# Graduated Penalty Scheme

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**Abstract**

Evaders of any dues such as local council tax, motor vehicle tax, tv license fees etc., if detected, can pay promptly the dues plus any fine or postpone, which usually means a larger fine, and potentially imprisonment if payments are not made in full. We provide a rationale for this *graduated penalty scheme*, based on criminal tracking costs. Although in conflict with the state's basic objective of deterring evasion, a graduated penalty scheme may emerge as an optimum balance between the dual objectives of deterrence and settlement delay minimization. The analysis also offers insights as to the types of citizens especially responsive to a graduated penalty scheme.

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# 1 Introduction

Collection of unpaid fines is an important problem in law enforcement. According to the year 2005 figures, total unpaid fines in the United Kingdom was of the order of £383 million, with a collection rate around 50%. While such a low collection rate can be attributed to large costs of tracking down defaulters, one cannot escape the feeling that the lack of credible serious consequences for persistent defaulters is one prime reason. To tackle the problem, a package of measures announced by Lord Chancellor Lord Falconer in 2005 was experimented that produced considerable increases in fine collection rates.[1] Among the measures proposed, the most important one, in our view, is to increase initial fines by up to 50% for offenders who fail to pay up on time and even sanction imprisonment if fines do not succeed.

In this paper we ask why such a graduated fine system with imprisonment as potential outcome for persisting defaulters could be optimal. We decompose the law enforcement process with regard to routine crimes, say, nonpayment of some dues such as local council tax, motor vehicle tax, tv license fees etc., into three components within a two-period model. Citizens, privately informed about their income potential and current (first-period) income, first decide on whether to pay the dues. Second, evaders if detected face a fine $f$, which, along with the original amount owed, they either settle promptly or postpone. Third, if an evader postpones, the fine becomes $e$. Nonpayment of this fine plus the dues out of the realized second-period income leads to a jail term.

The standard Beckerian argument suggests that both $f$ and $e$ be set at their maximal statutory levels to economize on deterrence costs. However, such maximal fines can induce a large proportion of evaders to postpone payments, hence, increase defaulter tracking costs. A graduated penalty scheme $f < e$ can emerge as an optimal balance between 'deterrence costs' and 'defaulter tracking costs'. We show that the target group whose penalty-settlement behavior is intended to be influenced by the graduated penalty scheme is a section of "wealth-unconstrained" citizens whose income realizations in the first period are not too high; these citizens can afford paying the maximal fine, if imposed in period one, but may still consider

[1] See the BBC News: "Fine dodgers face new penalties," 3 January, 2005 available at http://news.bbc.co.uk/1/hi/uk/4141475.stm. The pilot projects were tested in Cambridgeshire, Cumbria, Devon and Cornwall, South Yorkshire, Cheshire and Gloucestershire, leading to an increase in fine collection by more than 90%.

postponing due to high marginal benefits from immediate consumption (with tight budgets) if in comparison there is only a small risk of eventual non-payment and imprisonment due to extremely unfavorable realization of the second-period income. To induce these citizens to settle fines promptly (and thus save on the associated default tracking costs), the government would rather impose a less-than-maximal fine in the first period, deferring maximal fine for the final period.

Our argument for ascending fines on defaulters is not related to discounting, nor does it stem from differential rates of discount for the citizens and the state; we assume zero discounting for all the parties. Rather, the crucial element that generates strategic evasion and default decisions is the information structure about current and future incomes: Citizens privately know their current, but not future, ability to pay. Citizens with very low current incomes cannot obviously settle fines, and citizens with sufficiently high current incomes would always settle fines. Among the rest, those with reasonably sound future income potentials but neither too low nor too high a current income draw will take a somewhat optimistic view of the future (in terms of ability to settle fines and the dues) and deliberately choose to default at an insignificant risk of eventual imprisonment sentence. On the other hand, those with low future income potentials but "enough" current income (i.e., enough to settle) will be pessimistic about their future ability to pay, so, may pay promptly if they evade and are detected. We should expect current and potential income distributions to play an important role in determining the size and time profile of fines because the government chooses the fines under imperfect information: the larger the expected measure of wealth-unconstrained citizens, the larger is the expected response to a reduction in $f$ relative to $e$.

The results and graduated penalties approach in this paper can broadly be related to several themes in the literature. One of these is the literature on non-maximal optimal penalties, to which this paper contributes by identifying savings in defaulter tracking costs as a potential factor.[2] Another theme is explaining why

[2]Explanations for nonmaximal sanctions range from risk aversion of citizens (Polinsky and Shavell (1979)), adjudication errors and litigation costs (Rubinfeld and Sappington (1987)), impact of sanctions on probability of conviction (Andreoni (1991)) to marginal deterrence considerations, through impossibility of adjusting monitoring as a function of the seriousness of the offense (Mookherjee and Png (1992)). Marginal deterrence, i.e., deterring more harmful acts by imposing larger expected sanctions than less harmful acts, produces a social benefit by inducing offenders to moderate the harm they cause. It also produces a cost, by diluting deterrence: reducing the sanctions for minor harms will induce an increase in minor crimes, as noted by Shavell (1992),

more severe penalties are imposed on repeat offenders.[3] A preliminary observation in this literature is that some inadequacy in deterrence must exist to warrant conditioning sanctions on offense history. In our setup defaulting on the penalty is a further offense, although, it must be emphasized, not a repeat offense as such, in addition to the basic crime of evasion. Our justification of graduated penalties, while in similar economic spirit, is not because of the deterrence effect but rather due to more direct reasons of cost-saving in the pursuit of defaulters.

