On Offense History and the Theory of Deterrence

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This article uses a two-period version of the standard economic model of deterrence to study whether sanctions should depend on an individual's record of prior convictions—his offense history. The principal contribution of the article is to demonstrate that it may be optimal to treat repeat offenders disadvantageously because such a policy serves to enhance deterrence: When an individual contemplates committing an offense in the first period, he will realize that if he is caught, not only will he bear an immediate sanction, but also—because he will have a record—any sanction that he bears in the second period will be higher than it would be otherwise. © 1998 by Elsevier Science Inc.

I. Introduction

A basic question in the theory of deterrence is whether the sanction imposed on an offender should depend on whether he was convicted previously: Should an illegally parked driver who has already received several tickets pay more than a violator who has not been ticketed before? Should a firm that pollutes bear a greater fine if it has been found guilty of having caused pollution in the past? Should an individual convicted of a criminal offense who has a record of prior offenses be penalized more than someone who does not?

In practice, the law often sanctions repeat offenders more severely than first-time offenders. Under the U.S. Sentencing Commission's sentencing guidelines for Federal

crimes, both imprisonment terms and criminal fines are enhanced if a defendant has a prior record.[1] Under the Clean Water Act, criminal fines of $2,500 to $25,000 per day of violation and/or an imprisonment term of up to 1 year may be imposed for first-time negligent violations; the maximum penalties are doubled for "subsequent offenses."[2] Civil money penalties also sometimes depend on whether the defendant has a record of prior offenses. For example, hiring, recruiting, and referral violations under the Immigration Reform and Control Act impose minimum fines of $250 for a first offense, $2,000 for a second offense, and $3,000 for subsequent offenses; in addition, "due consideration shall be given to . . . the history of previous violations" in setting penalties for paperwork violations.[3] Under the Occupational Safety and Health Administration Act, if an employer's violation is not found to be "willful or repeated" the maximum fine is $7,000, but if the violation is found to be willful or repeated, the maximum fine rises to $70,000.[4]

The question of whether sanctions should depend on prior convictions has not been adequately addressed in the standard economic model of deterrence.[5] The contribution of this article is to answer this question in a two-period version of the standard model. In our analysis, risk-neutral individuals choose whether to commit a harmful act in each period. The state sets the probability of apprehending offenders and the level of monetary sanctions. Sanctions in the second period can be made to depend on offense history.

Our main result is that it may be optimal for the sanction in the second period to depend on whether the offender has a record of a violation from the first period. Specifically, we show that the optimal sanction for a repeat offender in the second period could be higher than the optimal sanction for a first-time offender in the second period.[6] Treating repeat offenders disadvantageously may be beneficial because such a

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[1]In the case of imprisonment, the adjustment is complicated to describe. Various aspects of a defendant's criminal history are assigned "points" (for example, three points are added "for each prior sentence of imprisonment exceeding one year and one month"), the sum of which places the defendant in a "criminal history category" in a sentencing table. The higher the criminal history category, the longer the imprisonment term for a given "offense level." In the case of fines, courts are instructed to consider, among other things, "whether the defendant previously has been fined for a similar offense." See United States Sentencing Commission (1995, § 4A1.1, Ch. 5 Pt. A, and § 5E1.2). Under state criminal law statutes, repeat offenders also are often sanctioned more severely than first-time offenders. In Illinois, for example, a first offense for misdemeanor theft is punishable by a fine of up to $1,000 or an imprisonment term of up to 1 year, whereas a second conviction for the same offense may be treated as a felony with a fine of up to $10,000 and an imprisonment term of 1 to 3 years. See 720 Ill. Comp. Stat. 5/16-1(b)(1)-(2) (1997); 730 Ill. Comp. Stat. 5/5-8-1(a)(7), 5/5-8-3(a)(1), 5/5-9-1(a)(1)-(2) (1997).

[2]See 33 U.S.C. § 1319(c)(1) (1997). The maximum penalties for "knowing violations" and "knowing endangerment" of persons also are doubled for second convictions. See 33 U.S.C. § 1319(c)(2)-(3) (1997).

[3]See 8 U.S.C. § 1324a(e)(4)–(5) (1997).

[4]See 29 U.S.C. § 666(a)–(c) (1997).

[5]This is true despite the existence of a formal literature on issues related to offense history. See Rubinstein (1979, 1980), Landsberger and Meilijson (1982), Polinsky and Rubinfeld (1991), Burnovski and Safra (1994), and Chu et al. (1997). We comment on the relationship between our article and these earlier analyses in notes 16 and 26 below. See also Stigler (1970, pp. 528–529) and Posner (1992, pp. 231–233) for some brief informal observations about repeat offenders. In addition, we note that, somewhat surprisingly, there is very little attention paid in the traditional criminal law literature to the rationale for taking offense history into account in determining punishment. Early scholars, notably Beccaria (1775) and Bentham (1823), essentially ignore this topic. Many prominent recent treatises on criminal law also largely neglect the issue of repeat offenders. See, for example, Packer (1968), Kadish (1983), and LaFave and Scott (1986). But see von Hirsch (1976, pp. 84–88) and Fletcher (1978, pp. 459–466).

[6]We demonstrate also that the optimal sanction for a first-time offender in the first period equals the optimal sanction for a repeat offender in the second period. Thus, the optimal sanctions can be interpreted as rewarding good behavior (because the sanction in the second period is lowered if the offender does not have a record) rather than

policy serves to enhance deterrence: When an individual contemplates committing an offense in the first period, he will realize that if he is caught, not only will he bear an immediate sanction, but also—because he will have a record—any sanction that he bears in the second period will be higher than it would be otherwise.

It is important to note that this rationale for conditioning sanctions on prior convictions does not apply if deterrence in each period induces first-best behavior—that is, if it leads individuals to commit harmful acts if and only if their gains exceed the harm. Suppose, for example, that the sanction for polluting and causing a $1,000 harm is $1,000. Then anyone who pollutes and pays $1,000 is a person whose gain from polluting (say the money saved by not installing pollution control equipment) must have exceeded $1,000. Social welfare, therefore, is higher as a result of his polluting. If such an individual polluted and was sanctioned in the past, that only means that it was socially desirable for him to have polluted previously. Raising the current sanction because of his having a record of sanctions would overdeter him now.

Accordingly, only if deterrence is inadequate is it possibly desirable to condition sanctions on offense history to increase deterrence. In our analysis (and often, of course, in practice) deterrence will be inadequate. This is because it is too expensive for the state to expend the enforcement resources needed to achieve first-best deterrence. Making sanctions depend on offense history then may be beneficial because such a policy can reduce the extent of underdeterrence. (However, for reasons that will be explained, such a policy is not necessarily beneficial.)

We prove our main result in Section II and illustrate it with a numerical example in Section III. In Section IV we discuss an interpretation of the result, various extensions of the analysis, and other reasons for taking offense history into account—learning about offender characteristics, and incapacitating of hard-to-deter individuals.

II. The Basic Model

Assume that parties are risk neutral, that they can commit an act causing an external harm in each of two periods, and that if they commit the act, they obtain a benefit. The magnitude of the benefit is the same in both periods for a given individual but varies among individuals.[7] Specifically, define the following:

h = harm from committing the act;
b = benefit an individual obtains from committing the act;
$f(b)$ = density of benefits among individuals, $f(b)$ is positive in $[0, \infty)$.

