Act-based versus harm-based sanctions for environmental offenders

Sandra ROUSSEAU and Thomas BLONDIAU

Faculty of Economics and Business, KU Leuven

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Abstract

We investigate the design of harm-based and act-based sanctions for environmental offences. Empirical evidence concerning both criminal and administrative sanctions for Belgium clearly shows that the determination of harm-based and act-based sanctions for environmental offences is less straightforward than theory predicts. In criminal cases, harm-based sanctions are influenced by offence related factors and specifically by the environmental harm caused, while the level of act-based sanctions is found to be independent of offence characteristics. Further, offender characteristics have a similar impact on both types of sanctions, with the exception of the treatment of corporate offenders. In administrative cases, both types of sanctions positively depend on the seriousness of (potential) harm caused. We find that sanctions 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. While our results confirm the general insights from previous studies, they are innovative in the distinction made between harm-based and act-based sanctions.

I. Introduction

The body of environmental legislation continues to grow all over the world (e.g. Gray & Shimshack, 2011; Tosun, 2012; Qi & Zhang, 2014). With the increase in the number and variety of regulatory initiatives, compliance is increasingly seen as a challenge for both corporations and individuals. As a result, the role of monitoring and enforcement is receiving an increasing amount of attention. Already at the Tampere summit of the European Council in October 1999, environmental crime was identified as one of the areas for which the foundations of a harmonized criminal policy would be developed (Billiet, 2014). More recently, the Directive 2008/99/EC on the protection of the environment through criminal law ('Ecocrime Directive') was the first EU-directive to contain an extensive set of provisions regarding criminal sanctioning. At a European level, criminal sanctioning is seen as an essential part of an enforcement model in which criminal, administrative and civil law enforcement act as complements (European Commission, 2011). The dominant focus of environmental enforcement is based on criminal and administrative law in most European member states, while the use of civil law is currently less developed. However, in some European countries such as the United Kingdom, civil sanctions are increasingly used as an alternative for criminal sanctions (Watson, 2005; Langpap & Shimshack, 2010). So enforcement systems can vary greatly between countries. In this contribution we focus on criminal and administrative sanctions for environmental offences in Belgium.

In general, environmental sanctions are used in two types of circumstances: firstly, when an offence caused actual harm, and secondly, when an offence involved risky behaviour 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. This division is closely related to the discussion regarding the punishment of 'abstract endangerment'. Abstract endangerment offences are punished because of the potential creation of risk and not because of the actual creation of risk or harm (Fissell, 2014). In the remainder of the text we call the two types of sanctions associated with harmful and potentially harmful offences harm-based and act-based sanctions respectively.

Both types of sanctions have their strengths and weaknesses. We first look at the characteristics of act-based sanctions. The main strength of act-based sanctions is that they intervene at an early stage, i.e. before the harm is done. However, such an enforcement strategy can rapidly inflate the number of punishments imposed and thus the costs associated with prosecution and sanctioning.

Moreover, act-based sanctions lead to overinclusion since part of the individuals who are punished would not have caused environmental harm and thus punishing them does not protect the environment as such. This aspect of overinclusion can be problematic for scholars or policy makers who allow for punishment of conduct only when it gives rise to personal gains (Fissell, 2014). However, from the point of view of deterrence, overinclusion is acceptable as long as it leads to a net reduction of harm and protects the environment (Fissell, 2014). Note that this assumption of net harm reduction may not always hold in reality when using act-based sanctions for administrative offences such as failures to report. Further, the level of act-based sanctions need not be as high as the level of harm-based sanctions to accomplish a given level of deterrence (Polinsky & Shavell, 2000). Finally, act-based sanctions are useful when harm is hard to assess or when acts are easy to observe (Garoupa & Obidzinsky, 2011).

Next we discuss the main characteristics of an enforcement strategy based on harm-based sanctions. For equal deterrence levels, a system relying on harm-based sanctions is cheaper since fewer offenders will be convicted, it provides incentives to acquire information concerning harm and it introduces appropriate incentives to control the occurrence of harm compared to a system based on act-based sanctions (Garoupa & Obidzinski, 2011). However, the level of harm-based sanctions will be higher than that of act-based sanctions. This leads the most serious disadvantage of using harm-based sanctions: namely the higher likelihood that offenders will be unable to pay the appropriate fine, which reduced the deterrence effect of these sanctions (Polinsky & Shavell, 2000; Garoupa & Obidzinski, 2011). In addition, harm-based sanctions are useful when acts are not easy to observe (such as carelessness when handling hazardous substances) or when expected harm is hard to calculate (Garoupa & Obidzinski, 2011).

