Act-based versus harm-based sanctions for environmental offenders

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ACT-BASED VERSUS HARM-BASED SANCTIONS FOR ENVIRONMENTAL OFFENDERS ¹

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Abstract

We investigate the design of harm-based and act-based sanctions for environmental offenses. Empirical evidence for Belgium concerning both criminal and administrative sanctions clearly shows that the determination of harm-based and act-based sanctions for environmental offenses is less straightforward than theory predicts. In criminal cases, harm-based sanctions are influenced by offense related factors and specifically by the environmental harm caused, while the level of act-based sanctions is found to be independent of offense characteristics. Offender characteristics have a similar impact on the level of harm-based as well as act-based sanctions, with the exception of the treatment of facilities. In administrative cases, both types of sanctions positively depend on the seriousness of harm, respectively potential harm, caused. As a rule, we find that sanction levels increase for repeat offenders and decrease for offenders who took actions to minimize (potential) damages. Moreover, the analysis provides evidence of multiple objectives pursued by enforcing authorities.

Keywords: Enforcement; Environmental regulation; Criminal and administrative penalties; Environmental crime

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1. Introduction

In general, environmental offenses are penalized under two types of circumstances: firstly, when an offense caused actual harm, and secondly, when an offense involved risky behavior or potentially harmful acts without the actual occurrence of harm. Examples of the first category include the destruction of natural habitats, emissions of hazardous pollutants and soil contamination caused by illegal disposal of waste; while examples of the second category include missing documents such as maintenance or fire reports, producing goods or services with an inappropriate environmental permit and the inaccessibility of measuring points for water sampling. The two types of sanctions associated with these types of offenses are called harm-based and act-based sanctions respectively.

Past research has already looked at the distinction between ex ante and ex post legislative design given these two types of offenses. One strand of the literature has focused on ex post liability compared to ex ante regulation (see, among others, Wittman, 1984; Kolstad et al., 1990; Innes, 2004). However, the arguments centered around the distinction between private action versus public enforcement. Another strand of literature has focused on the general structure of law enforcement. Shavell (1993) and Polinsky and Shavell (1994) have, for instance, discussed act-based versus harm-based enforcement from the point of view of choosing the appropriate timing for an intervention: after the risky act has been committed or after the harm has been observed. More recently, Garoupa and Obidzinski (2011) investigate the efficiency of harm-based and act-based sanctions. They find that for equal deterrence levels, a system based on harm-based sanctions is cheaper since fewer offenders are convicted, it provides incentives to acquire information concerning harm and introduces appropriate incentives to control the occurrence of harm compared to a system based on act-based sanctions. Moreover, they state that the most serious disadvantage of using harm-based sanctions is the higher likelihood that offenders will be unable to pay the appropriate fine (judgment proofness). Further, looking specifically at the differences between act-based sanctions and harm-based sanctions, Polinsky and Shavell (2000) show that act-based sanctions need not be as high to accomplish a given level of deterrence and thus their impact on risk averse individuals is different. Finally, Garoupa and Obidzinski (2011) observe that act-based and harm-based sanctions may differ in the ease with which they can be applied. First, when acts are not easy to observe (such as carelessness when handling hazardous substances) or when expected harm is hard to calculate, harm-based sanctions should prevail. Second, when harm is hard to assess or when acts are easy to observe, act-based sanctions should be used by the regulator.

While most of the literature on the design of optimal sanctions³ focusses on offenses that actually caused harm, little attention has been paid to the design of the optimal act-based sanctions. However, ignoring detection and prosecution costs, Polinsky and Shavell (2000) do state that for offenses causing harm the optimal expected sanction should equal the harm caused, while for offenses involving the risk - but not the actual occurrence - of harm the optimal expected sanction should equal the expected harm. This is quite a straightforward result, which might explain the lack of research effort spend on this topic. In this contribution we confront theory with practice and investigate whether the determinants of act-based and those of harm-based sanctions are indeed similar, with exception of the impact of the size of the harm or potential harm on the sanction level.

Therefore, we use data concerning the criminal environmental sanctions imposed on firms as well as individuals by courts of first instance in Flanders (one of three regions in the federal state Belgium) and the administrative environmental fines imposed by the administration in Brussels (another region in Belgium). Since over 80% of environmental legislation in Flanders and Brussels is directly based on European environmental directives, which are identical for all 27 EU member states, our results are likely to be relevant for and extend to a broader context than the Flemish or Brussels context. We find that judges and administrators do not take the same factors into account when determining the level of act-based sanctions and harm-based sanctions. Part of the differences are explained by the fact that several harm-related factors are taken into account when determining harm-based sanctions, which is not possible for act-based sanctions. However, some differences are not so easily explained. For instance, facilities can expect significantly higher criminal sanctions than individuals for offenses which caused actual harm, while the two types of offenders are treated equally for offenses which did not actually cause harm. Moreover, the same observation can be made for the administrative sanctions that are imposed which suggests that this might be a general phenomenon, at least in Belgium. The differences observed in practice concerning the determination of sanctions imposed for offenses related to actual harm and those related to potential harm are intriguing and invite additional – theoretical as well as empirical – research on the design of optimal act-based versus harm-based sanctions.

³ Following Becker's paper in 1968, one strand of literature points out that fines should be maximal, since raising fines is cheaper than increasing the likelihood of detection. However, to preserve marginal deterrence, Shavell (1992) and Mookherjee & Png (1994) argue that fines should be an increasing function of the severity of the violation(s), and thus maximal fines are not optimal. So, the literature provides straightforward results (see, e.g., Polinsky & Shavell, 1979, 1992; Garoupa, 2001): the regulator should set the optimal fine equal to the harm caused corrected for the probability that the violator is sanctioned (while taking the costs of prosecution and detection into account). Rousseau & Telle (2010) have studied the existence of this optimal fine for environmental crime.

