Social Welfare and the Benefits to Crime

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Abstract

There exists a large literature on optimal deterrence of crime. Within the literature, however, there exists a controversy over what the appropriate criterion is to determine optimality. The most popular method is that of maximization of a utilitarian welfare function. The controversy stems from the fact that the benefits to crime are included in the welfare analysis. Another criterion that could be used is that of cost minimization. This paper demonstrates that maximizing the sum of utilities is in fact equivalent to minimizing the costs of crime, independent of the benefits criminals receive from their illegal activities. The model developed also provides explanations for sanctions that increase in one's criminal history and why criminal law and the law of torts co-exist.

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1 Introduction

There exists a large literature that examines the optimal use of penalties to deter crime. There exists, however, a mild controversy over what criterion is appropriate to determine optimality. The most prevalent criterion at the moment is perhaps best explained in Polinsky and Shavell (2000). They consider penalties and enforcement to be chosen to maximize social welfare. The controversy lies in the fact that their welfare function includes the benefits criminals receive from their illegal endeavors.

While the distaste for such an objective function is clear (does society really care about the pleasure a rapist gets?), it is hard to reject if one truly believes in a utilitarian welfare function. This paper argues that the appropriate criterion for optimality is cost minimization, and that this is fully reconcilable with maximizing a utilitarian welfare function.

1.1 Background

Modern economic analysis of criminal law began with Becker (1968). He considered a "market approach" in which the supply of an offense is determined by the sanction and probability of conviction, while the "demand" is determined by the net social harm causes by the activities. Specifically, Becker considered the total gain to criminals, G, and the harm to society H, as functions of the number of offenses, O, so that $D(O) = H(O) - G(O)$. He assumed that $D'' = H'' - G'' > 0$ so that net social harm would (eventually) be increasing in the number of offenses. In the optimum, the social costs of enforcement are traded off with the net social harm from the illegal activities. Thus Becker's welfare calculus included the gains to criminals.

This inclusion was questioned by Stigler (1970), who pondered "what evidence is there that society sets a positive value upon the utility derived from a murder, rape, or arson?" (p. 527) He noted that one reason that Becker included the benefits to criminals was to avoid the so-called 'Becker paradox': that for any level of deterrence desired, the cheapest way to achieve it is to have punishments arbitrarily large and monitoring arbitrarily low. The 'paradox' lies in the fact that this is not observed. Stigler proposed another way to achieve the result of non-maximal penalties: marginal deterrence. If all crimes received the same penalty, then criminals would commit the one that gave them the highest benefit. If this benefit were correlated with social harm, then society could reduce social harm by reducing the penalties for crimes that were less harmful. This story is one of cost minimization, in which the marginal costs of crime (including enforcement) are equalized across crimes.

Currently, the methodology most used is perhaps best exposited by Polinsky and Shavell (2000).[1] The criterion for optimality is welfare maximization, and welfare is given by the sum of (net) benefits to criminals, harm to others and enforcement costs. The inclusion of the benefits to criminals remains controversial, however, even by those that use it (see for example Dharmapala and Garoupa 2004). As mentioned above, however, if one truly believes in the Pareto axiom for social welfare, one cannot disregard such sources of utility, no matter how distasteful.

An implication of the the SUW model, however, is that the optimal penalties are ones that induce "efficient crimes," i.e. ones for which the benefits to the criminals outweigh the social harm. Specifically, in the optimum, sanctions are set so that the potential criminal internalizes the costs of his actions. This is generally considered to be the role of the law of torts, and so criminal law and tort law would thus be thought of as serving the same purpose. This is not a view shared by all. Cooter and Ulen (2008) argue that "society is, in general, better off goods are acquired through voluntary exchange" (p. 492). Criminal law, then, plays a different role from that of torts, in that it is intended to deter crime and promote voluntary transactions. While this is asserted, no formal model is presented, although the discuss the optimum as occurring when the marginal social benefits (presumably the reduction in costs arising from crime) equal the marginal costs of deterrence. This paper presents a formal model that highlights many of the assertions of Cooter and Ulen.