Previous law and economic research has focused on the general structure of law enforcement including the design of sanctions for both types of offences. For instance, Shavell (1993) and Polinsky and Shavell (1994) 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. A related discussion deals with the question whether sanctions should be based on the harm caused by the offence or on the gain achieved by the offender (e.g. Wittman, 1984; Polinsky & Shavell, 1994; Bowles et al., 2005). This issue can be studied for both act-based and harm-based sanctions and is closely associated with the objectives pursued by the regulator (Cohen, 1999). In general, this strand of literature focusses on the optimal design of sanctions, rather than which of the two types of sanctions should be used. Moreover, most of the literature on the design of optimal sanctions focusses on offences that actually caused harm and little attention has been paid to the design of the optimal act-based

sanctions. One exception can be found in Polinsky and Shavell (2000). Ignoring detection and prosecution costs, these authors state that the optimal expected sanction should equal the harm caused for offences involving harm, while the optimal expected sanction should equal the expected harm for offences involving the risk - but not the actual occurrence - of 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. 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). While more than 80% of environmental legislation in Flanders and Brussels is directly based on European environmental directives, which are identical for all 27 EU member states, monitoring and enforcement policies are in essence a national matter. Our results therefore provide an interesting view of enforcement policy and attitudes of judges rather than deal with substantive environmental law. 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, corporate offenders can expect significantly higher criminal sanctions than individuals for offences which caused actual harm, while the two types of offenders are treated equally for offences 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 offences 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.

We provide an overview of relevant studies on environmental sanctioning in the next section. 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.

II. Literature overview

Now we describe a theoretical framework to discuss the optimal design of harm-based and act-based sanctions. This framework is based on an overview of theoretical and empirical studies (see Cohen, 1999; Rousseau, 2009a; Gray & Shimshack, 2011; Tosun, 2012 for relevant overviews of the literature). Besides the theoretical analysis of optimal sanctions, we summarize the main characteristics of sanctions in practice.

2.1 A theoretical framework

To keep the analysis as simple as possible, we restrict the theoretical analysis to a discrete setting (Becker, 1968; Polinsky & Shavell, 1979): either an individual or a corporation is in compliance or it is not. The degree of non-compliance is thus not included in the model. The following notation is used in the model:

i = index representing an economic agent
C_i = compliance costs, also called abatement costs
H_i = environmental harm
S_i = sanction level in monetary terms
p_{det} = probability of detection
p_{inc} = probability of an incident causing harm

Firstly, we discuss sanctions for violations that actually caused harm. An economic agent i is assumed to minimize the costs associated with the environmental regulation in place:

$$\min [C_i + p_{det} S_i]$$

This agent will prefer to be compliant if his compliance costs are lower than the expected sanction associated with an offence: $C_i \leq p_{det} S_i$. Equivalently, the agent will be violating the regulation if his compliance costs exceed the expected sanction: $C_i > p_{det} S_i$.

We now look at an enforcing authority who aims at maximizing social welfare, or equivalently at minimizing social costs:

$$\min_{S_i} \sum_i [C_i + H_i]$$

Hence, the imposed sanctions aim at forcing economic agents to take external costs (i.e. environmental harm) as well as compliance costs into account. As shown by Polinsky and Shavell (1979, 2000), the optimal sanction S_i^* is then based on the level of the harm caused and the probability of detection:

$$S_i^* = \frac{H_i}{p_{det}}.$$

Next, we look at an enforcing authority who aims at maximizing compliance, or equivalently at minimizing environmental harm:

$$\min_{S_i} \sum_i [H_i]$$

Maximization of compliance can follow from principles such as the notion that rules should be obeyed or that crime should not be profitable. Note that compliance costs do not enter this objective function. This implies that environmental sanctions should by based on the size of the gain obtained by the offender due to the violation (Cohen, 1999). The optimal sanction from this perspective is thus independent of the level of the environmental harm caused by the offence:

$$S_i^* = \frac{C_i}{p_{det}}.$$

Secondly, when no actual harm occurred (yet) but agents displayed risky behaviour, sanctions can be called risk-based or act-based sanctions (Shavell, 1993). This type of regulation may be preferred in case of serious environmental risks (Innes, 2004). The compliance decision of an economic agent is modelled in an identical manner as above. Again we start by looking at an enforcing authority who minimizes social costs:

$$\min_{S_i} \sum_i [C_i + p_{inc} H_i]$$

The optimal sanction then depends positively on the level of potential harm as well as on the probability that an incident could have happened (Polinsky & Shavell, 2000):

$$S_i^* = \frac{p_{inc} H_i}{p_{det}}.$$

Next, when we look at an enforcing authority who maximizes compliance, the optimal act-based sanction 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 (i.e. the gain to the offender):

$$S_i^* = \frac{C_i}{p_{det}}.$$

Thus, when an enforcing authority maximizes compliance, the optimal harm-based sanction equals the optimal act-based sanction. On the other hand, when the authority maximizes social welfare, the optimal harm-based sanction will exceed the optimal act-based sanction. In addition, the analysis shows the importance of the objective function in determining the optimal sanction (Blondiau & Rousseau, 2010).

