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ABSTRACT

The Scope of Punishment: An Economic Theory of Harm-Based vs. Act-Based Sanctions*

The harm caused by many acts is not certain but probabilistic. Current public enforcement of the law combines harm-based sanctions (usually in criminal law) with act-based sanctions (very common in administrative law and regulation). We propose an economic theory of the choice between harm-based and act-based sanctions in public enforcement. The efficiency of act-based versus harm-based sanctions is analyzed and a typology of the determinants is drawn up. In the simple model with risk neutral offenders, both legal policies have the same deterrent level, but act-based sanctions end up punishing more people and the sanctions are lower. However when the assessment of the probability of harm diverges across individuals, the choice between harm-based or act-based sanctions depends on whether it is the enforcer or the average individual who is better informed. Legal policy implications are discussed.

JEL Classification: K4
Keywords: act-based sanction, harm-based sanction and uncertain harm

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1 Introduction

The harm caused by many acts is not certain *ex ante*; it occurs with some given probability. For example, storing chemicals does not always result in environmental damage; shooting towards somebody does not always "succeed"; the lack of foresight of a political appointee while running a public service does not always turn out in harm. Furthermore, in many of these circumstances, even the probability of harm is unknown *ex ante* to the public enforcer and to the injurer. This is quite dramatic for new types of crime such as bioethics offences or computer hacking, or new regulatory violations such as the misuse of more sophisticated financial instruments, or even the control of pollution. The lack of past information about these new activities reduces the likelihood that individuals and enforcers have a good understanding of the production of harm. On the other hand, path-dependence with previous criminal or regulatory experiences in different economic and social environments might disconnect the law in the books with the perception of risk by individuals. The probability of harm might be over-estimated. Adultery or violations of canon law are standard examples of former crimes that are no longer considered as particularly harmful and yet it has taken some time to adjust the law to social perceptions. Another potential example relates to certain zoning regulations. Essentially past experience with these offenses has a durable effect in terms of current perceptions of legal policy.

To control these risks, a public enforcer of the law can use harm-based sanctions (a sanction is only imposed if harm has been produced, observed and verified by a court of law or an independent adjudicator) or act-based sanctions (a sanction is imposed if a certain act has been committed independently of the harmful consequences). In some cases, harm-based sanctions prevail (this is typical of criminal law where the intention to create harm is a condition for a criminal conviction, and the observation of harm usually makes the evaluation of harmful intentions much easier). In other cases, act-based sanctions are favoured (usually administrative law, including traffic law, and regulation). Enforcers often intervene even before the harm has been generated, once they

observe that individuals have engaged in certain acts.[1]

The objective of this paper is to provide a more comprehensive economic theory of harm-based versus act-based legal policies in the public enforcement of the law. In a sense, the conventional model of law enforcement (Polinsky and Shavell, 2000) mainly considers act-based policy because harm is certain, perfectly observable and verifiable. Uncertain or unobservable harm raises the issue of the evaluation of an alternative policy; the imposition of sanctions based on the actual occurrence of harm versus engaging in a certain act. In this article, we analyze the efficiency of act-based versus harm-based sanctions.

In the basic model, both act-based and harm-based sanctions can generate the same level of deterrence (if the sanction is chosen appropriately). However, the act-based sanction should be lower than the harm-based sanction. Consequently, fewer individuals are prosecuted and convicted under a harm-based sanction than under an act-based sanction (we assume that the probability of detection remains equal in both regimes). Both stylized facts seem to be consistent with criminal and administrative enforcement. For example, more people are punished for high speed driving than for car accidents.[2]

For the same level of deterrence, we find that harm-based sanctions are cheaper (fewer convictions) and riskier. Other advantages of harm-based sanctions include providing incentives to acquire information concerning harm and introducing appropriate incentives to control the production of harm. The most serious disadvantage of harm-based sanctions is the higher likelihood of judgment-proofness by offenders.

When acts are not easy to observe, harm-based sanctions should prevail. When harm is hard to assess, act-based sanctions should be enforced. This typology seems also to fit well with the reality of criminal law (where *means*

[1] We should not leave the impression that all criminal punishment is harm-based. A notable exception are attempts; also, not all administrative and regulatory punishment is act-based; consider environmental liability or tax evasion.

