suspect that many of the insights we derive may apply more broadly. For example, mutatis mutandis, scenarios involving shoplifting or free-riding on the bus, could likely be adequately captured by our analysis.

Section 2 describes the tax compliance/inspection game around which our subsequent analysis centers, and derives equilibria assuming standard preferences. Section 3 introduces the two forms of guilt aversion, and studies how equilibrium behavior changes. Section 4 explores policy implications and highlights novel effects concerning the choice between fines and imprisonment (4.1), the effects of information campaigns (4.2), and how welfare may be improved by applying a principle of public access (4.3). Section 5 offers concluding remarks.

2 Preliminaries: The tax compliance game

The game form We consider a very simple kind of evasion/compliance decision, namely that a taxpayer receives a certain (known) income and makes the dichotomous choice of whether to declare it and pay the corresponding tax or whether to evade. This may seem restrictive and is probably not applicable to all kinds of tax evasion, but we may think of self-employed individuals, or those who receive an extra income, which has not been reported to the tax authority by a third part. This approach allows us to highlight several idiosyncratic ways in which guilt can shape outcomes.

Our approach also endogenizes the tax authority's inspection behavior. Many previous models of tax evasion take that as given. As forcefully argued by Graetz et al. (1986), such an approach (a tradition that goes back to Allingham and Sandmo, 1972) may be too restrictive. Authorities anticipate taxpayer behavior as much as taxpayer behavior depends on inspection rules. Arguably, this is best modeled such that a tax payer and the authority make their moves *simultaneously*, neither party being able to condition its choice on that of the the other.[3] The game we explore is chosen to be as simple as possible game subject to the constraint that it be rich enough to capture

[3]Graetz et al. (1986), Andreoni et al. (1998) and Phillips (2014) all model the interactions between taxpayer and authority in different ways.

those strategic interdependencies, and some other key concerns: Player 1 is a taxpayer who chooses to declare (D) or to evade (E).[4] Player 2, the tax authority, simultaneously chooses to inspect (I) or not (N). Player 3 is a neighbor, a silent observer who has no choice.

The law says that income should be declared, but we allow that it requires awareness to know that. That some taxpayers are unaware of tax rules and uncertain about what taxes they really should pay has recently been pointed out as being important to overall compliance.[5] Only a share $\delta \in (0, 1]$ of the taxpayer population are aware, while the rest are unaware and therefore (unconsciously) evade with certainty.[6] Players 2 and 3 cannot tell, assigning probabilities δ and $1 - \delta$ to either case. Figure 1 presents the game form, with the players' material payoffs. Player 1 is the aware taxpayer while $1'$ (who formally speaking is a separate player with the same material payoffs as player 1) is unaware.

If 1 declares, his (material) payoff ($m_1(D, \cdot)$) is normalized to 0, irrespective of whether he is inspected. If 1 evades, the payoff depends on whether 2 inspects: $m_1(E, I) = -f < 0 < m_1(E, N) = t$, where t is the saved tax payment and f is the perceived cost of punishment to the tax payer. Payoffs for the authority when not inspecting are $m_2(E, N) = 0$ and $m_2(D, N) = t$, i.e., when 1 is evading tax revenue is foregone.[7] Inspection comes at a cost, c, irrespective of whether or not 1 is evading. Hence, $m_2(D, I) = t - c$. Inspecting an evader, however, gives payoff $x \in [0, f]$, so $m_2(E, I) = t - c + x$. A fine, were there are no administrative transaction costs, would involve $x = f$. A jail sentence would bring no revenue, so $x = 0$. A case where $0 < x < f$ would reflect some combination, maybe including also administrative costs of conviction.[8] If the taxpayer's experienced cost of the punishment, f, were

[4] According to Slemrod (2007, 2019) and IRS (2016), understating incomes (rather than overstating deductions) makes up the largest part of tax evasion.

[5] See, e.g., Slemrod (2019) and Alm (2019).

[6] One example of unawareness could be the 'd-type agents' in Hokamp and Pickhardt (2010), who want to be honest, but fail due to the complexity of the tax system. Alternatively, it could be more straightforward ignorance, such as if a poker player mistakenly assumes that his earnings are not subject to taxation.

[7] $m_2(E, \cdot)$ is the same irrespective of whether the active co-player is 1 or $1'$.

[8] One could, in principle, even assume a negative payoff, $x < 0$. Such an extension complicates the analysis with very little added to the results, so we limit our analysis to

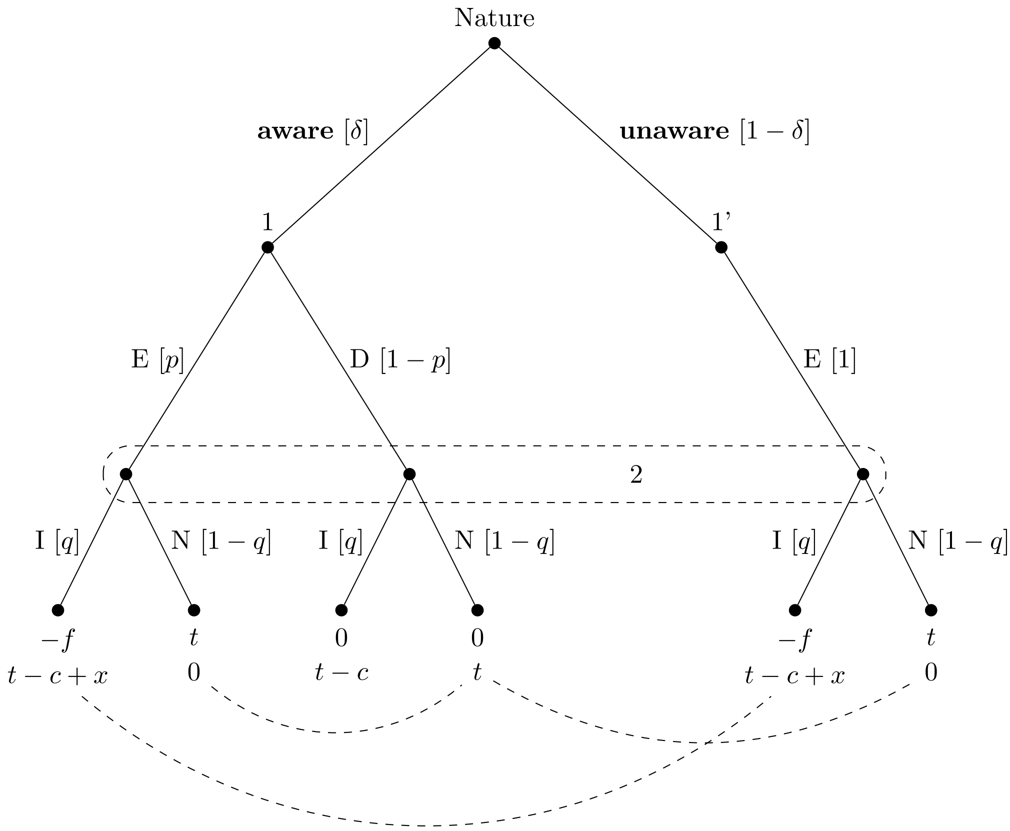

Figure 1: The tax compliance game.

the same, the cost to society would thus depend on the nature of punishment, i.e., the value of x. To avoid solutions where it is trivially in 2's interest to always choose N, we assume that $t - c + x > 0$.

What about player 3's payoff? Despite that the neighbor is a dummy player, his payoff and information is crucial to our analysis. We assume that players 2 and 3 have the same payoff. The interpretation is that player 2's payoff reflects in a meaningful way public resources. Player 3, being a representative agent for the public, is assumed to care about those just like 2 does. Alternatively put, 2's payoffs and incentives are designed to align with the payoffs of the public. Since the payoff of players 2 and 3 coincide, we collapse them into one (the second) line in Figure 1.

the nonnegative values $x \in [0, f]$.