2.2 Sanction setting in practice

We now confront the well-known theoretical results on optimal sanction design with results from empirical studies. Theoretical insights often need to be adapted to take account of differences between theoretical "perfect" models and actual "imperfect" circumstances. One important element is the presence of errors. In reality, measurement errors during inspections, managerial errors within firms, and judicial errors occur (e.g. Rousseau, 2009b). Another element is the setting of imperfect information in which sanctioning authorities need to make decisions (e.g. Botelho et al., 2005). Finally, the effectiveness of monetary sanctions is limited by the wealth constraints of offenders (e.g. Polinsky & Shavell, 2000).

Three major categories of information are typically taken into account in sentencing in reality (Fox & Freiberg, 1999; Australian Law Reform Commission, 2002): the circumstances of the offence, offenders' characteristics, and indirect institutional effects. Looking at the empirical evidence for these three categories, some general trends emerge (Rousseau, 2009a; Gray & Shimshack, 2011; Tosun, 2012): an overview of factors with an impact on the sanction level is presented in table1. Next we discuss the empirical evidence for these three categories.

Firstly, concerning the circumstances of the offence, it is striking that previous studies routinely included some measure of harm, but only a few studies included a proxy for the gain obtained by the offender. For example, Gray and Deily (1996) include an estimate of the compliance costs for corporate offenders; 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 sanctions. In the current study, we explicitly aim to take gain-related factors into account. Further, the empirical evidence shows that penalties generally increase with the harmfulness of the violation (Cohen, 1987; Earnhart, 1997; Lynch et al., 2004; Billiet et al., 2014). Penalties were found to increase with the amount of measured damages and with the presence of third parties that were harmed. Alternatively, sanctions were found to decrease when the offender took remedial actions to limit the environmental harm. Still, none of these studies explicitly distinguish between actual harm and potential harm. Intent-related factors also mattered. When the cause was related to human influence or negligence, the penalty imposed was significantly higher (Cohen, 1987; Earnhart, 1997). Also, when the offence was labelled as being intentional, the penalty increased (Oljaca et al., 1998).

Secondly, we look at the characteristics of the offender. Studies typically found that the size of the offending facility mattered. 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 (Oljaca et al., 1998; Gray & Deily, 1996)

Finally, political and institutional factors also matter in setting penalties. 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 favourably 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).

Table 1: Factors influencing environmental sanctions (based on Rousseau, 2009a)

	Higher sanctions	**Lower sanctions**	**Ambiguous effect**
Circumstances of the offence			
More harmful offences	x		
Potentially more harmful offences	x		
Offences with high illegal gains for the offender	x		
Harm to third parties	x		
Intentional offences	x		
Health risks	x		
Timely clean up		x	
Measures to control the (potential) damage		x	
Accidental offences		x	
Prompt (voluntary) reporting		x	
Easy cooperation with authorities		x	
Offender characteristics			
Repeat offenders	x		
Culpability	x		
Financial motives	x		
Corporations with bad reputations	x		
Corporations in financial distress		x	
Socially and/or economically weak individuals		x	
Size of a facility			x
Institutional factors			
High procedural costs	x		
Party affiliation of regulators			x
Legal procedures			x
Year of the verdict			x
Geographical location of court/administration			x

III. Data

We use a dataset of environmental sanctions for Belgium to investigate the use of act-based and harm-based sanctions in reality. First, we describe the dataset 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 and administrative sanctions for environmental violations. The criminal sanctions are imposed by the lower Courts of First Instance in seven judicial districts of the Flemish region in Belgium[1]. In total, the dataset contains 1313 judgments made between 2003 and 2006. The administrative sanctions are imposed by the Brussels Environmental Agency (BIM) and the dataset contains 610 administrative fining decisions imposed between 2004 and 2006.