The harm and the density of benefits among individuals are assumed to be known to the state, but not the benefit obtained by a particular individual.[8]

The state chooses the probability of apprehending offenders (those who commit the

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penalizing bad behavior (because the sanction imposed on a repeat offender is the same as that imposed on him for his first offense). In the "Interpretation of Optimal Sanctions" part of Section IV below we explain why we believe that this feature of the optimal solution in our model—treating repeat offenders disadvantageously by using a carrot rather than a stick—is not of general significance.

[7]Our results would not be affected if the benefit varied between periods for a given individual. See "Information about Offenders" in Section IV below.

[8]In the "Standard of Liability" part of Section IV, we consider the possibility that the state can observe an individual's benefit and can condition liability on whether his benefit is less than the harm (that is, that the state can employ the negligence rule). We explain there why our qualitative results would not be affected.

harmful act). We assume for simplicity that this probability is the same in both periods.[9] To achieve a given probability of apprehension requires an enforcement expenditure, which is increasing in the probability. Let

p = probability of apprehending offenders;
$e(p)$ = enforcement expenditure, $e'(p) > 0$.

The state also chooses three monetary sanctions:

s_1 = sanction for offense in Period 1;
s_2 = sanction for offense in Period 2 if there is no record of a previous offense;
s_r = sanction for offense in Period 2 if there is a record of a previous offense.

These sanctions cannot exceed some maximal sanction, which can be interpreted as the (common) wealth of individuals. Let

s_m = maximal sanction,

so that the s_i cannot exceed s_m.

Now consider the decision of an individual whether to commit the offense. In the second period, a person who has no record of offenses—either because he did not commit the offense in the first period or because he did but was not apprehended—will commit the offense if

$$b \geq ps_2, \tag{1}$$

and if he has a record he will commit it if

$$b \geq ps_r. \tag{2}$$

In the first period, a person's decision is more complicated because he must take into account how his action in the first period will affect his expected sanction and the decision in the second period. There are several cases that need to be examined.

First, consider a person for whom both (1) and (2) hold—who will commit the offense in the second period regardless of whether he has a record from the first period. If this person commits the offense in the first period as well, his expected utility over the two periods is[10]

$$2b - p(s_1 + ps_r) - (1 - p)ps_2, \tag{3}$$

for if he is caught in the first period, he will then face the sanction s_r in the second period; and if he is not caught in the first period, he will face s_2 in the second period. If he does not commit the offense in the first period, his expected utility is

$$b - ps_2. \tag{4}$$

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[9]In practice, it may be undesirable or difficult to alter the probability of apprehension, at least in the short run. For example, the substantial cost of training police makes it inefficient to vary the size of the police force frequently; and legislative inertia may have the consequence that the funds available to enforcement agencies are fixed for long periods. Nevertheless, were we to assume that the probability can be chosen independently in each period, our main result still would hold because it would remain true that treating repeat offenders disadvantageously in the second period increases deterrence in the first period.

[10]For simplicity, we assume that there is no discounting of utility.

Comparing (3) and (4), we see that he will commit the offense in the first period if and only if

$$b \geq ps_1 + p(ps_r - ps_2). \tag{5}$$

The interpretation of this is as follows. If a person commits the offense in the first period, he not only bears the expected sanction, ps_1, but also, if caught, alters his expected sanction in the second period from ps_2 to ps_r. If s_r exceeds s_2, the change in his second-period expected sanction increases deterrence in the first period. If s_r is less than s_2, the change reduces first-period deterrence. If s_r equals s_2, there is no change in his second-period expected sanction, so first-period deterrence is not affected.

Now consider a person for whom (1) holds but (2) does not—who will commit the offense in the second period if and only if he does not have a record from the first period. Note that this can occur only if $s_r > s_2$. If such a person commits the offense in the first period, his expected utility over the two periods is (6)

$$b - ps_1 + (1 - p)(b - ps_2), \tag{6}$$

and if he does not commit the offense in the first period, his expected utility is given by (4). Thus, he will commit the offense in the first period if and only if

$$b \geq ps_1 + p(b - ps_2). \tag{7}$$

The interpretation of (7) is that if a person commits the offense in the first period, he not only bears the expected sanction, ps_1, but also, if caught, forgoes the surplus he would have obtained from committing the offense in the second period.

Next, consider a person for whom (2) holds but (1) does not—who will commit the offense in the second period if and only if he has a record from the first period. This can occur only if $s_r < s_2$. Reasoning that is analogous to that in the previous paragraph implies that he will commit the offense in the first period if and only if

$$b \geq ps_1 - p(b - ps_r). \tag{8}$$

In this case, deterrence in the first period is *reduced* from ps_1 because, if a person commits the offense in the first period and is caught, he faces a lower sanction than he otherwise would have in the second period (which will induce him to commit the offense and to obtain a net benefit in that period).

Finally, consider a person for whom neither (1) nor (2) holds—who will not commit the offense in the second period regardless of whether he has a record from the first period. Such a person will commit the offense in the first period if and only if

$$b \geq ps_1. \tag{9}$$

This completes the description of how individuals make decisions in the two periods, given the sanctions.

We will refer to the critical level of benefit that determines individual behavior in the first period—that is, the right-hand side of (5), (7), (8), or (9)—as the *effective expected sanction* in the first period. The effective expected sanction incorporates the consequence of any change in the second-period sanction on first-period behavior; the expected sanction in the first period without this effect taken into account is ps_1. (Because there are only two periods, there is no need for a comparable distinction in the second period.)

Social welfare is defined to be the benefits obtained by individuals from committing

the harmful act, less the harm done, and less the enforcement expenditure of the state. The actual imposition of sanctions is assumed to be socially costless because the sanctions are monetary (and individuals are risk neutral).[11]

The state's problem is to choose the probability of apprehension and the magnitudes of the three sanctions so as to maximize social welfare. We assume that the solution is such that the probability is positive; otherwise, the problem is not interesting. An asterisk is used to indicate the optimal values of the variables.[12]

We now present our main results.

PROPOSITION 1: *Under the optimal system of enforcement:*

(a) *The first-period sanction is maximal:* $s_1^* = s_m$.
(b) *The second-period sanction for offenders without a record is less than or equal to that for offenders with a record, which is maximal:* $s_2^* \leq s_r^* = s_m$. *Furthermore,* $s_2^* < s_r^*$ *is possible.*
(c) *The probability of detection,* p^*, *is such that* $p^* s_m < h$.
(d) *In both periods, there is some underdeterrence—some individuals commit the offense even though their benefit is less than the harm.*

PROOF: *See the Appendix.*

Our principal point in Proposition 1 is (b), which is to say that it may be optimal in the second period to lower the sanction for offenders without a record below the sanction for repeat offenders.[13]

The intuition behind the proof of Proposition 1 is as follows.[14] We first demonstrate that when the probability of detection is chosen optimally, p^* is such that $p^* s_m < h$. Were this not the case, then either $p^* s_m > h$ or $p^* s_m = h$. If $p^* s_m > h$, then first-best behavior could be achieved by setting the sanctions less than maximally, such that $p^* s_1 = p^* s_2 = p^* s_r = h$. But this p^* cannot be optimal (for reasons that are familiar from the literature on the economic theory of deterrence): To save enforcement costs, it would be desirable to raise the sanctions to the maximum sanction and then to lower p to the lowest level that still allows the first-best outcome to be achieved, that is, to $p = h/s_m$. Then it would be desirable to lower p even more because, when deterrence is first-best, the marginal social loss due to underdeterrence is zero (the individuals at the margin are those for whom the benefit from committing the offense just equals the harm), yet there is a positive marginal savings in enforcement costs. If, alternatively, $p^* s_m = h$, then p^* cannot be optimal by the reasoning in the preceding sentence alone.

