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# Can the decentralization of law enforcement constrain socially optimal sanction levels?

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# Can the decentralization of law enforcement constrain socially optimal sanction levels?

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**Abstract**

This paper incorporates the reality that the bulk of law enforcement is decentralized while sanctions are chosen centrally, and explores the implications for the socially optimal sanction level. The presence of interregional externalities in the form of crime diversion induces socially excessive law enforcement incentives at the local level. We show that the adverse repercussions of uncoordinated enforcement decisions at the local level may be ameliorated by setting a nonmaximal sanction at the central level. In other words, we establish that the decentralization of law enforcement may effectively constrain socially optimal sanction levels.

*Keywords: crime, deterrence, federalism, spillovers, optimal sanctions*

*JEL: K42*

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# 1 Introduction

The bulk of law enforcement is conducted at the local level. For example, in the US in the year 2007, 70 percent of police protection expenditures were incurred by local governments (see Table 4 in USDOJ 2011). In contrast, the level of sanctions for criminal offenses are usually determined either at the state or at the federal level. In other words, the authority assessing the level of the sanction is different from the authority that determines the level of enforcement effort. Moreover, the enforcement effort is chosen at the local level knowing the sanction level set by the higher authority. In contrast, the portrayal of the decision-making process in the literature on optimal law enforcement is usually such that one policy maker determines all variables relevant to deterrence and that the level of the detection probability can be chosen independently of the applicable level of the sanction (see, e.g., the survey by Polinsky and Shavell 2009).

This paper explores the implications of the decentralization of law enforcement effort for the characteristics of optimal law enforcement in equilibrium. In particular, our interest lies with the level of the socially optimal sanction. The typical timing of the interaction between the state level and the local level is such that the former acts as a Stackelberg leader in setting the level of the sanction, with the latter responding to this level in a way that is optimal for the locality. Importantly, the state encompasses different localities whose decisions may be interrelated, but who simultaneously respond to the level of the state-imposed sanction. For example, Marceau (1997) portrays the interrelationship among competing jurisdictions and shows that an increase in the level of law enforcement in one locality will shift some crime to neighboring communities. Whereas such "diversion externalities" between communities would be taken into account if it were up to the state to determine both the level of the sanction and the levels of the local detection probabilities, there is no such internalization with decentralized law enforcement.

We establish, however, that decentralized law enforcement can constrain socially optimal (i.e., second-best) sanction levels. Due to the importance of crime diversion, localities have incentives for excessive spending on law enforcement, but the equilibrium enforcement effort is decisively influenced by the level of the sanction. For example, a very low sanction may limit the promise of spending a lot on enforcement in terms of the achievable levels of deterrence. In anticipation of the relationship between the level of the sanction and the level of law enforcement spending in the different communities, the authority at the state level may choose to set the sanction below the maximum level if this helps to curb the excessiveness of law enforcement spending. This finding stands in contrast to the classic maximal sanction result attributed to Becker (1968). To derive our central result, we use a very simple setup with two towns at the extremes of a unit interval sharing a population of potential offenders located in between.

Our paper is related to the literature on optimal law enforcement. In particular, since the seminal contribution by Becker (1968), several reasons have been presented that help to explain why sanctions in reality may not be maximal. For example, Andreoni (1991) argues that judges and juries will ask for better evidence in court when the level of the sanction is higher, allowing for the possibility that deterrence actually falls when the level of the sanction is raised. This literature is surveyed, for example, in Garoupa (1997). Moreover, the present paper is related to the law and economics literature that takes spatial aspects into account. Marceau (1997) presented the first analysis of jurisdictions diverting crime to other jurisdictions by their use of law enforcement. The excessiveness of law enforcement under decentralized decision-making that we rely on in the present paper is already derived there. Later literature in this stream includes Marceau and Mongrain (2011) and the literature cited therein. The possibility of crime diversion is also key in the literature on private precautions against crime (e.g., Baumann and Friehe 2013, Shavell 1991). There is a related literature about centralization and decentralization in public economics that usually analyzes the trade-off between imposing uniform policies despite heterogeneous localities or allowing for location-specific policies which do not internalize spillovers (e.g., Oates 1972). For simplicity, we consider symmetric localities. Our research question in the present paper is not the pros and cons of centralization and decentralization, but the implications for optimal law enforcement of having decentralized law enforcement combined with centralized setting of sanctions.

The remainder of the paper is structured as follows. Section 2 describes the model and how potential offenders behave. Section 3 first derives the first-best allocation; that is, the allocation that results when all variables relevant to deterrence are determined at the state level (centralized law enforcement), and then presents the analysis for decentralized law enforcement. Finally, Section 4 concludes.