A limited number of legislative texts dominate the criminal case law: over two in three accusations involve violations of the Flemish Environmental Permitting Act 1985 and the Flemish Waste Act 1981. The other charges that were brought to court mainly concern violations of manure and noise legislation. Judgments also contain information on the type of pollution or nuisance that took place. Waste problems (34%) and noise nuisance (14%) are most frequently cited, followed by water pollution (9%) and soil contamination (7%). Descriptions of the harm that was caused are scarce. When harm is explicitly mentioned, the decisions refer in general to damage done to public health or the health of third parties (8% combined). Environmental damage to fauna and flora is stated less often (5% in total), while damage to the property of third parties is hardly mentioned at all (less than 1%). Judges convicted three in four defendants, one in eight is acquitted, and for the remaining defendants the conviction is postponed. Looking at the type of sanctions, we find that a monetary fine is by far the most used criminal sanctioning instrument, as it is imposed in over 95 percent of convictions. Moreover some 10% of individual offenders faced a custodial sentence. However, the large majority of these prison sentences were suspended and never executed (Billiet & Rousseau, 2014).

We divide this dataset into two groups: namely ‘harm’ cases and ‘no harm’ cases. These groups correspond to defendants who actually caused environmental harm and defendants who displayed risky behaviour respectively. We use proxies related to the type of contamination to distinguish between the two groups. Firstly, the ‘no harm’ group includes those offences for which the

[1] More information on the design and construction of the database can be found in Billiet et al. (2009) and on the website www.environmental-lawforce.be.

judgment explicitly mentioned that 'no contamination was caused'. Most of these cases involved offences in which a defendant did not fulfil an administrative requirement. Secondly, the 'no harm' group also included cases dealing with one-off or infrequent noise nuisance where health damage was not mentioned. Then the remaining group of defendants are categorized as 'harm' cases[2]. For the group of defendants that face both 'harm' and 'no-harm' offences, we assume that the offences leading to actual environmental harm are the most important for determining the sanction and we categorize them among the 'harm' group.

Table 2: Number of defendants in each subset

	Offences with harm	**Offences without harm**
Criminal prosecution	1048 defendants	265 defendants
Administrative prosecution	276 defendants	334 defendants

As shown in table 2, the share of 'no harm' cases is much lower in the criminal than in the administrative enforcement track (20.2% versus 54.8%). This corresponds to the observation made by Garoupa and Obidzinski (2011): namely that criminal sanctions are more likely to be harm-based and administrative ones are more often act-based.

3.2 Dependent variables

We now describe the dependent variables we use 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 illicit gain that was forfeited. Typically, each sanction 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 acquittal. We construct one value (CRIM-SANCTION) to indicate the stringency of the sanction by aggregating fine levels, prison sentences and the removal of illegal gains (Table 3). This allows us to perform a consistent empirical estimation. However, we need to find an equivalent monetary value for a prison sentence. We use the transformation coefficient used by the Belgian regulator to transform the legal prison sentences that can be imposed on individuals into the maximum fines that can be imposed on corporations (Billiet et al., 2014). Thus, the variable LN(CRIM-SANCTION) represents the logarithmic transformation (ln) of the effective sanction level, defined as the sum of the

[2] We have very carefully briefed the researchers doing the data input on the importance of using the correct classification of harm. Moreover, we have performed many quality checks during and after the data input. Therefore we can be quite confident on the quality of the data.

monetary equivalent of an imposed prison sentence, the effective fine and the awarded removal of illicit gain. Some descriptive statistics can be found in Table 3 and in Figure 1. The average criminal fine equals 4807 euro, while the average forfeiture of illegal gains amounts to 403841 euro. The distribution of 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. Prison sentences for environmental offences tend to be fairly short with an average of 5.4 months.

Table 3: Descriptive statistics for effective administrative and criminal sanctions

	Administrative fine (in €)	**Criminal fine (in €)**	**Prison sentence (in months)**	**Removal of illegal gain (in €)**
Number of observations with this sanction	399 defendants	991 defendants	33 defendants	64 defendants
Minimum sanction level	62 €	55 €	1 month	500 €
Median sanction level	785 €	1 000 €	3 months	12 701 €
Average sanction level	3 628 €	4 807 €	5.4 months	403 841 €
Maximum sanction level	102 915 €	475 000 €	24 months	24 212 597 €