2 An Illustrative Model

Consider an economy with a continuum of agents who are potential criminals and another continuum of potential victims, each with mass one and all of whom are risk

[1] Such models shall be referred to as the Simple Utilitarian Welfare, SUW, model henceforth.

neutral.[2] Potential offenders differ in the benefits they receive from crime, b^o. Let $f(b)$ and $F(b)$ denote the population density function and cumulative density function of the benefits, respectively. Victims are assumed to be identical at this point. Victims have the property rights to something they value at b^v. This may be some physical property, such as a car, or something less tangible such as the right to go to certain parts of town without being assaulted. It is easier, from an expositional point of view, to consider physical property, and so the analysis shall proceed using such language (so that the crime considered is theft), although it is certainly generalizable to other crimes.

Criminals and victims are paired up at random. The criminal may either steal the property from the victim, negotiate to purchase it, or do nothing. It is assumed that there are no frictions to bargaining (such as asymmetric information), so that if the criminal decides to negotiate, then an agreement will be reached as long as $b^o > b^v$. It is further assumed that the victim and the criminal will agree upon a price that splits the surplus equally. If the criminal steals the good, then the victim incurs an additional harm of $h > 0$ on top of the loss of the property. The criminal faces an expected penalty of s when stealing the good. The payoffs are as follows:

	Criminal	Victim
Negotiate	$\frac{b^o - b^v}{2}$	$\frac{b^o + b^v}{2}$
Steal	$b^o - s$	$-h$
Nothing	0	b^v

2.1 The Criminal's Decision

For the moment, it shall be assumed that expected penalties, s are greater than the benefit to the victim. That is, $s \geq b^v$. Conditions for this to be the case are given later. The following lemma establishes the (expected) utility maximizing decision for the criminal as a function of b^o.

Lemma 2.1 *A criminal will do nothing if $b^o < b^v$. If $b^o > 2s - b^v$, then the criminal will steal the good. If $b^v < b^o < 2s - b^v$, then the criminal will purchase the good.*

[2] Nothing in the model changes if the potential victims and criminals are the same people.

Letting $\tilde{b} = 2s - b^v$, the expected payoffs are therefore as follows:

$$\begin{aligned}
EU^o &= \int_{\tilde{b}}^{\infty} (b^o - s) f(b^o)\, db^o + \int_{b^v}^{\tilde{b}} \frac{b^o - b^v}{2} f(b^o)\, db^o \\
&= -s\left[1 - F\left(\tilde{b}\right)\right] - \frac{b^v}{2}\left[F\left(\tilde{b}\right) - F(b^v)\right] + \int_{\tilde{b}}^{\infty} b^o f(b^o)\, db^o + \frac{1}{2}\int_{b^v}^{\tilde{b}} b^o f(b^o)\, db^o \\
EU^v &= -\int_{\tilde{b}}^{\infty} h f(b^o)\, db^o + \int_{b^v}^{\tilde{b}} \frac{b^o + b^v}{2} f(b^o)\, db^o + \int_{-\infty}^{b^v} b^v f(b^o)\, db^o \\
&= -h\left[1 - F\left(\tilde{b}\right)\right] + \frac{b^v}{2}\left[F\left(\tilde{b}\right) - F(b^v)\right] + \frac{1}{2}\int_{b^v}^{\tilde{b}} b^o f(b^o)\, db^o + b^v F(b^v)
\end{aligned}$$

2.2 Optimality

Consider now the expected sanction that maximizes the sum of utilities less enforcement costs. It is assumed that enforcement costs depend on the mass of criminals that commit a crime, M, as well as the expected sanction so that costs are given by $c(M, s)$. From Lemma 2.1 this mass is $1 - F\left(\tilde{b}\right)$. Social welfare is therefore

$$\begin{aligned}
W &= E[U^v] + E[U^o] - c(M, s) \\
& - (h + s)\left[1 - F\left(\tilde{b}\right)\right] + b^v F(b^v) + \int_{b^v}^{\infty} b^o f(b^o)\, db^o - c(M, s)
\end{aligned}$$

Note that the terms representing the criminals' and victims' benefits are independent of policy, s. The welfare maximization problem can therefore be written as

$$\max_s - (h + s)\left[1 - F\left(\tilde{b}\right)\right] - c(M, s)$$

which is a cost minimization problem. In particular, note that this is equivalent to a cost minimization problem in which criminals have the binary choice of whether to steal or do nothing.