In the next section we provide an overview of previous theoretical and empirical studies concerning environmental sanctioning. In section III, we present our data for the empirical analysis. We describe our estimation results in section IV and discuss them in section V. Section VI ends with some general conclusions.

2. Literature overview

The influence of factors such as intent, the gain resulting from the offense and the (potential) harm caused by the offense on the level of the imposed fine can greatly vary depending on the occurrence of harm as well as on the objective functions of the enforcing authorities.

Firstly, we discuss sanctions for violations that actually caused harm. We start by looking at an enforcing authority who aims at maximizing social welfare. Hence, the imposed sanctions aim at forcing economic agents to take external costs (i.e. environmental harm) into account. As shown by, among others, Polinsky and Shavell (1979, 2000), the optimal expected fine then is based on the level of the harm caused. Next, we look at an enforcing authority who aims at maximizing compliance. Maximization of compliance can follow from principles such as the notion that rules should be obeyed or that crime should not be profitable. As is shown in the literature (see e.g. Cohen, 1999) this implies that environmental sanctions should be based on the size of the gain obtained by the offender due to the violation. The optimal sanction from this perspective should thus be independent of the level of the environmental damage caused by the offense.

Secondly, when no actual harm occurred (yet) but agents displayed risky behavior, sanctions can be called risk-based or act-based sanctions (Shavell, 1993). As outlined by Innes (2004), this type of regulation may be preferred in case of serious environmental hazards. Garoupa and Obidzinski (2011) state that enforcement of act-based cases should in general be less stringent in terms of sanctioning levels and number of prosecution cases compared to harm-based cases. Again we start by looking at an enforcing authority who maximizes social welfare. The optimal fine then positively depends on the level of potential harm as well as the probability that an incident could have happened (Polinsky and Shavell, 2000). Next, when we look at an enforcing authority that maximizes compliance, the optimal act-based fine is independent of the size of the environmental harm that could have been caused and depends on the amount of compliance costs saved by the offender as well as the probability that an incident could have happened.

For a general overview of the theoretical and empirical issues associated with the sanctions imposed for environmental crime, we refer to Cohen (1999) and Rousseau (2009). With respect

to penalty setting, three major categories of information are typically taken into account in sentencing in reality (see, e.g., Fox & Freiberg, 1999; Australian Law Reform Commission, 2002):

- the particular circumstances of the offense such as its gravity compared to others in the same category; social danger; harm actually done; the prevalence of the type of offense; and the degree to which offenders are responsible for the offense;
- the characteristics of the offender that may mitigate his or her culpability for the offense or indicate the likelihood or otherwise of re-offending such as recidivism, the role of the individual in the corporation, and size of the offending corporation;
- the general aims of the penalty, to achieve one or more of the following: to exact retribution; deter others from committing similar offenses; rehabilitate the offender; denounce the action; and protect the community.

As noted by Rousseau (2009), the limited number of empirical studies investigating the determinants of penalties for environmental violations is striking. Moreover, the geographical scope of the studies is limited as well, since the majority deals with North American data. Nonetheless, these previous studies can be used to look at the empirical importance of the different categories of penalty determinants.

Concerning the circumstances of the offense, it is noteworthy that previous studies (see, for instance, Cohen, 1987; Earnhart, 1997, 2000; Kleit et al., 1998; Lynch et al., 2004; Blondiau & Rousseau, 2010) routinely include some measure of the harm caused by the violation, but only a few studies included a proxy for the possible benefit from the violation. For example, Deily and Gray (1991) and Gray and Deily (1996) include an estimate of the compliance costs for the facilities; however, this variable was statistically not significant. Thus the analyses performed so far do not allow us to establish whether gain-related factors influence the level of monetary fines. In the current study, we therefore explicitly aim to take gain-related factors into account. The empirical evidence derived from the included harm-related variables makes it clear that penalty amounts generally increase with the seriousness of the violation (see, for instance, Deily & Gray, 1991; Cohen, 1997; Earnhart, 1997, 2000; Kleit et al., 1998; Lynch et al., 2004; Blondiau & Rousseau, 2010). Penalties were found to increase, for example, with the number of violations, with the amount of measured damages, or with the presence of third parties that were harmed. Also, remedial actions were taken by the violator to limit the harm caused were found to lower the penalty. However, none of these empirical studies explicitly distinguish between actual harm

and potential harm. Further intent-related factors were also found to matter in previous empirical studies. Several studies (e.g. Cohen, 1987; Earnhart, 1997) incorporate variables relating to the cause of the offense. When the cause was related to human influence or negligence, the penalty imposed was significantly higher. Also, when the offense was labeled as being intentional, the penalty increased significantly (see, e.g., Oljaca et al., 1998).

Secondly, the characteristics of the offender also matter in practice. Studies typically find significant results for the variables relating to the size of the offending facility. However, the findings seem to be contradictory: whereas Oljaca et al. (1998) observed fines increasing with the number of employees employed by the violator, Lynch et al. (2004) found the opposite effect. Moreover, penalties significantly increase for repeat offenders. Studies that account for the number of past violations (e.g. Oljaca et al., 1998) or the past compliance status (e.g. Gray & Deily, 1996) all found evidence corroborating this result.

Finally, in principle political and institutional factors should not matter in setting penalties, but the evidence suggests that in practice they do. For instance, a republican president in power in the US led to lower environmental fines (Ringquist, 1998). Also, during the communist regime in the Czech Republic military and foreign facilities were favorably treated compared to the following democratic regime (Earnhart, 1997). Moreover, several studies point to the importance of sanctioning procedures, e.g. fines increased with the number of defendants in White (2006).

Next we use a dataset of environmental sanctions for Belgium to investigate the possible differences between the determination and use of act-based and harm-based sanctions in reality.

3. Data

First, we describe the dataset we are using and then we look at the dependent and explanatory variables that are included in the estimation of the sanction level.