# 2 The model and individual decision-making

## 2.1 The model

Suppose that on a line of unit length, town A is located at 0 while town B is located at 1. Individuals are located uniformly on the line between 0 and 1. Individuals choose, first, between a legal activity and an illegal activity, and, second, between town A and town B. The legal activity generates utility $v \geq 0$ The gross benefit from undertaking the illegal activity is $b$, where $b \in [0, G]$ according to $F(b)$ with $G > v$. The distribution of benefits is independent of the individuals' location; that is, the realized benefit $b$ is independent of where the individual ultimately undertakes the criminal act. However, there is a transportation cost $tx$ for somebody located at $x$ on the interval choosing to act in town A, where $t < 2v$. The transportation costs can be interpreted in many ways. This may be literal transportation costs, but it could also reflect differences in local characteristics or the familiarity with locations. For example, Curran et al. (2005) argue that criminals prefer to offend in places with which they are somewhat familiar.

Any offense creates social harm $h > G > 0$ as in, for instance, Bond and Hagerty (2010). In other words, there is no efficient crime in our setting.[1] In order to deter offending, there is a level of the expected sanction in town $i$, given by the product of the detection probability $p_i$ ($i = A, B$) and the level of the sanction $s$. We assume that the sanction is a fine and capped by the level of wealth $w$. With regard to the level of deterrence, the level of the sanction is uniform but the detection probabilities may be location-specific. Without loss of generality, we will consider the scenario in which $p_A \geq p_B$ (the opposite scenario can be

[1] This assumption is not critical to our results but helps us to more straightforwardly sign terms, therefore allowing us to save case distinctions.

accommodated by a relabeling of locations). The expenditures for detecting and convicting offenders cannot be used for other purposes. We assume that the remainder of the budget in location $i$, $k_i = R - p_i$, is used for production of a pure public good $Y_i = Y(k_i)$, where $Y' > 0 > Y''$.

## 2.2 Individual decision-making

Individuals determine the kind of activity, legal or illegal, and where to conduct their activity, town A or B. We can distinguish individuals according to their level of realized gross criminal benefit $b \in [0, G]$ and their location $x \in [0, 1]$ on the unit interval. At each location, we have to distinguish individuals who have drawn a small, intermediate or high level of gross benefit from the illegal activity from crime; that is, whether $b$ is in $\mathcal{C}_0 = [0, \bar{b}_B)$, $\mathcal{C}_1 = [\bar{b}_B, \bar{b}_A)$ or $\mathcal{C}_2 = [\bar{b}_A, G]$, where

$$\bar{b}_B = p_B s + v \tag{1}$$

$$\bar{b}_A = p_A s + v. \tag{2}$$

When law enforcement authorities choose uniform detection probabilities in towns A and B, then $\bar{b}_B = \bar{b}_A$. Otherwise, $\bar{b}_B < \bar{b}_A$ as we chose town A to be the one potentially investing in greater enforcement. We have that $d\bar{b}_i/dp_i = s > 0 = d\bar{b}_i/dp_j$ and $d\bar{b}_i/ds = p_i$.

Individuals in the set $\mathcal{C}_0$ are law-obedient in both towns because their gross benefits drawn from the distribution $F(b)$ fall short of the sum of the benefits from the legal act $v$ and the minimum of the two expected sanctions. The split of this set on the unit interval occurs at $x_0$ such that individuals located at $x \leq x_0$ ($x > x_0$) undertake the legal activity in town A (B), where

$$v - tx_0 = v - t(1 - x_0) \Leftrightarrow$$
$$x_0 = \frac{1}{2}. \tag{3}$$

Individuals with $b \in \mathcal{C}_1$ (if that set exists) prefer crime over the legal activity only in town B, whereas the higher expected sanction in town A reverses the preference for town A. The split of this set occurs at $x_1 \leq 1/2$, such that individuals located at $x \leq x_1$ select the legal activity in town A and individuals at $x > x_1$ undertake the illegal activity in town B, where

$$\begin{aligned} v - tx_1 &= b - p_B s - t(1 - x_1) \Leftrightarrow \\ x_1(b) &= \frac{1}{2} - \frac{b - (p_B s + v)}{2t} \\ &= \frac{1}{2} - \frac{b - \bar{b}_B}{2t}. \end{aligned} \tag{4}$$

The level $x_1(b)$ (i.e, the location on the unit interval of the individual who is indifferent between the legal activity in town A and crime in town B) is a function of the gross benefit from the illegal activity because individuals with $b \in \mathcal{C}_1$ compare the legal activity in town A to offending in town B. It follows from (4) that

$$\frac{dx_1}{dp_B} = \frac{s}{2t} > 0, \frac{dx_1}{ds} = \frac{p_B}{2t} > 0.$$

In words, an increase in the level of the detection probability in town B decreases the number of individuals with a given level of the gross benefit $b$ who choose to offend in town B, thereby increasing the number of individuals choosing the legal act in town A. The same holds for an increase in the level of the sanction. These marginal effects are critically influenced by the level of the transportation cost parameter $t$ because individuals find offending in the distant town B more appealing when traveling there is not very costly.