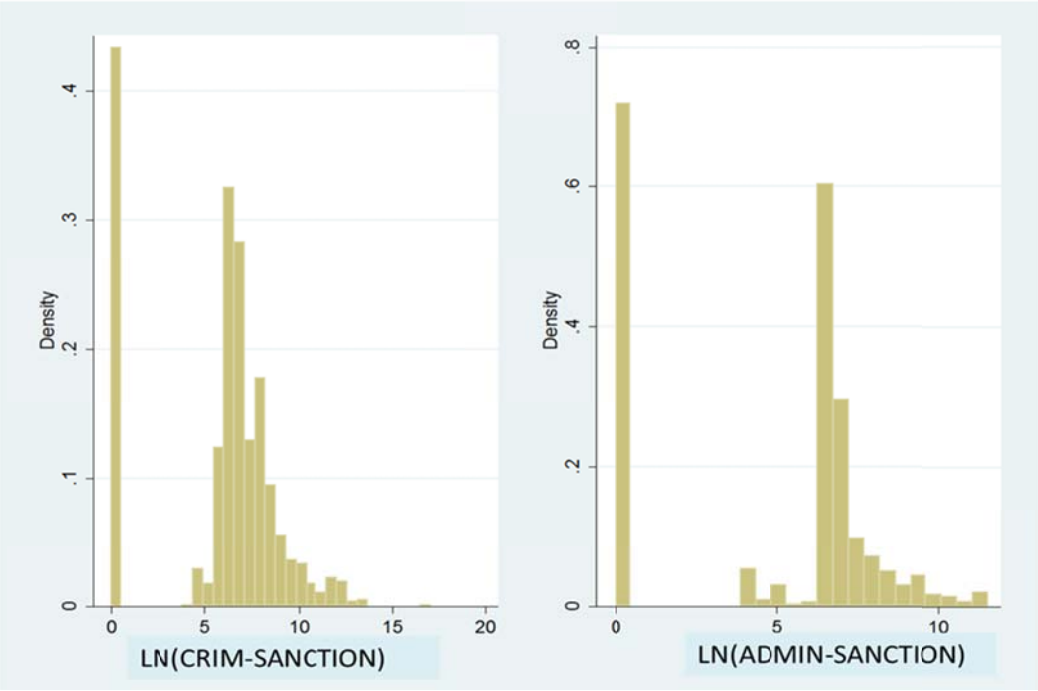

Figure 1

For the administrative sanctions, the dependent variable LN(ADMIN-SANCTION) equals the logarithmic transformation (ln) 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 and in Figure 1. The average fine (i.e. 3828 euro) is significantly higher than the median (i.e. 785 euro), so its distribution is again skewed to the right.

3.3 Explanatory variables

We present three groups of explanatory variables (see section 2.2): those related to the offence, those related to the offender and some control variables. Appendix A provides an overview of the variables, their definitions, and the enforcement tracks in which they are used.

Firstly, we look at the *characteristics of the offences*. In the criminal track, we define the variables NATURE, HEALTH and CIVIL PARTY to approximate the harm caused. These indicators are equal to one if 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 OFFENCES for the number of proven offences in each case. 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 include the variable ASBESTOS to analyse the administrative fining decisions. This variable indicates that the offence involved the toxic substance asbestos, thus causing serious environmental risk as well as health risks. Among the 610 administrative cases, more than 10 percent (i.e. 68) involved asbestos. We also control for contamination type through four variables: WASTE to indicate violations related to illegal waste disposal, NOISE for violations related to noise nuisance, SOIL-WATER for soil or water pollution, and ODOUR-AIR for odour or air pollution. Then, we control for cases related to AIRPLANE noise, since this is a quite specific and large group among the administrative enforcement cases. Finally, we include the dummy TECHNICAL for administrative cases only. This dummy equals one if the offence was caused by some mechanical failure. Also, we define a variable LN-FORFEIT, 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 to each verdict) and is equal to one if explicit statements[3] were written down indicating that the offence is considered to have been non-accidental. The variable REPEAT is equal to one if the judge mentions that the violator was a repeat offender and was previously convicted. Next, the dummy PREV-WARNING equals one if the offender received pervious warnings by an administrative agency before being brought to a criminal court. Also, an indicator GAIN is created to indicate whether judges explicitly mention the profit motive. 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 PREV-WARNING variable is now equal to one if the administrative agency send previous warnings before the defendant was tried. We add the variable POSITIVE to indicate whether actions were taken by the defendant to mitigate the extent of environmental damages, or to reduce the level of environmental risk in the 'no harm' case. Also, we control for the type of offender which can be a corporate offender (CORPORATE), an individual charged within his/her professional capacity (PROFESSIONAL), or an individual charged within his/her private capacity.

Finally, we include variables to control for regional differences and variations over time. We use indicator variables for the regions Gent, Oudenaarde, Kortrijk, Brugge and the Westhoek and for the years 2004, 2005 and 2006.

IV. Estimation

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

4.1 Estimation method

First we test 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 means for the 'harm' and 'no harm' sanctioning decisions in the both sanctioning tracks. So, it is best to estimate two separate regression models for the 'harm' and 'no harm' subsets.