3 The Model

Consider an economy with a large but finite number of potential sellers/victims and an equal number of potential buyers/offenders. Victims own a good that they value at b^v. Offenders value the good at $b^o > b^v$. The expected sanction for stealing is s, and victims vary in how they view this. Let $\theta(s)$ be the cost to an offender of an expected sanction s and be distributed among the population according to pdf $f(\cdot)$ and cdf $F(\cdot)$.[3] Let the support of $\theta(\cdot)$ be $[0, \infty)$. Note that the distribution is a function of s, but for the analysis here it does not matter how changes in s change the distribution.

To begin, offenders decide whether to steal one of the goods. Those that do are randomly paired with a victim and steal the good. It is assumed that all victims have an equal chance of being victimized. Note that this probability will be equal to the crime rate, or the proportion of offenders that choose to steal. Denote the crime rate by π. After any crime has been committed, those sellers who still have a good may choose to make it available by posting a price, p, at which they are willing to sell. Those buyers that did not choose to steal then observe all posted prices and choose who to visit (or choose the probability that they visit each seller).[4] For a given strategy profile of buyers, let q be the expected number of buyers that arrive at a seller. Buyers arrive according to a Poisson distribution, so that the probability that a seller has at least one buyer is $1 - e^{-q}$, and the probability that a given buyer is the one that gets to purchase the good (i.e. is at the front of the line) is $\frac{1-e^{-q}}{q}$.

Proposition 3.1 *The unique symmetric equilibrium entails* $p^* = b^o - \frac{b^o - b^v}{e-1}$, $q^* = 1$ *and* $\pi = F\left(b^o - \frac{b^o - b^v}{e}\right)$.

Proof The equilibrium is found by solving backwards. In particular, we are interested in the equilibrium in which, for a given profile of prices posted, buyers randomize over which seller to visit. In such an equilibrium, the expected payoff to visiting a seller is the same for all sellers. In other words, p and q will be such that $\frac{1-e^{-q}}{q}(b^o - p) = R$ for all sellers. Note that sellers with higher prices receive a lower probability of being visiting by each buyer, and therefore face a tradeoff between the probability of selling

[3] Note that this specification allows for variation in how much offenders dislike being punished as well as differences in ability to avoid detection and differences in attitudes to risk.

[4] Buyers also have the choice of doing nothing, but since it is assumed that $b^o > b^v$, this is never optimal.

and the return conditional on selling. Sellers therefore choose p to solve

$$\max_p \left(1-e^{-q}\right)p+e^{-q}b^v$$
$$\text{subject to } \frac{1-e^{-q}}{q}\left(b^o-p\right)=R$$

This is equivalent to solving

$$\max_q \left(1-e^{-q}\right)\left[b^o-\frac{qR}{1-e^{-q}}\right]+e^{-q}b^v$$

The first order condition is

$$e^{-q}\left(b^o-b^v\right)=R$$

There exists a symmetric equilibrium in which all sellers enter the market and post the same price and all buyers visit each seller with the same probability. Given that there are as many sellers as buyers[5], it must be that $q^*=1$, $R^*=\frac{b^o-b^v}{e}$ and $p^*=b^o-\frac{b^o-b^v}{e-1}>b^v$. Sellers expected profits are $b^o-2\frac{b^o-b^v}{e}$.