Since tracking costs are ultimately fine collection costs, our graduated fines recommendation appears in contrast with a result by Polinsky and Shavell (1992), namely, that optimal fines are larger in the presence of fine collection costs: introducing fine collection costs increases the social harm of the offense and calls for stronger deterrence, hence, an increase in the magnitude of fines. This logic holds in a static setup and depends crucially on the assumption that all detected offenders pay the fines. In our setup, citizens have the option to evade their dues and postpone fine payments. We also highlight an important law enforcement hurdle – non-observability of citizens' incomes or wealth – the aspect recently addressed by Polinsky (2006), who shows that wealth non-observability may lead the authorities to choose a fine–imprisonment combination that induces high-wealth offenders to pay a large fine and low-wealth offenders to face the risk of imprisonment.[4] In contrast to Polinsky's setup, in our model offenders of *all* income levels would always prefer fines over imprisonment except that some may not have any choice but to accept the latter due to poor income realizations.

Finally, our paper falls in the same category as Polinsky and Shavell (1992), who addressed the question of the relationships between two types of enforcement costs – fixed and variable – and the optimal magnitude of fines and monitoring efforts determining the probability of detection. Their paper is in a static setting and thus not suitable to ask the question of optimum time structure of fines/penalty. To focus on the time profile of fines, we carry out our analysis for any arbitrary but fixed monitoring intensity. It will become apparent from our analysis that the intuition favoring a graduated penalty scheme would hold for any such monitoring intensity that might be optimal.

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Wilde (1992) and Mookherjee and Png (1994). A similar tradeoff, though of a different nature, is also present in our model.

[3]See Polinsky and Rubinfeld (1991), Emons (2003; 2004; 2007), Miceli and Bucci (2007), etc.

[4]See also Kim (2007).

The next section develops the model. The formal analysis is contained in sections 3 and 4, and section 5 concludes. Most of the proofs are contained in an Appendix.

## 2 The Model

We consider an economy with a continuum of citizens and the state's law enforcement department. A measure $\alpha$ of these citizens are culpable and each owes, at the outset, some fixed dues $x$ to the state; $x$ could be some local council tax, tv license fees, motor vehicle tax, pollution permit fees etc. Citizens (alternatively, firms depending on the context) may also differ in their inherent characteristics, unknown to the law enforcement authority. Some are *honest* and pay their dues if income situations permit, without any fear or inducement. Others are opportunistic and evade their dues if evasion pays. Honest citizens make it doubly imperative to allow for some delay in payments of dues or fines before imposing severe sanctions. Since the behavior of honest citizens is transparent, we shall focus exclusively on culpable and opportunistic citizens.

There are two periods. The discount factor is common to all citizens and the state and will be assumed to equal one, which is equivalent to a zero real interest rate. The last characteristic of a citizen is his *income potential* $k$, which is determined at the outset. In each period $t$, the income $y_t$ of a citizen is drawn independently from the uniform distribution over $[0, k]$, where $k$, in turn, is drawn from a common distribution $F([1, \kappa])$.[5] Thus, citizens face income uncertainty in each period within the bounds $[0, k]$ determined at the outset, and this uncertainty is resolved at the beginning of each period. The type of a citizen, culpable or not, honest or opportunistic, the income potential $k$ and income realizations $y_1$ and $y_2$, are all private knowledge.

The law enforcement department relies on two activities, monitoring and enforcement, to ensure that citizens pay the fixed dues $x$, as well as the fines that will be administered as a function of the period in which full payment is made. The monitoring activity detects in period one any culpable citizen who evades his dues

[5]The income, $y_t$, can be thought of as the income in excess of the absolute minimum income necessary for survival. If $y_t > 0$, it adds to one's utility over and above the bare minimum. It is this extra utility summed over a two-period horizon that a citizen tries to maximize.

with probability $0 < \mu < 1$. Our focus is on the aspect of how the government enforces the fines *after* an evader has been caught.

Enforcement, we assume, is one of perfect tracking – detected evaders can never escape from the system unpunished if the dues and the fines are not fully settled.[6] A detected citizen has two options: to settle $x + f$ ($f$ is a fine) immediately and to postpone payment until period two. The amount due in period two becomes $x + e$. By the end of period two an evader must pay the dues or face a severe sanction that we term *imprisonment.*[7] The fines $(f, e)$ have a common statutory upper bound $\overline{f}$. Any nonpayment requires chasing up by enforcement authorities through letters, reminders, court orders etc., which are costly. Imprisonment is a last resort to ensure that the citizens comply with the authority and its imposition is uniform over anyone failing to pay the *full* amount due (original plus accumulated fines).

All citizens consume their entire disposable income in period one, and start in period two afresh relying on period two income draw. I SUGGEST ELIMINATE THIS:To simplify the analysis, ***we rule out private saving and borrowing.***[8] Citizens are risk averse and have a common and constant per-period (net) income utility function $u(y)$ with $u'(.) > 0$, $u''(.) < 0$.