In total we estimate four models: criminal sanctions for the 'harm' cases, criminal sanctions for the 'no harm' cases, administrative sanctions for the 'harm' cases, and administrative sanctions

[3] These statements include one of the terms 'knowingly and willingly', 'sustained', 'intentionally', 'on purpose', 'purposely', or 'unwillingness'.

for the 'no harm' cases. As mentioned in section 3.3, the explanatory variables are divided into three groups: offence characteristics ($X_{offence}$), offender characteristics ($X_{offender}$), and control variables ($X_{control}$). We estimate the determinants of the level of the sanction using ordinary least squares (OLS)[4] with β_i representing the estimated coefficients and u_i the error term. Thus, the OLS regression function can be written as:

$$S_i = \beta_0 + \beta_1 X_{offence} + \beta_2 X_{offender} + \beta_3 X_{control} + u_i$$

4.2 Estimation results

First we discuss the results for the criminal enforcement track, in which we separately analyse the cases where harm occurred and where no harm occurred. Next, we turn to the results of the administrative enforcement track, again analysing both groups separately.

4.2.1 Criminal enforcement

Belgian criminal court judges enjoy huge discretion over their sanctioning decisions since sentencing guidelines do not exist. Moreover, criminal judges are not bound by the public prosecutors' sanctioning requests nor by the sanctions imposed in any previous cases. The estimation results for criminal enforcement of environmental offences are given in table 4. First we discuss the results for the 'harm' cases and then we turn to the 'no harm' cases.

We start by looking at the impact of the offence characteristics in the 'harm' group. As expected, we find that harm is an important determinant of the sanction. Offences that had negative health effects (HEALTH) are sanctioned more severely. Also, sanction levels increase significantly for high DAMAGE offences, for cases where CIVIL PARTIES are involved and for a higher number of OFFENCES committed. We also find that WASTE related offences lead to higher sanctions and that the requested FORFEITURE of illegal gains has a significant positive impact on the sanction. Next, we look at how the offender characteristics influence the sanction level in the 'harm' group. We find that REPEAT and PREV-WARNING positively influence the level of the sanction. Moreover, the sanction increases significantly in cases where the economic benefits associated with the offence are regarded as an important element by the judge (GAIN). Offenders who reacted quickly to control and clean up the environmental harm (POSITIVE) incur a significantly lower sanction. Further, we see that corporate offenders (CORPORATE) are sanctioned more harshly than offenders who committed the offence in their private capacity. However, individual offenders incur

[4] The results from the OLS estimation are confirmed by a more extensive two-step estimation procedure where we first estimated the probability of being sanctioned and then the level of the imposed sanction in order to correct for a possible sample selection bias.

significantly lower sanctions when they are prosecuted in their official capacity (PROFESSIONAL). Finally, offenders in the regions of KORTRIJK and BRUGGE can expect lower sanctions[5], while we find no temporal effects.

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

Dep Var LN(CRIM-SANCTION) 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)
ODOURAIR	0.431 (0.360)	
LN-FORFEIT	**0.242 (0.038)***	0.117 (0.075)
OFFENCES	**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)***
PREV-WARNING	**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)****
PROFESSIONAL	**-0.467 (0.237)****	**-1.332 (0.448)***
CORPORATE	**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)
YEAR2004	-0.218 (0.279)	-0.723 (0.508)
YEAR2005	0.458 (0.260)	0.520 (0.569)
YEAR2006	-0.009 (0.257)	-0.207 (0.545)
adj. R^2	0.300	0.373

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

[5] We have not found any indication of the determinants underlying these lower sanctions in Brugge and Kortrijk. The Belgian judiciary system did not involve specialized environmental prosecutors nor specialized environmental courts within the time span of our dataset.

We now investigate the results for the criminal 'no harm' cases. Surprisingly, none of the offence 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 (PREV-WARNING) can expect higher sanction levels. Also, the judicial perception on the violations' profitability (GAIN) positively influences the sanction. POSITIVE actions taken to limit the environmental hazards after the offence lead to lower sanctions. Finally, we see that PROFESSIONAL offenders incur lower sanctions and that sanctions are significantly lower in the jurisdiction of BRUGGE.

4.2.2 Administrative enforcement

We now address the regression results for the administrative enforcement track, see table 5.

First we discuss the empirical results for the 'harm' cases. Among the offence related variables, we find that negative HEALTH impacts lead to significantly higher sanctions, that sanctions increase with each additional offence (OFFENCES), and that in the cases where violators are AIRPLANE companies the average sanction is also significantly higher. Considering the offender characteristics, we find that REPEAT offenders receive significantly higher sanctions. We find that offences due to mechanical failures (TECHNICAL) are sanctioned significantly less severely and that sanctions significantly decrease when POSITIVE actions are taken to limit environmental harm. Finally, we find that CORPORATE offenders and PROFESSIONALs receive higher fines than private offenders.

