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Time-Consistent Criminal Sanctions

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Abstract

A classic argument in the theory of crime is that optimal enforcement policy should involve maximal sanctions combined with minimal detection costs. Yet this is rarely observed in the real world. We argue that one reason for this has to do with the time inconsistency of such a policy. If sanctions are only applied after a crime has been committed, the enforcement authority may be reluctant to impose a high sanction since it will no longer have any deterrent effect. We show in a simple one period setting that if the enforcement authority can commit to its announced sanctions, the classic result is obtained. However, if the enforcement authority cannot commit, a minimal sanction with no enforcement effort is obtained. These extreme outcomes can be avoided in a setting in which crimes and enforcement occur repeatedly and the authority is able to build a reputation.

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1. Introduction

This paper addresses the puzzle of the non-trivial criminal sanction, an idea first developed by Becker (1968). If an individual committing a crime derives a finite expected benefit from it, then this individual can be deterred from committing the crime by some combinations of a sanction and of a probability of being caught. If resource costs must be incurred in order to increase the probability of catching criminals, and if sanctions can be imposed at no cost, the trivial way to deter criminal behavior is to set the probability of catching criminals at a minimal value while simultaneously imposing as severe a sanction as possible, referred to as the maximal sanction. With a maximal sanction (e.g., the death penalty), the deterrent effect is always large enough to insure the criminal will not commit the crime. Of course, this result is a "puzzle" because we do not observe maximal sanctions (with minimal apprehension effort) being imposed for most criminal behavior in the real world.

The literature has considered the issue of why we do not observe maximal criminal sanctions being imposed. Some explanations include the following.[1] Sanctions, especially nonmonetary ones, may be costly to impose and the costs may increase with the level of sanction (Polinsky and Shavell, 1979; Shavell, 1987; and Kaplow, 1990b). Further, if criminals can engage in avoidance activities which reduce the probability of being caught, and if such activities are costly, it may not be optimal to impose the maximal sanction since that will induce an excessive level of avoidance activity (Malik, 1990). Imperfect information about the probability of apprehension or about whether acts are subject to sanctions can also lead to less than maximal sanctioning (Kaplow, 1990a; Bebchuk and Kaplow, 1992a; and Bebchuk and Kaplow, 1992b). Another line of reasoning is that if law enforcement is general so that all crimes are deterred with the same probability, and if there is a limit to the maximal sanction so that the general probability of apprehension

[1] See also Cowell (1990) for a discussion of the optimal sanction in the context of tax evasion.

is not too small, it may be optimal to use less than maximal sanctions for lower gain crimes to prevent over-deterrence of these crimes (Mookerjee and Png, 1992 and Shavell, 1991). Another explanation for less than maximal sanction is that the enforcement authority could make a "mistake" and sanction an innocent individual ((Ehrlich, 1975). Andreoni (1991) has argued convincingly on these grounds that juries which use the "reasonable doubt" criterion for determining guilt will be reluctant to convict a person if the sanction is high. Finally, Polinsky and Shavell (1979) showed that if criminals are risk averse, and if some crimes are "good" ones in the sense that the private gain to the criminal exceeds the social cost, it might not be optimal to impose a maximal sanction with a small probability of detection.

These reasons for the absence of maximal criminal sanctions tend to rely on imperfections in the ability of the judicial authority to impose such sanctions, such as incomplete information, or indirect social costs of imposing such sanctions. In these analyses, the optimal sanction is, in fact, less than maximal; because of the imperfections in the enforcement of crime, some criminal behavior is desirable at the optimum. Our analysis focuses on a different sort of reason why maximal sanctions might not be used, even though such sanctions are feasible and society would be better off if they were used. In particular we exploit the temporal structure of the crime and punishment system, especially the fact that sanctions are imposed after a crime has been committed and the criminal apprehended. Our argument is that while the optimal sanction for deterrence purposes is a maximal one, the enforcement authority may not be able to commit itself to enforce maximal sanctions because such a policy of maximal sanctions will not be time-consistent. The problem arises because, once a crime has been committed and the social damage done, punitive sanctions will be welfare reducing. A rational judicial system will therefore not be able to enforce maximal sanctions.