Our main question concerns the time profile of the fines – should the fines in both periods be maximal, or should one or both be non-maximal? Also, should the

[6] Our main result holds even stronger under imperfect tracking.

[7] The authority can try to send defaulters to prison selectively by auditing and proving that a defaulter has acted opportunistically (rather than defaulted due to pure bad income draw). If auditing were costless and perfect, opportunistic defaults could be eliminated. But as long as it is imperfect, there is scope for opportunistic defaults and room for the fine schedule to play a role in affecting settlement incentives. As a working assumption, we rule out the possibility of auditing. Note also that a lower penalty in the first period would lessen the need for auditing as fewer citizens are expected to default opportunistically. On auditing and its implications for fines vs. imprisonment as means to control wrongdoing, see Levitt (1997).

[8] It is not unreasonable to assume that if a citizen lacks the income to pay the fines, then this person has no choice but to default. Borrowing is a costly option and moreover it is not unrealistic to assume that the capital market is imperfect so that citizens cannot borrow against their future income potentials. In a dynamic tax-evasion model, Andreoni (1992) allowed similar imperfections where tax-payers could not borrow against their future bequest incomes that were private information. In our context, it would be very costly for the government office to deal with citizens on a one-to-one basis to arrange a payment schedule according to income realization, even if one were to ignore the difficulty of verifying incomes. Our assumption that the citizens always consume all their current disposable incomes and thus do not save is to keep the analysis free of the complexity of consumption-saving decisions and focus mainly on the penalty default decisions.

government adopt a *graduated penalty* structure: $f < e \leq \overline{f}$?

The sequence of events is as follows.

- *The outset*: The state determines $f$ and $e$. Citizens privately learn their income potential $k$.

- *Period one*: Citizens privately observe their first-period income $y_1$. Culpable citizens who chose not to pay $x$, if detected, decide whether to settle $x + f$ or postpone. Evaders who settle receive utility $u(y_1 - x - f)$, and those who postpone receive $u(y_1)$.

- *Period two*: Citizens privately observe their second-period income $y_2$. Detected evaders who postponed settlement decide whether to settle the dues for the final time or go to jail. Anyone not having enough second period income must go to jail. The second period utility from settling $x + e$ is $u(y_2 - (x + e))$, whereas the corresponding utility of a defaulting citizen is $u(y_2) + u_{jail}$. The evader who settled in period one receives in period two utility $u(y_2)$.

Note that a citizen enjoys the full benefits of his second period income even if he continues to default and thus ultimately ends up in prison.[9] However, we assume that citizens would always avoid jail whenever possible:

$$-u_{jail} > u(x + e) - u(0). \tag{1}$$

While the stated condition is specifically for a citizen with $y_2 = x+e$, strict concavity of preferences guarantees that all citizens with $y_2 \geq x+e$ would avoid jail by paying up the dues and the accumulated fines in period two. We normalize $u(0) = 0$, which implies $u_{jail} < 0$.

# 3 Default decision

Given the fines and the enforcement policy, we determine in this section the optimal behavior of a detected evader – whether to settle or postpone – as a function of his income potential $k$ and period-one realization $y_1$.

[9]The enjoyment of period two income accrues in the form of expenses spent before going to prison, or possibly as a result of income transfers to family members, friends or relatives.

Since borrowing is ruled out, if $y_1 < x+f$, the citizen has no choice but to postpone payment. For citizens with period one income $y_1 \geq x+f$, the settlement/postponement decision is based on the following utility comparison:

$$\max\{u(y_1 - x - f) + \frac{1}{k}\int_0^k u(z)\,dz,$$
$$u(y_1) + [\frac{(x+e)}{k}u_{jail} + \frac{1}{k}\int_0^{(x+e)} u(z)\,dz + \frac{1}{k}\int_{(x+e)}^{k} u(z-(x+e))\,dz]\}. \quad (2)$$

The first term is the utility from paying $x+f$ before the end of period one, while the second term is the utility if payment is postponed until period two. The following definition will be useful.

**Definition 1** **(i)** *For any fixed $k$, $y_1(k)$ is the period one income level equalizing the two expressions in (2). $y_1(k)$ is unique when it exists.*

**(ii)** *For any fixed $y$, $k(y_1)$ is the income potential equalizing the two expressions in (2). $k(y_1)$ is unique when it exists.*

That is, a detected evader with income potential $k$ is indifferent between settling the fine and the dues in period one and postponing until period two if his period-one income is $y_1(k)$. Similarly, a detected evader with period-one income $y_1$ is indifferent between settling and postponing if his income potential is $k(y_1)$. The following proposition describes the behavior of detected evaders as a function of their first-period incomes and income potentials:

**Proposition 1** **(i)** *Fix $k$. A detected evader prefers settling his dues and the fine in period one if $y_1 > y_1(k)$, and would postpone if $y_1 < y_1(k)$; if $y_1 = y_1(k)$ the evader is indifferent between the two options.*

**(ii)** *Fix $y_1$. A detected evader with period one income $y_1$ prefers settling his dues and the fine in period one if $k < k(y_1)$, and would postpone if $k > k(y_1)$; if $k = k(y_1)$ the evader is indifferent between the two options.*

[Insert Figure 1 here]