For the administrative 'no harm' cases, we observe that fines are higher in ASBESTOS cases as well as in WASTE related cases. In addition, we find that fines increase when the offender previously received warnings (PREV-WARNING) 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. This may be a reflection of a growing environmental concern or it may simply reflect inflation.

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

	HARM	NO HARM
Dep Var: LN(ADMIN-SANCTION)	#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)	
ODOURAIR	0.494 (0.520)	-0.280 (0.590)
AIRPLANE	**1.809 (0.483)***	
OFFENCES	**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)
PREV-WARNING	0.425 (0.422)	**0.747 (0.330)****
POSITIVE	**-1.792 (0.299)***	**-3.312 (0.309)***
PROFESSIONAL	**2.076 (0.646)***	-0.036 (0.701)
CORPORATE	**2.405 (0 .631)***	0.573 (0.673)
YEAR2005	0.179 (0.425)	**0.769 (0.349)****
YEAR2006	0.070 (0.432)	**0.854 (0.382)****
adj R^2	0.557	0.351

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

V. Discussion of the results

Based on the empirical analysis, we comment on the similarities and differences between the determination of the level of harm-based versus act-based environmental sanctions. Next, we highlight some other interesting findings.

5.1 Design of harm-based versus act-based sanctions

Firstly, we concentrate on the criminal sanctioning decisions. While harm-based sanctions are clearly influenced by offence related factors and specifically by the environmental harm caused, the level of act-based sanctions is found to be independent of offence 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 associated with the prosecuted risky behaviour. 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 that of act-based sanctions, with the exception of the treatment of corporate offenders. While corporate offenders can expect to receive significantly higher harm-based sanctions than individuals, corporate offenders are not treated differently than private individuals when it comes to act-based sanctions. Overall, repeat offenders are treated more severely, as are offenders that focused excessively on the pursuit of profit. Offenders making an effort to reduce the (potential) environmental impact of the offence could expect significantly lower sanctions.

Secondly, we look at the administrative enforcement track. Both the impact of offence 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 offender characteristics, we find that harm-based sanctions increase for repeat offenders, professionals and corporate offenders, and decrease for offenders who took harm-reducing measures. 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 risk. Note 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. Corporate offenders can expected 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, offence 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.

Overall, the importance attached to harm found in this empirical study is in line with the focus on harm in the existing literature on optimal penalties (e.g., Polinsky & Shavell, 1979, 1994, 2000) as well as in existing sentencing guidelines (e.g., US Sentencing Commission 1993, 2008, and UK Sentencing Advisory Panel 2000). For example, Macrory (2006, p.31) explicitly mentioned as his fourth penalty principle that *"A sanction should be proportionate to the nature of the offence and the harm caused"*. The use of stricter sanctions for repeat offenders and intentional offences also confirms previous results in the literature (e.g. Oljaca et al., 1998) as well as in

policy documents (e.g. ALRC, 2002; US Sentencing Commission, 2008). For example, Macrory (2006, p.30) mentioned that *"It [a regulator] should have the flexibility to apply a sanction for punitive reasons even though a lesser sanction could be applied. This may be necessary for so-called 'repeat offenders' who have been given previous opportunities – alongside advice and guidance – to comply, but have deliberately and intentionally failed to do so."*

5.2 Other interesting results

Our results also provide evidence of the objectives pursued by enforcing authorities (see section 2.1). The results confirm the theoretical insights of Cohen (1999) as well as previous policy advice. For instance, Macrory (2006) formulated six penalty principles, two of which called for 'no financial gain' (principle 2) and 'proportionate sanctioning (with harm)' (principle 4).

For the criminal cases, we find different results for the judges' objective functions depending whether actual harm occurred or not. For the harm cases, we find evidence of two objectives. The increasing expected sanctions associated with gain related factors (GAIN and LN-FORFEIT) point toward a desire to maximize compliance, while the increasing sanctions associated with harm related factors (HEALTH, DAMAGE, CIVIL PARTY, OFFENCES 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 (Blondiau & Rousseau, 2010). Regarding the 'no harm' cases, the results point much stronger towards compliance maximization than towards social welfare maximization.

Turning to administrative enforcement, we find positive evidence of social welfare maximization for both 'harm' and 'no harm' cases. However, we only find indirect evidence of compliance maximization since there was little information available to identify a gain component. To start, it is impossible for the administration in Brussels to request for removal of illicit gains in administrative cases. In addition, the written motivations of sanctioning decisions are much less elaborate. One of the officers of the administrative enforcement agency in Brussels (BIM) explained us that[6]: *"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."*

[6] We have presented the results of our empirical analysis to an audience of practitioners and policy makers, including criminal judges and administrative officers. Their feedback and comments tend to validate our results.

