Marginal Deterrence and Escalating Penalties: Vicious Circles and Policy Options

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Abstract

The L&E literature on public law enforcement has generally treated separately the issue of marginal deterrence from that of punishing recidivism by escalating penalties. The main idea sketched by this is that of analyzing the joint effects generated by a policy maker who aims at pursuing both vertical and horizontal deterrence. We first show the emergence of a trade-off between the two policy aims. Then, we argue show that, in order to solve the trade-off and obtain both vertical and horizontal deterrence it is necessary to introduce, besides monetary sanctions, non-monetary sanctions (temporarily 'incapacitation'). We finally suggest that our conclusion may provide an economic rationale for demerit point systems – typically applied to traffic law enforcement – which constitutes a powerful instrument to solve the above trade-offs.

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1. Introduction

The L&E literature on law enforcement has outlined two open issues: the risk of general under-deterrence when marginal deterrence (here defined as 'vertical deterrence') is pursued; and the risk of over-deterrence, when recidivism (here defined as 'horizontal deterrence') is sanctioned by escalating penalties.

While the existing literature (Garoupa, 1997; Polinsky and Shavell, 2000), has generally treated separately the above two issues, this paper – here presented in its draft and very preliminary form - focuses on the joint effects generated by a policy maker (PM, henceforth) who aims at pursuing both vertical and horizontal deterrence.

This assumption, far to be unrealistic (law enforcement systems generally are explicitly built to jointly pursue the two policy aims), shows that a trade-off between vertical and horizontal deterrence may credibly occur when a unique policy instrument based on monetary sanction is applied: increased sanctions for repeated offenders may decrease marginal deterrence at any time and vice-versa.

In order to solve the trade-off between vertical and horizontal deterrence and obtain a pre-defined level of both policy aims, we outline that it is necessary to introduce, besides monetary sanctions, non-monetary sanctions (as temporarily 'incapacitation').

This conclusion, from one side, suggests new explanations for the adoption of nonmonetary sanctions as ancillary device to monetary sanctions (Garoupa, 1997; Shavell, 2003; Galbiati and D'Antoni, 2005); from the other, it provides an economic rationale for hybrid enforcement systems based on monetary and non-monetary sanctions, as the 'demerit point system' in traffic law enforcement (Basili and Nicita, 2005).

The paper proceeds as follows. First, we briefly recall the trade-off between general and marginal deterrence (in section 2) and the trade-off between over-deterrence and optimal penalties when recidivism is backed by escalating penalties (in section 3). Then, in section 4 we outline, through a simple example, the emergence of a pervasive trade-off between marginal deterrence ('vertical deterrence') and escalating penalties against recidivism ('horizontal deterrence'). In section 5, we formulate a simple outlines the trade-off between vertical and horizontal deterrence. In section 6 we show how a hybrid system of monetary and non-monetary sanction may solve the above trade-off shifting agents action towards the pre-defined social preferred configuration. In section 7, we

apply this result to the case of demerit point system introduced, as a traffic law enforcement measure, in several countries. Section 8 drowns the main conclusions.

2. The trade-off between General and Marginal Deterrence

Let us assume, from the perspective of a rational agent, that he would obtain a gain from committing a harmful act. Let us also assume that he will be caught with a probability p and that in this event he will be sanctioned. The general Beckerian consequence is that the individual "will commit the act if and only if his expected utility from doing so, taking into account his gain and the chance of being caught and sanctioned, exceeds his utility if he does not commit the act" (Polinsky and Shavell, 2000). If the expected utility of violating legal rules raises with the social harm generated, it might be optimal for the society to introduce a scheme of sanctions increasing with the social harm associated to the single violation unless in all those case in which it is not possible to increase the probability of detection according to the level of harm produced. This principle is known as general deterrence or general enforcement. However, the proportionality between sanctions and social harm acts as a sort of 'signal' towards offenders on the distribution of social preferences about harmful actions. This is exactly the principle of *marginal deterrence*.¹ The notion of 'marginal deterrence' is derived from the generally defined principle, expressed by Beccaria (1767, p. 32), on the proportionality between criminal sanctions and harmful actions. Polinsky and Shavell (2000) described the economic rationale behind this principle in the following way: "in many circumstances, an individual may consider which of several harmful acts to commit, for example, whether to release only a small amount of a pollutant into a river or a large amount, or whether only to kidnap a person or also to kill him. In such contexts, the threat of sanctions plays a role in addition to the usual one of deterring individuals from committing harmful acts: for individuals who are not deterred, expected sanctions influence which harmful acts individuals choose to commit. Notably, such individuals will have a reason to commit less harmful rather than more harmful acts if expected sanctions rise with harm".²

¹ Shavell (1992); Louis Wilde (1992); Mookherjee and Png (1994).

² Polinsky and Shavell (2000) also refer to Bentham (1789, p. 171).

Since there must be an upper bound on the effectiveness of sanctions that could be imposed on criminals³, the scheme of sanctions will start at the upper bound with the most severe sanction and then it will decrease accordingly to the level of social harm generated.

Let us define as *S* the fine designed as a sanction and as *D* the social harm associate to a given harmful action *A*. For any given probability of detection *p*, the optimal fine schedule, accordingly to a wide scholarly literature⁴, is given by:

$S^{*}(A) = D/p$

under the constrain that D/p does not exceed the maximal possible fine Dm. When the enforcement is general (i.e. when it is not possible to have a specific detection – and thus a specific probability of being caught – for any harmful act), "sanctions should rise with the severity of harm up to a maximum"⁵.