[2] In 2003, there were $90,220$ car accidents in France. Criminal fines for injury vary from $30,000$ Euro to a maximum of $100,000$ Euro, depending on circumstances, with the possibility of a prison sentence. On the other hand, $1,5$ million break of speed limits offences were detected. Fines for high speed driving amount to a maximum of $1,500$ Euro. Source: The French Ministry of Interior.

rea makes intentional acts more difficult to observe) and regulation (where the actual level of harm is in many cases extremely difficult to assess, as for example environmental damages or state violations of human rights in procedure).

In the second part of the paper, we look at imperfect information on the probability of harm. We conclude that a certain act-based policy can be substantially better than harm-based one, in spite of all the advantages identified previously, when assessments concerning the likelihood of harm vary significantly across the population. This rationale would support, for example, the widespread use of act-based sanctions in traffic law.

A big advantage of harm-based sanctions when learning is required to achieve the efficient punishment is that no reform of law is needed (as enforcers and potential criminals adjust expectations without any need to change the law), whereas under act-based sanctions, fines must be adjusted (the law must be changed). Hence we can argue that the law is more stable under harm-based sanctions than under act-based sanctions, a result very much consistent with patterns of legal reform across administrative and criminal law.

This paper applies harm-based versus act-based sanctions in the context of the economic model of law enforcement. The closest article is the survey by Polinsky and Shavell (2000). These authors discuss the case of "accidental harm,"and the implications for the choice between act-based and harm-based sanctions in a non-formal way. However they do not look at the possibility that the probability of harm is not known by the government and the injurer.

Other related branches of the literature include the distinction between *ex ante* and *ex post* intervention of law. First, the literature on rules versus standards (Ehrlich and Posner, 1974; Diver, 1983; Kaplow, 2000).[3] Kaplow (1992) presents a detailed analysis of legal rules based on the distinction between rules and standards to the extent in which efforts to give content to the law are undertaken before or after individuals actions. Some uncertainty is left *ex ante*. In our case, an act-based policy identifies a certain conduct as prohibited. On the other hand, an harm-based policy imposes a fine when harm occurs, requiring

[3]For an extensive review of the literature on legal rules characteristics, see Kaplow (2000).

individuals to make use of their own information regarding the dangerousness of the activity.

A second important related paper is Shavell (1993), who looks at the general structure of law enforcement. However, there the main purpose of act-based versus harm-based sanctions is to choose the appropriate timing for intervention; pure prevention, after the act has been committed, or only after the harm has been observed. The purpose of the present paper is not to choose optimal timing for intervention, but to highlight the determinants of successful law enforcement, in particular the enforcer's own constraints (cost of imposing sanctions) and the characteristics of the potential injurers (cost of imposing sanction, risk aversion, limited assets).

Similar questions have been tackled in an extensive strand of literature on *ex post* liability versus *ex ante* regulation but from a different perspective. By focusing on the distinction between private action versus public enforcement, the main issues there are the interaction of compensation[4], the actual report of the offense or damage[5], the costs of both regimes[6], and the level of care taken *ex ante*. More fundamentally, these are models of choice between private and public law enforcement (in most papers, public law enforcement is loosely defined without any particular attention to criminal versus administrative law). In contrast, we discuss unilateral accidents (consequently, the precaution of the victim has no impact and thus the compensation effect does not matter for purposes of efficient deterrence) where the choice to undertake an activity is binary (i.e. whether to commit or not a harmful act) and the sanction is publicly enforced.

Our analysis is also close to the issue of sanctioning attempts (Shavell, 1990; Friedman, 1991; Ben Shahar and Harel 1996). However, we do not examine

[4]See for example Wittman (1977) for a discussion on the behavioral effect of compensation of victims versus *ex ante* fines.

[5]In Shavell (1984a, 1984b), Kolstad, Ulen, Johnston (1990), Shavell (1993) damages are not always reported. In Schmitz (2000), it has no impact since punitive damages are allowed. Innes (2004) analyzes a particular case when the occurrence of accidents is rarely discovered while a negligent conduct is paradoxically always sanctioned.

[6]See for example Wittman (1977), Mookherjee and Png (1992), Innes (2004).

the desirability of the punishment of attempts *per se*; instead, we include the possibility of punishing attempts when we consider act-based sanctions. In this sense, under an act-based sanction, an attempt is punished with the exact same sanction as a harmful offense. However, under a harm-based policy, there is no punishment for failed attempts.