The information sets indicated at 3's payoffs at the end nodes describe what we assume that 3 knows about play. He does not have perfect information. He cannot tell whether his neighbor is aware or not, and if 2 does not inspect 3 cannot tell whether or not 1 evaded. The latter feature reflects an assumption that tax returns are private. Unless 1 is inspected, 3 cannot tell whether or not he committed a crime (although 3 will form beliefs). In Section 4.3, when we assume public tax returns, we consider a new game that modifies 3's information relative to Figure 1.

The end-node information of 1 and 2 is immaterial to our analysis, so we do not specify that.

Welfare To compare equilibria and evaluate policy, it is useful to define a notion of whether outcomes are good or bad. The game parameters do not offer clear guidance. For example, t reflects a transfer between players and it is not obvious why and how welfare is enhanced by such a payment. And while incurring an inspection cost c may be seen as pure waste, it is not a comprehensive account of resources spent on tax collection, as fixed costs are neglected. Yet another alternative would be to consider the expected payoff of player 2 (and 3), as this may reflect public resources. However, as will be made clear along the analysis, equilibrium expected payoff will be constant and unaffected by most policies. Hence, such welfare criterion would give little guidance for policy evaluation. We propose that the relevant way to asses welfare rather goes via the probabilities p and q with which players 1 and 2 evade and inspect, respectively. The lower these numbers are the better, *ceteris paribus*:

- Our game concerns a society where a democratic process decided that citizens' payment of taxes is a duty, while tax evasion is criminal. The benefits of paid taxes likely include societal gain of tax-financed public goods. The costs of evasion may be more nebulous. Perhaps if tax evasion is widespread this undermines civic morale more generally, such that people litter, steal, or engage in corruption more willingly? We shall not try to quantify exactly these societal gains and losses, but rather just take the view that a lower p tends to be a good thing.

- Tax inspection is costly. Beyond the costs-per-inspection, c, a background institutional structure is needed: buildings, administrators, lawyers, prosecutors, policemen. The less inspection is going on, the less costly the needed apparatus. Hence, the lower q is the better.

Solution with classical preferences We solve for the equilibrium probabilities p^0 and q^0 with which players 1 and 2, respectively, evade and inspect. If $\delta = 1$ (2 encounters the aware 1 for sure), we have an inspection game with standard properties:[9] If 2 knew that 1 declared it would not inspect, since $c > 0$. If 1 knew that 2 did not inspect, he would evade, since $t > 0$. If 2 knew that 1 evaded it would inspect, since $t - c + x > 0$. If 1 knew that 2 inspected, he would declare, since $0 > -f$ etc. Hence, there would be no Nash equilibrium in pure strategies, but we can solve for the (unique) equilibrium in mixed strategies. However, since we allow that $\delta \leq 1$, there is room for pure strategy Nash equilibria under some circumstances.

It will turn out that a crucial factor is how profitable an inspection is for the tax authority. Let $R = \frac{t-c+x}{t+x} < 1$ denote the "revenue ratio:" how large the net revenue of catching an evader is in relation to the gross revenue. The higher is R, the more "efficient" is the inspection of an evader.

In order to construct a pedagogical narrative, we present our results as a series of propositions. We intend to signal economic importance, not mathematical complexity. To enhance readability for those who wish to concentrate on implications more than logic, we relegate all proofs to the appendix.

Proposition 1. *(i) If $\delta < R$, the game described in this section has the unique equilibrium (D, I) for all parameter constellations.*

(ii) If $\delta > R$, the game described has a unique mixed-strategies equilibrium for all parameter constellations:

$$p^0 = 1 - \frac{R}{\delta}. \tag{1}$$

[9] See, e.g., Avenhaus et al. (2002).

$$q^0 = \frac{t}{t+f}. \tag{2}$$

The feature that if $\delta < R$ the equilibrium is (D, I) is true for all specifications, irrespective of guilt aversion: With a sufficiently high proportion of unaware taxpayers who evade with certainty, 2 always finds it worthwhile to inspect. This is understood by 1 who, therefore, chooses to declare, an obvious implication. The reason why we incorporate δ in our model, however, is to highlight effects that are relevant when that case it not at hand. Therefore, in what follows, we mostly focus on case (ii) of Proposition 1, where $\delta > R$.[10]

Keeping in mind the "classical results" from e.g. Becker (1968) and Allingham and Sandmo (1972), Proposition 1(ii) may appear counterintuitive. The cost to the taxpayer of getting caught, f, has no effect on the evasion probability, while the authority's inspection cost c has. While this effect is not the usual in the tax-compliance literature, where the taxpayer is regarded as the only active part, it is a typical finding for inspection games as presented e.g. in Graetz et al. (1986). When inspector and inspectee move simultaneously, the unique and mixed equilibrium implies that the two players, so to say, hold each other indifferent. Since a more severe punishment makes evasion less attractive, the inspection probability has to go down in order for the taxpayer to remain indifferent between evading and declaring. The effects of harsher punishment are manifested, not in terms of less crime, but rather in terms of less inspection.

Note that we have not mentioned player 3 at all. Rightly so, since 3 has no bearing on anything under classical preferences.

3 Incorporating guilt

The filing of tax returns is an example where guilt plausibly influences behavior. By withholding provision of public funds, tax evaders may hurt fellow

[10] If $\delta = R$, then equilibrium requires $p^0 = 0$ and $q^0 \in [\frac{t}{t+f}, 1]$.

citizens who expect compliance. Conscientious filers dislike that and may declare honestly in order to avoid guilt. This is in line with findings in psychology. In an influential study, Baumeister et al. (1994, p. 247) explain that "If people feel guilt for hurting their partners ... and for failing to live up to their expectations, they will alter their behavior (to avoid guilt) in ways that seem likely to maintain and strengthen the relationship."[11] Note the link to others' expectations. Using designs that elicit beliefs about beliefs, several experimental studies tested for such belief-dependent motivation and found support.[12] B&D develop two models – *simple guilt* and *guilt from blame* – that describe how belief-dependent guilt affects interaction in games. We introduce, adapt, and apply these to our setting.

3.1 Simple guilt

We solve for an equilibrium where 1 evades with probability p^{SG} and 2 inspects with probability q^{SG}. 2's payoff function is as before, but 1's utility is different. Before approaching our specific game, we reproduce the following:

Elements from B&D B&D consider finite extensive game forms. Players' material payoffs ($\neq$ their utilities, to be specified) are given by functions $m_i : Z \to R$, $i \in N$. Let H_i be the set of player i's information sets, including over endnodes. Conditional on $h \in H_i$, i holds a conditional first-order belief $\alpha_i(\cdot|h) \in \Delta(S_{-i})$ about co-players' strategies, where $S_{-i} = \times_{j \neq i} S_j$ with S_j player j's set of pure strategies. $\alpha_i = (\alpha_i(\cdot|h))_{h \in H_i}$ is i's system of first-order beliefs, and i holds a second-order belief $\beta_i(h)$ about the first-order belief system α_j of each $j \neq i$, a third-order belief $\gamma_i(h)$, etc. Assume that higher-order beliefs are degenerate point beliefs (anticipating their use in defining equilibrium) and so identify $\beta_i(h)$ with an array of conditional first-order beliefs $\alpha_{-i} = (\alpha_j(\cdot|h'))_{j \neq i, h' \in H_j}$, etc. The beliefs i

[11] Compare also Baumeister et al. (1995) and Tangney (1995).