Finally, individuals with $b \in \mathcal{C}_2$ prefer offending to the legal activity in both towns, and for that reason constitute the set of hardcore criminals. The split of this set occurs at $x_2 \leq 1/2$, such that individuals located at $x \leq x_2$ ($x > x_2$) offend in town A (B), where

$$\begin{aligned} b - p_A s - tx_2 &= b - p_B s - t(1 - x_2) \Leftrightarrow \\ x_2 &= \frac{1}{2} - \frac{(p_A - p_B)s}{2t}. \\ &= \frac{1}{2} - \frac{\bar{b}_A - \bar{b}_B}{2t} \end{aligned} \tag{5}$$

This implies that $x_2$, in contrast to $x_1$, is not a function of the level of the gross benefit from crime. Moreover, we find that

$$\frac{dx_2}{dp_A} = -\frac{s}{2t} < 0 < \frac{s}{2t} = \frac{dx_2}{dp_B}, \frac{dx_2}{ds} = -\frac{p_A - p_B}{2t} < 0.$$

The change in the critical level of $x$ dividing hardcore criminals in town A and in town B is greater the smaller is the level of the transportation cost parameter.

The split of individuals is illustrated in Figure 1 for the case in which $p_A > p_B$. The level of $x_1$ is decreasing with the level of the gross benefits from crime (see (4)). We have that $x_1 = x_2$ at $b = \bar{b}_A$, $x_1 > x_2$ when $\bar{b}_B < b < \bar{b}_A$, and $x_1 = x_0$ at $b = \bar{b}_B$. Individuals in Region I (II) choose the legal activity in town A (B); individuals in Region III offend in town B; and individuals in Region IV offend in town A.

INSERT FIGURE 1 ABOUT HERE

# 3 Determination of law enforcement

In our setup, the level of deterrence is shaped by the level of the sanction applicable in both towns, and the detection probabilities in locations A and B. In the next section, we first consider the benchmark case in which the central authority determines all policy instruments. We then turn to the more realistic scenario in which local law enforcement authorities select their own detection probabilities, taking as given the sanction that the central authority will uniformly impose on offenders in both locations. (We assume that the constitutional requirement of equal treatment requires a uniform sanction for comparable offenses, no matter where they were committed.)

## 3.1 Centralized law enforcement

The central authority maximizes – by assumption – total welfare, which is the sum of welfare in towns A and B with respect to the three policy instruments (namely, the level of the sanction and both detection probabilities). We assume that the level of welfare in town $i$ can be represented by the sum of individual utilities (including that of criminals) and production of the public good (e.g., Marceau 1997, Polinsky and Shavell 2007). This leads to welfare in town A as being defined by

$$W_A = v/2F(\bar{b}_B) + \int_{\bar{b}_B}^{\bar{b}_A} x_1(b) v dF(b) + x_2 \int_{\bar{b}_A}^{G} (b-h) dF(b) - TC_A(p_A, p_B) + Y(R - p_A), \quad (6)$$

and similarly for town B.

$$W_B = v/2F(\bar{b}_B) + \int_{\bar{b}_B}^{\bar{b}_A} (1-x_1(b))(b-h) dF(b) + (1-x_2) \int_{\bar{b}_A}^{G} (b-h) dF(b) - TC_B(p_A, p_B) + Y(R - p_B). \quad (7)$$

Individuals with $b \in [0, \bar{b}_B)$ choose the legal act and select the closest location to do so, implying an equal split of this subset. Individuals with $b \in [\bar{b}_B, \bar{b}_A)$ refrain from crime when they choose town A (i.e., when they are located on the unit interval such that $x \leq x_1(b)$), while individuals with $b \in [\bar{b}_B, \bar{b}_A)$ and $x > x_1(b)$ offend in town B. Finally, individuals with $b \in [\bar{b}_A, G]$ constitute the set of hardcore criminals, a fraction $x_2$ of whom offend in town A and a fraction $1 - x_2$ of whom offend in town B. The last terms in $W_A$ and $W_B$ represent the levels of production of the public good that are possible after resources for the detection probability are sunk. The transportation costs $TC_i$ incurred by the individuals active in town $i$ are given by

$$TC_A = t \left[ \frac{F(\bar{b}_B)}{8} + \int_{\bar{b}_B}^{\bar{b}_A} \frac{x_1(b)^2}{2} dF(b) + (1 - F(\bar{b}_A)) \frac{x_2^2}{2} \right] \quad (8)$$

$$TC_B = t \left[ \frac{F(\bar{b}_B)}{8} + \int_{\bar{b}_B}^{\bar{b}_A} \frac{(1 - x_1(b))^2}{2} dF(b) + (1 - F(\bar{b}_A)) \frac{(1 - x_2)^2}{2} \right] \quad (9)$$