3.1 Dataset

The database contains information on criminal sanctions as well as administrative sanctions for environmental violations. The criminal sanctions are imposed by the Courts of First Instance in seven judicial districts of the Flemish region in Belgium⁴. In total, we dispose of 1313 first instance judgments being made between 2003 and 2006. The administrative sanctions are

⁴ More information on the design of the database can be found in Billiet et al. (2009).

imposed by the Brussels Environmental Agency (BIM). We dispose of 610 fining decisions that were imposed between 2004 and 2006.

In this dataset, we distinguish between ‘harm’ cases and ‘no harm’ cases. These groups correspond to defendants that actually caused environmental harm and defendants who face accusations of displaying risky behavior or causing environmental hazards. For making a distinction between the two cases, we base ourselves on indications related to the type of contamination. A significant share of the offenses carried the indication that ‘no contamination was caused’. Thus, the motivation of the sanctions imposed on these defendants cannot be based on actual environmental harm estimates. Most of the cases with no contamination recorded involved offenses in which a defendant did not fulfill a legal requirement such as filing for an environmental permit. An alternative group of ‘no-harm’ cases are certain cases dealing with noise nuisance where the rationale for deterrence is the possibility that (repeated) exposure to loud music/noise may cause hearing damage. The remaining group of defendants, for whom there was an indication that their violations resulted in environmental harm, are categorized as ‘harm’ cases. For the group of defendants that face both ‘harm’ and ‘no-harm’ offenses, we assume that the offenses leading to actual environmental harm are the most important for determining the level of the sanction. Therefore, we categorize these defendants among the ‘harm’ group.

Table 1: Number of defendants in each subset

Number of defendants in each subset	Harm	No harm
Criminal track	1048	265
Administrative track	276	334

As is shown in table 1, the share of ‘no harm’ cases is much lower in the criminal than in the administrative enforcement track (20.2% versus 54.8%), which is in accordance with the statement of Garoupa and Obidzinski (2011) that criminal sanctions are more likely to be harm-based and administrative ones are more often risk-based.

3.2 Dependent variables

We now outline the construction of the dependent variables to measure the stringency of the sanction in the criminal and the administrative track. For the criminal sanctions, we focus on the principal penalties, which are fines and prison sentences, plus the amount of removal of illicit gain awarded. Each sanction imposed consists of an ‘effective’ component and a ‘conditional’

component. We restrict our attention to the effective component of the sanction and we only include proven accusations in our analysis, since cases where no sufficient proof is available automatically lead to acquittals. Some descriptive statistics can be found in Table 2.

Table 2: Descriptive statistics for effective criminal sanctions imposed

<i>Variable</i>	<i>Number of observations</i>	<i>Average</i>	<i>Median</i>	<i>Maximum</i>	<i>Minimum</i>
Fine (in €)	991	4807	1000	475 000	55
Imprisonment (in months)	33	5,4	3	24	1
Removal of illegal gain (in €)	64	403 841	12 701	24 212 597	500

Note that the distribution of the fine levels is skewed to the right, thus lower sanctions occur more frequently than higher sanctions. The same holds for the requested removal of illicit gain by the public prosecutors. To perform a consistent empirical estimation, we construct one value (CRISANC) to indicate the stringency of the sanction which is based on the three components of Table 2. Therefore, we need to find an equivalent monetary value for a jail sentence. To this end, we use the transformation coefficient used by the Belgian regulator to transform the legal prison sentences that can be imposed on natural entities into the maximum fines that can be imposed on legal entities (see also Billiet et al., 2009). Thus, the variable LN(CRISANC) represents the logarithmic transformation of the level of the effective sanction defined as the sum of the monetary equivalent of an imposed prison sentence, the effective fine and the awarded removal of illicit gain. In our dataset (Billiet et al., 2009), judges of the courts of first instance convicted three in four defendants. Moreover, one in eight defendants were acquitted, while for the remaining defendants without a conviction the verdict was suspended.

For the administrative cases, the dependent variable is equal to the imposed fine (ADMSANC) and the variable LN(ADMSANC) represents the logarithmic transformation of the administrative fine level. In our dataset, an administrative fine was imposed in 62% of the cases in which the fining procedure was started. Some descriptive statistics on the level of administrative fines are given in Table 3. The average fine is significantly higher than the median, so its distribution is again skewed to the right.

Table 3: Descriptive statistics for level of administrative fines

<i>Variable</i>	<i>Count</i>	<i>Average</i>	<i>Median</i>	<i>Max</i>	<i>Min</i>
Amount (in €)	399	3628	785	102 915	62

3.3 Explanatory variables

We subsequently present three groups of explanatory variables: those related to the offenses, those related to the offender and some additional control variables. Appendix A provides an overview of the variables, their definition and of enforcement tracks in which we use them to study the level of the sanctions.

Firstly, we look at the *characteristics of the offenses*. In the criminal track, we define the indicator variables NATURE, HEALTH and CIVIL PARTY to approximate the harm caused. These indicators are equal to one if (for at least one of the defendant's proven offenses) natural resources were affected, public health was affected or an affected third party was included in the case, respectively. Further, the variable DAMAGE is derived from the judge's motivation of the verdict and indicates his perception on the level of harm caused. DAMAGE equals 1 if the text mentions at least one of the terms 'damage', 'lack of respect for the environment', 'pollution' or 'contamination'. We also include a count variable for the number of proven offenses since one prosecution can bundle several offenses in one case; this variable is called OFFENSES. To measure the extent of harm in the administrative track, we use the same variables as in the criminal track, except that NATURE cannot be used due to insufficient observations, nor can CIVIL PARTY be used because third parties cannot be legally included in administrative cases in Belgium. We also include the variable ASBESTOS to analyze the administrative fining decisions. The dummy ASBESTOS indicates that the offense involved the toxic substance asbestos, thus causing serious environmental risk as well as health risks. Therefore, this variable can be interpreted as a proxy for high risk behavior. We also control for contamination type through the inclusion of four indicators: WASTE to indicate violations related to illegal waste disposal, NOISE for violations related to noise nuisance, SOIL-WATER for soil or water pollution offenses, and ODOR-AIR for violations that are related with odor or air pollution problems. Then, we control for cases related to AIRPLANE noise, because this is a quite specific and large group among the administrative enforcement cases. Finally, we include the dummy TECHNICAL for the administrative cases only. This dummy is equal to one if the offense was caused by some mechanical or technical failure, which indicates that the level of intent was probably rather low. In addition, we define a variable LNFORFEIT, which represents the (logarithmically transformed) amount of illicit gains (in euro) that the public prosecutor requested to be removed through a criminal trial.