[12] For example, Dufwenberg and Gneezy (2000) show for a dictator game that more is given by subjects who expect their co-players to expect a lot. See also Dufwenberg and Gneezy (2000), Charness and Dufwenberg (2006, 2011); Reuben et al. (2009); Dufwenberg et al. (2011). These studies have met some criticism – see Ellingsen et al. (2010) and Vanberg (2008) – and some follow-up defense – see e.g. Khalmetski et al. (2015).

would hold at $h \in H$ satisfy Bayes' rule and common certainty of that (cf. B&D). Given $s_j \in S_j$ and initial (=at the root, labeled h^0) first-order beliefs $\alpha_j(\cdot|h^0)$ player j forms a material payoff expectation: $\mathbb{E}_{s_j,\alpha_j}[m_j|h^0] = \sum_{s_{-j}} \alpha_j(s_{-j}|h^0)m_j(z(s_j, s_{-j}))$, where $m_j(z(s_j, s_{-j}))$ is j's material payoff at the end node reached if (s_j, s_{-j}) is played. For any end node z consistent with s_j, define $D_j(z, s_j, \alpha_j) = \max\{0, \mathbb{E}_{s_j,\alpha_j}[m_j|h^0] - m_j(z)\}$; this measures how much j is let down. If i knew z, $s_{-i} \in S_{-i}$, and $\alpha_j(\cdot|h^0)$, he could calculate how much of $D_j(z, s_j, \alpha_j)$ is due to his behavior: $G_{ij}(z, s_{-i}, \alpha_j) = D_j(z, s_j, \alpha_j) - \min_{s_i} D_j(z(s_i, s_{-i}), s_j, \alpha_j)$. He is affected by simple guilt if his utility function u_i^{SG} has the form

$$u_i^{SG}(z, s_{-i}, \alpha_{-i}) = \mathbf{m}_i(z) - \sum_{j \neq i} \theta_{ij} G_{ij}(z, s_{-i}, \alpha_j); \tag{3}$$

s_{-i} is consistent with reaching z and $\theta_{ij} \geq 0$ is i's guilt sensitivity wrt j.

Our solution We adopt the notions from B&D to our setting and (3) to u_1^{SG}, i.e., player 1's utility. However, if (3) were taken literally, if $x = f > 0$ there would be let-down also at the end node reached by (D, I): the taxpayer would feel guilty for denying the government a fine by not being dishonest! In a tax evasion context that is contrived. (3) describes the utility at each end node. Hence, we only apply it *at end nodes where* 1 *evaded.* With that, and assuming that $\theta_{13} = \theta \geq 0 = \theta_{ij}\ \forall\ (i, j) \neq (1, 3)$, the taxpayer has the following expected utility if he evades:

$$\begin{aligned}\mathbb{E}[u_1^{SG}(E)] = q^{SG}\big[-f - \theta \max\{0, Rt - (t - c + x)\}\big] + (1 - q^{SG})\big[t - \theta Rt\big] = \\ -q^{SG} f + (1 - q^{SG})\big[t - \theta Rt\big],\end{aligned} \tag{4}$$

where Rt is the expected payoff for player 3 (and 2).[13] Hence, the only end-node where simple guilt is sensed (actual payoff is lower than expected) is in the one where 1 evades and 2 does not inspect. Since no simple guilt is sensed when declaring, $u_1^{SG}(D) = 0$.

[13] See (17) in the Appendix

Proposition 2. *Assume that $\delta > R$. The game with simple guilt has a unique equilibrium for all relevant parameter constellations.*

(i) If $\theta < \frac{1}{R}$ the equilibrium will be in mixed strategies, where p^{SG} and q^{SG} are determined by (5) *and* (6)*, respectively:*

$$p^{SG} = p^0 = 1 - \frac{R}{\delta}, \tag{5}$$

$$q^{SG} = \frac{t - \theta Rt}{t + f - \theta Rt}. \tag{6}$$

(ii) If $\theta > \frac{1}{R}$ the equilibrium is (D, N).

Note that if $\theta = 0$ then $q^{SG} = q^0$ and that it is q^{SG}, which is affected by θ in the mixed-strategy equilibrium, while $p^{SG} = p^0$ irrespective of θ. From (6), we see that the inspection probability is decreasing in the guilt sensitivity θ. For high enough values of θ, the taxpayer will always prefer D to E irrespective of 2's actions and we reach the pure-strategy equilibrium with full compliance without any inspection.[14]

3.2 Guilt from blame

We solve for an equilibrium where 1 evades with probability p^{GB} and 2 inspects with probability q^{GB}. 2's utility remains as before, but 1's is different. Before approaching our specific game, we adapt the following:

Elements from B&D Given s_i and initial beliefs $\alpha_i(\cdot|h^0)$ and $\beta_i(h^0)$, compute how much i expects to let j down:

$$G^0_{ij}(s_i, \alpha_i, \beta_i) = \mathbb{E}_{s_i,\alpha_i,\beta_i}[G_{ij}|h^0] = \sum_{s_{-i}} \alpha_i(s_{-i}|h^0) G_{ij}(\mathbf{z}(s_i, s_{-i}), s_{-i}, \beta^0_{ij}(h^0)) \tag{7}$$

[14] If $\theta = \frac{1}{R}$, then equilibrium requires $p^{SG} \in [0, p^0]$ and $q^{SG} = 0$.

where $\beta^0_{ij}(h^0)$ denotes the initial (point) belief of i about $\alpha_j(\cdot|h^0)$. Suppose z is reached. $\mathbb{E}_{\alpha_j,\beta_j,\gamma_j}[G^0_{ij}|h]$, where $z \in h$, measures j's inference regarding how much i intended to let j down, or how much j "blames" i conditional on $H_j(z)$. Player i is affected by guilt from blame if he dislikes being blamed: his preferences are represented by utility function u^{GB}_i of the form

$$u^{GB}_i(z, \alpha_{-i}, \beta_{-i}, \gamma_{-i}) = \mathbf{m}_i(z) - \sum_{j \neq i} \theta_{ij} \mathbb{E}_{\alpha_j,\beta_j,\gamma_j}[G^0_{ij}|H_j(z)]. \tag{8}$$

Our solution Again assuming that $\theta_{13} = \theta \geq 0 = \theta_{ij}\ \forall (i,j) \neq (1,3)$, we extend these ideas to our setting. We make one adjustment relative to B&D. As seen above, the expectation $G^0_{ij}(s_i, \alpha_i, \beta_i)$ given by (7) is derived using $\alpha_i(\cdot|h^0)$ and $\beta_i(h^0)$; these are beliefs at the root rather than following nature's choice *aware*. Given our interpretation that 1 and $1'$ are different persons, it makes more sense to derive $G^0_{13}(s_1, \alpha_1, \beta_1)$ substituting $\alpha_1(\cdot|h)$ and $\beta_1(h)$ for $\alpha_1(\cdot|h^0)$ and $\beta_1(h^0)$, where h is the information set where 1 makes his choice rather than the root. That is, we compute how much 1 expects to let 3 down, *when he makes his choice*.

As in Section 3.1, we maintain that 1 cannot let 3 down when he declares. In the end-node where 1 evades and 2 does not inspect the actual let-down is Rt, which in case of evasion, occurs with probability $(1 - q)$. However, 3 cannot be sure that 1 chose E if 2 did not inspect. This matters under guilt from blame, which is sensed to the degree that 3 expects 1 to have the intention of letting him down.