After showing that p^* is such that $p^* s_m < h$, we demonstrate that, were sanctions not to depend on offense history, social welfare possibly can be improved. If sanctions do not depend on offense history, that is, if $s_r = s_2$, then it is clear that the sanctions in the

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[11]We explain in the "Imprisonment" part of Section IV why our conclusions would be essentially the same if sanctions were costly to impose.

[12]The model that we have described can be interpreted as an overlapping-generations model in which each generation of individuals lives for two periods, with a new generation entering the population in each period. Thus, in every period, there is a young and an old generation in the population, and s_1 would be the sanction imposed on a young first-time offender, s_2 would be the sanction imposed on an old first-time offender, and s_r would be the sanction imposed on an old repeat offender.

[13]As observed in note 6 above, although the optimal sanctions in our analysis reward good behavior, we explain in the first part of Section IV below why, more generally, optimal sanctions may have the character of penalizing bad behavior.

[14]Not all of the steps in the proof are discussed here.

first and second periods should be equal because the problems in each period are identical; moreover, the sanctions should be maximal, because otherwise the sanctions could be raised and the probability lowered, saving enforcement costs without affecting deterrence. However, because there will be underdeterrence—because $p^* s_m < h$—it would be beneficial to increase deterrence in each period.

To continue, now consider lowering s_2 below $s_r = s_m$, so that first-time offenders in the second period bear lower sanctions than repeat offenders (note that this cannot be accomplished by raising s_r because s_r already is maximal). Setting s_2 below $s_r = s_m$ will have two effects. Obviously, it will reduce deterrence in the second period for individuals without a record because s_2 will now be lower than s_m. But it will augment deterrence in the first period because now the consequence of committing an offense in the first period not only will be the risk of a sanction in the first period, but also the chance (equal to the probability that the individual is apprehended in the first period) that the sanction will be higher than it otherwise would be in the second period (because $s_2 < s_r$).

The increase in deterrence accomplished in the first period could outweigh in importance the decrease in deterrence in the second period (whether this is so depends on the density of individuals' benefits above and below $p^* s_m$). If the first-period increase in deterrence is more important, then it is optimal for s_2 to be less than $s_r = s_m$, in other words, for individuals without a record in the second period to be sanctioned less.[15] Otherwise, optimal sanctions are all maximal, which means that sanctions should not depend on offense history.[16]

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[15]For the first-period increase in deterrence to be more significant than the second-period decrease in deterrence, it must be that more individuals are deterred whose gains are above $p^* s_m$ than are induced to commit whose gains are below $p^* s_m$. A sufficient condition for this to occur is that the density of individuals' benefits is rising sufficiently steeply in some relevant range around $p^* s_m$. However, as will become evident from Step 5 of the proof in the Appendix, there is no simple way to characterize the class of densities for which the first-period increase in deterrence is more important than the second-period decrease in deterrence.

[16]Having now described our model and results, it will be useful to comment on how the literature cited in note 5 above differs from our analysis. Rubinstein (1979) studies how offense history should be taken into account in deciding whether or not to impose an exogenously determined sanction; he does not derive the optimal level of sanctions as a function of the number of offenses. Rubinstein (1980) shows that a policy of sanctioning repeat offenders more harshly than first-time offenders can increase deterrence, but he does not consider whether such a policy is socially optimal (where social welfare includes the gains to offenders and the harms to victims). The analytical difficulties in our proof below have to do with establishing that sanctions that depend on offense history may be optimal, not merely with establishing that such sanctions can increase deterrence. Polinsky and Rubinfeld (1991) do derive optimal sanctions as a function of the number of offenses, but they make the nonstandard assumption that part of the injurer's gain is illicit and does not count in social welfare. Burnovski and Safra (1994) study the deterrent effects of conditioning sanctions on offense history, but they assume that potential offenders must decide *ex ante* how many offenses to commit (and, therefore, cannot change their behavior if they are apprehended and face different future sanctions as a result). Chu et al. (1997) show that sanctions should be higher for repeat offenders than for first-time offenders, but their focus is on minimizing erroneous convictions of innocent individuals. Notably, all of these articles also assume that the probability of apprehension is fixed. But if the probability of detection is fixed (and high enough), then first-best deterrence can be achieved by imposing the same sanction ($s = h/p$), regardless of the number of prior offenses. As we have emphasized (in the Introduction and in the discussion following Proposition 1), when the probability is variable, the optimal probability is such that underdeterrence results—in which case making sanctions depend on offense history might be a socially desirable way to increase deterrence. Although Landsberger and Meilijson (1982) also allow the probability of detection to vary, their concern is with how the probability should depend on the number of offenses, not on how sanctions should depend on offense history. [See note 26 below for further discussion of Rubinstein (1979), Polinsky and Rubinfeld (1991), and Chu et al. (1997).]

III. Numerical Example

The principal results of this article can be illustrated using the following numerical example. Let the harm be $55 and the benefit from committing the act be distributed on the integers from $1 to $100, with a density that begins with a flat region, rises linearly to a peak, and then declines linearly to another flat region.[17] The maximum sanction is $150. The cost in dollars of achieving a probability of detection equal to p is assumed to be $10\exp(100p - 29)$.

We first show that it is optimal for the sanction for first-time offenders in the second period, s_2, to be less than the sanction for repeat offenders in the second period, s_r. Proposition 1 established that the latter sanction is maximal, so it is $150 in the example. Proposition 1 also demonstrated that the optimal sanction in the first period, s_1, is maximal. Thus, $s_1^* = s_r^* = s_m = \$150$. Using this information, it can be calculated that the optimal probability of detection, p^*, is 0.27 and that the optimal sanction for first-time offenders in the second period, s_2, is $71.[18] Thus, the optimal sanction in the second period is less than half as high if a person does not have a record than if he does. In other words, it is socially advantageous to substantially lower the second-period sanction for offenders without a record.

To see why taking offense history into account is desirable in the example, consider the effects of lowering s_2 from the maximal sanction, $150, to the optimal sanction, $71. If s_2 were equal to $150, then the expected sanction in both periods would be $40.50 ($=0.27 \times \$150$). By lowering s_2 to $71, the *effective* expected sanction in the first period rises to $46.26 [$=(0.27 \times \$150) + 0.27[(0.27 \times \$150) - (0.27 \times \$71)]$, as derived in (5)]. This has the effect of deterring individuals who obtain benefits of $41 through $46, who constitute 35.1% of the population (see note 17) and who would not be deterred if the expected sanction were $40.50. Deterring them is desirable because their commission of the act causes a harm of $55.

However, lowering s_2 from $150 to $71 reduces deterrence in the second period for individuals without a record. Their expected sanction falls from $40.50 to $19.17 ($=0.27 \times \$71$). Consequently, individuals with benefits of $20 through $40 now commit the act, but they would not have if the sanction were maximal. Because such individuals constitute only 11.1% of the population[17], the social welfare loss from their commission of the harmful act is more than offset by the social welfare gain from the additional beneficial deterrence in the first period (which, recall, involved 35.1% of the population).