Secondly, we investigate some relevant *characteristics of the offenders*. In the criminal track, the perception on the degree of the offender's intentionality is measured by the variable INTENT. This indicator is created from the judge's written motivation statement (which is a mandatory complement for each verdict) and is equal to one if explicit statements⁵ were written down indicating that the offense is considered to have been purposely committed. The variable REPEAT was also derived from the written verdict and is equal to one if the judge mentions that the violator was a repeat offender and was previously convicted. Next, the dummy PREWARN equals one if the offense was reported by an administrative agency before being brought before a criminal court, which is a sign of warnings previous to trial. Also, an indicator GAIN is created to indicate whether judges explicitly mention the profit motive when justifying the verdict. GAIN equals one if the judge's motivation of the verdict included one of the following terms: 'pursuit of profit', 'economic profits', 'self-interest', 'financial profit' or 'economic stakes'. For the administrative cases, INTENT and REPEAT are defined analogously to the criminal cases. The PREWARN variable is now equal to one if the administrative agency set up a proof of default document before the defendant was brought to court, which is again a sign of warnings previous to trial. Next, we add the variable POSITIVE to indicate whether actions were undertaken by the defendant to mitigate the extent of environmental damages caused, or to reduce the level of the environmental risk in the 'no harm' case. Furthermore we control for the type of offender which can be a legal entity (FACILITY), an individual charged within his/her professional capacity (PROF), or an individual charged within his/her private capacity.

Finally, we also include a number of variables to control for regional differences and variations over time.

4. Estimation

First, we briefly discuss the estimation method used and next we present the results from the estimations for the criminal and administrative environmental sanctioning processes in respectively Flanders and Brussels.

4.1 Estimation method

We start by testing for differences in means between our two subsets - 'harm' versus 'no harm' - using the non-parametric Wilcoxon rank-sum test. We find significant differences between the

⁵ These statements include the use of the terms 'knowingly and willingly', 'sustained', 'intentionally', 'on purpose', 'purposely', or 'unwillingness'.

means for the ‘harm’ and ‘no harm’ sanctioning decisions in the criminal as well as in the administrative sanctioning track. So, it is best to estimate two separate regression models for the ‘harm’ and ‘no harm’ subsets.

Thus, we estimate four regression models: two for each enforcement track and two for distinguishing between the ‘harm’ and ‘no harm’ cases. We estimate these models using ordinary least squares in which the level of the sanction is the dependent variable F_i . Further, the offense characteristics are denoted by $X_{offense}$, the offender characteristics by $X_{offender}$, the control variables by $X_{control}$, β_i represents the estimated coefficients and u_i the error term. Formally, the OLS regression function can thus be written down as:

$$F_i = \beta_0 + \beta_1 X_{offense} + \beta_2 X_{offender} + \beta_3 X_{control} + u_i$$

We also estimate a two-step regression model to evaluate the robustness of the OLS coefficients. The regression results are represented in appendix B. We first estimate a probit model of the probability that a sanction is imposed, in which the error term ε_i is assumed to follow a standard-normal distribution:

$$\Pr(\text{Sanction}_i = 1 | X_{offense}, X_{offender}, X_{control}) = \Phi \left[\varepsilon_i > -(\beta_0 + \beta_1 X_{offense} + \beta_2 X_{offender} + \beta_3 X_{control}) \right]$$

Next, we estimate the level of the imposed sanction, using the Inverse Mills Ratio (LAMBDA: Λ_i) as a correction term for possible sample selection bias (Heckman, 1979). In this equation, the coefficient for Λ_i equals the covariance between the standard error of the probit regression model and the error of this linear specification:

$$F_i = \beta_0 + \beta_1 X_{offense} + \beta_2 X_{offender} + \beta_3 X_{control} + (\rho * \sigma_\varepsilon * \sigma_v) * \Lambda_i + v_i$$

The differences between the results obtained by applying the two-step method with the results of the OLS approach are discussed in the text, while the estimated coefficients are provided in appendix B.

4.2 Estimation results

We start by discussing the empirical results of the criminal enforcement track, in which we separately analyze the cases where harm occurred and where no harm occurred. Next, we turn to the empirical results of the administrative enforcement track, in which ‘harm’ and ‘no harm’ cases are again separately analyzed.

4.2.1 Criminal enforcement

The estimation results for criminal enforcement of environmental offenses in Flanders are given in **Error! Reference source not found.** First we discuss the results for the ‘harm’ cases and then turn to the ‘no harm’ cases.

Looking at the impact of the offense characteristics in the ‘harm’ group, we see that harm is an important determinant of the sanction, as we expected. Offenses that had negative health effects (HEALTH) are sanctioned significantly more severe. Also, sanction levels increase significantly for high DAMAGE offenses, for cases where CIVIL PARTIES are involved and for a higher number of OFFENSES committed. We also find that WASTE related offenses lead to higher sanction levels and that the requested FORFEITURE of illegal gains has a significant positive impact on the sanction level. Next, we look at how the offender characteristics influence the level of the sanction in the ‘harm’ group. We find that REPEAT and PREWARN positively influence the level of the sanction. Moreover, in cases where the economic benefits associated with the offense are regarded as an important element by the judge (GAIN), the sanction increases significantly. Offenders who reacted quickly to control and clean up the environmental harm (POSITIVE) incur a significantly lower sanction. Further, we see that facilities (FACILITY) are sanctioned significantly more severely than offenders who committed the offense in their private capacity. In contrast, individual offenders in official capacity (PROF) incur significantly lower sanctions. Finally, offenders in the regions of KORTRIJK and BRUGGE can expect lower sanctions, while we find no temporal effects.