We focus on the case in which the policy maker takes as given that each town has resources $R$ to be spent in the town. The objective function of the central authority thus can be simply stated as

$$W = W_A + W_B, \quad (10)$$

which it seeks to maximize subject to the constraint on the level of the sanction $s \leq w$. We obtain

$$\frac{\partial W}{\partial p_A} = s(h - p_A s) f(\bar{b}_A) x_2 - Y'(R - p_A) + \frac{(p_A - p_B)s^2}{2t}(1 - F(\bar{b}_A)) = 0 \tag{11}$$

$$\frac{\partial W}{\partial p_B} = s(h - p_B s) f(\bar{b}_B)\frac{1}{2} + \frac{s}{2t}(h - p_B s)(F(\bar{b}_A) - F(\bar{b}_B)) - Y'(R - p_B) + \frac{(p_A - p_B)s^2}{2t}(1 - F(\bar{b}_A)) = 0 \tag{12}$$

$$\frac{\partial W}{\partial s} = p_A(h - p_A s) f(\bar{b}_A) x_2 + p_B(h - p_B s) f(\bar{b}_B)\frac{1}{2} + \frac{p_B}{2t}(h - p_B s)(F(\bar{b}_A) - F(\bar{b}_B)) - \frac{(p_A - p_B)^2 s}{2t}(1 - F(\bar{b}_A)) \tag{13}$$

With $\lambda \geq 0$ as a Lagrange multiplier, the first-order conditions would include $\partial W/\partial s - \lambda = 0$ and (11)-(12).

A marginal increase in the level of town A's detection probability has its deterrence benefits and resource costs. Moreover, when the two enforcement efforts diverge, there is an increase in the level of transportation costs (the third term in (11)). Increasing the level of town B's detection probability similarly has its deterrence benefits and resource costs. Finally, there is an impact on transportation costs unless the detection probability in town A is equal to the one in town B. A variation in the level of the sanction applies in both locations, raising the levels of deterrence $\bar{b}_A$ and $\bar{b}_B$. Since a higher sanction magnifies any existing wedge between $p_A$ and $p_B$, it increases transportation costs of hardcore criminals.

We focus on the case of symmetric towns, which implies that $p_A = p_B$ at the optimum.[2] This makes comparisons between the outcome that results from centralized decision-making to the equilibrium that is induced by decentralized decision-making most transparent. In that symmetric scenario (substituting $p_B$ for $p_A$), the conditions simplify to

$$\frac{\partial W}{\partial p_i} = \frac{1}{2}\left[s(h - p_B s) f(\bar{b}_B) - 2Y'(R - p_B)\right] = 0 \tag{14}$$

$$\frac{\partial W}{\partial s} = p_B(h - p_B s) f(\bar{b}_B) > 0, \tag{15}$$

Equation (14) is the usual condition for the optimal probability of apprehension: it says that the marginal benefit of deterrence (the first term on the right-hand side) should be

[2] Note that particularly interregional shifting of resources may under some circumstances allow for outcomes with focusing of law enforcement (see Lando and Shavell 2004).

set equal to the marginal cost in terms of foregone output (the second term). Condition (15) illustrates that fines are a costless transfer and thus yield a marginal deterrence benefit without marginal costs. The sign follows from condition (14). We present our key result for the case of centralized law enforcement in:

**Proposition 1** *When law enforcement is centralized, the policy maker implements the maximum sanction for* $p_A = p_B$.

**Proof.** The claim follows from (15). ■

For the scenario of centralized law enforcement, the Beckerian reasoning applies (Becker 1968). An increase in the level of the sanction is a socially costless way to improve the level of deterrence. As a result, the level of the sanction should be raised to the level of the individuals' wealth. In contrast, an increase in the detection probability uses up resources.

## 3.2 Decentralized law enforcement

We now turn to the case where each town chooses its own enforcement effort. We assume that the timing is such that the central authority determines the level of the sanction in stage 1, and the towns then simultaneously select their detection efforts in stage 2. For subgame perfection, we first analyze the decision-making of the towns.

### 3.2.1 Stage 2: Towns choose detection efforts

When non-cooperatively determining on how to split the tax revenues $R$ between the competing uses of local public good production and fighting local crime, towns maximize local welfare. The welfare of town A is defined in (6) and the welfare of town B is defined in (7).