Let us now measure the value of taking offense history into account in the example. If sanctions are constrained to be independent of offense history, the optimal probability of detection is 0.26, the optimal sanction is maximal, $150, and the resulting level of social welfare is $130. If offense history is taken into account in the optimal way, as described above, social welfare rises to $440—more than tripling. Thus, in this example, making sanctions depend on offense history leads to a substantial improvement in social welfare.

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[17]The density used in the example is 1/190 for $b = \$1, \ldots, \$40$, 1/57 for $b = \$41$, 2/57 for $b = \$42$, 3/57 for $b = \$43$, 4/57 for $b = \$44$, 5/57 for $b = \$45, \$46$, 4/57 for $b = \$47$, 3/57 for $b = \$48$, 2/57 for $b = \$49$, 1/57 for $b = \$50$, and 1/190 for $b = \$51, \ldots, \$100$. The assumption that the distribution is discrete rather than continuous is made to simplify the calculations. We assume that there are a thousand individuals in the population (this only affects the scale of social welfare).

[18]We used a computer to calculate social welfare for values of p in increments of 0.01 from 0.01 to 1 and for values of s_2 in increments of $1 from $1 to $150.

The example easily can be modified to illustrate the result that it may be optimal *not* to make sanctions depend on offense history. If the density of benefits among individuals is uniform, 1% for each level of benefit, it can be calculated that the optimal sanctions are all maximal: $s_1^* = s_2^* = s_r^* = s_m = \$150$. With a uniform density, the advantage of using offense history—achieving greater deterrence in the first period—cannot outweigh its disadvantage—diminishing deterrence in the second period.[19]

IV. Concluding Remarks

In this section, we discuss an interpretation of our result, various extensions of the analysis, and other reasons for taking offense history into account.

Interpretation of Optimal Sanctions

In our model, the optimal sanctions can be characterized as rewarding good behavior, because the sanction in the second period is lowered if the offender does not have a record of prior convictions (this occurs when s_2^* is strictly less than $s_r^* = s_1^* = s_m$). However, in more general models than the one we examined, we believe that penalizing bad behavior could be optimal—that is, it could be optimal for the sanction imposed on a repeat offender to exceed the sanction imposed on him for his first offense ($s_r > s_1$).[20] Thus, the important lesson from our analysis is that it may be optimal to take offense history into account in a way that disadvantages repeat offenders, not that this be done in a particular manner. As long as having a record of prior offenses disadvantages an individual—whether this is achieved by lowering sanctions for not having a record or raising sanctions for having a record—deterrence will be enhanced in early periods because the effective sanction if an individual commits an offense and is caught will exceed the immediate sanction imposed; it will include the expected cost from having to bear sanctions in the future that are higher than they would be otherwise.[21]

Multiple Periods

The result that it may be optimal to make sanctions depend on offense history would hold if the number of periods is three or more. For it would still be true that the effect of sanctioning individuals less severely if they do not have a record of offenses would be to increase deterrence in prior periods, because committing an offense in an earlier

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[19]This result is suggested by the discussion in Step 5 of the proof, especially the discussion after (A8). There it is shown that if s_2 is lowered marginally from s_m, the detrimental effect on deterrence in Period 2 is multiplied by p, whereas the beneficial effect on deterrence in Period 1 is multiplied by p^2, a smaller factor. If the density of benefits is uniform, the beneficial effect in Period 1 remains smaller than the detrimental effect in Period 2, no matter how much s_2 is lowered.

[20]The reason this result did not occur in our model is that it is optimal for the first-period sanction, s_1, to be maximal (why this is so is complicated and requires a reading of Step 3 of the proof to understand). Hence, the sanction for a repeat offender, s_r, cannot be higher in our model. However, in models incorporating considerations that we have not taken into account, s_1 may not be maximal. For example, it is well known that if individuals are risk averse, optimal sanctions generally are not maximal; or considerations of fairness might constrain the sanction imposed on first-time offenders but not on repeat offenders. In such models, it will be possible for s_r to exceed s_1 and will be potentially desirable for this to occur to enhance deterrence (essentially for the reasons we have given).

[21]A natural question that might occur to the reader is whether, in our model, penalizing bad behavior might be optimal if rewarding good behavior is precluded (in other words, whether it could be optimal for s_r to exceed s_2 if s_1 and s_2 are constrained to be equal). For the reason we explain in note 30 below, we do not believe that penalizing bad behavior would be optimal in this case.

period would raise the applicable sanctions in later periods. Although we have not formally analyzed a model with three or more periods, we believe that the optimal structure of sanctions would have the properties that, in each period, optimal sanctions are nondecreasing in the number of prior convictions, and that the sanction for individuals with the highest possible number of prior offenses is maximal. This is the natural generalization of the result in the two-period case.

Risk Aversion

If individuals are risk averse, the optimal fine and probability combination will differ from that in the risk-neutral case. But it is still possible that, if the fine is constrained to be independent of offense history, the resulting fine and probability combination will lead to underdeterrence. Then, making sanctions depend on offense history could affect deterrence in a socially beneficial way for the reasons we have discussed in this article. Although the consequences for risk allocation of such a policy also would have to be taken into account, it is clear that any adverse risk-allocation effect could be dominated by a beneficial deterrence effect.

Standard of Liability

We assumed that an injurer who is apprehended will be found liable regardless of his benefit from committing the offense, in other words, that he is subject to the rule of strict liability. Although this is the standard assumption made in the economic analysis of deterrence, the question arises of whether our results would be affected if liability were determined under the main alternative to strict liability, the negligence rule, under which an injurer would be found liable only if his act is undesirable. The natural interpretation of this rule in our model is that an injurer would be liable only if his benefit from committing the offense is less than the harm. Under the negligence rule, it can be demonstrated easily that if sanctions do not depend on offense history, the optimal choice of the probability of apprehension and the sanction leads to underdeterrence.[22] Hence, for reasons essentially identical to those under the strict liability rule, treating repeat offenders disadvantageously in the second period may be beneficial because such a policy increases deterrence in the first period.

Imprisonment

Our analysis assumed that the sanction was a fine and that fines are socially costless to impose. Suppose instead that the sanction is socially costly, in particular, an imprisonment term. It seems clear that taking offense history into account also can be optimal in this case, and for essentially the same reasons that were applicable in the case of fines. If the imprisonment term were constrained to be independent of offense history, the optimal imprisonment term combined with the optimal probability of detection could result in underdeterrence.[23] In a two-period model, lowering the imprisonment sanction for first-time offenders in the second period—so that repeat offenders are treated disadvantageously—would, as in the case of fines, increase deterrence in the first period

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[22]The proof of this claim is essentially identical to the corresponding proof under strict liability; see Step 1 of the proof in the Appendix.