It is easy to see how a trade-off between marginal deterrence and general deterrence may occur in this case: some less harmful actions may actually be not sanctioned at all, and if they are optimally deterred then it means a risk of under-deterrence for more serious harmful actions. As Polinsky and Shavell (2000) pointed out "fostering marginal deterrence may conflict with achieve deterrence generally: for the schedule of sanctions to rise steeply enough to accomplish marginal deterrence, sanctions for less harmful acts may have to be so low that individuals are not deterred from committing some harmful act".

In order to illustrate that with an example, let us consider table 1. Let us assume for instance that agents' utility *U* raises with harmful actions *a1*, *a2*, *a3*, *a4*, *a5*, so that U(a1) < U(a2) < U(a3) < U(a4) < U(a5) while the social harm *D* imposed on society raises with harmful actions D(a1) < D(a2) < D(a3) < D(a4) < D(a5). Accordingly, let us assume that society decides to impose a scheme of monetary sanctions *S*, such S(a1) < S(a2) < S(a3) < S(a4) < S(a5). The highest monetary sanction is thus imposed on the most harmful action *a5*.

³ It could be an economic upper bound equal to the total amount of income available to the criminal or to a 'physical' constraint of non monetary sanctions, or again determined by fairness reasons.

⁴ Becker (1968); Polinsky and Shavell (1979, 1994, 2000); Garoupa (1997).

⁵ Polinsky and Shavell (2000).

Table 1: marginal deterrence design					
ACTIONS	SANCTIONS				
a5	100€				
a4	80€				
аЗ	60€				
a2	40€				
al	20€				
a0	0€				

The trade-off between marginal and general deterrence (Shavell, 2003) could be envisaged in the circumstance that an harmful action like a0 receives a sanction equal to zero. If we assume that the social harm generated by a0 is greater than zero than it means that the application of the principle of marginal deterrence implies underdeterrence for a0. On the other hand, if we try to correct the value of the sanctions for lower harmful actions, we may provide the wrong signal at the upper levels, treating as substantially 'substitutable' – from the point of view of society – two actions which produce two different levels of harm. Marginal deterrence "is naturally accomplished if the expected sanction equals harm for all levels of harm" (Polinsky and Shavell, 2000). Given the system of sanctions in table 1, the actual distribution of harmful actions will

depend on detection policy, on agents' utility and on income constraints.

Standard approach on marginal deterrence, and the correspondent design of optimal sanctions under that framework, are based on two assumptions:

- (i) the choice of harmful actions is limited to one period;
- (ii) offenders only choose one act at any time.

In section 4 we try to remove the above assumptions outlining possible interdependencies between marginal deterrence and repeated violations over time. Before doing that let us consider first, in the next section, the trade-off, envisaged in the law and economics literature, between optimal sanctions and escalating penalties against recidivism.

3. Optimal sanctions vs. escalating penalties against recidivism

Beside marginal deterrence, another principle which generally shapes the design of public law enforcement is that of punishing repeated offenders more severely than non-

repeat offenders. As Dana (2001) outlined "the general principle of escalating penalties based on offence history is so widely accepted that it strikes most people as simple common sense. The principle is embedded in formal federal, state, government officials at all level of government".

When expected sanction of repeating a given harmful act increases with the number of repeated offences the problem raised is that of punishing not only the harmful act but also a behavior, often denoted as recidivism. As Garoupa (1997), Dana (2001), and Shavell (2003) outlined, the L&E literature treated escalating penalties based on history offence as a puzzle. If a scheme of sanction is built in period 1 such that fines are based on the optimal deterrence principle, then any sanction will reflect the optimal balance between the net social costs and the net social benefit associated with a given harmful act. That means, in turn, that any increase in the level of sanction will induce overdeterrence, i.e. a social waste: "the illegal discharge of waste into the ocean causes as much social harm when the discharging company is a first-time offender as when it has a long history of such offences. Thus standard economic theory would seem to suggest that, contrary to actual practice, penalties should not escalate based on offence history" (Dana, 2001).

The intuition behind escalating penalties for repeated offenders is that repetition reveals the information regarding the 'type' of offender. The information revealed by recidivist behaviour somehow allows the implementation of specific rather than generic enforcement: those who are not deterred in the first instance will continue to violate in the future, thus repeated offences should be deterred by increasing fines (Polinsky and Shavell, 1998)⁶. For instance, in table 2, we show a possible design of sanctions, for action a4, increasing with the number of repeated offences.

Horizontal marginal deterrence design							
ACTIONS	SANCTIONS						
	1°	2°	3°				
a5	100€	120€	140€				
a4	80€	100€	120€				
a3	60€	80€	100€				
a2	40€	60€	80€				
al	20€	40€	60€				
a0	0€	20€	40€				

Table 2:	
Horizontal marginal deterrence design	

⁶ However, if fines are optimally designed with respect to social harm one should ask whether it would be efficient to raise the sanction for repeated offences.

However, as some scholars have outlined (Garoupa, 1997; Polinsky and Shavell, 2000), increasing fines for repeated offences could produce over-deterrence if the total amount of sanctions exceeds the social harm of action *a4*. If the sanction designed for the first offence *a4* is optimal in the first instance (i.e. it is maximal), then increasing the fines for repeated offences will always be sub-optimal. Thus, as Polinsky and Shavell (1998) outlined, for a sanction imposed to repeated offenders to be optimal, one should require that the sanction for the first offence is not maximal in the first instance. However, if this design of sanctions reveals to be optimal ex-post towards repeated offenders, it generates under-deterrence for non-repeat, i.e. it interferes with the principle of marginal deterrence according to which sanctions have been designed at any period for non-repeat offenders.