Note the implications of the two parts of Proposition 1. Since there is no link between realized income in period one and the given income potential in period two, a detected evader with the same $k$ but smaller $y_1$ may prefer not to settle in period one because of the relatively high marginal utility associated with low incomes. On the other hand, given a first-period income, a larger income potential for period two may induce the evader to gamble on nonpayment and take the risk of a jail term (the likelihood of which must remain small). Thus, in terms of first-period incomes, relatively *poor citizens* gamble and *better-off* ones settle, which is intuitive. In terms of period two income potentials, citizens with relatively *sound* potential would gamble. We like to make two remarks about this last observation. *First,* it's not that somebody who can settle today doesn't settle simply because he expects to be rich/wealthy tomorrow![10] Rather a more apt description would be that, even if one's current income allows one to barely settle the fines today, the income is not that high so that the citizen might be hard-pressed to consume immediately with the realistic expectation that tomorrow's income would enable him to be solvent.[11] Thinking carefully, such expectations (or behavioral pattern) are not unusual by any means and may even be the defining characteristics of defaulters who go for instant gratification (i.e., place a premium on today's consumption) in the hope of an improved future. *Second,* as shown in part (i) of Proposition 1, anyone with sufficiently high first-period income would always settle, irrespective of his second-period income potential; thus, part (ii) of Proposition 1 should not be viewed as an unconditional statement – after all, the critical $k$ depends on $y_1$ and, as will be shown in Proposition 2, $k(y_1)$ will be an increasing function of $y_1$.

The prospect of a jail term can induce settlement in period one even if the fines are not of the *graduated* type, in particular for a detected evader with a high period-one income but a low income potential $k$. Such a person would prefer to pay up in period one even if $f \geq e$ because the marginal utility in period one is low and, moreover, a low income potential means a high probability of default if payment is postponed, hence a high risk of ending up in jail. This further indicates

[10]If true, this would have resulted in a counter-factual prediction – if an empirical distribution of the second-period income were to be estimated then one would see that the defaulters are systematically richer than non-defaulters, which is clearly unrealistic.

[11]This has a similar flavor to an interesting observation made by Andreoni (1992), who argues that if an agent expects to receive a generous bequest in the future but cannot borrow against the bequest (because it cannot be used as collateral, just like our future income potential cannot be used as collateral), then such an agent will cheat in the current period by evading taxes and thereby transfer consumption from the future period to the current period even if this means detection and punishment. In our context default on penalty is an act of "borrowing" against one's expected future income, as in Andreoni's setup.

that, in principle it is possible to even allow the second period fine, $e$, to be lower than the first period fine, $f$, and still have some citizens pay up in period one. Our observations on the efficacy of graduated penalties, implied from a Corollary to Proposition 2 and subsequently Proposition 4, should be viewed in this context.

The behavior of $y_1(k)$ and $k(y_1)$, especially with respect to the fines, will be important for our analysis. We first identify a range of income potentials where the choice between settlement and postponement is meaningful. Detected evaders with little income and no prospect of a decent income have no choice but to postpone payment of $x + f$. So we define a critical income potential:

**Definition 2** *Let* $\overline{k} = \inf\{k|y_1(k) < k\}$.

We have $y_1(k) < k$ if and only if $k > \overline{k}$. Thus, for any $k < \overline{k}$ a detected evader always postpones paying the fine and the dues until period two (or is at best indifferent between settling and not settling). Only those with $k > \overline{k}$ might settle $x+f$ if their period one income realization is sufficiently high, in the range $(y_1(k), k]$. Such a $\overline{k} < \kappa$ must exist so that not all evaders always default, if $\kappa$ is large enough, which we assume. A large $\kappa$ also guarantees that $k(y_1) < \kappa$.

**Proposition 2** **(i)** $y_1(k)$ *is increasing in* $k$, $f$, *but decreasing in* $e$, *for any* $y_1(k) < k$.

**(ii)** $k(y_1)$ *is increasing in* $y_1$ *for any* $k(y_1) < \kappa$.

Thus, an increase in the first-period fine, $f$, leads to an increase in $y_1(k)$, hence, in more citizens postponing payment for any given income realizations in period one. The opposite holds for the second-period fine, $e$: an increase in $e$ leads to a decrease in $y_1(k)$, hence in fewer citizens postponing payment for any given income realizations in period one. The following corollary obtains:

**Corollary.** *Starting from an initial configuration of* $f < \overline{f}$, *raising the first-period fine towards the statutory maximum,* $\overline{f}$, *would make fewer citizens pay up in period one. On the other hand, starting from an initial configuration of* $e < \overline{f}$, *raising the second-period fine towards* $\overline{f}$ *would make more citizens pay up in period one.*

This corollary accords very well with the *graduated penalty scheme* recommendation, to *raise the penalty for evaders who fail to settle promptly.* Given that chasing defaulters costs the authority significant resources and considering the additional cost of feeding persistent defaulters in prison, any government's objective must include keeping the defaulters to a minimal size.[12] Thus, any prudent government is likely to adopt a graduated penalty scheme.