[23]Either underdeterrence or overdeterrence could be optimal in the case of imprisonment. See Polinsky and Shavell (1984, p. 94).

and reduce deterrence in the second period. The net effect of these deterrence changes could be socially beneficial for the reasons discussed in the case of fines and could exceed in importance any adverse consequences for the social cost of imprisonment.[24]

First-Best Deterrence

As we mentioned in the introduction, when deterrence is first-best, it is not optimal for sanctions to depend on offense history—there is no need to increase deterrence. There may be situations in which deterrence will be approximately first-best. Suppose, for example, that the cost of detection is very low. Then it will be optimal to set the probability of detection such that the expected fine almost equals the harm, thereby roughly inducing first-best behavior and obviating the need to take offense history into account.[25]

Information about Offenders

The fact that an individual has a record of prior offenses might be thought to provide information about a characteristic of that individual, such as a higher-than-average propensity to commit offenses, that justifies raising the sanction.[26] However, information about offenders is *not* the basis in our analysis for making sanctions depend on offense history. Rather, the potential value of taking offense history into account that we have emphasized is that such a policy can enhance deterrence in earlier periods. This effect operates even if there are no characteristics of individuals to be learned about. To see this, suppose our model were modified so that individuals are identical *ex ante*, with each individual's gain in each period being the realized value of a random variable having the same distribution. By construction, there is nothing to learn about an individual. Yet, what is crucial for our main conclusion would still be true: Deterrence in the first period would be enhanced by a policy of treating repeat offenders disadvantageously in the second period. The reason is that, as long as there is a positive probability that an individual would want to commit the offense in the second period, deterrence in the first period can be increased by making the second-period sanction depend on offense history; and there is a positive probability that an individual will want to commit an offense in the second period because his gain in the second period is random and might be sufficiently high.

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[24]Indeed, the effect on the social cost of imprisonment could be beneficial too. For example, suppose that the number of individuals who are induced to commit the harmful act in the second period as a result of lowering the imprisonment term for first-time offenders in the second period is negligible, but that the number of individuals thereby deterred in the first period is significant. Then, not only will deterrence be improved, but also the aggregate social cost of imprisonment will decline as well.

[25]Even if detection is costly, it can be shown that deterrence will be first-best for acts resulting in harms below a threshold, provided that the probability of detection is the same for all acts. See Shavell (1991).

[26]The information-based reason for taking offense history into account is examined in Rubinstein (1979), Polinsky and Rubinfeld (1991), and Chu et al. (1997). In Rubinstein (1979), individuals can commit offenses either deliberately or accidentally; a history of offenses indicates that an individual probably acted deliberately. In Polinsky and Rubinfeld (1991), individuals differ in terms of the level of an illicit gain they obtain from committing an offense; a history of offenses indicates that an individual's illicit gain is likely to be high. In Chu et al. (1997), individuals may be falsely convicted of offenses; a history of offenses suggests that an individual probably committed an offense. In all three models, a record of prior offenses signals the need for more deterrence and may make it socially desirable to have sanctions depend on offense history.

Incapacitation

Although we have focused on a deterrence-based reason for taking offense history into account in setting sanctions, there also may be an incapacitation-based rationale for such a policy. Incapacitation will be especially valuable when the level of deterrence is quite low (which might be the result of limited sanctions and/or of a low probability of detection). A low level of deterrence implies that there will be offenders who obtain gains far below the harm caused. Even if these individuals cannot be deterred, they can be prevented from committing offenses if they are incapacitated—put in jail.[27] Because imprisonment is a socially costly sanction, it makes sense only to use it to incapacitate those individuals who would commit a relatively high number of offenses. If individuals systematically differ in terms of the number of offenses that they would commit,[28] then repeat offenders are, on average, more likely than individuals without a record to commit offenses in the future. In other words, a record of prior offenses conveys information about the future likelihood of an individual to commit offenses. Hence, to cost-effectively reduce the commission of future offenses, it is best to incapacitate repeat offenders.[29]

Appendix

The Appendix contains the proof of Proposition 1. We proceed in a number of steps.

Step 1: $p^*s_m < h$

To demonstrate this, suppose that p is such that $ps_m \geq h$ or, equivalently, $s_m \geq h/p$. Then it is feasible to set $s_1 = s_2 = s_r = h/p$, in which case $ps_1 = ps_2 = ps_r = h$. These sanctions will induce individuals to commit the offense if and only if $b \geq h$ and result in social welfare equal to

$$2 \int_h^\infty (b - h)f(b)\,db - e(p). \tag{A1}$$

Given p, and hence e, this level of social welfare obviously cannot be improved on. However, because (A1) is decreasing in e, it is clear that if $ps_m > h$, social welfare can be raised by lowering p until $ps_m = h$ and then by setting $s_1 = s_2 = s_r = s_m$. Thus, $p = h/s_m$ dominates any higher p.

Now hold the sanctions fixed at s_m and consider social welfare for p such that $p \leq h/s_m$. Social welfare then is

$$2 \int_{ps_m}^\infty (b - h)f(b)\,db - e(p). \tag{A2}$$

The derivative of (A2) with respect to p is (A3)

$$-2s_m(ps_m - h)f(ps_m) - e'(p). \tag{A3}$$

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[27]On the theory of incapacitation, see Shavell (1987).

[28]This might be because they have different propensities to commit offenses (some individuals have a lower threshold of anger) or different opportunities to commit offenses (individuals who work in financial institutions are in a better position to embezzle).

[29]A rationale similar to what we discuss in this paragraph is sometimes mentioned in the criminal law literature. See, for example, Fletcher (1978, p. 466) and Posner (1985, p. 1216).
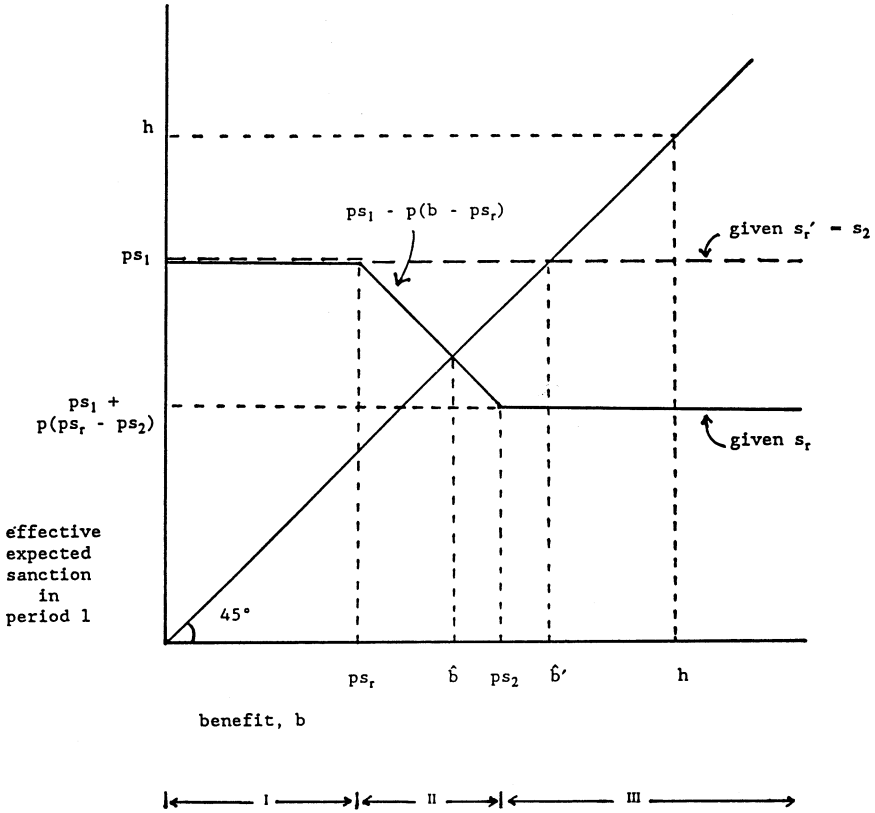
FIG. 1. Step 2 of proof.