Finally, note that offenders are forward looking and decide to steal if the expected payoff from stealing is greater than the expected return from buying. This occurs if

$$b^o-\theta(s)>e^{-q}\left(b^o-b^v\right)$$
$$\theta(s)>\bar{\theta}=b^o-\frac{b^o-b^v}{e}$$

Thus the crime rate is given by $\pi=F\left(b^o-\frac{b^o-b^v}{e}\right)$. ■

Given this equilibrium, we can construct the welfare maximization problem. A utilitarian welfare function will add the expected payoffs to offenders and victims and subtract the costs of enforcement.

$$\begin{aligned} W &= (1-\pi)\left(b^o-2\frac{b^o-b^v}{e}\right)-\pi h+(1-\pi)\frac{b^o-b^v}{e}+\int_0^{\bar{\theta}}\left(b^o-\theta\right)dF(\theta)-c(\pi,s) \\ &= b^o-(1-\pi)e^{-q}\left(b^o-b^v\right)-\pi h-\int_0^{\bar{\theta}}\theta dF(\theta)-c(\pi,s) \end{aligned}$$

which is a cost minimization problem.

[5] Recall that we started with equal numbers and for each seller that no longer has a good, there is a buyer that is no longer in the market as they already have a unit via theft.

Theorem 3.2 *Maximizing a utilitarian welfare function in which offenders have the option to get what they want through voluntary trade is equivalent to minimizing costs when offenders may only commit crime or do nothing.*

3.1 Comparison of the Predictions

At this point, it is worth asking how the predictions generated by the SUW model compare to those generated by the EUW model. Both predict that punishments should be proportional to the harm caused. One important difference, however, is that the cost minimization model considers the harm to the victim of having suffered from a crime *but not* the foregone consumption of the good. This would help explain why rape would be penalized more than the theft of goods, no matter how valuable.

3.1.1 Increasing Penalties

It is also worth noting that the SUW model has the criminal system essentially replicating the tort system (with the exception that the victim does not receive compensation), in that the objective is to give incentive for only efficient acts to occur. As such, there is no room for penalties to reflect criminal history or whether the offender shows remorse for his actions. In the EUW model, criminal history and remorse both influence the expectation of that particular agent's benefits to crime and would therefore be reflected in the sentencing. This can be seen as follows.

Consider a dynamic version of the EUW model as described above, but with the small change that, instead of a continuum of potential criminals and victims, there is in fact one of each. The offender's benefit is private knowledge and drawn from the distribution above, now labeled $f_0(b^o)$. The cost function, $c(\cdot)$, now changes, however. When there is a single potential offender, the government hands out the first period expected punishment, s_0, with probability $1-F\left(\tilde{b}\right)$, where $\tilde{b}$ is the threshold level for benefits above which the offender commits crime, or does not have to punish anyone. Thus the government's per period expected costs are $\left[1-F\left(\tilde{b}\right)\right]c(s_0)$. Social welfare in the first period is given by

$$W(s_0) = -\left[1-F\left(\tilde{b}\right)\right]\left[h+s_0+c(s_0)\right]$$

In this case, the government is trading off expected harm with the expected costs of enforcement.

It is straightforward to see that the dynamic aspect to the problem does not change the criminal's behavior. The offender will commit the crime if $b^o > 2s - b^v$ as before. In the event that no crime occurs in the first period, the government can maintain s at its current level and completely deter crime. Should a crime occur, however, the government will update its beliefs about b^o. In the second period, the government uses the distribution $f_1(b^o) = f_0(b^o | b^o > 2s - b^v)$. The government's maximization problem in the second period is therefore given by

$$\max_{s_1} - [1 - F_1(2s_1 - b^v)] [h + s_1 + c(s_1)]$$

Proposition 3.3 *Penalties are increasing in criminal history. That is, $s_1^* > s_0^*$ if the criminal commits crime in the first period.*

This proposition can easily be extended to T periods. Criminals would commit crime in a given period, t, as long as $b^o > 2s_t - b^v$. Whenever crime is committed, the government would update its beliefs over b^o and increase the penalty for the next period.