The debate over the economic rationale against recidivism and on adopting escalating penalties to reach that aim is very rich and open.⁷ Some authors contend that if there is any economic rationale for recidivism affecting the design of sanctions, it should be found in imposing decreasing rather than increasing penalties for repeated offenders, since the probability of being detected and caught depends on having been caught in the past. Some other scholars also reach similar conclusion by recurring to behavioural assumptions⁸. It is not our purpose here to understand the economic rationale about having escalating penalties, rather we intend to analyze what happens when a public law enforcement is aimed at both implementing marginal deterrence and punishing recidivism. To this end we need only to emphasize the 'immediate' trade-off between optimal deterrence and escalating penalties for repeated offences.

4. The vicious circle between vertical and horizontal deterrence

Let us turn back to table 2. Let us assume first that for a4, a sanction of $80 \in$ is not maximal so as to have under-deterrence if the harm is committed ones, but optimal deterrence if it is committed twice. What happens however in table 2, after agents have committed a4? They have two possible choice: to repeat a4 paying a fine of $100 \in$ or to jump to a5 paying a fine of $100 \in$. Since we have assumed that agents' utility increases

⁷ See also Polinsky and Rubinfeld (1991), Craswell (1999), and Sunstein (2000).

⁸ See Dana (2001) for a survey.

with harm⁹, then the rational choice of those agents will that of jumping from a4 to a5. As we can see from table 2 and from figure 1, this result may apply for every level of harm so that at any period it is as if the level of more harmful acts increases over time, showing a high interdependence between marginal deterrence (let us define it 'vertical deterrence') and escalating penalties (let us define it 'horizontal deterrence').

Figure 1

Thus we have here a first result: *horizontal* deterrence may reduce *vertical* deterrence at any period. A trade-off then occurs between punishing for repeated offences or obtaining marginal deterrence at any period. The choices of committing less harmful acts (i.e. the impact of vertical deterrence) will thus depend on the rate of increase in fines for repeated offences: a slower rate may reduce the horizontal deterrence effect, while a higher rate may decrease the vertical deterrence effect.

In the example above, in order to avoid such a trade-off we have two possibilities: (a) increasing the fine of a5 say up to $130 \in$; (b) decreasing the fine of a4, say from $80 \in$ to $60 \in$. However, in the first case, the increase in fines for a5 may imply over-deterrence if the initial fine was intended to be maximal; in the second case, the decrease of fines for a4, may eliminate any marginal deterrence between a4 and a3. Thus, increasing fines for more harmful offences may imply over-deterrence, while reducing fines for less harmful acts implies under-deterrence. For any given system of sanctions there seems to

⁹ The assumption here is that utility increases both with the harm and with the repetition of the same harm. If sanctions are not increasing with repetition, we assume that if agents select a given action in t=1 she will repeat the same choice in t>1. However we assume that if sanctions increase with repetition, than for any given amount of sanction at any time, a higher harm implies a higher utility.

be a trade-off between having optimal vertical marginal deterrence and optimal horizontal marginal deterrence.

It is possible to show that the same result applies to the case in which several actions are committed in the same period. When two actions are committed in the same period there might be the case for which agents are indifferent between choosing a1 and a2 in the first instance or a3. If a3 is associated to a higher utility with respect to a1 and a2, agents will jump to a3 generating a higher harm. Also in this case horizontal marginal deterrence may conflict with vertical marginal deterrence (in the second period rather than repeating a1 and a2 agents may decide to jump to a5).¹⁰

Of course the above result is simply based on the numbers we have inserted in table 2. It is possible to build a different table that does not present any overlap. However, the question raised here is that any system of sanction should provide optimal deterrence both from a vertical and from a horizontal perspective, whereas vertical deterrence binds horizontal deterrence and vice-versa.

Let us assume that the preferences ordering of the PM – reflecting those of society – is such that low harmful act repeated few times (depicted in figure 1 as the area A, where the trade-off between vertical and horizontal deterrence is actually solved or dramatically decreased) are preferred to configurations characterized by non-repeated very harmful acts and repeated low harmful acts (depicted in figure 1 as the area B), which in turn are preferred to situation characterized by repeated high harmful acts

(depicted in figure 1 as the area *C*): *ApBpC*.

If a PM aims at obtaining a desired level of general deterrence through a design of sanction aimed at implementing (i) marginal deterrence and (ii) escalating penalties for repeated offences, without coordinating the two policy tools, the final effect could be that of increasing under-deterrence at an time, towards the area C.

5. A simple model

In this section we provide a simple framework derived from Emons (2003) in order to illustrate trade-offs and vicious circles between vertical and horizontal deterrence when

¹⁰ It is also possible to imagine that recidivism could be sanctioned in scope. To this end a record of past violations, even if different in type, is sufficient to increase at any time the fine. However, also in this case the trade/off outlined above applies.

a policy maker aims at implementing marginal deterrence and at increasing penalties against recidivists.