When we estimate a two-step regression model with Heckman correction for sample selection for the harm cases, we generally find that the coefficients obtained in the OLS regression are quite robust (see appendix B). What we see is that some of our significant variables rather have an impact on the probability of sanction (REPEAT, HEALTH, WASTE), while others lead to higher sanction levels once the decision to impose a sanction has been taken (LNFORFEIT, DAMAGE, CIVIL PARTY, OFFENSES, PROF, FACILITY, BRUGGE, KORTRIJK).

We now investigate the results for the criminal ‘no harm’ cases. Surprisingly, none of the offense related characteristics seem to have a significant effect on the imposed sanction. However, looking at the impact of offender related variables, we again see that REPEAT offenders and offenders who received warnings prior to being brought to trial (PREWARN) can expect significantly higher sanction levels. Also, the judicial perception on the violations’ profitability (GAIN) positively influences the sanction level. POSITIVE actions taken to limit the environmental hazards after the offense lead to lower sanctions, *ceteris paribus*. Finally, we see that PROF offenders incur lower sanctions and that in the jurisdiction of BRUGGE sanctions are significantly lower. When we estimate a two-step regression model (see appendix B), we see that

the significant effects for the variables REPEAT, PREWARN, POSITIVE and PROF are all mainly due to an increase or decrease in the sanction probability, rather than in the sanction level.

Table 4: Estimation of criminal sanction level for ‘harm’ and ‘no harm’ cases

Dep Var LN(CRISANC) Variables	HARM cases #obs 1048 Coeff. (Std.Err.)	NO HARM cases #obs 265 Coeff. (Std.Err.)
ONE	4.453 (0.355)*	5.410 (0.620)*
HEALTH	1.361 (0.381)*	-
NATURE	-0.653 (0.439)	-
DAMAGE	0.523 (0.212)**	0.708 (0.590)
CIVIL PARTY	0.760 (0.241)*	-
WASTE	0.604 (0.269)**	-
NOISE	-	-0.201 (0.500)
SOILWATER	-0.527 (0.297)	0.083 (0.580)
ODORAIR	0.431 (0.360)	-
LNFORFEIT	0.242 (0.038)*	0.117 (0.075)
OFFENSES	0.101 (0.049)**	-0.106 (0.111)
INTENT	0.280 (0.284)	-0.378 (0.547)
REPEAT	0.915 (0.254)*	1.991 (0.565)*
PREWARN	1.645 (0.229)*	1.893 (0.562)*
GAIN	1.730 (0.269)*	2.565 (0.565)*
POSITIVE	-1.412 (0.238)*	-1.264 (0.502)**
PROF	-0.467 (0.237)**	-1.332 (0.448)*
FACILITY	0.916 (0.295)*	-0.226 (0.545)
GENT	-0.158 (0.232)	0.414 (0.548)
OUDENAARDE	-0.062 (0.366)	-1.488 (1.724)
KORTRIJK	-1.185 (0.404)*	-0.354 (0.640)
BRUGGE	-0.994 (0.390)**	-2.824 (0.638)*
WESTHOEK	0.148 (0.356)	-0.699 (0.673)
Y04	-0.218 (0.279)	-0.723 (0.508)
Y05	0.458 (0.260)	0.520 (0.569)
Y06	-0.009 (0.257)	-0.207 (0.545)
adj. R ²	0.300	0.373

**** indicates statistical significance at 1% level. * at 5% level**

4.2.2 Administrative enforcement

We now address the regression results for the administrative enforcement track, see **Error! Reference source not found.**

Table 5: Estimation of administrative sanction level for the ‘harm’ and ‘no harm’ cases

	HARM	NO HARM
Dep Var: LN(ADMSANC)	#obs:276	#obs:334
Variables	Coeff. (Std.Err.)	Coeff. (Std.Err.)
ONE	1.378 (0.700)**	3.454 (0.720)*
HEALTH	1.803 (0.388)*	-
TECHNICAL	-1.031 (0.457)**	-
ASBESTOS	-	1.143 (0.490)**
WASTE	-	0.827 (0.362)**
SOILWATER	-0.311 (0.471)	-
ODORAIR	0.494 (0.520)	-0.280 (0.590)
AIRPLANE	1.809 (0.483)*	-
OFFENSES	0.109 (0.027)*	0.054 (0.047)
INTENT	-1.301 (0.682)	-0.737 (0.474)
REPEAT	1.749 (0.393)*	0.548 (0.486)
PREWARN	0.425 (0.422)	0.747 (0.330)**
POSITIVE	-1.792 (0.299)*	-3.312 (0.309)*
PROF	2.076 (0.646)*	-0.036 (0.701)
FACILITY	2.405 (0.631)*	0.573 (0.673)
Y05	0.179 (0.425)	0.769 (0.349)**
Y06	0.070 (0.432)	0.854 (0.382)**
adj R ²	0.557	0.351

**** indicates statistical significance at 1% level, * at 5% level**

We first discuss the empirical results for the ‘harm’ cases. Among the offense related variables, we find that negative HEALTH impacts lead to significantly higher sanctions, that sanctions

increase with each additional offense (OFFENSES), and that in the cases where violators are AIRPLANE companies the average sanction is also significantly higher. Turning to the offender characteristics, we find that REPEAT offenders receive significantly higher sanctions. We see that offenses due to mechanical failures (TECHNICAL) are sanctioned significantly less severely and that sanctions also significantly decrease with POSITIVE actions. Finally, we find that FACILITY and PROF receive higher fines than private offenders. The results of the two-step regression confirm that the estimated OLS coefficients are quite robust. The main difference is that the PREWARN variable now has a significantly positive effect on the sanction level (after the sanctioning decision has been taken). The significant OLS coefficients for TECHNICAL, HEALTH and POSITIVE can mainly be attributed to changes in the sanction probability, rather than changes in the sanction level. The effect for AIRPLANE can be mainly attributed to a higher sanction level, rather than a higher sanction probability. The positive effect for the variable OFFENSES seems to be a combination of a higher probability and a higher level.