3.1.2 Necessity as a Defense

An interesting feature of the criminal justice system is that necessity can constitute a defense. Since the SUW model uses sanctions to make offenders internalize the harm of their actions, there would seem to be no room for necessity to influence the sentencing. Interestingly, the notion of necessity is intertwined with that of emergency, or the inability to bargain. If one were to interpret necessity in this manner, then optimal penalties would be set according to welfare maximization as in the SUW model, with the idea that only efficient crimes would be committed. Note that in this interpretation, punishments would never be set above $b^v + h$. If punishment is costless, then $s = b^v + h$ is optimal. If punishment is costly, then the cost of inefficient crimes being committed would be traded of with the cost of enforcement. Note that, in the model above, allowing for the opportunity to bargain means that punishments are *higher* than when bargaining is not possible. This is consistent with the idea that necessity as a defense can *reduce* penalties.

Another possible interpretation for necessity is that, in cases of emergency, certain actions are clearly efficient. As such, there is no need to incur costs of punishment in order to induce efficient actions. Such an interpretation would allow for sanctions to be *eliminated* in the event of necessity. The SUW model allows for this latter type of necessity, but not the former. The model presented above allows for both. Thus one possible test to determine the criterion that courts actually use in setting penalties is to examine whether penalties are awarded when necessity is accepted as a defense. This is in fact the case, as illustrated by the following examples.

Case 1: *U.S. v Holmes* (1842)

On March 18, 1841, the William Brown departed Liverpool en route to Philadelphia with 17 crewmen and 65 passengers. On the night of April 19, the ship hit an iceberg off about 250 miles off the coast of Newfoundland and sank. The captain, 8 crew members and one passenger made their way onto the smaller of the two lifeboats (a jolly boat), while the other 9 crewmen took the other, larger one (a long boat), along with 32 passengers. The first mate, Francis Rhodes, was placed in charge of the latter vessel. The boats separated in order to increase their chances of being found. The long boat was overcrowded, however, and when winds picked up the next day, it was in danger of capsizing. The crewmen thus began to throw passengers overboard. In total, 12 men and 2 women were forced off the long boat. The remaining people were rescued the next day and taken to Le Havre, France.

Some of the passengers filed a complaint against the crewmen when they finally reached Philadelphia. Since Alexander Holmes was the only crew member in the city, he alone faced charges. A grand jury refused to indict him on charges of murder, so he was tried for manslaughter in the killing of Frank Askin, one of the passengers. He was found guilty, but received a sentence of only 6 months and a fine of $20, which was later remanded. At that time, manslaughter committed by a seaman at sea carried a penalty of up to three years imprisonment and a fine of no more that $1,000. In the absence of necessity, Holmes' actions would have surely constituted murder and so the penalty received was greatly diminished.

Case 2: *R. v Dudley and Stephens* (1884)

In 1883, John Henry Want, an Australian lawyer, purchased the English yacht *Mignonette*. On May 19, 1884, Want finally found a crew that could take her from Southampton to Sydney: Tom Dudley (the captain); Edwin Stephens; Edmund Brooks; and Richard Parker (a 17 year-old cabin boy). On July 5, the boat was overwhelmed by waves and sank. It was about 1,600 miles from the Cape of Good Hope. The crew managed to get into the lifeboat, but only managed to salvage some navigational instruments and two tins of turnips. They had no fresh water.

On July 9, the crew managed to capture a sea turtle, which they ate, along with the turnips, until possibly July 17. They did not manage to catch any rainwater. On July 13, they began to drink their own urine. Around July 20, Parker became sick from drinking seawater. Stephens was also ill.

The crew began discussing the possibility of drawing lots to determine a sacrificial victim (who would be eaten) around the time that the food ran out. On July 23 or 24, Parker had lapsed into a coma and Dudley became insistent that they draw straws. Brooks refused. The next day, Dudley and Stephens killed Parker, and the three remaining survivors fed on his body. On July 29, they were rescued by the German ship *Moctezuma* and brought the men back to England. They told their story to customs officials (as required), believing that they could not be prosecuted. However, they were charged with murder and brought to trial, beginning November 3. The presiding judge, however, made some procedural errors and so the case was passed on the Queen's Bench Divisional Court. On December 4, Lord Chief Justice Lord Coleridge gave the Court's decision that the men be found guilty and sentenced to death. However, the Home Secretary Sir William Harcourt advised Queen Victoria to exercise her royal prerogative of mercy, and so, on December 12, the sentence was commuted to 6 months imprisonment. This case is known for setting the English precedent that an individual cannot be found not guilty of murder because of necessity.