However, as the first-period fine is lowered below $\overline{f}$ inducing more and more evaders opt to settle in period one, different types of costs are borne. Besides reducing the government's fine collections, the lower fine would encourage additional citizens, who previously might not have evaded, to evade now. So the ultimate decision to lower $f$ cannot be viewed purely from the point of minimizing the size of defaulters for any *given* proportion of citizens who evade. The choice of $f$ (along with $e$ and the monitoring intensity parameter, $\mu$) would *endogenously determine* the size of defaulters. Ultimately, the government must pay attention to the prevention of the basic crime, evasion. Successful law enforcement policy must seek a balance between prevention of evasion and keeping defaulters to a manageable proportion. Below we analyze formally the evasion decision, show the need for this compromise objective and identify the characteristics of citizens who may, following a reduction in the first-period fine, switch from paying dues $x$ to evasion.

# 4 Evasion decision

The decision of whether to evade dues $x$ or not will be solved backwards. Define $X$ to be the expected second-period payoff to a detected evader who postpones the payment $x + f$:

$$X = \begin{cases} \frac{(x+e)}{k} u_{jail} + \frac{1}{k}\int_0^{(x+e)} u(z)\,dz & \\ \qquad\qquad + \frac{1}{k}\int_{(x+e)}^{k} u(z-(x+e))\,dz, & \text{if } k \geq (x+e) \\ u_{jail} + \frac{1}{k}\int_0^k u(z)\,dz, & \text{if } k < (x+e). \end{cases}$$

Turning back to the evasion decision, the expected payoff from evasion to any citizen who plans to postpone if detected is

$$U_{Evade}(y_1, k|postpone) \;=\; u(y_1) + \mu X + (1-\mu)\frac{1}{k}\int_0^k u(z)dz$$

[12]We do not explicitly write the default tracking costs, or for that matter a social welfare function. The social welfare function should ideally attach positive weights to both the objectives of deterrence of the basic crime and control of the post-evasion (and post-detection) settlement delay. After all, any government would always operate under a limited budget to be spent on monitoring (to deter crime) and enforcement (to deter settlement delay).

$$= \quad u(y_1) + \mu[X - \frac{1}{k}\int_0^k u(z)dz] + \frac{1}{k}\int_0^k u(z)dz. \quad (3)$$

To determine whether and under what conditions evasion actually pays, first let us classify using Definition 1 the (culpable and opportunistic) citizens into four first-period income categories, $y_1 < x$, $y_1 \in [x, x+f)$, $y_1 \in [x+f, y_1(k))$ and $y_1 \in [y_1(k), k]$. Citizens in the first category of incomes have no choice but to evade. For the remaining categories of citizens, paying up the amount $x$ due (rather than evade) yields the expected payoff

$$U_{Pay}(y_1, k) = u(y_1 - x) + \frac{1}{k}\int_0^k u(z)dz. \quad (4)$$

Further analysis is divided according to the above income classification.

For citizens with $y_1 < x$ and $y_1 \in [x, x+f)$, the evasion and settlement/postponement decisions are de facto determined by the first-period income level: the first category evade their dues, while the second category, if they choose to evade, must postpone settlement of fines.

- **Citizens with** $y_1(k) < k$ **and** $y_1 \in [x+f, y_1(k))$.

These are "unconstrained" citizens who, if they evade and are detected, prefer to postpone the payment $x+f$. Their expected payoff from evasion is given by (3). Comparing this payoff with (4) reveals that evasion of dues $x$ is optimal for these citizens if and only if

$$\mu \leq \frac{u(y_1) - u(y_1 - x)}{[\frac{1}{k}\int_0^k u(z)dz - X]}. \quad (5)$$

It is easy to check that the denominator of (5) is positive; note also that (5) guarantees that $U_{Evade}(y_1, k) \geq 0$. The evasion decision of this group can be summarized as follows:

**Proposition 3** *A citizen of income potential $k$ with $y_1(k) < k$ will evade his initial dues $x$ at period-one income $y_1 \in [x+f, y_1(k))$ if and only if (5) holds. Further, given $\mu$,*

**(i)** *A citizen who evades at $y_1 \in [x+f, y_1(k))$ continues to evade at $y_1' < y_1$;*

**(ii)** *A citizen who chooses not to evade at $y_1 \in [x+f, y_1(k))$ continues not to evade at $y_1' > y_1$ (so long as $y_1' < y_1(k)$ );*

**(iii)** *If a citizen of income potential $k$ evades at $y_1 \in [x+f, y_1(k))$, then any citizen with a higher income potential $k' > k$ also evades at $y_1$.*

To see why an evader will continue to opt for evasion if his first-period income realization is lower, first note that by Proposition 1 the detected evader prefers postponing his dues and the fine. Given this, turning to the evasion decision and comparing (3) and (4) reveals that paying the dues $x$ entails a larger sacrifice of first-period utility when $y_1$ is smaller, with no net change in the second-period utility due to smaller $y_1$. Hence, evasion continues to be optimal. By a similar argument as above, someone who prefers not to evade dues $x$ would still not evade if his period-one income realization were higher.