The optimal level of enforcement effort in town A in response to a given enforcement effort in town B fulfills the first-order condition

$$\frac{\partial W_A}{\partial p_A} = -Y'(R-p_A)+sf(\bar{b}_A)(h-p_A s)x_2-\frac{s}{2t}\int_{\bar{b}_A}^{G}(b-h)dF(b)+(1-F(\bar{b}_A))x_2\frac{s}{2}=0. \quad (16)$$

Condition (16) implicitly defines town A's best-response function $p_A^*(p_B, s)$; that is, the level of $p_A$ that is optimal for town A as a function of town B's effort and the level of the sanction.

A higher level of $p_B$ influences town A's marginal incentives via an increase in $x_2$, augmenting marginal benefits of enforcement efforts in town A. In other words, the enforcement effort in town A is an increasing function of the enforcement effort in town B (i.e., they are strategic complements). Town A's marginal incentives are also varied by a change in the level of the sanction. This can be illustrated as a shift in town A's best response function (for an illustration, see Section 3.3). Whether or not town A wishes to spend more on enforcement when the level of the sanction is raised, holding town B's effort constant, depends on

$$\begin{aligned}\frac{\partial^2 W_A}{\partial p_A \partial s} =& (h - p_A s)\left[x_2\{f(\bar{b}_A) + f'(\bar{b}_A) s p_A\} - \frac{2p_A - p_B}{2t} s f(\bar{b}_A)\right] - \frac{1}{2t}\int_{\bar{b}_A}^{G}(b-h)dF(b) \\ &+ f(\bar{b}_A) p_A s\left[\frac{v}{2t} - \frac{3x_2}{2}\right] + \frac{(1 - F(\bar{b}_A))}{2}\left[\frac{1}{2} - \frac{p_A - p_B}{t}s\right] \end{aligned} \tag{17}$$

which cannot be signed at this general level. Intuitively, town A increases (decreases) its own detection effort for any effort by town B when the level of the sanction increases and (17) is positive (negative). Garoupa (2001) has established for the standard framework that the two policy instruments – sanction level and detection probability – are complements when the level of underdeterrence is significant. Our focus on inefficient crime suggests that there will be underdeterrence even for very high levels of $p_A s$. The forces present in the standard framework are, in the present setup, joined by the effect of the sanction on crime diversion from town A's standpoint. Specifically, a higher level of the sanction ensures a higher level of deterrence for fixed enforcement efforts. However, the marginal productivity of enforcement efforts with regard to deterrence is higher at a higher level of the sanction. In addition, town A recognizes that it can shift some crime to the neighboring community. The rate at which a marginal increase in the enforcement effort can achieve this effect is impacted by the level of the sanction.

Formally, an increase in $p_A$ will also affect the welfare in town B as follows

$$\frac{\partial W_B}{\partial p_A} = \frac{s}{2t}\int_{\bar{b}_A}^{G}(b-h)dF(b) - \frac{s}{2}(1 - F(\bar{b}_A))x_2 < 0. \tag{18}$$

A higher enforcement effort in town A means that more individuals with high criminal benefits will be diverted to town B, increasing the net harm $(h - b) > 0$ and incurring transportation costs. In other terms, the detection effort of town A imposes a negative externality on town B. This diversion effect will induce town A to choose an excessive level of enforcement effort (Marceau 1997).

Town B's optimal enforcement effort fulfills the first-order condition

$$\begin{aligned}\frac{\partial W_B}{\partial p_B} =& - Y'(T - p_B) + \frac{s}{2}(h - p_B s) f(\bar{b}_B) - \frac{s}{2t}\int_{\bar{b}_B}^{G}(b-h)dF(b) \\ &+ \frac{s}{2}\left[\int_{\bar{b}_B}^{\bar{b}_A}(1 - x_1(b))dF(b) + (1 - F(\bar{b}_A))(1 - x_2)\right] = 0, \qquad (19)\end{aligned}$$

which implicitly defines town B's best-response function $p_B^*(p_A, s)$; that is, the level of $p_B$ that is optimal for town B as a function of town A's effort and the level of the sanction. A higher level of $p_A$ augments town B's marginal incentives via a decrease in $x_2$. The marginal effect via $\bar{b}_A$ is zero because $x_1 = x_2$ at $b = \bar{b}_A$. The marginal impact of a higher sanction level on town B's marginal enforcement effort incentives follows from

$$\begin{aligned}\frac{\partial^2 W_B}{\partial p_B \partial s} =& (h - p_B s)\left[\frac{1}{2}\{f(\bar{b}_B) + f'(\bar{b}_B) s p_B\} - \frac{p_B}{2t} s f(\bar{b}_B)\right] - \frac{1}{2t}\int_{\bar{b}_B}^{G}(b-h)dF(b) \\ &+ f(\bar{b}_B) p_B s\left[\frac{v}{2t} - \frac{3}{4}\right] + \frac{(1 - F(\bar{b}_A))}{2}\left[\frac{1}{2} + \frac{p_A - p_B}{t}s\right] + \frac{1}{2}\int_{\bar{b}_B}^{\bar{b}_A}(1 - x_1)dF(b).\end{aligned} \qquad (20)$$