As in Emons (2003) we consider a set of individuals who live for two periods t=1, t=2. In each period the agents can select an action (for simplicity an illegal activity x or y), receiving a benefit from this behavior. Let us assume that in each period t_i (with i=1, 2), the agent has three possible choices:

(i) status quo, i.e. the agents does not engage in any illegal activity

(ii) select $x_{i,}$ i=1, 2 (time period) receiving a benefit b>0 in each period and causing in each period a monetary harm h>0 to society, with h>b;

(iii) select $y_{i, i} = 1, 2$ (time period) receiving a benefit c > 0 in each period and causing in each period a monetary harm k > 0 to society, with k > c and with c > b.

Let us define the utility function of the agent in each period as $U_i=U(0, x_i, y_i)$, thus agent's total utility from the two periods is given by $U=[U(0, x_1, y_1)+ U(0, x_2, y_2)]$. However since h>b and k>c, both the illegal actions available to the agent in each period are not socially desirable and individuals are to be deterred from incurring in illegal activities at any period. In order to deter illegal actions the government chooses sanctions and probability of detections for each action in each period.

In particular the government may consider to impose sanctions increasing in social harm in any period and to punish recidivism. i.e. to increase penalties according to previous records¹¹ of past offences.

When an action is observed, the government cannot evaluate if an agent is in the first or second period of her life. The government only observes whether the crime is the first or the second one committed. Accordingly, the government uses fines s1, s2 respectively for x1 and x2, and z1 and z2 for y1 and y2, where s1 and z1 apply to first-time and s2 and z2 to second-time observed offences.

Moreover, the government chooses a probability of apprehension: *general enforcement* (the probability of apprehension p is the same for each action in each period) and *specific enforcement* (the probability is p for $x_{i, i} = 1, 2$ and q for $y_{i, i} = 1, 2$). We focus

¹¹ We are here assuming that recidivism is defined as the behavior of an agent having record of previous offences of the same type x or y. An agent which commits x at t=1 and then y at t=2 is not considered a recidivist. That is assuming that from the legal perspective x and y are not correlated.

here only on general enforcement. The following tables summarizes the framework proposed.

Actions	Private benefit	Social harm	Sanction if observed once	Sanction of observed twice
у	С	k	z1	z2
x	В	h	x1	x2

We further assume that individuals are risk neutral and maximize expected income. They have initial wealth¹² W>0. If the fine exceeds the agent's wealth, she goes bankrupt and the government seizes the remaining assets. As a consequence, monetary fines $s_{i,}$ i=1, 2 and $z_{i,}$ i=1, 2 have to satisfy (assuming the interest rate being zero) the following "budget constraint": $\sum_{i} [s_i + z_i] = W$ with i=1, 2.

In each period the agent maximizes its expected utility subject to the budget constraints which depends on the sanctions enforced by the government under a given probability of detection.

Under the general enforcement assumption the probability of detection p is independent of the specific action selected and of the specific time horizon considered.

The agent may choose one of the following strategies:

- i. She can choose not to commit the act at all. We call this strategy (0, 0) which gives rise to utility U(0, 0) = W.
- ii. She can choose to commit the act in period 1 and not in period 2 (and vice-versa). Call this strategy (1, 0) or (0,1); here we have U = W+b-ps1 or U = W
 +c-pz1 so the choice of the agent depends on U= Max [W+b-ps1; W+c-pz1]
- iii. Moreover, the agent can commit the act in both periods¹³ which we denote by (1, 1) and U(1, 1) = Max[W + b - ps1; W + c - pz1] + Max[b - p((1 - p)s1 + ps2); c - p((1 - p)s1 + pz1); c - p((1 - p)z1 + pz2)].

¹² Following Emons (2003), we assume that "*W* is the value of the privately owned house or assets with a long maturity. The agents hold on to their wealth over both periods unless government interferes with sanctions. Any additional income they receive in both periods, be it through legal or illegal activities, is consumed immediately. Accordingly, all the government can confiscate is W".

¹³ We assume that when repeating an illegal action the agent is repeating at least the same harmful act or a more serious.

We are interested in understanding what are the minimum level of sanctions which inhibits agents to engage in illegal activities, under the four assumptions made above, thus focusing on case (ii) and on case (iii).

Case (ii)

In case (ii), the minimum amount of sanctions which generates deterrence for each harmful act is given by:

(1)
$$s_1^* \ge \frac{b}{p}$$
 and $z_1^* \ge \frac{c}{p}$

The expression in (1) identifies the minimum value of sanctions in each period and for each harmful act which generates total dissipation of agents' wealth in case of apprehension, so that agents maintain the incentives not to engage in any illegal activity at any time. Since by assumption c > b, then $z_1^* \ge s_1^*$.

Proposition 1 – Choice of harmful act in (1,0) or (0,1)

When the actual design of sanction are such that $z_1 \ge z_1$ and/or $s_1 \ge s_1$ the choice of the harmful act (x, y) depends on the value $(z_1 - s_1)$. Agents will select y when $(z_1 - s_1) < \frac{(c-b)}{n}$ and x otherwise.

Proposition 1 tells us that when sanction are below their minimal deterrence level, the choice of the degree of harm will depend on the proportion between the two levels of sanctions, given the expected value of the increasing private benefits by moving from x to y. The lower is the distance between s1 and z1 the higher is the probability that agents will 'jump' to the more serious harm.

Proposition 2

When $z_1 \le z^*{}_1$, $s_1 \le s^*{}_1$ and $z_1 \ge s_1$, in order to increase the expected value of *x*, and consequently inducing agents to choose *x* instead of *y*, it is sufficient for the public law enforcer to design a level of $s_1 \le s^\circ{}_1 < s^*_1$ such that $(z_1 - s^\circ{}_1) > \frac{(c-b)}{p}$.