To see the last part, first note that an increase in $k$ increases $y_1(k)$ (by Proposition 2), thus any detected evader with income in the specified range would still prefer not to settle his dues and the fine in period one. For the evasion decision, the only difference in the impacts of an increase in $k$ on the two payoffs in (3) and (4) is due to the bracketed term, $[X - \frac{1}{k}\int_0^k u(z)dz]$, in (3). It is enough to show that $\frac{\partial X}{\partial k} - \frac{\partial[(1/k)\int_0^k u(z)dz]}{\partial k} \geq 0$, which we verify in the Appendix.[13]

One key message of Proposition 3 is as follows:

*Within a medium income range of first-period income ( $y_1 \in [x+f, y_1(k))$), relatively poor citizens are more likely to evade their initial dues. For the same income range, those who expect to receive relatively higher expected incomes tomorrow are also more likely to evade their dues.*

• **Citizens with $y_1(k) < k$ and $y_1 \in [y_1(k), k]$.**

These are also "unconstrained" citizens but, if they evade and are detected, prefer settling $x + f$ in period one. Given this plan of action, these citizens prefer to evade initially if and only if:

$$(1-\mu)u(y_1) + \mu u(y_1 - x - f) \geq u(y_1 - x). \tag{6}$$

[13]A definitive statement about the evasion choice with the same first-period income but lower income potential (i.e., $k' < k$) is impossible. Since the critical income level $y_1(k)$ is lower for citizens with a lower $k$, at the same $y_1$ these citizens may instead prefer settlement in period one (as against preference for postponement by citizens with higher $k$ values). This behavioral change could well mitigate incentives for evasion and increase the possibility that a citizen with a lower $k$ prefers not to evade.

This condition does not depend on $e$ (for small changes) because this group of citizens promptly settle on detection. They will opt for evasion (and settle $x + f$ if detected), provided detection is an unlikely event, that is, if $\mu$ is sufficiently small. We can define for any first-period income $y_1 \in [y_1(k), k]$, a critical level for $\mu$ such that a citizen is indifferent between evading and paying $x$:

$$\mu_C^{Pay}(y_1) = \frac{u(y_1) - u(y_1 - x)}{u(y_1) - u(y_1 - x - f)}. \tag{7}$$

Thus, a citizen with first-period income $y_1$, who on detection of evasion would settle in period one, will evade if $\mu < \mu_C^{Pay}(y_1)$; for $\mu > \mu_C^{Pay}(y_1)$, the same citizen will *not* evade.[14]

We now like to return to verify our observation at the end of section 3. In particular we want to check that when the first-period fine $f$ is lowered, (i) there will be some citizens who shift from the plan of *not evading (and 'postponing if evade')* to *evading (and 'settling if evade')*, and (ii) there will be other citizens who shift from the plan of *not evading (and 'settling if evade')* to *evading (and 'settling if evade')*.

Let us denote the critical income $y_1(k)$ by $y_1(k, f)$ for a clear exposition. As shown in Figure 2, a fall in the first-period fine from $f$ to $\hat{f}$ will shift the income range $[x + f, y_1(k, f))$ to the left and therefore enlarge the range $[y_1(k, f), k]$, given any $k > \overline{k}$. To see why the strategy change in (i) would happen, consider a citizen with first-period income $y_1$ slightly lower than $y_1(k, f)$, hence, with a plan to 'postpone if evade,' and assume that (6) holds so that the citizen evades. When the fine is sufficiently reduced to $\hat{f}$ so that his first-period income $y_1$ is larger than $y_1(k, \hat{f})$, he will optimally switch to 'settle if evade'. However, now the citizen's evasion decision at the outset is governed by (7), not by (6). If $\mu < \mu_C^{Pay}(y_1)$ at the fine $\hat{f}$, the citizen will switch to *evading (and 'settling if evade')*. Thus, the

[14] We state the evasion decision in terms of the critical monitoring intensity parameter, $\mu_C^{Pay}$, rather than the first-period income because how changes in $y_1$ affect the evasion behavior would depend in non-intuitive ways on how the critical-$\mu$ changes with respect to $y_1$. More specifically, it is easy to check that $\mu_C^{Pay}$ is increasing if and only if

$$\frac{u'(y_1) - u'(y_1 - x)}{u'(y_1) - u'(y_1 - x - f)} > \frac{u(y_1) - u(y_1 - x)}{u(y_1) - u(y_1 - x - f)},$$

which has no obvious economic intuition, for or against.

strategy change in (i) will happen if the following condition holds for $0 < \hat{f} < f$:

$$\begin{aligned} \text{There exists some} \quad & y_1 \in [x+f, y_1(k,f)) \cap [x+\hat{f}, y_1(k,\hat{f})), \\ \text{such that} \quad & \frac{u(y_1)-u(y_1-x)}{[\frac{1}{k}\int_0^k u(z)dz - X]} < \mu < \frac{u(y_1)-u(y_1-x)}{u(y_1)-u(y_1-x-\hat{f})}. \end{aligned} \tag{8}$$

By choosing $\hat{f}$ sufficiently small, $\frac{u(y_1)-u(y_1-x)}{u(y_1)-u(y_1-x-\hat{f})}$ can be made to approach 1 so that there will be some range of $\mu$ satisfying (8).