Following B&D's formulas, in our context, we must calculate the probability that 1 is blameworthy according to 3. We can do this by noting that, as seen in Figure 1, player 3 has three information sets:

- $\{(aware, D, I)\}$ – player 2 inspects finding a declaring 1, so 3 knows that 1 did not intend to let 3 down (as 1 chose D). 1 is not blamed.
- $\{(aware, D, N), (aware, E, N), (unaware, E, N)\}$ – 2 does not inspect. The taxpayer could be an aware (player 1) or unaware (player $1'$) evader, or an aware declarer, only the first of whom is blameworthy. In

equilibrium, by Bayes' rule, the probability of an aware (blameworthy) evader is $\lambda = \frac{\delta p^{GB}}{\delta p^{GB}+\delta(1-p^{GB})+(1-\delta)} = \delta p^{GB}$.

- $\{(aware, E, I), (unaware, E, I)\}$ – 2 inspects catching a tax evader, who could either be aware or unaware; only the former is blamed by 3 (because $1'$ had no choice but E, and so could not have intended to let 3 down). In equilibrium, by Bayes' rule, choice E was made by blameworthy 1 (rather than $1'$) with probability $\mu = \frac{\delta p^{GB}}{\delta p^{GB}+(1-\delta)}$.

The blame is the product of the expected let-down in case of evasion, $(1-q)Rt$ and the probability that the taxpayer actually is a blameworthy evader (0, λ, or μ depending on the information set of 3 as just described). The expected blame in case of inspection is thus $\mu(1-q)Rt$ and in case of no inspection $\lambda(1-q)Rt$. Hence, if the taxpayer declares, his expected utility is

$$\mathbb{E}[u_1^{GB}(D)] = q^{GB}0 + (1-q^{GB})\big[0 - \theta\lambda(1-q^{GB})Rt\big], \tag{9}$$

and in case he evades it is

$$\mathbb{E}[u_1^{GB}(E)] = q^{GB}\big[-f-\theta\mu(1-q^{GB})Rt\big]+(1-q^{GB})\big[t-\theta\lambda(1-q^{GB})Rt\big]. \tag{10}$$

Under simple guilt, if θ were high enough ($\theta > \frac{1}{R}$) then the taxpayer would not evade regardless of the authority's action, and the equilibrium would be (D, N). A striking insight is that this result does not have a counterpart under guilt from blame:

Proposition 3. (D, N) *cannot be an equilibrium under guilt from blame, regardless of* θ*.*

Intuitively, if (D, N) were an equilibrium, then 3, on observing information set $\{(aware, D, N), (aware, E, N), (unaware, E, N)\}$, would infer that the probability of $(aware, E, N)$ equals 0. Hence 3 would not blame regardless of 1's choice, so 1 would be safe to evade.

The equilibrium under guilt from blame rather looks as follows:

Proposition 4. *Assume that $\delta > R$. The game with guilt-from-blame has a unique equilibrium for all parameter constellations, where p^{GB} and q^{GB} are determined by* (11) *and* (12)*, respectively:*

$$p^{GB} = p^0 = 1 - \frac{R}{\delta}. \tag{11}$$

$$q^{GB} = \frac{t}{t + f + \theta t A(1 - q^{GB})}, \tag{12}$$

where $A = \frac{R[c-(t+x)(1-\delta)]}{c} \leq R$.

Note that if $\theta = 0$, then $q^{GB} = q^0$. Moreover, if $\theta > 0$, then q^{GB} is defined implicitly, as it appears in each side of (12). As noted in the proof (in the Appendix) it is straightforward to verify that (12) has a unique solution $q^{GB} \in (0, 1)$. Hence, with guilt from blame, no pure strategy equilibrium is attainable, no matter how strong the guilt sensitivity, θ. Under simple guilt, guilt is only sensed in (E, N). With guilt from blame 1 instead senses guilt whenever 3 may have a reason to believe that 1 had the intention to let 3 down, whether or not he actually did so. Hence, $(aware, D, I)$ is the only end node where no guilt at all is sensed and the guilt associated with $(aware, D, N)$ and $(aware, E, N)$ is the same.

3.3 Comparisons

Comparing results, we note that the taxpayer evades with the same probability irrespective of the guilt sensitivity, i.e., $p^{GB} = p^{SG} = p^0$. The difference induced by guilt aversion, is seen via the inspection probability, which is lower in the equilibria with guilt, and especially with simple guilt:[15]

Proposition 5. *Whenever $\theta > 0$, then $q^0 > q^{GB} > q^{SG}$.*

Under guilt from blame the cause of a bad conscience is the perceived intention to let down rather than the actual let-down. If 2 chooses not to inspect, then 3 believes with probability λ that 1 evaded. Hence, unlike the

[15]Note that if $\theta = 0$ then $q^{GB} = q^{SG} = q^0$.

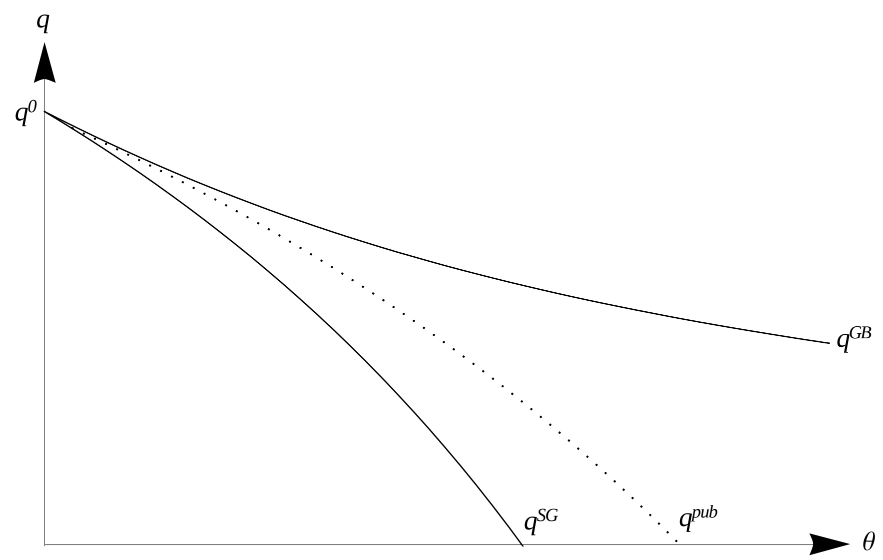

Figure 2: Comparison of inspection probabilities

case with simple guilt, the taxpayer cannot fully avoid a bad conscience by choosing D. Therefore, the inspection probability which keeps the taxpayer indifferent between evading and not is higher under guilt from blame than under simple guilt.

In Figure 2, the solid lines show q^{GB} and q^{SG} as functions of θ. (The dotted line will be addressed in section 4.3.)

4 Policy

With guilt in the picture, several novel policy implications emerge:

4.1 Fines vs. jail

Should fines or imprisonment be preferred, if both forms of punishment impose the same cost (f) to the taxpayer? This question itself is not new, but our line of reasoning is. Becker (1968) claimed that if fines and imprisonment impose the same cost to someone who is caught doing an illegal activity, this will not change the level of criminal activity. However, since fines bring revenue to the government ($x > 0$, in our case), Becker argued that they would be superior to imprisonment. We too will reach that conclusion, but for rather different reasons. The analysis centers on our parameter x, and for expositional purposes we limit attention to the two distinct cases $x = f$ (fines) and $x = 0$ (imprisonment). Moreover, we assume that $\delta = 1$ to simplify primarily the guilt-from-blame analysis (but see footnote 17)

Let us first consider a taxpayer's evasion probability in equilibrium. Recall that irrespective of any guilt aversion, this is always determined by (1).[16] Proposition 6 follows directly:

Proposition 6. *In the mixed-strategy equilibrium, with or without guilt aversion, the taxpayer evades with a lower probability under the threat of a fine than of imprisonment, i.e.,* $p_{|x=f} < p_{|x=0}$.