Proposition 2 is another way of clarifying the role played by vertical deterrence (marginal deterrence) in reducing agents' incentives to choose more serious harms in each period: by decreasing the value of the sanction towards the less harmful act, the government obtains under-deterrence for x, but deterrence against y.

Case (iii)

In case (iii), the agent is inhibited in engaging in any harmful act if the conditions of proposition 3 hold.

Proposition 3

The agents is induced not to engage in any harmful activity in each period if the following conditions hold:

(1)
$$s_1^* \ge \frac{b}{p}$$
 and $z_1^* \ge \frac{c}{p}$, with $z_1^* \ge s_1^*$

or

(2)
$$s_2^* = s_1^*$$
 and $z_2^* = z_1^*$

Proposition 3 simply asserts that in order to deter agents it is sufficient to fix in each period a fine equal to the expected benefits.

Now, since the value of sanctions in proposition 3 implies general deterrence, it is interesting to investigate the cases in which sanctions in period 1 are lower than the deterrence level so as to imply some under-deterrence in period 1 and in period 2 for repeated offenders (as long as the sanction in period 1 does not 'dissipate' all the budget constraint W). We focus here on a specific rationale for having in the first period under-deterrence at least for action x, i.e. on the policy maker implementing a *marginal deterrence policy* between action x and action y.

Since economic agents maximize utility, a sanction $s_1^\circ < s_1^*$ will induce them to choose x instead of y as long as $(z_1^* - s_1^\circ) > \frac{(c-b)}{p}$. When this happens, however, agents also have a residual income to be 'spent' in period 2 for engaging in illegal activities. Proposition 4 outlines this case.

Proposition 4

When $s_1^\circ < s_1^*$ and $z_1^* \ge \frac{c}{p}$, with $z_1^* \ge s_1^*$ and $s_1^* \ge \frac{b}{p}$, and agents select x in t=1, the choice of x in t=2 depends on the following conditions:

$$s_2 \le s_1^* + \frac{b}{p} - s_1^\circ \text{ or } s_2^\circ \le 2s_1^* - s_1^\circ$$

Proposition 4 shows how in order to deter action x in period 2 it is necessary to increase penalties of an amount such as to compensate the under-deterrence effect of the first period. This outcome provides a rationale for having under-deterrence in the first period coupled with increasing penalties against repeated offences.

What happens in the above framework when both action x and y are under-deterred in the first period? Proposition 5 adds an argument to proposition 4, showing the conditions under which economic agents 'jump' in period 2 from x to y.

Proposition 5

Let us assume that $s_1^{\circ} < s_1^{\circ}$ and $z_1^{\circ} < z_1^{\circ}$, with $z_1^{\circ} \ge s_1^{\circ}$ and $(z_1^{\circ} - s_1^{\circ}) > \frac{(c-b)}{p}$ so that economic agents choose x in the first period. If $s_2 < z_1^{\circ} < s_2 + \frac{c-b}{p^2}$, for every value of s_2 such that $s_2 \le s_1^{\circ} + \frac{b}{p} - s_1^{\circ}$, then agents will always choose to 'jump' towards y in period 2. Proposition 5 outlines an important consequence of our argument.

When the sanction against repeated offenders for the same type of offence is high enough, repeated offenders may maintain the incentive to jump to the more serious offence in period 2.

That means, in turn, that there is a range of value for increased penalties such that:

- (i) repeated offenders are not horizontally deterred and moreover
- (ii) the vertical under-deterrence scheme between x and y, designed in period 1, does not work for repeated offenders in period 2.

The main consequence of our argument is thus that when a policy maker aims at pursuing both vertical and horizontal deterrence, there could emerge a trade off between the two policy aims: the higher is vertical deterrence effecting the first period (low s1), the higher should be the penalty for increased offences of the same type in period 2 (high s2); however the lower is the gap between *c* and *b* the wider is the range of value $(s_2 < z_1^\circ < s_2 + \frac{c-b}{p^2})$ for which the sanction for the more serious harm approaches the critical threshold which induces repeated offenders to jump towards the more serious harmful action (y).

On the other side, in order to reduce this effect it is necessary to fix the fines in the first period equal to the maximum fine s*and z^* . However, if from one side that means assuring no repetition of the illegal act, from the other it implies renouncing to obtain any vertical deterrence: since any action is punished with a sanction high enough to cover the entire budget constraint of the economic agent, each agent is induced to select the most harmful act in period 1.

6. Hybrid sanction and the option of restoring moral capacity: an application to the demerit point system in traffic law

In most developed countries (Australia, Belgium, Canada, France, Germany, Italy, Japan, New Zealand, Norway, the United Kingdom and the USA) traffic law rules are

backed by a system of deterrence and sanctions based on a Demerit Point System (DPS). This system explicitly aims at identifying persistent traffic offenders who have a high accident risk by their accumulation of demerit points and at discouraging unsafe and irresponsible driving behavior by persistent offenders, as the accumulation of demerit points becomes a constant reminder that the drivers' license could be suspended.