The arguments elaborated for (17) equally apply here. Further, town B's enforcement effort has a diversion effect on town A measured by

$$\frac{\partial W_A}{\partial p_B} = \frac{s}{2t}\left[v(F(\bar{b}_A) - F(\bar{b}_B)) + \int_{\bar{b}_A}^{G}(b-h)dF(b)\right] - \frac{s}{2}\left[\int_{\bar{b}_B}^{\bar{b}_A} x_1 dF(b) + (1 - F(\bar{b}_A))x_2\right]. \qquad (21)$$

A higher enforcement effort in town B means that fewer individuals with intermediate criminal benefits will commit offenses in town B and instead will engage in the legal activity $v$ in town A and incur transportation costs (first and third term). In addition, the policy variation in town B shifts a greater share of individuals with high criminal benefits to town A, adding the negative net benefits and transportation costs (second and fourth term).

In a symmetric equilibrium, the towns spend the same level of enforcement effort (i.e., we obtain $p_A^* = p_B^*$). And, as argued before, the towns' best-response functions are shifted by a change in the level of the sanction. The implication for the equilibrium level of enforcement effort follows from evaluating the system

$$\begin{pmatrix} \frac{\partial^2 W_A}{\partial p_A \partial p_A} & \frac{\partial^2 W_A}{\partial p_A \partial p_B} \\ \frac{\partial^2 W_B}{\partial p_B \partial p_A} & \frac{\partial^2 W_B}{\partial p_B \partial p_B} \end{pmatrix} \begin{pmatrix} dp_A^* \\ dp_B^* \end{pmatrix} = \begin{pmatrix} -\frac{\partial^2 W_A}{\partial p_A \partial s} \\ -\frac{\partial^2 W_B}{\partial p_B \partial s} \end{pmatrix} ds$$

Sufficient second-order conditions impose the conditions that $\partial^2 W_i/\partial p_i \partial p_i < 0$ and the determinant of the Hessian matrix is positive, $H > 0$. Given this, we obtain the following expressions for the marginal changes in the equilibrium levels of enforcement effort

$$\frac{dp_A^*}{ds} = \frac{\frac{\partial^2 W_B}{\partial p_B \partial s}\frac{\partial^2 W_A}{\partial p_A \partial p_B} - \frac{\partial^2 W_A}{\partial p_A \partial s}\frac{\partial^2 W_B}{\partial p_B \partial p_B}}{H} \tag{22}$$

$$\frac{dp_B^*}{ds} = \frac{\frac{\partial^2 W_A}{\partial p_A \partial s}\frac{\partial^2 W_B}{\partial p_B \partial p_A} - \frac{\partial^2 W_B}{\partial p_B \partial s}\frac{\partial^2 W_A}{\partial p_A \partial p_A}}{H}. \tag{23}$$

In order to sign these marginal effects, we recall from above that town A's marginal benefits from $p_A$ are increasing in the level of $p_B$ and vice versa. Specifically

$$\frac{\partial^2 W_A}{\partial p_A \partial p_B} = \frac{s}{2t}\left(s(h - p_B s) f(\bar{b}_B) + \frac{s}{2}(1 - F(\bar{b}_A))\right) > 0 \tag{24}$$

$$\frac{\partial^2 W_B}{\partial p_B \partial p_A} = \frac{s^2}{4t}(1 - F(\bar{b}_A)) > 0. \tag{25}$$

As a result, we deduce from (22)-(23) that the sign of the change of equilibrium enforcement effort when the level of the sanction is raised depends only on the sign of $\partial^2 W_i/\partial p_i \partial s$ when $p_A^* = p_B^*$ (see expression (17) and the related discussion). We summarize our analysis of the second stage of the interaction as follows:

**Lemma 1** *The equilibrium enforcement effort $p_i^*$ of towns A and B is increasing (decreasing) in the level of the sanction when $\partial^2 W_i/\partial p_i \partial s >$ $(<)0$.*

**Proof.** The claim follows from (22)-(25). ■

This section has established that the equilibrium enforcement levels that result in stage 2 are indeed critically influenced by the level of the sanction. This is a reality that the central authority must bear in mind when setting the level of the sanction, an issue that we turn to next.

### 3.2.2 Stage 1: The state chooses the level of the sanction

In stage 1, the central authority chooses the level of the sanction to maximize the level of welfare in the state; that is, with $W = W_A + W_B$ as the objective function. The central authority is handicapped relative to the benchmark scenario in that it cannot also determine the detection probabilities applicable in towns A and B. Accordingly, the central authority must take into account that the towns will make their enforcement choices contingent on the level of the sanction; that is, that $p_A^*$ and $p_B^*$ are functions of $s$. Finally, the central authority cannot set a higher level of the fine than individuals' wealth $w$.