Our analysis is an application of the well-known problem of time inconsistency to the problem of criminal sanctions.[2] It exploits the intertemporal sequence of decisions taken by the criminals and the enforcement authority, that is, the courts or the judicial system. We contrast two cases. The first is that in which the courts can commit to enforcing a criminal sanction announced before the criminals act. This is the full commitment case. In our model, if the courts could commit to announced sanctions, the classic solution of a maximal sanction would be obtained. However, this case is not sustainable because maximal sanctions will not be a time- consistent

[2] A survey of various applications of the notion of time inconsistency to problems of macroeconomic policy and tax policy may be found in Persson and Tabellini (1990).

policy in the presence of criminal behavior. Therefore, we next investigate the case in which the courts cannot commit, and in which criminals rationally anticipate that the sanction set by the courts will be that which is optimally chosen after any crimes have been committed. The time-consistent solution, in contrast with the full commitment case, involves a minimal sanction because *ex post* the sanction merely imposes disutility on the criminals without the benefit of having a deterrent effect on them. The fact that maximal sanctions are not sustainable implies that even though crimes are socially bad and society would be better off without them, a rational judicial system would not be able to eliminate them.

The striking contrast between the full commitment outcome with its maximal sanction and the time-consistent one with its minimal sanction arises because we consider a static model in which criminals and the courts act only once. In fact, just as we do not observe maximal sanctions, so we do not observe minimal sanctions either. One reason for this is that in the real world the sequence of criminal behavior followed by punishment occurs repeatedly. In such a context, even though the courts continually act after crimes have been committed, presumably they can build a reputation for tougher than minimal behavior. We construct a simple model of repeated criminal behavior and show how in this case it is possible for an "interior" (non-extreme) sanction to be obtained. The enforcement authority would still rather not punish the past criminals. But because imposing a positive sanction helps to build the reputation that the enforcement authority is tough, and because such a reputation deters the future criminals, the optimal sanction can be positive without being maximal.

2. The Model

The model used is similar in structure to that introduced by Becker (1968). There are N risk-neutral individuals each endowed with the same initial wealth y. All of them are potential criminals, but they differ in the amount of private gain g they obtain from committing a crime. Individuals can be indexed by their levels of gain g, where g has a continuous distribution over $[g^\ell, g^h]$. The gain from committing a crime is private information, so the enforcement authority cannot observe the value of g for particular individuals. This implies that a criminal sanction cannot be made dependent on g. The authority does know the distribution $f(g)$. If an individual commits a crime, a cost Z per crime is imposed on society, where Z is the same for all criminals.[3] An important feature of the model is that we assume that $Z > g^h$;

[3] Assuming that damage from crimes is imposed on society at large rather than on identifiable

that is, every crime is socially undesirable.

Since crimes are costly to the society, there is an enforcement authority whose role is to apprehend and punish individuals who have committed a crime. The enforcement authority spends an amount m on apprehension effort. The probability that a criminal will be apprehended is linked to this apprehension effort through an apprehension function $p = p(m)$ which is increasing ($p' > 0$), strictly concave ($p'' < 0$), and has a value $0 < p(m) < 1$, $\forall m \geq 0$. Note that the latter property implies that the probability of apprehension is positive even if no resources are devoted to it. The apprehension effort is financed by a head tax at rate t. The budget constraint of the enforcement authority can therefore be written as $Nt = m$. If a criminal is caught, the enforcement authority imposes a costless (to the authority) non-monetary sanction s on him, where s can be freely chosen, but is the same for all criminals.[4]