A DPS is a penalty system that involves the allocation of some penalty points (demerits) to infringers for a range of harmful acts¹⁴. The more serious are the offences, the greater is the number of points that are allocated against infringers (in some cases, as in traffic law enforcement in UK, infringers accumulate points up to a given threshold - tottingup system -, while in some other, as in Italy, drivers have an initial endowment of points which they loose after violation occurs). DPSs are not substitute of monetary penalties but are generally coupled with them to support deterrence of violations and enforcement of traffic rules for road safety. Such schemes assign a certain amount of points to some of the traffic offences according to their gravity. When a driver accumulates¹⁵ offences so as to trespass the maximum endowment of points available to him and within a specified time span, then automatic license suspension results (that is the non monetary sanction takes the form of 'incapacitation'). DPSs allow thus road users to make a certain number of errors before more serious penalties are incurred and the non monetary sanction is applied. Generally, drivers can restore their original endowment of points by attending a driving course. Recently DPS rules have been applied also to support environmental protection policies (Scheule M., Hughes P., Weier A. 2004). Likely, the main reason underlying the widespread adoption of DPS relies on the idea that there exists a significant correlation between the inclination to accumulate demerit points and accident likelihood. By focusing especially on certain violations and by tracking recidivist violators, a DPS is generally intended as an effective way to cast out those drivers whose behavior is likely to be more socially harmful and that can be then properly deterred and punished.

¹⁴ The first version of a Demerit Points Scheme was introduced in Connecticut in 1957.

¹⁵ In the case in which drivers have an initial endowment of points, automatic license suspension results accordingly when the original endowment of points is lost. This is the case we are analyzing in our model.

The expected impact of a DPS on driving behavior has received attention in the literature (Dingle, 1985; Williams et al., 1992), but none has focused on the reason why economic agent should comply to a higher degree under a DPS, which is the focus of our paper. A first motivation provided in the literature (SWOV, 2005) explains DPS as a mean of differentiating between different types of road users (*signaling/selection effect*) thus providing information on the group of systematic infringers; a second motivation looks at DPS as a way of providing a regulated deterrent threat to those road users who consistently violate traffic laws (*frightening effect* or *deterrence effect against recidivism or multiple offenders*); a third motivation relies upon the discrimination operated by DPS in favor of those road users who usually follow the traffic rules and only exceptionally break those rules (*leniency effect*); and finally a fourth motivation for DPS has been found in the role of education for serious infringers (*correction effect*) which is generally activated after the critical threshold of demerit points has been reached and severe non-monetary sanctions have been enforced (such as educational courses for drivers who have lost their driving license)¹⁶.

Despite the widespread adoption of DPS in all western world, the economic rationale surrounding its design, implementation and effectiveness remains largely unexplored. There is little mention of DPSs even in the law and economics literature on public law enforcement. That the law and economic literature have overlooked at DPS should not come as a surprise. DPSs have been developed in the specific context of traffic law, generally considered as a field of research on its own¹⁷. However, we believe that some features of DPS are extremely interesting also to pursue general deterrence in the context of public law enforcement design, and that the widespread use of DPS deserves an attempt to provide an economic explanation of the incentives to comply under this regime, both from a positive and from a normative side. With respect to traditional monetary sanctions, a DPS is a more efficient sanction system since it induces a given

¹⁶ These arguments refer to the effectiveness of DPS in reducing infringements rather than to the efficient design of sanctions aimed at equalizing private benefits with social harm.

¹⁷ Some of this detachment may be due to the different meaning of deterrence adopted in traffic law enforcement literature and in the law and economics literature. While in law and economics literature deterrence is generally referred to as efficient deterrence (i.e. as the design of a sanction that equalizes private benefits and/or social harm) in traffic law enforcement literature deterrence is manly referred as effectiveness concerning individual or specific deterrence (see Zaal, 1994).

level of (endogenous) compliance without requiring any increase in the probability of detection which is assumed to be socially costly.

One of the features of a DPS is that it allows the possibility to restore the stock of points, which means, in our previous model, the possibility of restoring 'moral quality' F.

In this section we extend the previous model in a setting, based on Diamond (1965), in which at each period t a new generation of individual is born. The main purpose is to focus on the choices available in the second period when the agent has to choose between action x and y and thus, between the two sanctions s and z, as defined in the previous section. In this section we introduce the possibility of a hybrid sanction based on monetary and non-monetary sanctions. We will show how this hybrid sanction affects the choice between x and y in the second period.

Let us assume no population growth, and consider a representative agent. Each generation lives two periods. The representative agent's preferences are defined over consumption $C_{v,t+1}$ (where v=s,z) and over an index of the agent's rate of respecting the law or 'moral quality' $F_{v,t+1}$. Let us interpret the reversal of agent's moral quality $F_{v,t+1}$ as a measure of the non-monetary sanctions, in the form of temporarily incapacitation, imposed on the agent when her violations are detected. In each period the agent can select an action (for simplicity an illegal activity x or y), receiving a private benefit from this behavior. As in the previous section, we simply consider an agent that violates the law in both periods: in the first period she commits action x receiving a benefit b>0 and causing a monetary harm h>0 to society, with h>b; in the second she has to choose between *repetition of x* or jumping to most dangerous crime y receiving a benefit c>0 and causing a monetary harm k>0 to society, with k>c and with c>b. The agent has a wealth W that represents a budget constraint to be used to cover possible sanctions related to x, *repeated x* and y, i.e. s_1, s_2, z respectively.

The agent's preferences are given by a time-separable utility function:

$$U(C_{1}) + \delta U(C_{v,2}, F_{v,2})$$
[1]

where $\delta \ge 0$ represents the psychological discount factor.