At $p = h/s_m$, this equals $-e'(p)$, so social welfare is increased by lowering p below h/s_m. Because for $p \geq h/s_m$, social welfare when sanctions are *optimal* is given by (A1), and because social welfare can be raised above (A1) if p is lowered below h/s_m, the optimal p must be less than h/s_m.

Step 2: $s_2^* \leq s_r^*$

Assume otherwise, that $s_r < s_2$. We will show that this leads to a contradiction, because, whenever $s_r < s_2$, social welfare can be increased if s_r is raised to $s_r' = s_2$. Figure 1 will be used to demonstrate this result.

Classify individuals into three groups, depending on their benefit, b. Let Group I be those individuals for whom $b < ps_r$; let Group II be those for whom $ps_r \leq b < ps_2$; and let Group III be those for whom $ps_2 \leq b$. Group I individuals will not commit an offense in the second period regardless of whether they have a record. Group II individuals will commit an offense in the second period if and only if they have been convicted previously. And Group III individuals will commit an offense in the second period regardless of whether they have a record. These groups are demarcated along the line below the horizontal axis in Figure 1.

We now show that, in Period 1, the effective expected sanction is suboptimal—that is,

it is less than harm h—for each of the three groups. For Group I individuals, this is true because they commit offenses according to (9), and $ps_1 \leqslant ps_m < h$ (where the second inequality was demonstrated in Step 1 above). Group II individuals commit offenses according to (8), so the same logic applies, because as the right-hand side of (8) is less than the right-hand side of (9). And similarly for Group III individuals, the right-hand side of (5) is less than the right-hand side of (9) (given the premise that $s_r < s_2$).

In Figure 1, the solid line labeled "given s_r" depicts the effective expected sanction in Period 1 when s_r is the sanction for repeat offenders in Period 2. Because $ps_1 \leqslant ps_m < h$, the horizontal line at the height h must be above ps_1.

Observe that if s_r is raised to $s_r' = s_2$, the sanction that an individual will face in Period 2 is independent of his behavior in Period 1; hence, the effective expected sanction in Period 1 is simply ps_1 (for individuals in all three groups). This is illustrated in Figure 1 by the dashed line labeled "given $s_r' = s_2$."

Next, consider how the behavior of individuals in the first period changes when s_r is raised to s_r'. When the sanction for repeat offenders is s_r, let $\hat{b}$ be the level of benefit such that individuals will commit the offense in the first period if and only if their benefit equals or exceeds $\hat{b}$. Analogously, let $\hat{b}'$ be the critical level of benefit for committing the offense in the first period when $s_r' = s_2$ is the sanction for repeat offenders. In terms of Figure 1, $\hat{b}$ occurs where the 45° line intersects the solid line labeled "given s_r", and $\hat{b}'$ occurs where the 45° line intersects the dashed line labeled "given $s_r' = s_2$." Note that $\hat{b}'$ must be less than h because $ps_1 \leqslant ps_m < h$.

Assume that, as shown in Figure 1, the 45° line intersects both effective expected sanction schedules to the right of ps_r (we examine the alternative assumption below). In this case, $\hat{b} < \hat{b}'$. This means that there are some individuals—those with benefits between $\hat{b}$ and $\hat{b}'$—who would commit the offense in Period 1 when the sanction for repeat offenders in Period 2 is s_r but who will not commit the offense in Period 1 when the sanction for repeat offenders is raised to $s_r' = s_2$. Because $b < \hat{b}' < h$ for these individuals, this additional deterrence is beneficial. In other words, if s_r is raised to $s_r' = s_2$, social welfare in Period 1 increases.

Now consider how individual behavior and social welfare in Period 2 are affected when the sanction for repeat offenders is raised from s_r to $s_r' = s_2$. Before the change from s_r to s_r', an individual either faces a sanction of $s_r < s_2$ or s_2. After the change, the individual faces s_2 for sure (because $s_r' = s_2$). Hence, the change from s_r to s_r' can only increase his sanction and thus (because $ps_2 \leqslant ps_m < h$) can only raise social welfare in Period 2.

Because social welfare in Period 1 rises, and because social welfare in Period 2 rises or remains the same, increasing s_r to $s_r' = s_2$ raises social welfare.

The preceding discussion assumed that the 45° line in Figure 1 intersected both effective expected sanction schedules to the right of ps_r. If the intersection occurs at or to the left of ps_r, then $\hat{b} = \hat{b}'$ and there is no effect on behavior or social welfare in Period 1 as a result of raising s_r to $s_r' = s_2$. However, social welfare in Period 2 will rise, for the following reason. Individuals who commit the offense in Period 1 are those for whom $b \geqslant \hat{b} = \hat{b}'$, where $\hat{b} = \hat{b}' \leqslant ps_r < ps_r' = ps_2$. Hence, there will be a group of individuals—those for whom $ps_r \leqslant b < ps_2$—who will commit offenses in Period 1 and who, if caught, will be deterred in Period 2 if the sanction for repeat offenders is $s_r' = s_2$, but not if it is s_r. Because, for these individuals, $b < ps_2 \leqslant ps_m < h$, social welfare will rise in Period 2.

The contradiction now has been established: Whenever $s_r < s_2$, social welfare can be increased by raising the sanction for repeat offenders to s_2.
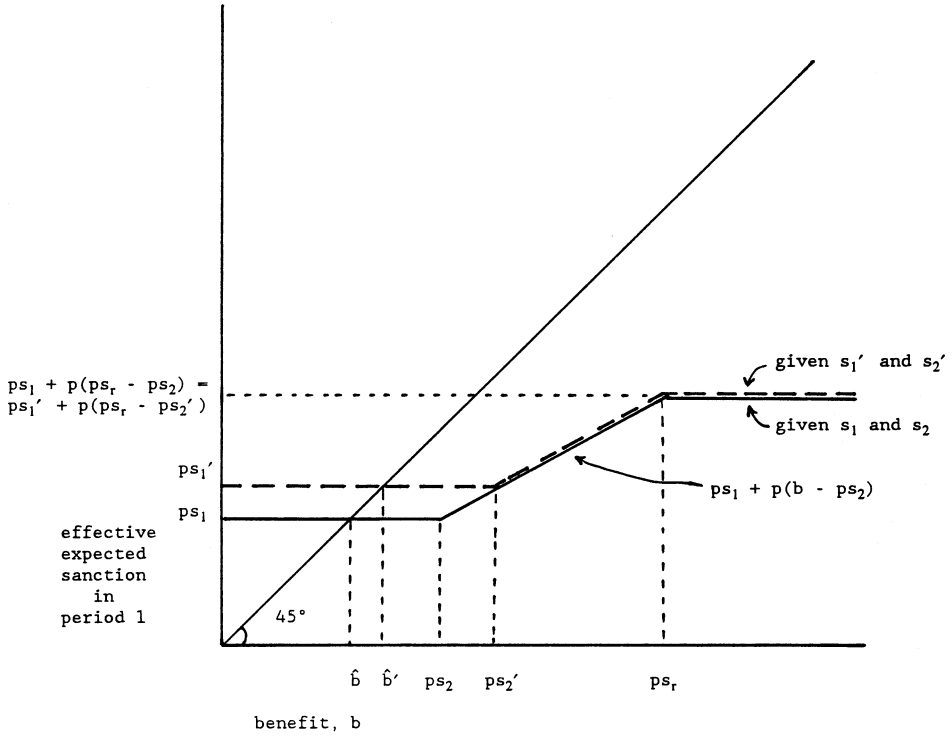
FIG. 2. Step 3 of proof.