For simplicity, we normalize the value of the sanction such that s is the monetary equivalent of the utility cost of the sanction of level s. The expected payoff of an individual who commits the crime may be written as:

$$E^A(g,p,s) = (1-p)(y-t+g) + p(y-t+g-s) \ .$$

Writing explicitly the dependence of p on m, and substituting in the enforcement authority's budget constraint, the expected payoff may be rewritten as:

$$(1) \qquad \begin{aligned} E^A(g,m,s) &= (1-p(m))\left(y - \frac{m}{N} + g\right) + p(m)\left(y - \frac{m}{N} + g - s\right) \\ &= y - \frac{m}{N} + g - p(m)s \ . \end{aligned}$$

The payoff to an individual who decides not to commit the crime is:

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individuals is standard in the literature. If the damage were imposed on individuals, our analysis could be interpreted as applying to the case in which the costs are redistributed among all individuals.

[4] The use of a non-monetary sanction is for simplicity only. The results obtained below are qualitatively similar for the case in which sanctions are monetary. Monetary sanctions add the unnecessary complication that they involve a redistribution of wealth whose effects must be taken into account in evaluating their optimal level.

$$E^{NA}(m) = y - t = y - \frac{m}{N} \,. \tag{2}$$

Note that $E^A(\cdot)$ is increasing in g, while $E^{NA}(\cdot)$ is constant.

The only decision taken by individuals is whether to commit a crime or not. Those for whom $E^A(g,m,s) > E^{NA}(m)$ will commit the crime, and vice versa. Since E^A is increasing in g, the population will divide itself between those with higher values of g who commit the crime and those with lower values who do not. It is useful to identify the marginal person who is just indifferent between committing and not committing the crime. This individual has g denoted by $\hat{g}$ defined by $E^A(\hat{g},m,s) = E^{NA}(m)$, or, from (1) and (2), by $\hat{g} - p(m)s = 0$. That is, for the marginal individual, the benefit from committing the crime g just equals the expected cost from being caught and sanctioned. Any individual with $g > \hat{g}$ will commit the crime while any with $g < \hat{g}$ will not. We have that $\hat{g} = \hat{g}(m,s)$, where $\partial\hat{g}/\partial m > 0$ and $\partial\hat{g}/\partial s > 0$. That is, if either the apprehension effort or the size of the sanction (or both) are increased, the value of g for the indifferent person will rise, so fewer people will commit the crime.

2.1 Enforcement Authorities Which Are Able to Commit

The problem of time consistency arises because criminal sanctions are applied only after the crimes have been committed and some criminals apprehended. The issue of time inconsistency involves whether a criminal sanction announced before crimes are committed (*ex ante*) will be enforced after criminals are caught (*ex post*). As we shall see, the optimal treatment of apprehended criminals when evaluated *ex post* by the enforcement authority is to renege on the announced policy. For now we consider the case in which the enforcement authority is able to announce a criminal sanction *ex ante* and carry out its announced policy *ex post*. This can be thought of as the first best outcome.

From the point of view of analysis, the enforcement authority takes all its decisions first, and then individuals decide whether to commit a crime, taking as given the sanctions and apprehension effort that the authority has announced. The authority anticipates the behavior of the individuals. Assuming that the enforcement authority chooses apprehension effort and the level of sanctions to maximize the sum of expected utilities,[5] its problem can be stated as follows:

[5] In this utilitarian social welfare function, the same weight is given to all individuals whether

$$(3) \quad \max_{\{m,s\}} \Omega = N \int_{g^l}^{\hat{g}(m,s)} E^{NA}(m) f(x) dx + N \int_{\hat{g}(m,s)}^{g^h} [E^A(x,m,s) - Z] f(x) dx \ .$$