A possible interpretation of the variable *F* is as follows: at the beginning of her life the individual has a null criminal score and she has full capacity defined by $F_t > 0$. That means that if she is detected in committing a criminal action she not only will suffer a fine but will also incur in a non monetary sanction, i.e. temporarily incapacitation, that is a reduction of F_t .

Assumption 1.

The utility function $U(C_1) + \delta U(C_{v,2}, F_{v,2})$ is twice continuously differentiable with: $U'_{C_1}(.) > 0; U'_{C_{v,2}}(.) > 0; U'_{F_{v,2}}(.) > 0; U''_{C_1}(.) < 0; U''_{C_{v,2}}(.) < 0; U''_{F_{v,2}}(.) < 0;$ $U_{C_{..,F..}}(.) > 0$. We also assume that $\lim_{c\to 0} [U(C_1) + \delta U(C_{v,2}, F_{v,2})] = \infty$ and $\lim_{F\to 0} [U(C_1) + \delta U(C_{v,2}, F_{v,2})] = \infty$

The individual's moral quality is affected negatively her criminal actions, in particular F is a decreasing function of the degree of criminal activity. In the second period, all future is collapsed in it, the evolution of F can be represented as:

$$F_{s,2} = \rho F_1 - p((1-p)\beta_1 + p\beta_2)$$

$$F_{z,2} = \rho F_1 - p((1-p)\beta_1 + p\gamma)$$
[2]

where $\beta_{\nu}, \gamma > 0$ $\beta_1 \le \beta_2; \gamma \ge \beta_{\nu}$ and $\rho \in (0,1)$

The individual's moral quality *F* degrades with crime seriousness, where $0 < \rho < 1$ measures the degree of persistence of the moral quality. In order to show the effect of the introduction of a restoring option to the previous model, let us extend the model by introducing the possibility of restoring moral capacity as follows:

$$F_{s,2} = \rho F_1 - p((1-p)\beta_1 + p\beta_2) + \lambda pi$$

$$F_{z,2} = \rho F_1 - p((1-p)\beta_1 + p\gamma) + \lambda pi$$
[3]

where $0 < \lambda < 1$ is the rate at which agent restores her moral capacity that implies an expenditure $i \ge 0$ with a probability $p \ge 0$.

The individual's monetary budget constraints are:

 $s_1 + s_2 = W$ and $s_1 + z_1 = W$

$$C_{1} = b - ps_{1} - R - pi \ge 0$$

$$C_{v,2} = Max[(1+\sigma)R + b - p((1-p)s_{1} + ps_{2}); (1+\sigma)R + c - p((1-p)s_{1} + pz_{1})] \ge 0 \quad [4]$$

where $\sigma > 0$ is return on saving, *R*.

Hence, in each period the agent maximizes the inter-temporal utility function

$$Max[U(C_1) + \delta U(C_2, F_{v,2})]$$

subject to equations [3] and [4] and $C_t \ge 0; F_{v,t} \ge 0; R \ge 0$

Given *assumption 1*, the optimization problem admits a solution and the First Order Conditions are:

$$\frac{U'_{C_1}(C_1)}{U'_{C_{\nu,2}}(C_{\nu,2})} = \delta(1+\sigma)$$
[5]

$$\frac{U'_{C_1}(C_1)}{U'_{F_{s,2}}(F_{s,2})} = \delta\lambda$$
[6]

$$\frac{U'_{C_2}(C_2)}{U'_{F_2}(F_{s,2})} = \frac{\lambda}{1+\sigma}$$
[7]

Equations [6] and [7] define an arbitrage condition between the rate of return on saving and the rate of restoring moral capacity, then the agent chooses R and i in order to equate the marginal rate of substitution between consumption and her moral quality λ

with their marginal rate of transformation, $\frac{\lambda}{1+\sigma}$.

The main consequence of that is that the choice in period two is affected also by the non monetary sanction imposed in case of detection.

As a consequence, as shown in Basili and Nicita (2005), agent's attitude to violate the law also depends on the possibility of controlling the rate of incapacitation through restoring option.

Thus, one way of obtaining horizontal deterrence is to sanction recidivism by introducing a non-monetary sanction (x) for repeated offences, aimed at generating some 'incapacitation' on offenders' ability to repeat the violation.

The introduction of a hybrid system of both monetary and non monetary sanctions erases the interdependence between vertical and horizontal marginal deterrence.

An important result is that horizontal marginal deterrence is here obtained without increasing the probability of detection and thus without inducing higher social cost on enforcement. Thus, when monetary fines defined for vertical marginal deterrence are optimally designed a demerit point system acts on horizontal marginal deterrence without inducing over or under-deterrence, or at least decreasing the distortion generated by the use of the same instrument of monetary sanction to enforce both vertical and horizontal marginal deterrence.

The above example also suggests that compliance is obtained once a given threshold of points has been reached with respect to the sole use of monetary sanctions. In some cases it also allows for distinctions between occasional and systematic violation, since the non-monetary sanction is applied only for any further violation. There is another feature which may improve overall efficiency with respect to the sole use of monetary sanctions which is that of allowing some sort of flexibility in the choice of harm.

This conclusion also reverses some of the main conclusions reached by standard literature (Polinsky and Shavell, 2000) on the optimal use of monetary and non-monetary sanctions. While standard approaches suggest that non-monetary sanctions should be implemented only once fines are exhausted and for more harmful acts, here we suggest that non-monetary sanctions should be activated also for less harmful, but repeated, together with monetary sanctions.