Step 3: $s_1^* = s_m$

We will demonstrate this by showing that if $s_1 < s_m$, it is possible to raise social welfare. So, suppose $s_1 < s_m$. Two cases will be considered, depending on whether s_2 is equal to or less than s_m.

If $s_2 = s_m$, then $s_r = s_2 = s_m$ (because $s_r \geq s_2$ from Step 2, and $s_r \leq s_m$). And because $s_r = s_2$, individuals will commit the offense in the first period if and only if $b \geq ps_1$. It is optimal, therefore, to raise s_1 to s_m to reduce underdeterrence in the first period. This does not affect behavior in the second period. Thus, social welfare rises, contradicting the assumption that $s_1 < s_m$ is optimal.

Now suppose that $s_2 < s_m$. If $s_r = s_2$, then the logic of the preceding paragraph implies that $s_1 = s_m$ is optimal. Therefore, assume that $s_r > s_2$ (by Step 2, s_2 cannot be greater than s_r).

Individuals for whom $b < ps_2 < ps_r$ do not commit the offense in Period 2, regardless of whether they have a record; hence, their effective expected sanction in Period 1 is given by the right-hand side of (9). Those for whom $ps_2 \leq b < ps_r$ commit the offense in Period 2, if and only if they do not have a record; their effective expected sanction in Period 1 is given by the right-hand side of (7). And individuals for whom $b \geq ps_r$ commit the offense in Period 2, regardless of whether they have a record; their effective expected sanction is given by (5). In Figure 2, the solid line labeled "given s_1 and s_2" depicts the resulting effective expected sanction schedule in Period 1.

Because $s_1 < s_m$ (our beginning premise) and $s_2 < s_r$ (assumed two paragraphs

above), it is possible to raise s_1 to some s_1' and to raise s_2 to some s_2' less than or equal to s_r such that

$$ps_1 - p^2 s_2 = ps_1' - p^2 s_2'. \tag{A4}$$

By construction, the right-hand sides of (7) and (5) are not affected by this change in s_1 and s_2; but raising s_1 obviously raises the right-hand side of (9). The dashed line in Figure 2 labeled "given s_1' and s_2'" describes the new effective expected sanction schedule in Period 1.

It is seen readily from Figure 2 that social welfare in the first period cannot be lower than before: If the 45° line intersects the effective expected sanction schedules to the left of ps_2', as illustrated in Figure 2, then the change to s_1' and s_2' increases deterrence in the first period; this is clearly beneficial because the individuals deterred are those for whom $b \leqslant \hat{b}' < ps_2' \leqslant ps_m < h$. If, however, the 45° line intersects the effective expected sanction schedules at or to the right of ps_2', individual behavior and social welfare will not change in Period 1.

We next show that social welfare in Period 2 must rise as a result of raising s_1 to s_1' and s_2 to s_2'.

Individuals for whom $b < ps_2$ do not commit the offense in Period 2 regardless of whether they have a record; hence, their second-period behavior is not affected by the change in sanctions.

Individuals for whom $ps_2 \leqslant b < ps_2'$ would have committed the offense in Period 2 if they did not have a record (because $b \geqslant ps_2$); now they do not commit the offense in Period 2, regardless of whether they have a record (because $b < ps_2' \leqslant ps_r$). Further, there will be some individuals in this range of benefits who will be deterred as a result of s_2 rising to s_2', for even if every individual in this range commits the offense in Period 1, some will not be caught and, therefore, will not have a record in Period 2. Because $b < ps_2' \leqslant ps_m < h$, this additional deterrence in Period 2 raises social welfare.

Finally, consider individuals for whom $b \geqslant ps_2'$. It is clear from Figure 2 that they will behave the same way as before in Period 1 (their effective expected sanction does not change). The only possible change in their behavior in Period 2 is as a result of s_2 rising to s_2'. However, because $b \geqslant ps_2'$ for individuals in this range of benefits, those without a record will commit the offense in Period 2, regardless of whether s_2 or s_2' applies. Hence, social welfare does not change with respect to individuals in this range.

The contradiction has now been established: Whenever $s_1 < s_m$, social welfare can be increased. Hence, $s_1 = s_m$ must be optimal.

Step 4: $s_r^* = s_m$

Suppose that $s_r < s_m$. One possibility is that $s_2 = s_r$. If this is so, raise s_2 and s_r, equally, a small amount. This change will not affect behavior in the first period, but it will increase deterrence in the second period. The latter effect is beneficial because $ps_2 = ps_r \leqslant ps_m < h$. Hence, it cannot be optimal for s_r to be less than s_m and for s_2 to equal s_r.

The other possibility is that $s_2 < s_r$. In this case, we will again show that both s_2 and s_r can be raised by an equal amount without affecting behavior in the first period but beneficially increasing deterrence in the second period.

Because $s_1 = s_m$ (by Step 3) and $s_2 < s_r < s_m$ (our current premise), the effective expected sanction schedule in the first period can be drawn as the solid line labeled "given s_2 and s_r" in Figure 3. It is clear from Figure 3 that $\hat{b} > ps_m$.

Now raise s_r to some $s_r' \leqslant s_m$ and raise s_2 an equal amount to s_2', so that $(s_2' - s_2) =$
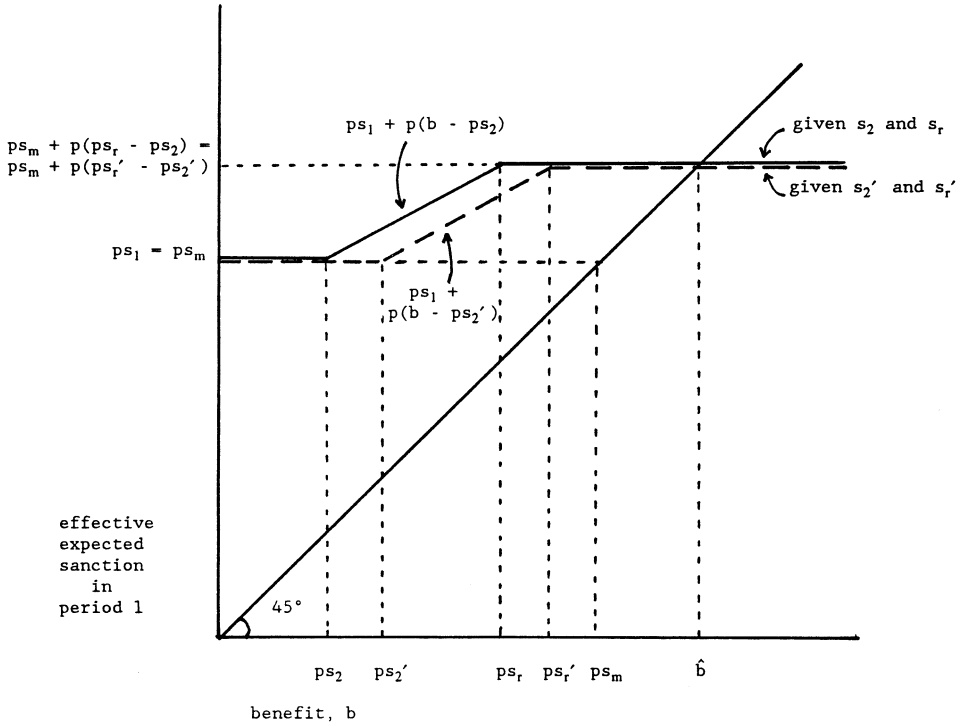
FIG. 3. Step 4 of proof.