Note that $\hat{g}(m,s)$ summarizes the individuals' behavior since it divides the population into those who commit the crime and those who do not. Clearly, the argument of Becker (1968) applies here: sanctions which are sufficiently high to deter all crime should be imposed. To see this, observe that the best outcome for society would be one where, at no costs, no crimes are committed. Now pick any g and find a combination of $\{m,s\}$ so that individual g^h does not commit the crime. If this person does not commit the crime, no other person will either. As long as $m > 0$, it is always possible to get the same deterrent effect by decreasing m and increasing s appropriately. Since s can be increased indefinitely at no cost and the costly m brought down to zero (recalling that $p(0) > 0$), there are a large number of solutions to this problem, each with $m = 0$ and $s \in [\tilde{s}, \infty]$ where $\tilde{s}$ is defined by $g^h - p(0)\tilde{s} = 0$. We refer to these sanctions which are sufficient to deter all crime given apprehension effort as "maximal" sanctions. With maximal sanctions, we have $\hat{g} = g^h$. Nobody commits the crime, no apprehension effort is used, and, therefore, no losses Z are incurred by society. A first best outcome is achieved with a fully committed enforcement authority.

This first-best outcome is sustainable if criminals anticipate that the announced maximal sanction will be applied in the event of a criminal being apprehended. If so, no crimes will actually occur and there will be no need for the courts actually to apply the maximal sanction. However, should any crimes actually occur, it is easy to see that the maximal sanction will not be time-consistent. That is, given an interior value for $\hat{g}$ and a prior value of $m = 0$, the derivative of the objective function in (3) with respect to the sanction s at the first best optimum yields

$$\frac{\partial \Omega}{\partial s} = -N \int_{\hat{g}}^{g^h} p(0) f(x) dx < 0 \ .$$

If individuals are rational they will recognize that the courts will not enforce maximal sanctions. Therefore, some will be inclined to commit a crime. We turn next

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they are criminals or not. In this respect, we follow the literature. This raises an interesting ethical issue. One could argue that a lower weight should be attached to the utility of criminals on the grounds that not only do the end results matter, but also the means of reaching them. Our qualitative results are not affected by giving a lower weight to criminals as long as that weight is not zero.

to the equilibrium that will occur when the individuals correctly anticipate the *ex post* behavior of the courts. This will be the time-consistent equilibrium with an enforcement authority which cannot commit.

2.2 Time-Consistent Sanctions

Suppose the enforcement authority cannot commit to fixed levels of m and s. Furthermore, individuals correctly expect that the authority will revise its policies *ex post* if criminals are apprehended, whatever the policies announced *ex ante*. Thus, the order in which decisions are taken is effectively reversed; the individuals take their decisions first and the enforcement authority second. The individuals anticipate the future behavior of the enforcement authority and the authority takes the individuals' behavior as given. We consider here the case where the enforcement authority can revise both the apprehension effort and the sanction *ex post*. The results obtained below would still hold if the authority was able to commit to fixed level of apprehension effort but not to the choice of the sanction.

To obtain the equilibrium solution when the enforcement authority cannot commit, we proceed by backward induction, first solving the authority's problem, then the'individuals'. *Ex post*, the enforcement authority solves the following problem:

$$(4) \quad \max_{\{m,s\}} N\int_{g^l}^{\hat{g}}\left(y-\frac{m}{N}\right)f(x)dx + N\int_{\hat{g}}^{g^h}\left(y-\frac{m}{N}+x-p(m)s-Z\right)f(x)dx,$$

where $\hat{g}$ is a fixed number since the crimes have already been committed. Since nothing can be done to change $\hat{g}$, m or s no longer have a deterrent effect. Imposing a positive sanction simply makes the caught criminals worse off. Therefore, the optimal sanction is $s = 0$. But since $s = 0$, there is no point in catching criminals. So the optimal apprehension effort is $m = 0$. Therefore, for any $\hat{g}$ observed *ex post* by the enforcement authority, the optimal policy is to set both m and s at zero. Rather than being maximal, the optimal sanction is now minimal.