At a general level, the first-order condition for the level of the sanction is

$$\frac{dW}{ds} = \frac{\partial W}{\partial s} + \frac{\partial W}{\partial p_A}\frac{dp_A^*}{ds} + \frac{\partial W}{\partial p_B}\frac{dp_B^*}{ds} \tag{26}$$

We have seen that the direct welfare effect of a higher sanction (the first term in (26)) is positive for $p_A = p_B$. However, the total welfare effect also includes the indirect effects that run via the influence of the level of the sanction on enforcement efforts in towns A and B. The reality that detection probabilities are determined at the local level implies that

$$\frac{\partial W}{\partial p_i} = \frac{\partial W_j}{\partial p_i} < 0$$

since town $i$ ensures that $\frac{\partial W_i}{\partial p_i} = 0$ in stage 2 ($i, j = A, B,\ i \neq j$). This implies that the second and the third terms of (26) represent marginal costs of increasing the level of the sanction when $dp_i^*/ds > 0$, in which case a maximal sanction may not be optimal. In order to obtain the latter sign, it is required that detection efforts and the level of the sanction are complements from the town $i$'s perspective as explained in Lemma 1. We use this fact to state the following key result:

**Proposition 2** *When law enforcement is decentralized, the policy maker may implement a sanction smaller than the maximum sanction when* $\partial^2 W_i/\partial p_i \partial s > 0$.

**Proof.** The claim is established by reference to the example in Section 3.3. ■

For the scenario of decentralized law enforcement, the Beckerian reasoning does not necessarily apply because there is a positive marginal cost from increasing the level of the sanction under some circumstances. An increase in the level of the sanction has marginal benefits in terms of increasing the level of deterrence, but may bring about an increase in the excessiveness of law enforcement in towns A and B. When the latter effect is sufficiently strong, a nonmaximal sanction may be socially optimal.

### 3.3 Numerical example

In this section, we very briefly lay out an example to illustrate the possibility that the decentralization of law enforcement can constrain the level of the socially optimal sanction. We assume that the criminal benefit $b$ from a criminal act is uniformly distributed in $[0, 2]$, while the social harm is $h = 10$, such that $G = 2 < 10 = h$. The benefit from the legal activity is fixed at $v = 1$, transportation costs are given by $t = 1/10$, the individual wealth level that represents the maximal sanction level is $w = 1/4$, and the resource costs enter by subtracting $(5/2)p_i^2$ from the level of welfare.

In the case of centralized law enforcement, the policy maker chooses $(s_{FB}, p_A^{FB}, p_B^{FB}) = (1/4, 40/321, 40/321)$. In other words, the solution accords with the known prescription of relying on the level of the sanction to the greatest extent possible, that is, setting $s = w$. The level of welfare when the first-best policy vector is implemented is $-3.7$.

In the case of decentralized law enforcement, towns choose enforcement effort simultaneously to maximize own welfare in stage 2. The best-response function $p_i^*(p_j, s)$ of town $i$ is upward sloping, highlighting the strategic complementarity (see Figure 2). The level of the sanction enters the best-response function as a shift parameter. Figure 2 shows how the towns' best-response functions are influenced by a change in the level of the sanction for the present example. Reducing the sanction from $s_{FB}$ to $s_{FB} - 0.1$ shifts both best-response functions inward and thus yields a lower level of equilibrium enforcement effort.

INSERT FIGURE 2 ABOUT HERE

In stage 1, the policy maker at the state level anticipates the repercussions of any given sanction level for the enforcement effort levels that result in equilibrium in stage 2. Formally, the policy maker maximizes welfare $W = W_A + W_B$ where the towns' equilibrium effort levels $p^*_A(s)$ and $p^*_B(s)$ replace $p_A$ and $p_B$. The resulting level of welfare, which is a function of the level of the sanction alone, is visualized in Figure 3. It follows from the graph that the policy maker at the state level would implement rather a small sanction than to implement an intermediate sanction (including the possible maximum of $s = 0.25$). The level of welfare when $s \to 0$ is $-3.775$ whereas it is $-6.96$ when $s = w$.

INSERT FIGURE 3 ABOUT HERE

# 4 Conclusion

Law enforcement in practice is decentralized in many jurisdictions. This paper shows that this reality may be consequential for the choice of socially optimal sanctions. Whereas fines are usually considered to be a socially costless instrument that can be chosen independently of the level of enforcement, we establish that there may be positive social marginal costs due to the fact that the **local law** enforcement effort responds to changes in the level of the sanction. In other words, the socially optimal level of the sanction may be nonmaximal in a decentralized setting even though it would be equal to the maximal level in a centralized regime. We show that a necessary condition for this result is that a higher level of the sanction increases the productivity of law enforcement at the local level, which is the more likely fulfilled the more severe underdeterrence is.