We take an extreme view in the paper by imposing a choice between harm-based and action-based sanctions in order to identify the important trade-offs. In some practical cases, both regimes coexist. If they are complements, their coexistence serves as a palliative to several of the identified trade-offs between harm-based policies (fewer convictions, higher risk, incentives to acquire information and to control the production of harm) and act-based policies (judgment proof, imperfect information about the probability of harm) that we discuss in the paper. Nevertheless, both regimes might also be substitutes when one or the two can achieve efficiency alone. Therefore, their coexistence might result in some duplication of costs since individuals are punished simultaneously for their actions and for harm.

Section 2 considers the case where the government and the individuals have the same assessment of the probability of harm; different assessments or appreciations of the risk of harm are discussed in section 3. Section 4 concludes the paper with legal policy implications.

2 The Basic Framework

Contrary to the conventional model in law enforcement (Polinsky and Shavell, 2000)[7], suppose the harm imposed on society by each activity is not known *ex ante* to the government and to risk-neutral potential criminals, although it is known *ex post* (hence the problem here is not how courts assess harm). *Ex ante* the government and the potential criminal assess the probability that such an activity is harmful to be σ (with $0 < \sigma < 1$). If harmful, the activity causes a

[7]In the framework of Polinsky and Shavell (2000), the probability that the act to be committed is harmful is implicitly assumed to be equal to 1, as an individual chooses whether or not to commit a harmful act.

social loss given by h. Hence the expected harm caused by the activity is σh.

The government has the possibility to criminalize *ex ante*, before harm, hence it could set a sanction f to be announced in advance (this will constitute an act-based sanction). In this case, the government forbids any individual to undertake the activity. Thus, the individual undertaking the activity estimates an expected punishment given by pf, where p (with $0 < p < 1$) is an exogenous and invariant probability of detection and conviction determined by general law enforcement (Dharmapala and Garoupa, 2004).[8] Alternatively, the government can also criminalize *ex post*, after harm, (we call this criminal policy a harm-based sanction), hence there will be a unique sanction s imposed every time the harm is h. The expected sanction is σps.

The timing is the following: At time 0, the government announces a certain legal policy.[9] At time 1, the individual chooses whether or not to undertake an activity. At time 2, the harmfulness of the activity is revealed. At time 3, the law is enforced.

Individuals are assumed to be risk neutral. Under act-based sanction, the expected benefits of undertaking the activity are $b - pf$ for the criminal. Therefore, she undertakes an activity iff $b \geq pf$ where the individual knows f as defined *ex ante* by law. Under harm-based sanctions, the expected benefits of undertaking the activity are determined by $b - \sigma ps$. Therefore, she undertakes an activity iff $b \geq \sigma ps$. We can see immediately that there will be more deterrence under harm-based sanction than under act-based sanction iff $\sigma s > f$, *ceteris paribus*.

Social welfare is defined as in the standard literature (Polinsky and Shavell, 2000), where $g(b)$ is the density and $G(b)$ is the cumulative distribution of

[8]Notice that if we allow the probability to vary and be determined endogenously, under the assumptions of the model explained below, Beckerian maximal fines apply in both regimes and all our comments in the paper would be on the probability rather than on the severity of punishment.

[9]When the government has imperfect information about the harm, in section three, we should distinguish two bodies of government, the constitutional legislator that makes a normative assessment of which regime of sanctions should prevail and an enforcement branch that chooses the severity of punishment by maximizing expected social welfare.

benefits with support in $[0, B]$. Under act-based sanctions we have:

$$W = \int_{pf}^{B} (b - \sigma h) dG(b) \tag{1}$$

where we assume that the sanction is imposed without cost (Becker, 1968).

Under harm-based sanctions, we have:

$$W = \int_{\sigma ps}^{B} (b - \sigma h) dG(b) \tag{2}$$

By solving the appropriate first-order conditions, we get the following solutions, $f = \sigma h/p$ and $s = h/p$. In this simple set-up, the use of act-based or harm-based sanctions makes no difference in terms of law enforcement.

Remark 1 *Although the harm-based sanction is higher than an act-based sanction, the expected punishment is the same and hence it makes no difference in terms of social welfare.*

However, *ex post*, there will be fewer individuals prosecuted and convicted under harm-based sanction than under act-based sanction, $\sigma p(1 - G[\sigma h])$ and $p(1 - G[\sigma h])$ respectively. Since punishment is without cost, this effect has no impact on social welfare, but it would make a difference if punishment were costly.