[Insert Figure 2 here]

The strategy change in (ii) refers us to citizens with first-period incomes in the range $[y_1(k,f), k]$, whose plan if they evade is to settle. Though the reduction in $f$ will not affect this plan, it could well switch the initial decision from 'not evade' to 'evade'. This will happen if the following condition holds for $0 < \hat{f} < f$:

$$\begin{aligned} \text{There exists some} \quad & y_1 \in [y_1(k,f), k], \\ \text{such that} \quad & \frac{u(y_1)-u(y_1-x)}{u(y_1)-u(y_1-x-f)} < \mu < \frac{u(y_1)-u(y_1-x)}{u(y_1)-u(y_1-x-\hat{f})}. \end{aligned} \tag{9}$$

Since $\hat{f} < f$, clearly there is a whole range of $\mu$ satisfying (9). The income ranges to which conditions (8) and (9) apply are visualized in Figure 2.

These two cases of strategy change from non-evasion to evasion are exhaustive. A change in the opposite direction following a reduction in $f$ with $e$ maintained at its maximal level is impossible; following a reduction in $f$, whether an evader becomes or remains "unconstrained" in his choice to evade, he will remain an evader. We have established the following result:

**Proposition 4** *Given a monitoring intensity $\mu$, suppose the fines in both periods are maximal, $f = e = \overline{f}$. If the first-period fine $f$ is lowered while maintaining the second-period fine $e$ at $\overline{f}$, overall there will be more evasion. That is, there is a basic conflict between controlling evasion and ensuring prompt payment of the fines, and a graduated penalty scheme helps the second objective but erodes the first.*

The "flatter" the fine schedule, given $e$ set at its maximal level, the larger the fraction of evaders who choose to default, but smaller is the fraction of the population initially evading the dues $x$. Thus, *a graduated penalty scheme can* *emerge as an optimal balance between minimizing deterrence costs and defaulter tracking costs.*

Until now we had assumed implicitly that the second-period fine, $e$, should be set at the maximal level. This we formally verify next. Starting from any initial level of $e < \overline{f}$, if $e$ is raised, the following two observations can be made:

(1) $y_1(k)$ decreases so that any citizen who had earlier, in the post-detection stage, opted to postpone settlement may now switch to settlement in period one, and anyone who had previously opted settlement would continue to favor settlement (see the Corollary to Proposition 2);

(2) a citizen's expected payoff from evasion and postponement, given in (3), would decrease (because $\frac{\partial X}{\partial e} < 0$), while his expected payoff from non-evasion, (4), remains unchanged.

Thus, if at the initial level of $e$ a citizen had evaded and postponed then by raising $e$ towards $\overline{f}$ the evasion option, even if the citizen might still postpone in the post-detection phase, becomes less attractive (because of point (2) above). This may induce the citizen to switch from evasion to non-evasion. On the other hand, if at the initial level of $e$ a citizen had evaded and settled then an increase in $e$ cannot overturn the decision of settlement in the post-detection stage, because postponement would yield a worse outcome (see point (1) above). This citizen would continue to evade. Finally, if a citizen had originally chosen not to evade, raising $e$ cannot make evasion anymore attractive (in fact, it becomes strictly less attractive because of the worsening of the postponement option in the post-detection stage) and thus would never switch to evasion. We obtain the following result:

**Proposition 5** *The fine in the second period should be maximal: $e = \overline{f}$. Such a policy achieves both maximum deterrence and settlement delay minimization, for any given monitoring intensity $\mu$ and first-period fine $f$.*

# 5 Concluding remarks

In this paper we identify a tradeoff in the dynamics of the fines when detected offenders have an option to pay soon or postpone. An ascending fine profile with initially nonmaximal fines saves defaulter tracking costs but dilutes deterrence. Most importantly, we identify the income group most likely to switch from postponing to settlement if they evade, and another income group, to switch from non-evasion to evasion, following a reduction in initial fines. We argued that the larger the sizes of these income groups, the stronger the impact of an ascending fine profile on the citizens' behavior.

We made several simplifying assumptions in order to convey the main results as clearly as possible. One of the assumptions is that all detected evaders are tracked down. Under imperfect tracking a fraction of evaders can get away without paying the fine, as a result fewer evaders will settle in period one. Then the case for graduated fines becomes even stronger because tracking costs will increase, hence, adopting a steeper fine schedule is likely to be more cost-effective despite the negative impact on deterrence. We also ruled out private saving to smooth out consumption across the two periods. Allowing citizens to save will increase their control over their future ability to pay (or act as a partial insurance against default and imprisonment) and generate an increase in strategic default decisions. This, in turn, strengthens the case for graduated fines.

Graduated fines are justified in this paper based on a simple economic rationale. Two periods is the minimal duration within which the issue could be addressed. Moreover, on grounds of fairness it is appropriate that citizens do get more than one chance to settle their dues and the fines. While imprisonment may seem draconian for petty crimes and more so if it is imposed on someone who is not necessarily dishonest, it is used only as a last measure so that persistent defaulters who may have the ability to pay cannot hide because of income non-verifiability.

## Appendix

*Proof of Proposition 1.* (i) The result follows from (2), using $u''(.) < 0$.