Our paper is a first exploration of the implications of federalist systems for optimal law enforcement. To make our point about decentralization of law enforcement possibly constraining the socially optimal sanction, we make use of a very simple setup. Extensions of the setup, for example, to heterogeneous localities present interesting avenues for future research.

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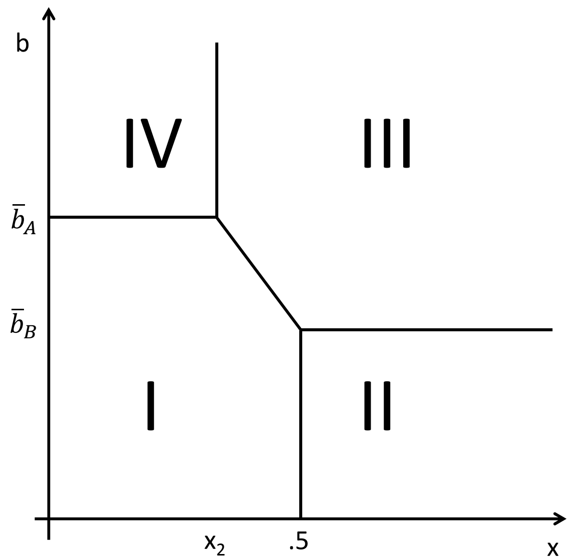


Figure 1: Split of population according to activity and town when $p_A > p_B$

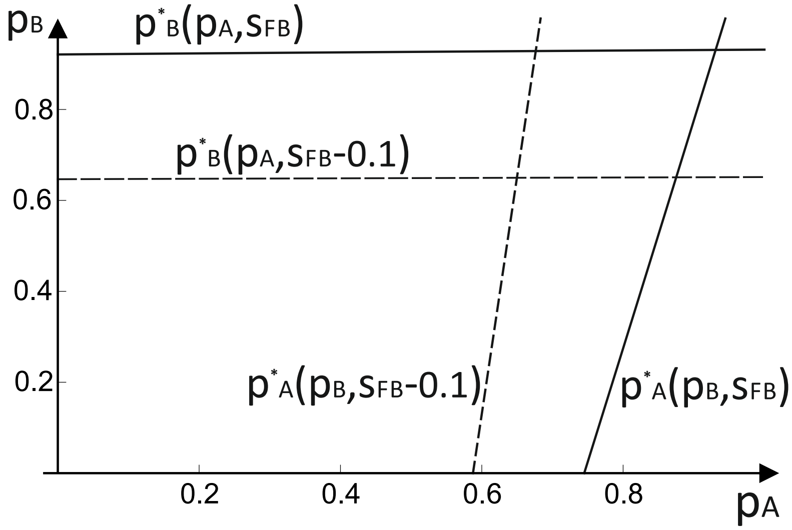


Figure 2: Decentralized law enforcement: Towns' best-response functions $p_A^*(p_B, s_{FB})$, $p_A^*(p_B, s_{FB} - 0.1)$, $p_B^*(p_A, s_{FB})$, and $p_B^*(p_A, s_{FB} - 0.1)$.

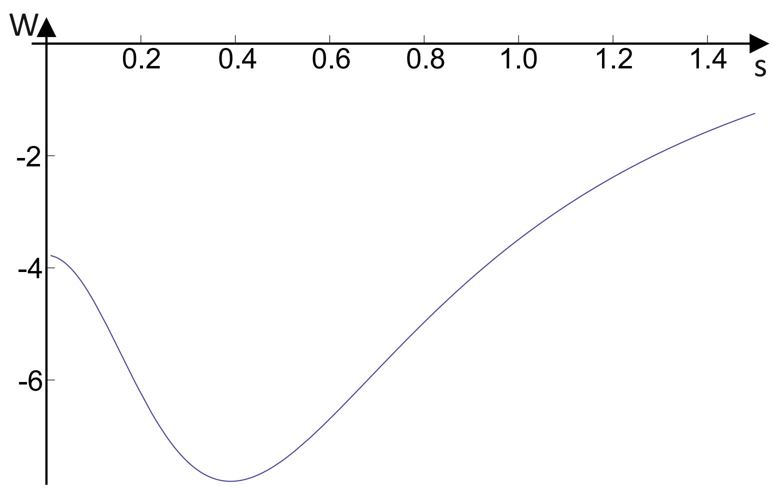


Figure 3: Decentralized law enforcement: Welfare as a function of the sanction using $p^*_A(s)$ and $p^*_B(s)$.