Remark 2 *If punishment were costly (the same cost for each person convicted independently of the level of the sanction), we would prefer harm-based sanction to act-based sanction, for the same level of deterrence.*

We briefly look at some possible limitations to our result. The most obvious and immediate one is judgment-proofness. Because a sanction is higher under harm-based punishment, we expect fewer criminals to pay the adequate fine under harm-based sanctions when they have limited assets. Such effect, in turn, also dilutes deterrence and therefore implies that there will be more criminals under a harm-based sanction. Therefore, when judgment-proof is a serious concern, we should have an act-based sanction.[10]

[10]We abstract here from nonmonetary sanctions. One obvious argument for nonmonetary sanctions is to overcome judgment-proofness. However, given that the number of years in jail is also constrained, a similar argument applies there.

A related aspect that must be assessed when individuals have imperfect information is the set of incentives to acquire information on harmfulness of the act (that is, h or zero). As in Kaplow (1995), suppose individuals can choose to acquire information at a fixed cost that provides them a better assessment of the harmfulness of their acts (with certainty). Obviously, it only matters for harm-based sanctions since information on harmfulness of the act is irrelevant for act-based sanctions. Therefore, when there is the possibility that potential criminals can acquire information on the harmfulness of the act, a harm-based sanction is more efficient than an act-based sanction. The expected sanction is higher under a harm-based sanction than under an act-based sanction (more deterrence). The rationale is that with a harm-based sanction some potential criminals will acquire (costly) information about harmfulness and will engage in the activity only when it is socially beneficial (since interests are perfectly aligned).

So far we have assumed that individuals decide whether or not to engage in the activity, but there is no mechanism to control the likelihood of harm. Suppose the likelihood of harm σ is decreasing in avoidance activities (precaution, care, externality abatement, etc.). When individuals can decide whether or not to engage in the activity, and on the level of avoidance activities, harm-based sanctions are strictly better than act-based sanctions because they reduce the likelihood of social damage and increase the proportion of individuals engaged in activity when it is socially beneficial (again if the sanction is appropriately defined, the interests are perfectly aligned).

We have assumed so far that potential criminals are risk neutral and only care about expected punishment. When they are risk averse, they also care about the risk premium. Clearly, for the criminal policies derived before, a regime of harm-based sanction is riskier than a regime of act-based sanction for the same probability. For example, the variance of punishment under act-based sanction is $(1-p)\sigma^2 h^2/p$ whereas under harm-based sanction is $\sigma(1-\sigma p)h^2/p$.

Following Polinsky and Shavell (1979), when there is risk aversion, we should lower fines since we can keep deterrence at the same level as when criminals are

risk neutral, and reduce the risk premium which is costly for society. In the context of our model, it means we should have f strictly less than $\sigma h/p$ and s strictly less than h/p. In fact, we will have a new pair of f and s that maximizes social welfare (including the social cost created by the risk premium).

For example, suppose the expected utility of criminals is given by the expected punishment plus the variance of punishment (where the variance of punishment is a proxy for the risk premium). Social welfare is no longer (1) and (2) but given by the following functions:

$$W = \int_{pf+p(1-p)f^2}^{B} (b - \sigma h - p(1-p)f^2) dG(b) \tag{3}$$

$$W = \int_{\sigma ps+\sigma p(1-\sigma p)s^2}^{B} (b - \sigma h - \sigma p(1-\sigma p)s^2) dG(b) \tag{4}$$

We can see that (3) is the same as (4) when p is substituted by σp. Hence given an optimal sanction policy, social welfare must be the same. Given that (3) and (4) are the same when maximized, it must be the case that $\sigma s < f < [(\sigma(1-\sigma p))/(1-p)]^{1/2}$. In other words, the risk premium plus the expected fine for the criminal are lower under an act-based policy. To see why, suppose the expected fine plus risk premium for the criminal are the same under both regimes. Then an act-based policy should be strictly preferred because there will be the same number of offenders, but the risk premium (which is a social cost) is lower. Suppose, instead, that the risk premium is the same. Then $f > \sigma s$, and therefore the expected fine plus risk premium for the criminal are higher under an act-based policy. There are fewer criminals under an act-based policy, which should be strictly preferred to a harm-based policy.