(ii) Write the difference between the payoffs from postponing until period two and payoffs from paying up in period one as:

$$\begin{aligned} D(k, y_1) &= u(y_1) - u(y_1 - x - f) - \frac{1}{k}\int_0^k u(z)\,dz \\ &+ [\frac{(x+e)}{k}u_{jail} + \frac{1}{k}\int_0^{(x+e)} u(z)\,dz + \frac{1}{k}\int_{(x+e)}^k u(z-(x+e))\,dz] > 0. \end{aligned}$$

Differentiate $D$ partially w.r.t. $k$ to obtain:

$$\frac{\partial D}{\partial k} = \frac{1}{k^2}\int_0^k u(z)\,dz - \frac{1}{k}u(k) + [-\frac{(x+e)}{k^2}u_{jail} - \frac{1}{k^2}\int_0^{(x+e)} u(z)\,dz$$

$$
\begin{aligned}
& -\frac{1}{k^2}\int_{(x+e)}^{k} u(z-(x+e))\,dz + \frac{1}{k}u(k-(x+e))] \\
= \quad & \frac{1}{k^2}[\int_{(x+e)}^{k} u(z)\,dz - k\{u(k)-u(k-(x+e))\} \\
& -(x+e)u_{jail} - \int_{(x+e)}^{k} u(z-(x+e))\,dz] \\
= \quad & \frac{1}{k^2}[\int_{(x+e)}^{k} \{u(z)-u(z-(x+e))\}\,dz - k\{u(k)-u(k-(x+e))\} - (x+e)u_{jail}] \\
\underbrace{>}_{\text{by } u''(.)<0} \quad & \frac{1}{k^2}[\{k-(x+e)\}\{u(k)-u(k-(x+e))\} \\
& -k\{u(k)-u(k-(x+e))\} - (x+e)u_{jail}] \\
= \quad & \frac{1}{k^2}[-(x+e)\{u(k)-u(k-(x+e))+u_{jail}\}] \\
\underbrace{>}_{\text{by } (1)} \quad & \frac{1}{k^2}[-(x+e)\{[u(k)-u(k-(x+e))]-[u(x+e)-u(0)]\}] \\
\underbrace{>}_{\text{by } u''(.)<0} \quad & \frac{1}{k^2}[-(x+e)\{[u(k)-u(k-(x+e))]-[u(k)-u(k-(x+e))]\}] \\
= \quad & 0.
\end{aligned}
$$

Since $D = 0$ for $k = k(y_1)$, it follows that $D > 0$ for all $k > k(y_1)$ and $D < 0$ for all $k < k(y_1)$. **Q.E.D.**

*Proof of Proposition 2.* (i) The result on the impact of $k$ follows from Proposition 1(ii). An increase in $k$ from $k_0$ to $k_1$ at income $y_1 = y_1(k_0)$ makes the net payoff $D(k, y_1)$ from postponing payment to period two positive, so, a larger income $y_1 > y_1(k_0)$ is necessary to restore $D = 0$ (recall, $\frac{\partial D}{\partial y_1} = u_1'(y_1) - u_1'(y_1 - x - f) < 0$). The impacts of $f$ and $e$ on $y_1(k)$ can be verified in a similar way.

(ii) Since $\frac{\partial D}{\partial y_1} < 0$, an increase in $y_1$ from $y_{10}$ to some $\hat{y}_1$ with $k$ fixed at $k(y_{10})$ makes the net payoff $D(k, y_1)$ become negative. Thus, a larger $k$ is necessary and sufficient to restore $D = 0$ (because $\frac{\partial D}{\partial k} > 0$; see the argument in Proposition 1 proof). **Q.E.D.**

*Proof of Proposition 3.* In the text we already outlined an argument. Here we only verify that $\frac{\partial X}{\partial k} - \frac{\partial[(1/k)\int_0^k u(z)dz]}{\partial k} > 0$ for $k \geq (x+e)$. (For $k < (x+e)$, $\frac{\partial X}{\partial k} - \frac{\partial[(1/k)\int_0^k u(z)dz]}{\partial k} = 0$.)

$$
\begin{aligned}
&\frac{\partial X}{\partial k} - \frac{\partial[(1/k)\int_0^k u(z)dz]}{\partial k} \\
&= -\frac{(x+e)}{k^2}u_{jail} - \frac{1}{k^2}\int_0^{(x+e)} u(z)\ dz - \frac{1}{k^2}\int_{(x+e)}^{k} u(z-(x+e))\ dz \\
&\quad +\frac{1}{k}u(k-(x+e)) + \frac{1}{k^2}\int_0^k u(z)\ dz - \frac{1}{k}u(k) \\
&= \frac{1}{k}\{\frac{(x+e)}{k}[-u_{jail}] + \frac{1}{k}\int_{(x+e)}^{k}[u(z)-u(z-(x+e))]\ dz - [u(k)-u(k-(x+e))]\} \\
&\underbrace{>}_{\text{by (1)}} \frac{1}{k}\{\frac{(x+e)}{k}[u((x+e))-u(0)] \\
&\qquad +\frac{1}{k}\int_{(x+e)}^{k}[u(z)-u(z-(x+e))]\ dz - [u(k)-u(k-(x+e))]\} \\
&\underbrace{>}_{\text{by } u''(.)<0} \ \frac{1}{k}\{\frac{(x+e)}{k}[u(k)-u(k-(x+e))] \\
&\qquad +\frac{k-(x+e)}{k}[u(k)-u(k-(x+e))] - [u(k)-u(k-(x+e))]\} \\
&\quad = \ 0.
\end{aligned}
$$

**Q.E.D.**

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