Hence, to reduce evasion it is better to levy fines on tax evaders, rather than sending them to jail, if the perceived cost to the taxpayer is the same.

What about the inspection probability? With classical preferences, i.e. $\theta = 0$, the inspection probability q^0, determined by (2), is unaffected by whether the government gains any revenue or not. With guilt averse taxpayers, however, the picture changes. Player 3's expected payoff depends positively on x, so when getting away with evading, the taxpayer lets 3 down to a larger extent under fines, which in turn increases guilt. In equilibrium inspections therefore occur with a lower probability than with imprisonment:

Proposition 7. *If taxpayers are motivated by guilt aversion, the inspection probability is higher when caught evaders are sentenced with imprisonment than when they are fined, both under simple guilt and under guilt from blame.*

In Proposition 2(ii), we found that with simple guilt, a sufficiently high θ would lead to an equilibrium without evasion and where no inspections are made. Comparing the two forms of punishment we find that

Proposition 8. *Under simple guilt, the game has the pure-strategy equilibrium* (D, N) *for lower degrees of guilt sensitivity under the threat of a fine than of imprisonment.*

[16] With $\delta = 1$, (1) reduces to $p = \frac{c}{t+x}$.

We conclude that fines are superior to imprisonment if the experienced cost is the same for the taxpayer; evasion as well as inspection (if there is guilt aversion) are less likely and the public's expected payoff is higher.[17]

4.2 Information campaigns

In many countries, tax authorities run information campaigns hoping to increase compliance by increasing awareness of rules. We can explore the impact of such policies within our model, via δ, the share of aware taxpayers.

For a low share of aware taxpayers, i.e., $\delta < R$, the tax authority chooses to inspect with certainty so that all aware taxpayers choose to declare.[18] Since the unaware evade with certainty, increasing δ implies that fewer taxpayers evade, i.e., overall tax evasion is reduced. Hence

Proposition 9. *Increasing the share of aware taxpayers when $\delta < R$, reduces over-all evasion.*

If δ is sufficiently large to generate a mixed-strategy equilibrium, we get:

Proposition 10. *Increasing the share of aware taxpayers when $\delta \geq R$, increases their evasion probability, while over-all evasion remains constant.*

If δ increases, the likelihood of catching an evader when inspecting a random taxpayer is reduced In equilibrium, 2 is indifferent between inspecting or not, so 1 evades with a higher probability to compensate for the reduction in unaware taxpayers. Hence, overall evasion remains constant.

How is the inspection probability affected by a marginal increase in δ when $\delta \geq R$?[19] What happens depends on whether and how guilt aversion affects the aware taxpayer. With classical preferences, $q^0 = \frac{t}{t+f}$ determined

[17]If we relax the assumption that $\delta = 1$, the inspection probability with guilt from blame is, however, not necessarily lower with fines. As the taxpayer evades with a lower probability with fines than with jail, the perception of him as the blameworthy player 1 rather than the unaware player $1'$ is lower with a fine and thereby guilt from blame. 2 therefore inspects with a higher probability with a fine. This counteracts the previous effect, leaving the overall effect undetermined.

[18]Compare Proposition 1 (i) and the subsequent discussion.

[19]If $\delta < R$ then player 2 always chooses I.

in (2) is unaffected by δ. Nor will there be an effect under simple guilt,[20] where actual let-down by the aware taxpayer causes guilt, irrespective of how many others are aware or unaware. Guilt from blame is instead caused by the inference made about the intention to let player 3 down. Increasing awareness then increases the probability that a caught evader is aware and thus blameworthy, i.e., μ, increases with δ.[21] Hence, with guilt from blame the aware taxpayer will be worse off evading, since he cannot "hide" behind a widespread ignorance of the tax rules to the same extent anymore. In equilibrium, where he is indifferent between evading and declaring, he is therefore inspected with a lower probability.

Proposition 11. *Under guilt from blame, the inspection probability decreases in the share of aware taxpayers.*

Information campaigns may thus reduce overall evasion, but only if the level of awareness is low. Under guilt from blame, the costs for the government could be reduced if inspections are more costly than increasing the level of awareness. Hence, it may be worthwhile for a government to run such information campaigns also when awareness is so high so that overall evasion would not decrease.

4.3 Private vs. public returns

Lately, scholars have taken interest in the potential effects from publicly disclosing tax-returns from individuals and firms (See, e.g., Bø et al., 2015; Hoopes et al., 2018). Up till now, we treated the neighbor (player 3) as unable to distinguish whether or not the taxpayer chose to evade, unless there is an inspection. In countries where income-tax returns are not public information this is probably a fair assumption. Neighbors then only have the information which is disclosed by the authorities and as long as a certain tax return is not inspected, potential evasion remains a secret. In some countries, however, there is a principle of public access to official records, which also applies to

[20] $q^{SG} = \frac{t-\theta Rt}{t+f-\theta Rt}$ according to (6).

[21] Note that $\frac{\partial \mu}{\partial \delta} = \frac{t+x}{c} > 0$.

tax returns.[22] This allows anyone to get information about incomes declared and taxes paid by anyone else, even if the tax authority does not inspect. Hence, a neighbor who observes someone's fancy car or luxurious lifestyle can check whether they have actually declared this income and if not, they can draw the inference that they are likely living next door to a tax evader.

What difference does it make whether neighbors (to whom one may sense guilt) can retrieve information about the income declared and can we determine whether public or private tax returns are preferred from a welfare point of view? The point with public access to tax returns is that people would be more reluctant to evade when their neighbors are able to check up on them. For this to matter, taxpayers need to care about what others think about them. Neither with classical preferences nor under simple guilt is this the case. However, guilt from blame depends on 3's inference about 1's intentions to let 3 down, which depends on 3's information. Hence, the notion of private versus public tax returns is highly relevant, and the rest of the section deals with this case. We mostly focus on the inspection probability since in the mixed-strategy equilibrium the probability of evasion is still determined by (1), unaffected by guilt or the neighbor's information.

Under the principle of public access, player 3 has four information sets, as shown in Figure 3. Comparing with Figure 1, the difference is that player 2 does not have to inspect in order for 3 to be able to learn whether player 1 evaded or not.

Hence, for 3, the only unknown is whether a caught evader is aware or unaware, i.e., whether the evasion is blameworthy or not.[23] Since there is no uncertainty regarding whether evasion actually took place, the uninspected honest taxpayer senses no guilt from blame towards 3. This is the crucial difference to the case with private tax returns, analysed in section 3.2. With

[22] Norway, Sweden, Finland, and Iceland all have public disclosure of personal tax returns to some extent. In Norway the tax authority provides the information online, free to access by anyone. This policy has been studied by, e.g., Bø et al. (2015). In Sweden, anyone can call the authority to get the information for free. There are also private actors who sell online information and the "taxation calendar," where incomes and taxes of ordinary people, high-income earners and celebrities are listed, is a yearly bestseller.

[23] Remember that the unaware does not intend to let anyone down, but evades due to lack of knowledge.