Remark 3 *When potential criminals are risk averse, risk premium and expected fine of criminals are higher under a harm-based sanction than under an act-based sanction. Therefore, criminals are better off with act-based rather than harm-based sanctions.*

Summing up, our model predicts that harm-based and act-based sanctions are broadly equivalent. However, judgment-proof, acquiring information about

harm, and harm avoidance activities can push our result one way or the other. When individuals have serious wealth limitations act-based sanctions are more appropriate. When acquiring information or engaging in avoidance activities is important harm-based sanctions should be used.

3 Imperfect Information

3.1 Estimated Probability of Harm

Suppose now that σ is not known, but is estimated to be σ_e by individuals and by the government. Social welfare is still (1) and (2), with the appropriate limits of integration, but expected social welfare to be maximized by the government must be rewritten in the following way. Under an act-based sanction, we have:

$$W = \int_{pf}^{B} (b - \sigma_e h) dG(b) \tag{5}$$

whereas under a harm-based sanction, we have:

$$W = \int_{\sigma_e ps}^{B} (b - \sigma_e h) dG(b) \tag{6}$$

By solving again for the appropriate first-order conditions, we get the following solutions $f = \sigma_e h/p$ and $s = h/p$. Hence, whereas the harm-based sanction is invariant, the act-based sanction varies with the estimation of the probability of harm by the government.

Let us start by considering situations when σ is systematically underestimated[11], that is, $\sigma_e < \sigma$. An example of this case would be new harmful activities, in the sense that their dangerousness is not recognized in early stages. For these activities, the optimal act-based sanction is lower than it should be (that is, when $\sigma_e = \sigma$). There will be more activity than there should be. When σ is overestimated, that is, $\sigma_e > \sigma$, we obtain the opposite result. An example of this case would be path dependence in law enforcement, crimes that were

[11] Obviously, these problems are solved in a dynamic setting as the government realizes mistakes and updates beliefs. However, our point is simply on how lack of sureness about the level of risk influences the shape of law enforcement. Furthermore, the law is not in continuous change; in fact significant legal changes only take place by major court decisions or reforms of legislation. Legal security in the sense of stability is a value appreciated in most jurisdictions inasmuch as the ossification of the law is to be avoided.

perceived as very harmful in the past but no longer are. There will be too few of these crimes from an efficiency viewpoint.

Remark 4 *Whereas a harm-based sanction does not change, an act-based sanction adjusts to under- or overestimation of the probability of harm by the government. However, both regimes are still equivalent in terms of social welfare given that the expected sanction is the same.*

Our simple model nevertheless fails to recognize a big advantage of harm-based sanctions. No reform of law is required under harm-based sanctions as government and potential criminals adjust expectations whereas, under act-based sanctions, fines must be adjusted when it is realized that $\sigma \neq \sigma_e$. Hence we can argue that the law is more stable under harm-based sanctions than under act-based sanctions, a result very much consistent with patterns of legal reform across administrative and criminal law.

3.2 Divergent Assessments of the Probability of Harm

Consider now the case where individuals and the government have different *estimations* for the probability of harm, say σ_i and σ_g respectively. Social welfare is still (1) and (2), with the appropriate limits of integration, but expected social welfare to be maximized by the government is not (5) and (6). Under an act-based sanction, we have:

$$W = \int_{pf}^{B} (b - \sigma_g h) dG(b) \tag{7}$$

whereas under a harm-based sanction, we have:

$$W = \int_{\sigma_i ps}^{B} (b - \sigma_g h) dG(b) \tag{8}$$

By solving the appropriate first-order conditions, we get the following solutions $f = \sigma_g h/p$ and $s = \sigma_g/\sigma_i \times h/p$. Now both fines vary, although the expected sanction is the same and given by $\sigma_g h$, that is, the expected sanction is determined by the perception of the government.

Under act-based sanctions, the fine varies according to the beliefs held by the government. It will be higher than it should be if there is *overestimation* (e.g., path dependence in law enforcement) and lower than it should be if there is *underestimation* (e.g., new harmful acts).

Under harm-based sanctions, the fine varies according to relative beliefs. It will be higher than it should be if the estimation of the government is higher than that of individuals, and lower than it should be in the opposite case.