It is worth noting that there are not many cases in which sentences are reduced rather than eliminated. This may be because, as mentioned above, the criminal action for which the defendant is being tried is obviously efficient. This is akin to the courts applying a fault-based standard for liability. The fact that there exist even a few cases in which necessity *reduces* the penalty suggests that sanctions are generally set above a level consistent with inducing efficient crimes.

3.1.3 Crime Avoidance

Finally, in the SUW model, private property protection that increases the costs of criminals (or reduces the number of criminal opportunities) is socially wasteful. The model therefore predicts that banning such devices as car alarms, or even locks on doors, would be efficiency enhancing. In comparison, cost minimization is compatible with the notion that the criminal justice system serves to provide incentive for individuals to acquire what they want through productive means. Private property protection can be optimal in that the costs associated with it are traded off with costs of public enforcement. The following section examines crime avoidance in greater detail.

4 Coexistence of Tort and Criminal Law

It is well recognized within the literature that the costs of crime include other factors such as crime avoidance and the reduced incentive to produce wealth. This point was made in Becker's (1968) seminal paper as well as in the literature that attempts to measure the costs of crime (see, for example Atkinson, Healey and Mourato (2005) and Brantingham and Easton (1996)). This section considers such costs of crime.

The above analysis considered victims as passive entities. In this section, potential victims decide how much to invest in private property protection, or crime avoidance. They are also no longer simply endowed with a unit of the good. Victims must also decide whether to produce the good (which can also be interpreted as accumulating enough wealth to purchase the good). Finally, offenders will also be subject to civil suits as well as criminal charges.

Let D denote the expected damages to be paid to the victim in the event that the offender commits a crime. Let avoidance on behalf of the victim increase the cost of committing the crime by a, and let the cost to the victim of such avoidance be $e(a)$.

The payoffs to the offender and victim are therefore given by

	Criminal	Victim
Negotiate	$\frac{b^o-b^v}{2}$	$\frac{b^o+b^v}{2}-e(a)$
Steal	$b^o-s-D-a$	$D-h-e(a)$
Nothing	0	$b^v-e(a)$

In this case, again assuming that $s \geq b^v$, offenders will do nothing if $b^o < b^v$, negotiate to purchase the good if $b^v \leq b^o \leq 2(s+D+a)-b^v$ and steal the good if $b^o > 2(s+D+a)-b^v$ As before, let $2(s+D+a)-b^v=\bar{b}$ to simplify the notation.

As mentioned above, potential victims must decide whether to produce the good. Let the cost of production be κ, and let this cost vary throughout the population according to pdf $g(\kappa)$ and cdf $G(\kappa)$. The timing is therefore as follows. First, victims observe their cost of production and decide whether to produce. They then choose their level of avoidance. Potential offenders and victims are then paired up at random and offenders decide whether to steal, negotiate or do nothing. As such, an individual will produce the good if and only if

$$\begin{aligned}\kappa &< EU^V \\ &< [D-h]\left[1-F\left(\bar{b}\right)\right]+\int_{b^v}^{\bar{b}}\frac{b^o+b^v}{2}f(b^o)\,db^o+b^vF(b^v)-e(a)\end{aligned}$$

the probability of which is $G(EU^v)$. In the event that a victim does not produce, both the victim and the offender with which she is paired receive a payoff of zero.