For the administrative ‘no harm’ cases, we observe that fines are higher in more ‘risky’ cases (ASBESTOS) as well as for WASTE related cases. Also, we see that fines increase when the offender previously received warnings (PREWARN) and that they are lower when the offender took POSITIVE actions to limit the risk. Finally, expected administrative fines are significantly higher in the years 2005 and 2006. The results for the two-step regression show that all the significant coefficients from the OLS regression can be explained by an increase in the sanction probability, rather than in the sanction level. However, there seems to be a higher sanction level for REPEAT offenders and for violators that are accused of committing multiple OFFENSES.

5. Discussion of the results

Based on the empirical analysis, we can comment on the similarities and differences between the determination of the level of harm-based versus act-based environmental sanctions.

Firstly, we concentrate on the criminal sanctioning decisions. While harm-based sanctions are clearly influenced by offense related factors and specifically by the environmental harm caused, the level of act-based sanctions is found to be independent of offense characteristics. Thus, as predicted by theory, harm-based sanctions are positively correlated by the level of harm caused. However, theory also predicted that act-based sanctions should depend on the expected level of harm that could be associated with the prosecuted risky behavior. Surprisingly, this prediction is not confirmed for our dataset. Further, we see that the offender characteristics have a similar impact on the level of harm-based sanctions as well as on the level of act-based sanctions, with

the exception of the treatment of facilities. While facilities can expect to receive significantly higher harm-based sanctions than individuals, facilities are not treated differently than private individuals when it comes to act-based sanctions. Overall, repeat offenders are treated more severely, as were offenders that focused excessively on the pursuit of profit. Offenders investing in effort to reduce the (potential) environmental impact of the offense such as self-reporting violations could expect significantly lower sanctions.

Secondly, we look at the administrative enforcement track. Here both the impact of offense related factors and that of offender characteristics differ between harm-based and act-based sanctions. Both types of sanctions positively depend on the seriousness of harm, respectively potential harm, caused. Thus confirming theoretical predictions. Looking at the characteristics of the offender, we find that harm-based sanctions increase for repeat offenders, professionals and facilities and decrease for offenders who took measures to reduce the extent of the harm caused. Act-based sanctions, on the other hand, increase for offenders that previously received warnings and also decrease for offenders who took measures to reduce the extent of the environmental risk. It is also noteworthy that the level of harm-based sanctions was similar for the three years studied, while the level of act-based sanctions seems to increase over time.

To conclude, some similarities between criminal and administrative sanctions can be observed. Overall, sanction levels increase for repeat offenders and decrease for offenders who took actions to minimize (potential) damages. Harm-based sanctions increase with the level of harm. Facilities can expect higher harm-based sanctions, but similar act-based sanctions, compared to private individuals. However, we also note some differences between criminal and administrative sanctions. Regarding act-based sanctions, offense characteristics seem to have no impact in the criminal track, while they do have an impact in the administrative track. Moreover, an excessive focus on financial gains is treated as a negative factor in the criminal track and leads to higher sanctions, while this motive is not included as such in the administrative track.

Besides insight into the design of harm-based and act-based sanctions, our results also provide evidence of the objectives pursued by the enforcing authorities. For the criminal enforcement cases, we find different results for the judges' objective functions depending on the fact whether actual harm occurred or not. Based on the results for the harm cases, we find evidence of two objectives. The increasing expected sanctions associated with the gain related factors (GAIN and LNFORFEIT) point toward a desire to maximize compliance, while the increasing sanctions associated with the harm related factors (HEALTH, DAMAGE, CIVIL PARTY, OFFENSES and POSITIVE) point to a judicial objective function that includes social welfare maximization. Thus, judicial objectives can be described as a combination of both social welfare maximization

and compliance maximization (see also Blondiau & Rousseau, 2010). Regarding the ‘no harm’ cases, the results point much stronger towards compliance maximization than towards social welfare maximization.

Turning to the results for administrative enforcement, we find positive evidence of social welfare maximization for both ‘harm’ and ‘no harm’ cases. However, we find only indirect evidence of compliance maximization since there was little or no information available to identify a gain component. To start, it is not possible for the administration in Brussel to request for removal of illicit gains in administrative cases. In addition, the written motivations that accompany sanctioning decisions are much less elaborate in their description. One of the officers of the administrative enforcement agency in Brussels (BIM) explained us that: *“Although economic profit or gain is one of the elements that is taken into account when determining the appropriate level of a particular fine, it is not always clear how to calculate the profits that violating persons or facilities have made. However, there are specific regulations for which exact calculations of profits, or costs avoided, is possible. For example, in the regulation on transformers containing PCBs, the cost of removal of these transformers is taken into account.”* Moreover, Billiet (2008), a judge of the Brussels’ administrative court of appeal, mentions that BIM seems to take the illegal profit into account when calculating the level of the fine for PCB-related cases.

6. Conclusion

Using a recent dataset we investigated how the determination of harm-based and act-based sanctions happens for both criminal and administrative sanctions. Looking at the sanctioning decisions by courts of first instance in Flanders and the environmental administration in Brussels, we commented on similarities and dissimilarities between these two types of sanctions. Previous theoretical analyses are scarce and straightforward: to maximize social welfare, the optimal expected harm-based sanction should depend on the level of harm caused, while the optimal expected act-based sanction should depend on the expected level of harm associated with the offense (Polinsky & Shavell, 2000). Or alternatively, if compliance maximization is the goal, the optimal expected harm-based sanction as well as the optimal expected act-based sanction should depend on the level of benefits resulting from the offense.