Notice that both act-based and harm-based sanctions yield the same level of social welfare since the expected sanction is the same. In other words, (1) equals (2), with the appropriate limits of integration, when the sanctions are chosen by maximizing (7) and (8). Such mathematical property is valid because the government knows that individuals have a belief given by σ_i although the government holds a different belief given by σ_g.

Remark 5 *Since the expected sanction is the same under both regimes and solely determined by the perception of the government, there is no incentive for the government to disseminate information or to change the beliefs of individuals.*

Let us take now the opposite case, where the government has the belief that criminals have the same probability of harm σ_g although they do not have it. The choice of sanctions is $f = \sigma_g h/p$ and $s = h/p$. Now the expected sanctions are different, $\sigma_g h$ under an act-based sanction and $\sigma_i h$ under a harm-based sanction. Therefore (1) is no longer equal to (2), for the appropriate limits of integration.

Remark 6 *We can easily see that the best legal policy is the one that produces an expected fine closest to expected social damage, σh. It is clear that the better informed player determines the best legal policy.*

This remark can be shown by a general proof. We can write the expected sanctions under act-based and under harm-based regimes as $\sigma_g h/p$ and $\sigma_i h/p$ respectively. The first-best expected sanction is given by σh. By convexity

assumptions, the regime that has an expected sanction closest to σh is the most efficient policy; it is first-best if exactly equal to σh and second-best otherwise. We can state that in general, an act-based sanction is more efficient than a harm-based sanction iff:

(1) $\sigma_g < \sigma_i$ and $\sigma \in [0, \frac{\sigma_g + \sigma_i}{2}]$;

or

(2) $\sigma_g > \sigma_i$ and $\sigma \in [\frac{\sigma_g + \sigma_i}{2}, 1]$.

As expressed by Friedman (2000), *ex ante* punishment provides incentives based on the beliefs of the people making the law (act-based), *ex post* punishment provides incentives based on the beliefs of the people who the law applies to (harm-based)[12]. In the case of the act-based policy, the enforcer integrates the risk of harm in the sanction. In the case of the harm-based policy, it is the individuals who integrate the risk of harm in the probability of being detected and convicted.

Take the case where $\sigma_g < \sigma_i$ (the government thinks there is a lower risk of harm than individuals). An act-based sanction is more efficient as long as the actual risk of harm is relatively low and hence closer to the estimation by the government. Now consider the case where $\sigma_g > \sigma_i$ (the government thinks that there is a higher risk of harm than individuals). An act-based sanction is more efficient than a harm-based sanction as long as the actual risk of harm is relatively high. Therefore we can say that an act-based sanction in public law enforcement is usually better than a harm-based sanction if we believe that the government is better informed about the risks of harm but is unable to assess the beliefs of the potential population of criminals.

3.3 Assessments of the Probability of Harm Vary Across the Population

Suppose now that the probability σ_i varies across the population according to a density $v(\sigma_i)$ and cumulative $V(\sigma_i)$ with support in the interval $[0, 1]$. The

[12]The same reasoning applies for the choice between liability versus regulation: if the regulator over (under) estimates the potential for harm, the standard will be too stringent (Shavell, 1984a).

government cannot observe individual probabilities but knows the distribution. Social welfare is no longer (1) and (2) but:

$$W = \int_0^1 \int_{pf}^{B} (b - \sigma h) dG(b) dV(\sigma_i) \tag{9}$$

whereas under harm-based sanctions we have:

$$W = \int_0^1 \int_{\sigma_i ps}^{B} (b - \sigma h) dG(b) dV(\sigma_i) \tag{10}$$

and expected social welfare to be maximized by the government is obtained by replacing σ by σ_g.

The choices of sanctions after the appropriate maximization of expected social welfare under act-based and under harm-based sanctions are $f = \sigma_g h/p$ and $s = \sigma_g/E[\sigma_i] \times h/p$, where $E[\sigma_i]$ is the finite expected value of σ_i.[13] The expected sanction is however not the same, since it will be $\sigma_g h$ under an act-based sanction and $\sigma_i/E[\sigma_i] \times \sigma_g h$ under a harm-based sanction.