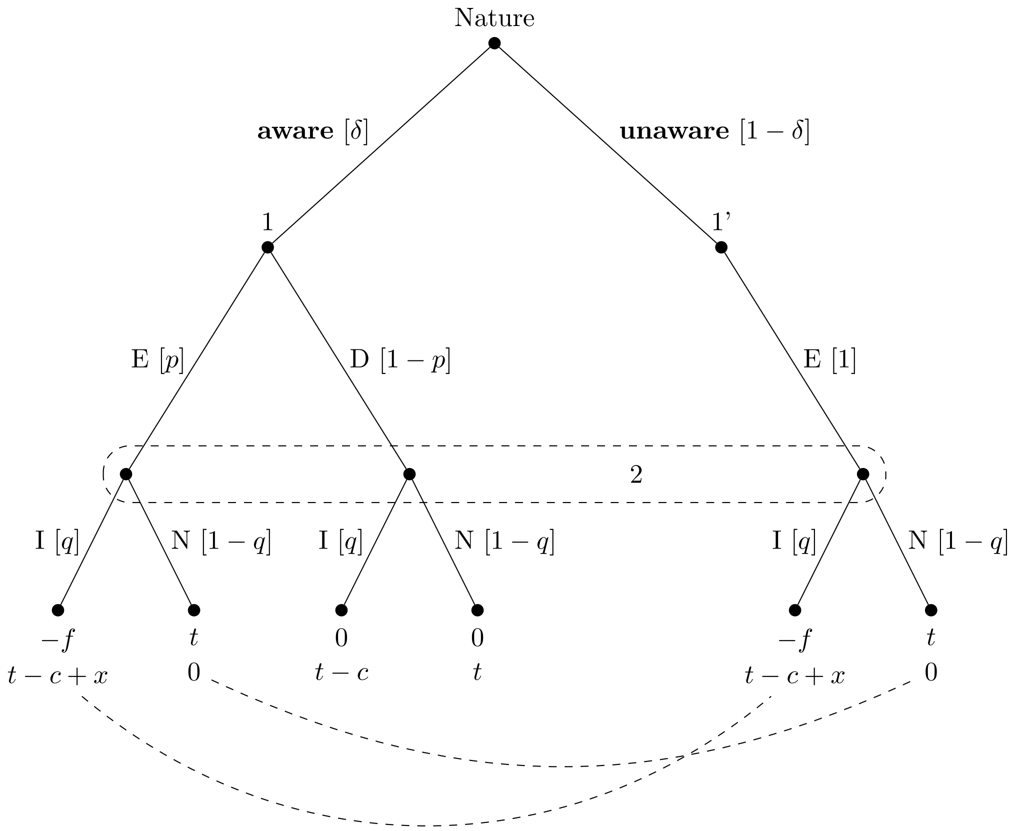

Figure 3: The information sets with public returns.

public tax returns, the taxpayer's expected utilities are different. Utility when declaring is 0, just as under simple guilt, since 3 does not suspect evasion. If evading, the expected utility is different from that with private returns in (10). Since 3 knows that 1 evades also when 2 does not inspect, probability μ is assigned to 1 being blameworthy. When 2 inspects with probability q^{pub}, the 1's expected utility in case of evasion thus becomes

$$\mathbb{E}[u_1^{pub}(E)] = q^{pub}\big[-f-\theta\mu(1-q^{pub})Rt\big]+(1-q^{pub})\big[t-\theta\mu(1-q^{pub})Rt\big]. \quad (13)$$

The equilibrium probability q^{pub} that keeps 1 indifferent between evading and not when 3 has full information about evasion is now the explicit function

$$q^{pub} = \frac{t - \theta tA}{t + f - \theta tA}, \tag{14}$$

where $A = \frac{R[c-(t+x)(1-\delta)]}{c} < R$ for $\delta < 1$.

Proposition 12. *Under the principle of public access, the equilibrium inspection probability under guilt from blame, q^{pub}, is lower than when tax returns are private. However, the probability is still higher than under simple guilt whenever $\delta < 1$, i.e., $q^{GB} > q^{pub} > q^{SG}$. Moreover, under the principle of public access, there will be a pure-strategy equilibrium (D, N) for $\theta > \frac{1}{A} > \frac{1}{R}$, also under guilt from blame.*

When neighbors can freely access tax returns evasion is less rewarding, so less formal inspection is needed in equilibrium. In Figure 2 q^{pub} is represented by the dotted line. The structure of q^{pub} in (14) is reminiscent more of q^{SG} in (6) than of q^{GB} in (12). Recall that the implicit structure of q^{GB} was due to 3's uncertainty about evasion in case of no inspection. Under the principle of public access, this uncertainty is gone. This is also the reason why the "good" equilibrium, (D, N) is attainable under guilt from blame when tax returns are public. As long as $\delta < 1$ player 3 is, however, uncertain whether an evader is aware or unaware and thereby not blameworthy. Therefore, 2 inspects with a higher probability than under simple guilt.[24]

5 Concluding remarks

Classify our contribution as "applied behavioral theory." Drawing on Battigalli and Dufwenberg's (2007) psychological games based approach, we explore how two forms of guilt may shape tax evasion (or possibly also other forms of cheating) and the need for audits. The analysis highlights several novel, and perhaps unexpected, effects.

Intuition may suggest that if tax evaders feel guilty then they are more likely to comply. However, if a tax authority anticipates compliance that

[24] In the special case where $\delta = 1$, all uncertainty is removed when tax returns are public, and $q^{pub} = q^{SG}$.

reduces the incentives for inspection, which in turn makes evasion more lucrative. The overall equilibrium effect is in most cases null for the taxpayer, while the authority inspects less. Guilt is beneficial, not by making people more honest but by reducing the need for audits.

The presence of guilt has idiosyncratic policy implications. We highlight new reasons to prefer fines over jail sentences, beneficial effects of awareness campaigns, and potential gains from making tax returns public. The impact of guilt is in many cases quite non-standard from a conventional viewpoint. For example, the issue of private versus public tax returns affects merely the information-structure across a game form's end nodes. That aspect would be irrelevant had we explored a standard rather than a psychological game.

We reached our conclusions for a highly stylized setting. Yet, it is rich enough to realistically capture several crucial strategic and informational features that are financially and psychologically relevant: We consider an inspection game where each party's optimal behavior depends on that of another party. We accounted for the presence of unaware tax payers as well as the extent to which a citizens reporting behavior is observable to neighbors, aspects which would be irrelevant with conventional preferences but which turn out to matter crucially with the belief-dependent effect of guilt in the picture.

A Appendix: Proofs

Proof of Proposition 1

Proof. (i)

Player 2's expected payoff from I is $t - c + x(\delta p + 1 - \delta)$ and from N it is $\delta(1-p)t$. Assume $\delta < R = \frac{t-c+x}{t+x}$. Then I is preferred to N also if $p = 0$:

$$t - c + x(1-\delta) > \delta t \Leftrightarrow t - c + x > \delta(t + x).$$

Hence, 2 will always find it more profitable to inspect, and 1's best response is to declare (so $p = 0$).

(ii)

Instead assume $\delta > R$. In equilibrium, if 2 mixes it must be indifferent between inspecting and not, i.e., p must satisfy

$$\delta(1-p)t = t - c + x(\delta p + 1 - \delta) \tag{15}$$

which implies that 1 must evade with probability

$$p^0 = 1 - \frac{t-c+x}{\delta(t+x)} = 1 - \frac{R}{\delta}. \tag{1}$$

$\delta > R$ assures that $p^0 \in (0,1)$.

Similarly, 1's expected payoffs of D and E are, respectively, 0 and $q(-f) + (1-q)t$. In equilibrium, if 1 mixes he is indifferent between D and E, so

$$0 = q(-f) + (1-q)t \tag{16}$$

which implies that in equilibrium, 2 inspects with probability

$$q^0 = \frac{t}{t+f}. \tag{2}$$

Hence, $q^0 \in (0,1)$. □

Proof of Proposition 2

Proof. *(i)* $\theta < \frac{1}{R}$

Could we have an equilibrium where 2 chooses I? If so, 1 responds with D (this maximizes material payoff, and there is no guilt by assumption) and only $1'$ is caught evading. This is an equilibrium iff 2's payoff from I is no lower than that of N, i.e. $t - c + x(1-\delta) \geq \delta t$, or $\delta \leq R$. Hence, assuming that $\delta > R$, (D, I) cannot be an equilibrium.