The empirical evidence from both criminal and administrative sanctions clearly showed that the determination of harm-based and act-based sanctions for environmental offenses is less straightforward than theory predicts. In criminal cases, harm-based sanctions are influenced by offense related factors and specifically by the environmental harm caused, while the level of act-

based sanctions is found to be independent of offense characteristics. Further, offender characteristics seem to have a similar impact on the level of harm-based as well as act-based sanctions, with the exception of the treatment of facilities. In administrative cases, both harm-based sanctions and act-based sanctions positively depend on the seriousness of harm, respectively potential harm, caused. Further harm-based sanctions increase for repeat offenders, professionals and facilities, while act-based sanctions increase for offenders that previously received warnings. As a rule, we find that sanction levels increase for repeat offenders and decrease for offenders who took actions to minimize (potential) damages. The differences observed in reality regarding the level of harm-based and act-based sanctions imposed for environmental offenses are intriguing and invite additional – theoretical as well as empirical – research on the design of optimal act-based versus harm-based sanctions.

The analysis also provided evidence on the objectives pursued by enforcing authorities when sanctioning environmental offenders. The empirical evidence clearly indicates that enforcing authorities often pursue multiple objectives. Since the probability as well as the level of sanctions increase with the level of environmental harm, decisions made by courts and administration both point to social welfare maximizing behavior. The fact that the probability and level of sanctions increase with the illegal gain obtained from environmental violations indicates a desire by the enforcing authorities to maximize compliance. Thus, theoretical models limited to one particular objective function are likely to lead to results which are less relevant in practice. It is important to find ways of dealing with combinations of objectives when analyzing optimal sanctions. This would also improve communication between economic scholars, legal scholars and enforcing authorities. Conflicting opinions and results might simply be caused by an incorrect or partial specification of the relevant objective functions.

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APPENDIX A: Definition of dependent and explanatory variables

VARIABLE NAME	DEFINITION	Crim.	Admin.
<i>Dependent variables</i>			
PROBCRIM	=1 if judge imposes an effective criminal sanction on the defendant; =0 else	X	
LN(CRISANC)	= logarithm of the level of the effective criminal sanction combining fine, monetary equivalent of prison term and the removal of illegal gains	X	
PROBADM	=1 if agency imposes an effective administrative sanction on the defendants; =0 else		X
LN(ADMSANC)	= logarithm of the level of the effective administrative fine		X
<i>Explanatory variables</i>			
<i>Characteristics of the offense</i>			
OFFENSES	= total number of proven offenses	X	X
NATURE	=1 if offense damaged ecosystem, fauna or flora; =0 else	X	
HEALTH	=1 if offense damaged public or private health; =0 else	X	X
CIVIL PARTY	=1 if civil party (parties) are involved in the case; =0 else	X	
DAMAGE	= 1 if the occurrence of damages was explicitly mentioned; =0	X	
TECHNICAL	=1 if the cause of the offense was technical; =0 else		X
WASTE	=1 if offense related to illegal waste treatment or disposal; =0 else	X	X
SOILWATER	=1 if offense related to soil or groundwater contamination; =0 else	X	X
NOISE	=1 if offense related to noise pollution; =0 else	X	
ODORAIR	=1 if offense related to odor nuisance; =0 else	X	X
ASBESTOS	=1 if offense related to asbestos removal; =0 else		X
AIRPLANE	=1 if offense related to airplane noise; =0 else		X
LNFORFEIT	= logarithm of amount of removed illegal gains	X	
<i>Characteristics of the offender</i>			
FIRM	=1 if offender is legal person; =0 else	X	X
PROF	=1 if offender is individual offending during professional activities; =0 else	X	X
POSITIVE	=1 if offender took action to limit damage; =0 else	X	X

REPEAT	=1 if offender was previously convicted; =0 else	X	X
PREWARN	=1 if offender was previously warned; =0 else	X	X
INTENT	=1 if offender was mentioned to have offended intentionally; =0 else	X	X
GAIN	=1 if offender was explicitly mentioned to have offended in pursuit of gain; =0 else	X	
<i>Control variables</i>			
BRUGGE	=1 if verdict was pronounced by court of first instance of Brugge; =0 else	X	
GENT	=1 if verdict was pronounced by court of first instance of Gent; =0 else	X	
KORTRIJK	=1 if verdict was pronounced by court of first instance of Kortrijk; =0 else	X	
OUDENAARDE	=1 if verdict was pronounced by court of first instance of Oudenaarde; =0 else	X	
WESTHOEK	=1 if verdict was pronounced by court of first instance of Ieper or Veurne; =0 else	X	
Y04	=1 if verdict was pronounced in 2004; =0 else	X	
Y05	=1 if verdict was pronounced in 2005; =0 else	X	X
Y06	=1 if verdict was pronounced in 2006; =0 else	X	X

APPENDIX B

We define a variable PROBCRIM that equals one if the judge imposed an effective sanction on the defendant and equals zero if the verdict was postponed. The variable PROBADM equals one if an administrative fine was imposed and is zero otherwise.