Given the choice of policy by the government, social welfare is given by

$$W = \int_0^1 \int_{\sigma_g h}^{B} (b - \sigma h) dG(b) dV(\sigma_i) \tag{11}$$

whereas under a harm-based sanction, we have:

$$W = \int_0^1 \int_{\sigma_g h \frac{\sigma_i}{E[\sigma_i]}}^{B} (b - \sigma h) dG(b) dV(\sigma_i) \tag{12}$$

and expected social welfare for the government is obtained by replacing σ by σ_g.

The difference between the two levels of social welfare is strictly positive if $\sigma_g = \sigma$, hence in favor of using an act-based sanction:

$$\Delta W = \int_0^{E[\sigma_i]} \int_{\sigma_g h \frac{\sigma_i}{E[\sigma_i]}}^{\sigma_g h} (\sigma h - b) dG(b) dV(\sigma_i) + \int_{E[\sigma_i]}^1 \int_{\sigma_g h}^{\sigma_g h \frac{\sigma_i}{E[\sigma_i]}} (b - \sigma h) dG(b) dV(\sigma_i) \tag{13}$$

An act-based sanction is more efficient than a harm-based sanction and an act-based sanction is also preferred by the government when σ_g is quite close to

[13] The optimal level of s is given by $\sigma_g \times h/p$ multiplied by $\int_0^1 g(p\sigma_i s) dV(\sigma_i)$ divided by $\int_0^1 \sigma i g(p\sigma i s) dV(\sigma i)$. We assume $g(.)$ to be independent of σ_i, e.g., a uniform distribution, in order to derive $\sigma_g \times h/p$ divided by the $E[\sigma_i]$.

σ. When $\sigma_g = \sigma$, (13) is positive. In order for (13) to be negative, it must be the case that σ_g is either too much below or too much above σ. Suppose σ_g is quite high relatively to σ (e.g., path dependence in law enforcement). Whereas the second term in (13) is positive, the first term must be negative if the overall expression is negative. Consider the opposite situation where σ_g is quite low relatively to σ (e.g., new types of harmful activities). Whereas the first term in (13) is now positive, it is the second term that must be negative for the overall expression to be negative. Therefore, we can say that as long as σ_g is close to σ an act-based sanction is better than a harm-based sanction, when σ_g is high above or below σ, a harm-based sanction can be better than an act-based sanction.

Remark 7 *If the government's expectations with respect to harm are not substantially wrong, an act-based sanction is generally better when assessments concerning the likelihood of harm vary significantly across the population.*

4 Conclusion

This paper compares the efficiency of *ex ante* versus *ex post* harm public enforcement policies when there is uncertainty on the occurrence of harm. We find that neither harm-based sanctions nor act-based sanctions uniformly dominate public law enforcement in response to controlling risks. However, we have provided a typology to choose between these two regimes in an efficient way. Our taxonomy is more comprehensive than previous literature in this respect.

Our model suggests that harm-based sanctions are more efficient when (i) acquiring information about the act is important, (ii) engaging in harm avoidance activities is advisable, (iii) judgment-proofness is not a very significant problem, (iv) punishment is especially costly, (v) changes in law are expensive or difficult to negotiate, and (vi) on average, potential criminals are better informed than the government about losses for society.

The conclusions of the model are certainly more striking than the standard differences between criminal and administrative or regulatory law would pre-

dict. Some of the advantages of harm-based sanctions fit easily with the usual dichotomy criminal-administrative, namely the importance of acquiring information or engaging in avoidance activities, the costs of punishment or the costs of frequently reforming criminal law and procedure. However, judgment-proof usually goes the other way around (most criminals are poor and many administrative and regulatory violations are committed by wealthy corporations). In criminal law, public enforcers also intervene *ex ante*. For example, shooting in streets is prohibited and the harm done by firearms is punishable; the intervention on act complements the punishment based on harm. On the other hand, adding a harm-based regime to regulation multiplies costs as both policies generally are substitutes.

As to who is better informed about losses due to harmful activities, it is difficult to say in general. Broadly speaking, one would think that victims have better information (even though there are victimless crimes). However they play a very limited role in public enforcement (in clear contrast with private enforcement and litigation, as pointed out by the literature on liability and regulation). The government (police and prosecution in criminal law, regulatory agencies and administrative authorities in administrative law) represents these victims and therefore it could be case that they have a better understanding of the losses. But there are certainly many cases where the offender is better informed. Corporate crime, tax evasion and regulatory violations would be typical cases.

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