In the first stage, the individuals will make their decision according to what they expect to occur *ex post*. Let s^e and m^e be the expected levels of s and m respectively. Then, $\hat{g}$ is defined by $\hat{g} = p(m^e)s^e$. An equilibrium will exist when the values of the enforcement authority's behavior expected by the individuals turn out to be the optimally chosen values *ex post*. In principle, there are two sorts of equilibria. One type is that analogous to the full commitment outcome in which

$\{s \geq \tilde{s}, m = 0\}$. In this type of equilibrium, the expected values held by individuals are $m^e = 0$ and $s^e \geq \tilde{s}$. Under these expected values, no crimes are committed, and *ex post*, the criminal authority's behavior fulfills the expectations. However, such an equilibrium is a weak one since it is not "trembling hand perfect".[6] That is, the equilibrium is a very tenuous one in the sense that if even one individual were to commit the crime, then the equilibrium would collapse since the enforcement authority would then want to set $s = 0$. Thus, if any one individual anticipated this reaction by the authority and committed the crime (i.e., behaved as a Stackelberg leader), the equilibrium would not apply. It seems reasonable, therefore, to look for another type of rational expectations equilibrium.

The only other sort of equilibrium is that in which some persons do commit a crime. As we have seen above, as soon as this is so, it must be the case that $s^e = s = 0$ and $m^e = m = 0$. Therefore, $\hat{g} = 0$. Everybody with a positive g commits the crime without being refrained in any way by the authority. Note that the social welfare achieved when the authority cannot commit is unambiguously inferior to that obtained when it can commit.[7]

To summarize, in this simple model when the enforcement authority cannot commit, we no longer obtain maximal sanctions. Indeed, we find the opposite extreme case of minimal sanctions. This is not completely satisfactory since we do not observe minimal sanctions either. This extreme case has arisen because of the fact that we have considered only a one-shot model. In fact, in the real world, crimes are continuously being committed and sanctions continuously being imposed. In such a setting, one might expect that the enforcement authority might be able to build a reputation for imposing more than the minimal sanctions. In the next section we present a repeated version of the above model and illustrate using a very simple example how reputations might sustain a policy of positive sanctions and deterrent effort.

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[6] The notion of trembling hand perfection was introduced by Selten (1975). A general discussion of it may be found in Kreps (1990) or in Binmore (1992).

[7] When the authority can commit, we have $\{s^C \geq \tilde{s}, m^C = 0\}$ and therefore, social welfare V^C is given by $V^C = Ny$. For the case where the authority cannot commit, we have $\{s^{NC} = 0, m^{NC} = 0\}$ so that $\hat{g} = 0$ and social welfare is given by $V^{NC} = Ny + N\int_{g^\ell}^{g^h} (x - Z) f(x) dx < Ny$ since $g^h < Z$.

3. Reputations

In this section, we retain the basic structure of the above model with an enforcement authority that cannot commit. We simply extend it to a setting in which the sequence of crime and enforcement are repeated indefinitely. There are no state variables, or other "real" links, connecting the various periods. However, the past behavior of the enforcement authority is known to all and this leads to the possibility of the authority building a reputation for tough enforcement. We consider the case in which the individuals have adaptive expectations.[8] This results in an interior solution for the sanction.

With adaptive expectations, the values of sanctions and enforcement effort expected by individuals are functions of past values. We take the case in which only the immediate past values are relevant so reputations last only one period. Formally, assume that values of s and m expected next period are increasing functions of the ones observed this period: $s^e_{t+1} = \theta_s(s_t)$ and $m^e_{t+1} = \theta_m(m_t)$. Given the inertia of the judicial system, it could be argued that these are reasonable expectations. For simplicity, consider the special case where $s^e_{t+1} = s_t$ and $m^e_{t+1} = m_t$; that is, expectations are static. Similar results would be obtained for more general forms of the increasing functions $\theta_s(s_t)$ and $\theta_m(m_t)$. The individuals behave in the same way as before and thus, we have $\hat{g}_t = \hat{g}(s^e_t, m^e_t) = \hat{g}(s_{t-1}, m_{t-1})$.