Two-step regression model for criminal cases, using Heckman's correction for sample selection (** indicates statistical significance at 1% level, * at 5% level):

Variables	HARM CASES		NO HARM CASES	
	PROBIT	SELECTION	PROBIT	SELECTION
	Dep Var PROBCRIM	Dep Var LNCRISANC	Dep Var PROBCRIM	Dep Var LNCRISANC
	#obs: 1048	#obs: 920	#obs: 265	#obs: 196
	Coeff. (Std.Err.)	Coeff. in selection group (Std.Err)	Coeff. (Std.Err.)	Coeff. in selection group (Std.Err.)
ONE	0.938 (0.230)*	5.496 (0.487)*	1.530 (0.357)*	6.829 (0.559)*
INTENT	0.047 (0.189)	0.292 (0.242)	0.390 (0.334)	-0.743 (0.588)
REPEAT	0.767 (0.231)*	0.453 (0.358)	1.513 (0.473)*	1.079 (0.973)
PREWARN	0.714 (0.198)*	1.181 (0.338)*	1.050 (0.407)**	1.040 (0.794)
GAIN	0.601 (0.222)*	1.424 (0.322)*		1.594 (0.442)*
LNFORFEIT	-0.014 (0.026)	0.231 (0.033)*	-0.021 (0.040)	0.130 (0.096)
HEALTH	0.904 (0.366)**	0.770 (0.464)		
NATURE	-0.492 (0.269)	-0.196 (0.439)		
DAMAGE	0.179 (0.143)	0.439 (0.194)*	0.114 (0.365)	0.660 (0.572)
CIVIL PARTY	0.296 (0.169)	0.607 (0.237)**		
OFFENSES	0.000 (0.028)	0.151 (0.048)*	0.054 (0.063)	-0.144 (0.122)
POSITIVE	-0.392 (0.137)*	-1.216 (0.275)*	-1.012 (0.283)*	-0.737 (0.799)
WASTE	0.503 (0.167)*	0.104 (0.324)		
NOISE			0.184 (0.324)	-0.667 (0.466)
SOILWATER	-0.021 (0.182)	-0.469 (0.261)	-0.343 (0.299)	-0.056 (0.629)
ODORAIR	0.301 (0.256)	0.064 (0.334)		
PROFESSIONAL	-0.123 (0.149)	-0.444 (0.209)**	-0.692 (0.261)*	-0.810 (0.591)
FACILITY	0.252 (0.193)	0.796 (0.275)*	-0.224 (0.318)	0.126 (0.526)
GENT	-0.085 (0.149)	-0.179 (0.200)	-0.438 (0.325)	0.856 (0.569)

OUDENAARDE	-0.141 (0.226)	0.072 (0.321)	-1.557 (0.893)	0.558 (1.903)
KORTRIJK	-0.009 (0.241)	-1.329 (0.351)*	-0.082 (0.395)	-1.064 (0.580)
BRUGGE	-0.117 (0.239)	-1.172 (0.347)*	-1.333 (0.343)*	-2.732 (1.095)**
WESTHOEK	-0.167 (0.223)	0.286 (0.313)	-1.175 (0.348)*	0.572 (1.051)
Y04	-0.391 (0.180)**	0.134 (0.288)	-0.083 (0.289)	-0.613 (0.504)
Y05	-0.093 (0.178)	0.455 (0.223)**	0.119 (0.316)	0.889 (0.550)
Y06	-0.428 (0.169)**	0.275 (0.281)	-0.022 (0.309)	0.889 (0.527)
LAMBDA		-0.106 (1.229)		-1.555 (1.199)
Correct % (Benchmark)	69.37% (88%)	Adj R ² : 0.320	83.6% (74%)	Adj R ² : 0.361
Correct 1 %	69.13%		84.2%	
Correct 0 %	71.09%		78.3%	

Two-step regression model for administrative cases, using Heckman's correction for sample selection (** indicates statistical significance at 1% level, * at 5% level):

Variables	HARM CASES		NO HARM CASES	
	PROBIT	SELECTION	PROBIT	SELECTION
	Dep Var PROBADM	Dep var LNADMSANC	Dep Var PROBADM	Dep Var LNADMSANC
	#obs: 276	#obs: 216	#Obs: 334	#Obs: 183
	Coeff. (Std.Err.)	Coeff. in selection group (Std.Err.)	Coeff. (Std.Err.)	Coeff. in selection group (Std.Err.)
ONE	-0.554 (0.501)	2.905 (0.599)**	-0.004 (0.415)	5.926 (0.351)*
INTENT	-0.853 (0.435)	-0.313 (0.477)	-0.519 (0.263)**	0.111 (0.188)
REPEAT	0.921 (0.412)*	1.136 (0.255)**	0.095 (0.269)	0.531 (0.112)*
PREWARN	-0.152 (0.292)	0.747 (0.267)**	0.342 (0.177)	0.156 (0.126)
TECHNICAL	-0.657 (0.327)*	-0.006 (0.315)		
HEALTH	1.407 (0.301)**	0.076 (0.353)		
OFFENSES	0.037 (0.024)	0.101 (0.064)	0.015 (0.023)	0.052 (0.015)*
POSITIVE	-1.387 (0.272)**	-0.303 (0.302)	-1.505 (0.166)*	-0.060 (0.479)
ASBESTOS			0.702 (0.281)**	-0.098 (0.222)
WASTE			0.421 (0.194)**	0.106 (0.155)
SOILWATER	-0.109 (0.326)	0.307 (0.306)		

ODORAIR	0.303 (0.374)	-0.746 (0.338)*	-0.088 (0.352)	-0.111 (0.139)
PROFESSIONAL	1.194 (0.471)*	1.276 (0.480)**	-0.017 (0.406)	0.207 (0.189)
FACILITY	1.088 (0.452)*	1.714 (0.479)**	0.310 (0.393)	0.243 (0.204)
AIRPLANE	0.590 (0.462)	1.588 (0.292)**		
Y05	0.154 (0.305)	0.286 (0.263)	0.437 (0.191)**	-0.003 (0.156)
Y06	0.208 (0.320)	0.147 (0.267)	0.481 (0.209)**	0.043 (0.168)
LAMBDA		1.217 (0.466)**		0.221 (0.386)
Correct % (Benchmark)	85.5% (78%)	Adj R ² : 0.686	78.1% (55%)	Adj R ² : 0.263
Correct 1%	86.6%		79.8%	
Correct 0%	81.7%		76.2%	