$(s_r' - s_r)$. (This is possible because of the hypothesis that $s_2 < s_r < s_m$.) The new effective expected sanction schedule is the dashed line labeled "given s_2' and s_r'" in Figure 3. As can be seen, the new schedule differs from the previous one only in that it is lower for individuals whose benefits are between ps_2 and ps_r'. It is apparent from Figure 3, however, that this change does not affect anyone's behavior in the first period because the effective expected sanction still is high enough to deter individuals for whom $ps_2 < b \leq ps_r'$. Put differently, $\hat{b}$ has not changed.

Because it is clear that raising s_2 and s_r increases social welfare in the second period, the contradiction is established in this case.

In sum, regardless of whether $s_2 = s_r$ or $s_2 < s_r$, it cannot be optimal for s_r to be less than s_m. This proves Step 4.

Step 5: $s_2^* < s_r^*$ is possible

That s_2^* can be less than s_r^* was demonstrated in a numerical example in Section III. To gain some insight into why this result can occur, we will consider here how social welfare is affected as s_2 is lowered from $s_r^* = s_m$.

Because $s_1^* = s_r^* = s_m$, social welfare can be written as:

$$\int_{ps_m + p(ps_m - ps_2)}^{\infty} (b - h)f(b)\,db + \int_{ps_2}^{\infty} (b - h)f(b)\,db - e(p). \tag{A5}$$

The first term is social welfare in the first period. The lower bound of integration can be explained as follows: Because the effective expected sanction in Period 1 is at least equal to $ps_1 = ps_m$, any individual who commits the offense in the first period must have a benefit at least equal to ps_m. Because ps_m is the maximal sanction in the second period, such individuals also will commit the offense in the second period, regardless of whether they have a record. Hence, (5) is applicable, implying that individuals will commit the offense in the first period if and only if their benefit equals or exceeds

$$\hat{b} = ps_1 + p(ps_r - ps_2) = ps_m + p(ps_m - ps_2), \tag{A6}$$

which is the lower bound of the first integral.

The second term in (A5) is social welfare in the second period. Clearly, no individual will commit the offense in Period 2 if his benefit is less than ps_2. Individuals with benefits such that $ps_2 \leq b < ps_m + p(ps_m - ps_2)$ do not commit the offense in Period 1 [see (A6)] and, hence, do not have a record in Period 2. Accordingly, these individuals face ps_2 and thus will commit the offense in Period 2. The remaining individuals have benefits equal to or exceeding $ps_m + p(ps_m - ps_2)$ and, therefore, will commit the offense in Period 2, whether or not they have a record. Consequently, every individual whose benefit equals or exceeds ps_2 will commit the offense in the second period, which explains the lower bound of the second integral.

The derivative of (A5) with respect to s_2 is

$$[ps_m + p(ps_m - ps_2) - h] f(\hat{b}) p^2 - [ps_2 - h] f(ps_2) p, \tag{A7}$$

where $\hat{b}$ is given by (A6). The first term of (A7) is negative for s_2 sufficiently close to s_m (because then the expression in brackets is negative given the result from Step 1 that $ps_m < h$). This reflects the beneficial effect of enhanced deterrence in the first period caused by lowering s_2—the greater the difference between the treatment of first-time and repeat offenders in Period 2, the greater the incentive to refrain from committing the offense in Period 1. The second term of (A7) is positive, which reflects the detrimental effect of reducing deterrence in the second period caused by lowering s_2.

Observe that at $s_2 = s_m$, (A7) becomes

$$[ps_m - h] f(ps_m) p(p - 1) > 0, \tag{A8}$$

where the term in brackets is negative by Step 1. In other words, it is not optimal to lower s_2 from s_m *locally*. The explanation is that, starting at $s_2 = s_m$, the detrimental effect on deterrence in the second period from lowering s_2 initially dominates the beneficial effect on deterrence in the first period. The detrimental effect of lowering s_2 on deterrence in Period 2 is multiplied by p (deterrence falls by p times the change in s_2), whereas the beneficial effect on deterrence in Period 1 is multiplied by p^2, a smaller factor (for the enhanced differential treatment of first-time and repeat offenders to matter in Period 2, an individual has to be caught twice, once in each period). Starting at $s_2 = s_m$, the density of individuals who are affected by lowering s_2 marginally is the same in each period—equal to $f(ps_m)$—so the detrimental effect initially outweighs the beneficial effect for the reason given in the previous sentence.

If s_2 is lowered more than marginally, however, social welfare could increase. Suppose, for example, that the density of individuals whose benefits are less than ps_m is very low for an interval of benefits below ps_m, whereas the density of individuals whose benefits exceed ps_m is very high for an interval above ps_m. Then, if s_2 is lowered enough, the beneficial effect on deterrence in Period 1 will exceed in importance the detrimen-

tal effect on deterrence in Period 2, making it desirable to lower s_2 more than marginally. This is what accounts for the result in the numerical example in Section III that the optimal s_2 is less than $s_r^* = s_m$.[30]

Step 6: There is Underdeterrence in Each Period

Finally, we want to show that there is underdeterrence in both periods. This clearly is true in the second period because $ps_2 \leqslant ps_r = ps_m < h$.

To see that there also is underdeterrence in the first period, recall that the critical value of benefit in the first period, $\hat{b}$, is given by (A6). Hence, if there is *not* underdeterrence in the first period, it must be that

$$\hat{b} = ps_m + p(ps_m - ps_2) \geqslant h. \tag{A9}$$

But (A9) implies that (A7)—the derivative of social welfare with respect to s_2—is positive, which contradicts the assumption that s_2 is optimal. Thus, at the optimal s_2 it must be that (A9) does not hold, which means that there will be underdeterrence in Period 1.

The intuition behind this result is as follows. If there were overdeterrence in the first period, it could be reduced by raising s_2 (because reducing the differential treatment between first-time and repeat offenders in the second period reduces deterrence in the first period). Raising s_2 is beneficial not only because of this effect, but also because raising s_2 reduces *under*deterrence in the second period. Once s_2 is raised to a level such that overdeterrence in Period 1 is just eliminated, the question remains as to why it is optimal to raise s_2 further, thereby creating underdeterrence in the first period. Raising s_2 further is desirable because the first-order effect on social welfare in Period 1 is zero (the marginal individuals who are induced to commit have benefits equal to harm), whereas the first-order effect of the additional deterrence in Period 2 is positive (because there is underdeterrence in the second period).

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[30]Note that if s_2^* is less than s_r^*, first offenders are sanctioned less in the second period than in the first period (because $s_1^* = s_r^* = s_m$). If s_2 and s_1 were constrained to be equal, we do not believe that it would be optimal in our model to sanction repeat offenders more severely than first-time offenders. This is because, if s_2 is lowered below s_r, s_1 also must be lowered, but lowering s_1 reduces deterrence in the first period.

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