The enforcement authority is assumed to care for the future. Instantaneous social welfare is taken to be the sum of individuals' welfare as above. At time t it is defined as:

$$(5) \quad V_t(\hat{g}_t, s_t, m_t) = N \int_{g^l}^{\hat{g}_t} \left(y - \frac{m_t}{N}\right) f(x)dx + N \int_{\hat{g}_t}^{g^h} \left(y - \frac{m_t}{N} + x - p(m_t)s_t - Z\right) f(x)dx,$$

where, at the time the enforcement authority takes its decision, $\hat{g}_t$ is predetermined. Let δ be the discount factor applied by the enforcement authority to the social welfare of successive periods, where $0 \leq \delta < 1$. The authority's problem at time t

[8] An alternative way to model reputations is to use a repeated game framework with rational expectations. See, for example, the discussion in Persson and Tabellini (1990). These types of games can give rise to a large number of equilibria including interior ones similar to that discussed below.

is then to choose a sequence of s_τ and m_τ, $\tau = t, \cdots, \infty$, that solves the following problem:

$$\max_{\{s_\tau, m_\tau\}} W_t(\hat{g}_t) \equiv \sum_{\tau=t}^{\infty} \delta^{\tau-t} V_\tau(\hat{g}_\tau, s_\tau, m_\tau), \tag{6}$$

subject to $\hat{g}_t$ given and $\hat{g}_\tau = \hat{g}(s_{\tau-1}, m_{\tau-1})$, $\tau = t+1, \cdots$.

This can be solved using the techniques of dynamic programming. The Bellman equation for this problem is written:

$$W_t(\hat{g}_t) = \max_{s_t, m_t} \left\{ V_t(\hat{g}_t, s_t, m_t) + \delta W_{t+1}(\hat{g}_{t+1}(s_t, m_t)) \right\}, \tag{7}$$

where $\hat{g}_t$ is the state variable, and s_t and m_t are the control variables. The first order conditions for s_t and m_t are:

$$\frac{\partial V_t}{\partial s_t} + \delta \frac{\partial W_{t+1}}{\partial \hat{g}_{t+1}} \frac{\partial \hat{g}_{t+1}}{\partial s_t} = 0 , \tag{s_t}$$

$$\frac{\partial V_t}{\partial m_t} + \delta \frac{\partial W_{t+1}}{\partial \hat{g}_{t+1}} \frac{\partial \hat{g}_{t+1}}{\partial m_t} = 0 . \tag{m_t}$$

We already know from the static framework that $\partial V_t/\partial s_t < 0$ and $\partial V_t/\partial m_t < 0$; this is why it was optimal to set $s = m = 0$. The intuition was that, since the crimes have already been committed, having a positive sanction and enforcement effort cannot deter these crimes, it can only make the past criminals worse off. But here, the sanction imposed on past criminals and the level of enforcement effort chosen to catch them have a deterrent effect on future criminals; the second term of the right-hand side of equations (s_t) and (m_t) reflects that. Applying the envelope condition to (7) and using (5), we obtain $\partial W_{t+1}/\partial \hat{g}_{t+1} = NZf(\hat{g}_{t+1}) > 0$. And, since $\partial \hat{g}_{t+1}/\partial s_t > 0$ and $\partial \hat{g}_{t+1}/\partial m_t > 0$, the second terms on the right-hand side of equations (s_t) and (m_t) are positive. This reflects a future deterrent effect from current enforcement efforts. So, there are benefits and costs to a current positive sanction and enforcement effort: the costs are that past criminals are worse off; the

benefits are that there will be less criminals in the future. Since there are these counterbalancing effects, it is clearly possible to obtain an interior solution for the sanction and enforcement effort — $\{0 < s_\tau < \tilde{s}, m_\tau > 0;\ \tau = t, \cdots, \infty\}$ — unlike with the single-period case.