It is first worth considering a scenario in which the government chooses the avoidance level of the victim as well the expected sanction and damages. Let the judicial costs be given by $c(M,s,D)$, where M is the mass of offenders that actually commit a crime. In other words, consider the government solving

$$\max_{s,D,a} G(EU^v)\left[EU^v+EU^o\right]-\int_{-\infty}^{EU^v}\kappa g(\kappa)\,d\kappa-c(M,s,D)$$

where EU^v and EU^o denote the expected utilities of the victim and offender, respectively, in the case in which the victim has produced. This can be rewritten as

$$\begin{aligned}&\max_{s,D,a} G(EU^v)\left[-(h+s+a)\left[1-F\left(\bar{b}\right)\right]-e(a)\right]-\int_{-\infty}^{EU^v}\kappa g(\kappa)\,d\kappa-c(M,s,D)\\ &\quad+\int_{b^v}^{\infty}b^of(b^o)\,db^o+b^vF(b^v)-\left[1-G(EU^v)\right]\left[\int_{b^v}^{\infty}b^of(b^o)\,db^o+b^vF(b^v)\right]\end{aligned}$$

which is also a cost minimization problem in which the last term represents lost consumption and which is influenced by the crime rate. For the analysis below, an additional assumption shall be placed on the judicial cost function, $c(\cdot)$, so that $c_s(\cdot) \geq c_D(\cdot)$.

Proposition 4.1 *Suppose that $c_s(\cdot) \geq c_D(\cdot)$. Then if the government were able to choose the level of avoidance by victims, the optimal judicial system would use only damages, D.*

Proof First consider the following lemma.

Lemma 4.2 *A victim's expected utility is strictly increasing in both the expected penalty, s, and the expected damages awarded, D. The effect of expected damages is greater, however. That is, $\frac{\partial EU^v}{\partial D} > \frac{\partial EU^v}{\partial s} > 0$.*

Proof Taking the derivative of EU^v with respect to s and D yields

$$\begin{aligned} \frac{\partial EU^v}{\partial s} &= f\left(\bar{b}\right)[2h+s+a] > 0 \\ \frac{\partial EU^v}{\partial D} &= f\left(\bar{b}\right)[2h+s+a] + 1 - F\left(\bar{b}\right) > \frac{\partial EU^v}{\partial s} \end{aligned}$$

■

The first order conditions to the welfare maximization problem are

$$\begin{aligned} s: \quad & \left[\int_{b^v}^{\infty} b^o f(b^o)\, db^o + b^v F(b^v) - (h+s+a)\left[1-F\left(\bar{b}\right)\right] - e(a) - EU^v\right] \cdot \\ & \frac{\partial EU^v}{\partial s} g(EU^v) - G(EU^v)\left[1 - F\left(\bar{b}\right) + 2(h+s+a) f\left(\bar{b}\right)\right] \\ & -c_M \frac{\partial M}{\partial s} - c_s = 0 \\ D: \quad & \left[\int_{b^v}^{\infty} b^o f(b^o)\, db^o + b^v F(b^v) - (h+s+a)\left[1-F\left(\bar{b}\right)\right] - e(a) - EU^v\right] \cdot \\ & \frac{\partial EU^v}{\partial D} g(EU^v) - G(EU^v)\, 2(h+s+a) f\left(\bar{b}\right) - c_M \frac{\partial M}{\partial s} - c_s \leq 0 \end{aligned}$$

It is straightforward to see that at all levels of s and D, $\frac{\partial W}{\partial D} > \frac{\partial W}{\partial s}$, and so the solution must entail $s = 0$. ■

If the government were able to choose the levels for all factors of deterrence (the sanction, damages, policing and avoidance activities), then damages are clearly superior to sanctions. Damages provide just as much deterrence as sanctions but have the added benefit of stimulating production. The only case to made for imprisonment would be to maintain deterrence in the event that the offender was judgment proof (could not pay the damages) - debtor's prison.

When the victim chooses their level of property protection, however, an increase in damages awarded reduces the incentive to engage in avoidance. Since the optimal level of avoidance trades off public costs of enforcement with private costs, damages give victims incentive to engage in too little avoidance. As such, damages would have to be set lower than would otherwise be the case, and criminal sanctions can be used to increase the level of deterrence.