7. Conclusions

This paper, even in its very preliminary and draft version, analyzes the case of a public enforcer who pursues the aim of maximizing vertical and horizontal deterrence. What happen to marginal deterrence policy if we take onto account the possibility that actual sanctions affect incentives to repeat violations in the future and/or the possibility that agents may select more than one harmful action? We try to answer these questions by extending traditional marginal deterrence approach in two respects: time and scope. While there is a literature on optimal sanctions against recidivism and repeated offenders, those results are generally obtained in a framework that neglects reciprocal interdependence between recidivism and marginal deterrence.

We show that a trade-off between marginal deterrence and escalating points against recidivism occurs when a unique policy instrument based on monetary sanction is applied: increased sanctions for repeated offenders may decrease marginal deterrence at any time and vice-versa. We show that, in order to solve the trade-off between vertical and horizontal deterrence it is necessary to introduce, besides monetary sanctions, a new policy instrument, based on virtual budgets of penalty points and on non-monetary sanctions (temporarily 'incapacitation') for repeated offences.

We finally applied this result to the case of demerit point systems in traffic law enforcement. In particular, we addressed an explanation for the meaning and the extent of penalty point systems as a solution of potential trade-offs between marginal deterrence (here denoted as vertical marginal deterrence in scope) and escalating penalties against recidivism (here denoted as horizontal marginal deterrence in time). The intuition here outlined by a simple numeric example will be further developed in a formal framework in future extension of this preliminary paper.

References

- Basili M., Nicita A. (2006) "Deterrence and Compliance in Demerit Points System", paper presented at the Conference of the American Law and Economics, Berkeley 2006.
- Camerer, C. F. and Ho, T.-H. (1994), "Nonlinear Weighting of Probabilities and Violations of the Betweenness Axiom", *Journal of Risk and Uncertainty*, 8, 167-196.
- Chipman and Morgan (1975), "The role of driver demerit points and age in the prediction of motor vehicle collisions" in *Br J Prev Soc Med*. Sep;29(3):190-5.
- Diamantopoulou, K., Cameron, M., Dyte, D. & Harrison, W. (1997) *The relationship between demerit points accrual and crash involvement*, Monash University Accident Research Centre, Report No. 116

Diamond P. (1965) "National Debt in a Neoclassical Growth Model", *American Economic Review*, 55, 1126-1150.

- Dingle, V., (1985) "Deterring traffic offenders through license actions and license administration procedures". *Proceedings of the International conference on the prevention of traffic crime* (p. 72- 86). Riyadh, Kingdom of Saudi Arabia.
- Garoupa, N. (1997) "The Theory of Optimal Law Enforcement", Journal of Economic Surveys, vol. 11 (3), pp. 267-295.

- Haque, M. (1987) Evaluation of the Demerit Points Systems DPS in deterring traffic offences. Hawthorn, Vic., Road Traffic Authority RTA, 1987, General Report; GR 87/21
- Harrison, W. A. and Pronk, N. J. (1998), An investigation of the relationship between traffic enforcement and the perceived risk of detection for driving offences, Monash University Accident Research Centre, Report No. 134
- Makinen T., D.M. Zaidel et al. (2003), "Traffic enforcement in Europe: effects, measures, needs and future", Escape project
- Nyborg K. and Telle K. (2004) "The role of warnings in regulation: keeping control with less punishment", *Journal of Public Economics* 88, 2801-2816
- Parker, D., S.G. Stradling and A.S.R.Manstead (1995) "Modifying beliefs and attitudes to exceeding the speed limit: An intervention study based on the theory of planned behaviour" *Journal of Applied Social Psychology*, 26,1-19.
- Polinsky M. A. and S. Shavell (2000) "The Economic Theory of Public Enforcement of Law," *Journal of Economic Literature*, American Economic Association, vol. 38(1), pages 45-76.
- Scheule M., Hughes P., Weier A. (2004) "Innovative approaches for managing environmental impact of aquaculture", Mimeo.
- Shavell S. (2003), Foundations of Economic Analysis of Law, Harvard
- SWOV (2005), Demerit Points Facts Sheet, Leidschendam
- Vaa, T. (2000) "Effects of police enforcement measures on accidents and levels of injury". Working paper SM/1104/2000. Oslo, Institute of Transport Economics (TOI).
- Vaa, T. and Glad, A. (1995), "Pavirkning av fart: En vurdering av politiovervaking, automatisk trafikkontroll, sanksjoner mot regelbrudd, informasjonskampanjer", Oslo, Institute of Transport Economics (TOI).
- Williams, S.H., Gerner, G.J. & Philby, F.N. (1992) "The use of traffic offence points and license suspension as a means of deterring motorists who have committed less severe traffic offences" in W .D. Smith. (Ed.), *The prevention of Road Traffic accidents: An* overview of behavioural modification techniques. (p. 85-97). Chicago: University of Chicago Press.
- Zaal, D. (1994) *Traffic law enforcement: a literature review*, Monash University, Accident Research Centre, Report No. 53Williams et al. 1992;
- Zaidel, D. (2000) "Traffic Law Enforcement Practices in Sixteen European Countries". Working paper for GADGET, WP5 – *Legal measures and enforcement*. Contract No RO-96-SC.202. VTT, Finland.

Zaidel David M. (2002) "The impact of enforcement on accidents", Project "ESCAPE