Could we have an equilibrium where 2 chooses N?

Then $\mathbb{E}_E[u_1]^{SG} = (t - \theta R t) > 0$, so 1 responds with E, which in turn would cause 2 to choose I. Hence, when $\theta < \frac{1}{R}$, 2 cannot choose N in equilibrium.

Instead consider the possibility that $q^{SG} \in (0,1)$. If so, 2 must be indifferent between inspecting and not. Using the same logic as in the proof of Proposition 1 we see that p^{SG} must satisfy

$$p^{SG} = p^0 = 1 - \frac{R}{\delta} \in (0,1). \tag{5}$$

and we infer that 1 must be indifferent between D and E. Plugging p^{SG} into (either side of) (15) one furthermore sees that

$$\mathbb{E}_{s_3,\alpha_3}[m_3|h^0] = Rt > 0, \tag{17}$$

1 is indifferent between D and E, and since D gives utility 0, so must E. Using notation $[a]^+ = \max\{a, 0\}$ we get

$$\begin{aligned} 0 =& \\ &(1-q^{SG})\Big(t - \theta\Big[\mathbb{E}_{s_3,\alpha_3}[m_3|h^0] - 0\Big]^+\Big) + q^{SG}\Big(-f - \theta\Big[\mathbb{E}_{s_3,\alpha_3}[m_3|h^0] - (t-c+x)\Big]^+\Big) \\ =&(1-q^{SG})\Big(t - \theta Rt\Big) - q^{SG}f. \end{aligned} \tag{18}$$

Simplifying this, we get

$$q^{SG} = \frac{t - \theta Rt}{t + f - \theta Rt}. \tag{6}$$

(ii)

When $\theta > \frac{1}{R}$, $\mathbb{E}_E[u_1]^{SG} = (1-q^{SG})(t - \theta Rt) - q^{SG}f < 0$, so the taxpayer always prefers D to E also if not inspected. Given that, 2 will prefer not to inspect since $\delta t > \delta(t-c) + (1-\delta)(t-c+x)$. Hence, the equilibrium will be in pure strategies (D, N).

□

Proof of Proposition 3

Proof. If (D, N) were an equilibrium then $p^{GB} = q^{GB} = 0$ and (as seen in the bullets of section 3.2) $\lambda = \mu = 0$. Plugging this into (9) and (10) we get, regardless of θ, $\mathbb{E}_D[u_1]^{GB} = 0 < \mathbb{E}_E[u_1]^{GB} = t$, so player 1 would be able to profitably deviate, contradicting that (D, N) is an equilibrium. □

Proof of Proposition 4

Proof. Could we have an equilibrium where 2 chooses I under guilt from blame? If so, 1 responds with D (this maximizes material payoff, and as explained in Section 3.2 there is no blame or guilt once 3's information set $\{(aware, D, I)\}$ is reached) and only $1'$ is caught evading. As before, this is an equilibrium if 2's payoff from I is no lower than that of N, i.e. $t - c + x(1-\delta) \geq \delta t$ which is false under the assumption that $\delta > R$.

We have thus ruled out that $q^{GB} = 1$. Could it be that $q^{GB} = 0$? No: If so, 1's best response would be E (this maximizes material payoff, and although some guilt-from-blame may be involved it is the same regardless of whether D or E is chosen as seen by noting that in each case 3 would apportion blame based in on the same information set $\{(aware, D, N), (aware, E, N), (unaware, E, N)\}$), and 2's best response would be I, which is a contradiction. Hence, it must hold that $q^{GB} \in (0, 1)$, so that 2 must be indifferent between inspecting and not. Using the same logic as in the proofs of Propositions 1 and 2 we see that p^{GB} must satisfy

$$p^{GB} = p^0 = 1 - \frac{R}{\delta}. \tag{5}$$

Since $R > \delta$ we get $p^{GB} \in (0, 1)$ and we infer that 1 must be indifferent between D and E, a property which hence q^{GB} must induce. Equating the expected utilities associated with D and E, respectively, we get

$$-(1-q^{GB})\theta\lambda(1-q^{GB})Rt = q^{GB}[-f-\theta\mu(1-q^{GB})Rt] + (1-q^{GB})\left[t-\theta\lambda(1-q^{GB})Rt\right], \tag{19}$$

which, in turn implies that 2 has to inspect with probability

$$q^{GB} = \frac{t}{t + f + \theta\mu(1-q^{GB})Rt}. \tag{20}$$

Without guilt or with simple guilt, the probabilities p & q and p^{SG} & q^{SG} were unrelated. With guilt from blame, however, p^{GB} affects the probability that the taxpayer will be blamed and therefore affects his expected utility. Hence, q^{GB} becomes a function of p^{GB}via μ.[25] However, in equilibrium, $p^{GB} = p^0$ and still determined in (1) and we can write the inspection probability:

$$q^{GB} = \frac{t}{t + f + \theta t(1 - q^{GB})A}. \tag{12}$$

where $A = \frac{R[c-(t+x)(1-\delta)]}{c} \leq R$. We have already verified that q^{GB} must take a value in $(0, 1)$. As the rhs of (12) is increasing in q^{GB}, we know that (12) has a unique solution $q^{GB} \in (0, 1)$.

□

Proof of Proposition 5

Proof. Subtract (12) from (2)

$$q^0 - q^{GB} = \frac{\theta t^2 A(1 - q^{GB})}{[t + f + \theta t A(1 - q^{GB})]\,(t + f)} > 0 \tag{21}$$

Hence, $q^0 > q^{GB}\ \forall\ \theta > 0$.

Next, let us show that $q^{GB} > q^{SG}\ \forall\ \theta > 0$. We know that when $\theta = 0$, $q^{GB} = q^{SG}$. Moreover, we know from Proposition 4 that $q^{GB} > 0\ \forall\ \theta \geq 0$ and from Proposition 2 ii) that $q^{SG} = 0$ when $\theta > \frac{1}{R}$. Thus, for $\theta > \frac{1}{R}$, $q^{GB} > q^{SG}$. If the two inspection probabilities never cross in the interval $\theta \in (0, \frac{1}{R}]$, we have thus shown that $q^{GB} > q^{SG}\ \forall\ \theta > 0$.

Assume that q^{GB} and q^{SG} cross somewhere in the interval $\theta \in (0, \frac{1}{R}]$. Then, the expressions in (6) and (12) are equal, i.e.,

[25] This is because 3 cannot tell whether an inspected evader is aware or unaware, i.e., blameworthy or not. In case also 3 started the game in node t^1, the equilibrium inspection probability would have been slightly different: $q^{GB} = \frac{t}{t+f+\theta(1-q^{GB})Rt}$ independent of p.

$$\frac{t-\theta Rt}{t+f-\theta Rt} = \frac{t}{t+f+\theta At(1-q)} \tag{22}$$

$$\Rightarrow \qquad At(1-q)(1-\theta R) = Rf \tag{23}$$

In a potential crossing, $q = q^{SG} = \frac{t-\theta Rt}{t+f-\theta Rt}$, which makes (23) equivalent to

$$t(A-R)(1-\theta R) = Rf. \tag{24}$$

Since $A \leq R$, this cannot be true, so q^{SG} and q^{GB} cannot cross. Hence $q^{GB} > q^{SG} \; \forall \; \theta > 0$.

□

Proof of Proposition 7

Proof. Differentiating q^{SG} in (6) with respect to x, we get:

$$\frac{\partial q^{SG}}{\partial x} = -\frac{\theta tfc}{(t+f-\theta Rt)^2(t+x)^2} < 0 \tag{25}$$

Hence, it follows that $q^{SG}_{|x=0} > q^{SG}_{|x=f}$, i.e., the proposition holds under simple guilt.