To see this, let us consider the victim's maximization problem. Conditional on producing the good, the victim will then choose avoidance to solve

$$\max_a [D-h]\left[1-F\left(\bar{b}\right)\right]+\int_{b^v}^{2(s+D+a)-b^v}\frac{b^o+b^v}{2}f\left(b^o\right)db^o+b^vF\left(b^v\right)-e\left(a\right)$$

The first order condition is

$$1-F\left(\bar{b}\right)+2f\left(\bar{b}\right)[s+a+h]-e'\left(a\right)=0$$

Lemma 4.3 *An increase in the expected sanction reduces avoidance less (or increases avoidance more) than an increase in damages. That is* $\frac{\partial a^*}{\partial s}>\frac{\partial a^*}{\partial D}$.

Proof Applying the Implicit Function Theorem to the above first order condition yields

$$\begin{aligned}\frac{\partial a^*}{\partial D} &= -\frac{4f'\left(\bar{b}\right)[s+a+h]}{4f'\left(\bar{b}\right)[s+a+h]+2f\left(\bar{b}\right)-e''\left(a\right)}\\ \frac{\partial a^*}{\partial s} &= -\frac{4f'\left(\bar{b}\right)[s+a+h]+2f\left(\bar{b}\right)}{4f'\left(\bar{b}\right)[s+a+h]+2f\left(\bar{b}\right)-e''\left(a\right)}\\ &= \frac{\partial a^*}{\partial D}-\frac{2f\left(\bar{b}\right)}{4f'\left(\bar{b}\right)[s+a+h]+2f\left(\bar{b}\right)-e''\left(a\right)}\end{aligned}$$

Since the denominator is the second order condition, it must be negative and therefore $\frac{\partial a^*}{\partial s}-\frac{\partial a^*}{\partial D}>0$. ■

The government's problem in this case is to solve

$$\max_{s,D} G\left(EU^v\right)\left[EU^v+EU^o\right]-\int_{-\infty}^{EU^v}\kappa g\left(\kappa\right)d\kappa-c\left(M,s,D\right)$$

given the reaction of the victim's avoidance above. Note that, because of the Envelope Theorem, $\frac{\partial EU^v}{\partial D} > \frac{\partial EU^v}{\partial s} > 0$ as before.

Proposition 4.4 *A necessary condition for the judicial system to employ both criminal sanctions as well as civil damages is* $-\left[1-F\left(\bar{b}\right)\right]\left[1+\frac{\partial a^*}{\partial s}\right]-c_M\frac{\partial M}{\partial a}\frac{\partial a^*}{\partial s} > -\left[1-F\left(\bar{b}\right)\right]\frac{\partial a^*}{\partial D}-c_M\frac{\partial M}{\partial a}\frac{\partial a^*}{\partial D}$ *when* $s=0$.

As mentioned above, criminal sanctions have a different effect on avoidance from damages. Typically, an increase in criminal sanctions lead victims to reduce their avoidance by less than they would if damages were increases by the same amount (although it is possible that sanctions induce a greater increase in avoidance). As long as the disutility of sanctions is offset by the fact that less crime occurs, then it will be optimal to use them. Note that if sanctions were monetary fines (so that the disutility of sanctions are not a social cost), then this condition holds with certainty.

5 Conclusion

To come...

References

[1] Atkinson, Giles, Andrew Healey and Susana Mourato (2005) "Valuing the Costs of Violent Crime: A Stated Preference Approach," *Oxford Economic Papers*, **57**, pp. 559–585.

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

[3] Brantingham, Paul and Steve Easton (1996) *The Costs of Crime: Who Pays and How Much?*, The Fraser Institute.

[4] Cooter, Robert and Thomas Ulen (2008) *Law & Economics*, 5th edition, Pearson Addison Wesley: Boston.

[5] Dharmalapala, Dhammika and Nuno Garoupa (2004) "Penalty Enhancement for Hate Crimes: An Economic Analysis," *American Law and Economics Review*, **6**, pp. 185–207.

[6] Polinsky, A. Mitchell and Steven Shavell (2000) "The Economic Theory of Public Enforcement of Law," *Journal of Economic Literature*, **38**, pp. 45–76.

[7] Stigler, George J. (1970) "The Optimum Enforcement of Laws," *Journal of Political Economy*, **78**, pp. 526–536.