To summarize, in the absence of a reputational effect, an enforcement authority which cannot commit would choose a minimal sanction with no enforcement effort. However, in a dynamic framework when a reputation can be built, it is possible to obtain a positive (non-maximal) sanction and a positive enforcement effort because there are future benefits associated with being tough now.

4. Concluding Remarks

We have argued that one reason for the failure to observe maximal criminal sanctions in the real world has to do with the time inconsistency of such a policy. If sanctions are only applied after a crime has been committed, the enforcement authority may be reluctant to impose a high sanction since it will no longer have any deterrent effect. We have illustrated this using a simple model involving an enforcement authority and criminals. In the static version of this model, the potential criminals decide whether or not to commit crimes and the enforcement authority decides on sanctions and apprehension effort that deter crime. We obtained two types of equilibria, both involving extreme sanctions. If the enforcement authority can commit, then the classic maximal sanction with no enforcement effort is obtained. On the other hand, if the enforcement authority cannot commit, it is instead a minimal sanction with no enforcement effort that is obtained.

We then showed how it is possible to obtain equilibria in which sanctions are neither minimal nor maximal by introducing the possibility for the enforcement authority to build a reputation. We have shown this for the case of adaptive expectations. This may contribute to explaining why interior solutions tend to be observed in the real world.

References

Andreoni, J (1991), "Reasonable Doubt and the Optimal Magnitude of Fines: Should the Penalty Fit the Crime?" *Rand Journal of Economics* **22**, 385–95.

Bebchuk, L.A., and L. Kaplow (1992a), "Optimal Sanctions when the Probability of Apprehension Varies Among Individuals," NBER Working Paper No. 4078.

Bebchuk, L.A., and L. Kaplow (1992b), "Optimal Sanctions when Individuals are Imperfectly Informed About the Probability of Apprehension," *Journal of Legal Studies*, forthcoming.

Becker, G.S. (1968), "Crime and Punishment: An Economic Approach," *Journal of Political Economy* **76**, 169–217.

Binmore, K. (1992), *Fun and Games: A Text on Game Theory*, Lexington, Mass.: D.C. Heath and Company.

Cowell, F.A. (1990), *Cheating the Government: The Economics of Evasion*, Cambridge, Massachusetts: MIT Press.

Ehrlich, I. (1975), "The Deterrent Effect of Capital Punishment: A Question of Life and Death," *American Economic Review* **65**, 397–417.

Kaplow, L. (1990a), "Optimal Deterrence, Uninformed Individuals, and Acquiring Information about Whether Acts Are Subject to Sanctions," *Journal of Law, Economics, and Organization* **6**, 93–128.

Kaplow, L. (1990b), "A Note on the Optimal Use of Nonmonetary Sanctions," *Journal of Public Economics* **42**, 245–247.

Kreps, D.M. (1990), *A Course in Microeconomic Theory*, Princeton, New Jersey: Princeton University Press.

Malik, A.S. (1990), "Avoidance, Screening, and Optimum Enforcement," *Rand Journal of Economics* **21**, 341–353.

Mookherjee, D., and I.P.L. Png (1992), "Monitoring vis-à-vis Investigation Enforcement of Law," *American Economic Review* **82**, 556–65.

Persson, T., and G. Tabellini (1990), *Macroeconomic Policy, Credibility and Politics*, Switzerland: Harwood Academic Publishers.

Polinsky, A.M., and S. Shavell (1979), "The Optimal Tradeoff Between the Probability and Magnitude of Fines," *American Economic Review* **69**, 880–891.

Selten, R. (1975), "Re-examination of the Perfectness Concept for Equilibrium Points in Extensive Games," *International Journal of Game Theory* **4**, 25–55.

Shavell, S. (1987), "The Optimal Use of Nonmonetary Sanction as a Deterrent," *American Economic Review* **77**, 584–592.

Shavell, S. (1991), "Specific Versus General Enforcement of Law," *Journal of Political Economy* **99**, 1088–1108.