The inspection probability under guilt from blame is implicitly defined in (12) and differentiating with respect to x, we get:

$$\frac{\partial q^{GB}}{\partial x} = -\frac{t^2\theta\left[(1-q^{GB})\frac{\partial A}{\partial x} - A\frac{\partial q}{\partial x}\right]}{[t+f+\theta tA(1-q^{GB})]^2}, \tag{26}$$

where $\frac{\partial A}{\partial x} = \frac{c}{(t+x)^2} > 0$, assuming that $\delta = 1$. Expanding and rewriting (26), we get

$$\frac{\partial q^{GB}}{\partial x}\left\{\left[t+f+\theta tA(1-q^{GB})\right]^2 - \theta t^2 A\right\} = \frac{-\theta t^2(1-q^{GB})c}{(t+x)^2} < 0 \tag{27}$$

Hence, the sign of $\frac{\partial q^{GB}}{\partial x}$ is the opposite of the sign of the expression within curly brackets. Rewriting this we arrive at

$$\left\{\cdot\right\} = f^2+2tf[1+\theta A(1-q^{GB})]+t^2[1+\theta^2 A^2(1-q^{GB})^2+\theta A(1-2q^{GB})]. \quad (28)$$

We note that $[1+\theta^2 A^2(1-q^{GB})^2+\theta A(1-2q^{GB})] > [1-\theta A(1-q^{GB})]^2 > 0$. Hence, the whole expression is positive and $\frac{\partial q^{GB}}{\partial x} < 0$.

Since the derivative is a continuous function for all $x \geq 0$, it follows that $q^{GB}_{|x=f} < q^{GB}_{|x=0}$. Thus, also under guilt from blame, the equilibrium inspection probability is lower with fines than with imprisonment.

□

Proof of Proposition 8

Proof. The degree of guilt sensitivity above which player 2 chooses $q^{SG} = 0$ (and 1 chooses $p = 0$) is, according to (6)

$$\theta^* = \frac{1}{R} = \frac{t+x}{t-c+x},$$

which is obviously decreasing in x, which implies that $\theta^*_{|x=0} > \theta^*_{|x=f}$.

□

Proof of Proposition 9

Proof. If the share of aware taxpayers $\delta < R$, the aware choose $p = 0$ according to Proposition 1, while the unaware evade with certainty. Hence, total evasion is $(1-\delta)$. Increasing δ thus reduces overall evasion. □

Proof of Proposition 10

Proof. Differentiating equation (1), $\frac{\partial p}{\partial \delta} = \frac{R}{\delta^2} > 0$, i.e., a higher share of aware taxpayers, δ results in a higher evasion probability, p

Differentiating overall evasion, i.e., $\delta p + (1-\delta)$ gives:

$$\frac{d(\delta p + (1-\delta))}{d\delta} = p - 1 + \delta \frac{\partial p}{\partial \delta} = 0 \tag{29}$$

□

Proof of Proposition 11

Proof.

$$q^{GB} = \frac{t}{t + f + \theta t(1 - q^{GB})A}, \tag{12}$$

where $A = \frac{(t-c+x)[c-(t+x)(1-\delta)]}{c(t+x)} < 1$. Implicitly differentiating (12) with respect to δ gives:

$$\frac{\partial q^{GB}}{\partial \delta} = -\frac{t^2\theta\left[(1-q^{GB})\frac{\partial A}{\partial \delta} - A\frac{\partial q}{\partial \delta}\right]}{[t + f + \theta t A(1-q^{GB})]^2}, \tag{30}$$

where $\frac{\partial A}{\partial \delta} = \frac{(t-c+x)}{c} > 0$. Expanding and rewriting (30), we get

$$\frac{\partial q^{GB}}{\partial \delta}\left\{\left[t+f+\theta t A(1-q^{GB})\right]^2 - \theta t^2 A\right\} = \frac{-\theta t^2(1-q^{GB})\frac{\partial A}{\partial \delta}}{\left[t+f+\theta t A(1-q^{GB})\right]^2} < 0 \tag{31}$$

Hence, the sign of $\frac{\partial q^{GB}}{\partial \delta}$ is the opposite of the sign of the expression within curly brackets. Rewriting this we arrive at

$$\left\{\cdot\right\} = f^2 + 2tf[1+\theta A(1-q^{GB})] + t^2[1+\theta^2A^2(1-q^{GB})^2 + \theta A(1-2q^{GB})]. \tag{32}$$

We note that $[1+\theta^2A^2(1-q^{GB})^2+\theta A(1-2q^{GB})] > [1-\theta A(1-q^{GB})]^2 > 0$. Hence, the whole expression is positive and $\frac{\partial q^{GB}}{\partial \delta} < 0$. □

Proof of Proposition 12

Proof. Whenever $\theta \geq (1/A)$, the right-hand side of (14) is negative. Since q^{pub} must be non-negative, this means that player 2 cannot reduce q sufficiently to keep player 1 indifferent between E and D, but player 1 will always prefer D, irrespective of the action of player 2, who will therefore choose N. As $\frac{1}{A} > \frac{1}{R}$ for $\delta < 1$, the threshold value of θ is higher under guilt from blame when tax returns are public than under simple guilt.

We know that when $\theta = 0$, $q^{pub} = q^{GB}$. Moreover, we know from Proposition 4 that $q^{GB} > 0 \; \forall \; \theta$ and from the reasoning above that $q^{pub} = 0$ when $\theta > \frac{1}{A}$. Thus, for $\theta > \frac{1}{A}$, $q^{GB} > q^{pub}$. If the two inspection probabilities never cross in the interval $\theta \in (0, \frac{1}{A}]$, we have thus shown that $q^{GB} > q^{pub} \; \forall \; \theta > 0$.

Assume that q^{GB} and q^{pub} cross somewhere in the interval $\theta \in (0, \frac{1}{A}]$. Then, the expressions in (14) and (12) are equal, i.e.,

$$\frac{t - \theta At}{t + f - \theta At} = \frac{t}{t + f + \theta At(1 - q)} \tag{33}$$

$$\Rightarrow \qquad t(1 - q)(1 - \theta A) = f \tag{34}$$

In a potential crossing, $q = q^{pub} = \frac{t - \theta At}{t + f - \theta At}$, which makes (34) equivalent to

$$tf(1 - \theta A) = f(t + f - t\theta A) \;\Leftrightarrow\; f = 0. \tag{35}$$

Since $f > 0$, this cannot be true, so q^{pub} and q^{GB} cannot cross. Hence $q^{GB} > q^{pub} \; \forall \; \theta > 0$.

Now, compare the inspection probability, q^{pub} in (14) with q^{SG} determined in (6). We know that when $\theta = 0$, then $q^{pub} = q^{SG} = q^0$. Moreover $q^{SG} = 0 \; \forall \; \theta > \frac{1}{R}$ and $q^{pub} = 0 \; \forall \; \theta > \frac{1}{A} > \frac{1}{R}$, i.e., q^{SG} reaches zero for a lower value of θ than q^{pub}. It is obvious that both inspection probabilities are negative functions of θ and thus never cross.[26] Hence, $q^{pub} > q^{SG} \; \forall \; \theta > 0$.

$\square$

[26] $\frac{\partial q^{SG}}{\partial \theta} = -\frac{ftR}{[f + t(1 - \theta R)]^2} < 0$ and $\frac{\partial q^{pub}}{\partial \theta} = -\frac{ftA}{[f + t(1 - \theta A)]^2} < 0$

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