A second intriguing observation relates to the treatment of individuals who are prosecuted in their professional capacity for work related offences. These professionals receive lower sanctions than corporate offenders, all else equal. This difference could follow from a difference in the gross benefits associated with offences. However, enforcing authorities could also consider the deeper pockets of the corporate offenders compared to individuals. While wealth constraints could be counteracted by using prison sentences for individuals, the overcrowding in prisons reduces the use of prison sentences in Belgium (Billiet & Rousseau, 2014).

Finally we comment on the trend towards risk-based regulation (Hampton, 2005; Taylor et al. 2012). As stated by Rothstein et al. (2006, p.1057): *"At its simplest, risk based regulation can be conceived as allocating resources in proportion to risks to society (such as health, safety or environmental risks), considering both the impacts themselves and the likelihood that they happen, in order to establish appropriate levels of control."* Within this regulatory framework, monitoring and enforcement policies should be developed according to risk. The adoption of a risk-based approach can then enable environmental agencies to engage with firms in a more responsive way (Gouldson et al., 2009). For example, in the UK this has enabled the UK environmental agency to adopt a sanctions-based style for higher risks and worse performers and a more cooperative compliance-based approach for the lower risk and better performers (Gouldson et al., 2009). Such reforms were called for in the UK Hampton and Macrory Reports (Hampton, 2005; Macrory, 2006). Targeting regulatory resources according to risk would help to reduce the administrative burdens of regulatory monitoring and enforcement (Taylor et al., 2012). The development of risk-based enforcement will lead to an increased use of act-based sanctions rather than harm-based sanctions. Since act-based sanctions focus on the prevention of harm, they are more responsive and fit better within a risk-based framework. It is therefore important to take the (potential) differences between the design of the two types of sanctions into account, when the regulator wants to achieve the same, or even higher, levels of compliance.

VI. Conclusion

Using a recent dataset we investigated the determination of harm-based and act-based sanctions 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, while the optimal expected act-based sanction should depend on the expected level of harm. Or alternatively, if compliance maximization is the

goal, optimal expected harm-based sanctions as well as optimal expected act-based sanctions should depend on the level of benefits resulting from the offences. The empirical evidence for both criminal and administrative sanctions clearly showed that the determination of harm-based and act-based sanctions for environmental offences is less straightforward than theory predicts. In criminal cases, harm-based sanctions are influenced by offence related factors and specifically by the environmental harm caused, while the level of act-based sanctions is found to be independent of offence 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 corporate offenders. In administrative cases, both harm-based sanctions and act-based sanctions positively depend on the seriousness of (potential) harm. Further harm-based sanctions increase for repeat offenders, professionals and corporate offenders, 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.

While our results confirm the general insights from theoretical, empirical and policy studies, they are innovative in the distinction made between harm-based and act-based sanctions. Thus, the differences observed in reality regarding the level of both types of sanctions are intriguing and invite additional – theoretical as well as empirical – research on the design of optimal act-based versus harm-based sanctions. Since the evolution towards risk-based regulation can lead to an increased use of act-based sanctions, it is crucial to get a firm grasp of their use and optimal design.

Furthermore, our analysis provided insight into the objectives pursued by enforcing authorities when sanctioning environmental offenders. The evidence clearly indicated that authorities tend to pursue multiple objectives. Since the sanctions increase with the size of the environmental harm, decisions made by courts and administration both point to social welfare maximizing behaviour. The fact that sanctions increase with the size of illegal gain obtained from environmental violations indicates a desire by the enforcing authorities to maximize compliance. Thus, theoretical models limited to one objective function are likely to lead to results which are less relevant in practice. Especially since policy documents often require sanctions to reflect both harm and gain (e.g. Macrory, 2006). For this reason, it is important to find ways of dealing with combinations of objectives when analysing optimal sanctions. One way of combining objectives is by introducing policy weights into the objective function. 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.

While we investigated the differences in the design of act-based versus harm-based sanctions, we could not comment on their effectiveness due to lack of data. Such a lack of data is a wide-spread characteristic of empirical studies on environmental monitoring and enforcement (Rousseau, 2009a; Tosun, 2012). Effectiveness could be measured based on environmental outcomes and incomes or the compliance levels documented by environmental agencies. However, in analogy to the comments of Tosun (2012, p.443) on the measurement of monitoring and enforcement activities, we can say that there is not one perfect measure of the impact of environmental sanctions that is high in construct validity but low in data gathering efforts. Thus, the comparison of the effectiveness of act-based versus harm-based sanctions remains an interesting challenge for future research.

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APPENDIX A: Definition of dependent and explanatory variables

Table A1

Variable name	Definition	Crim.	Admin.
Dependent variables			
LN(CRIM-SANCTION)	= logarithm of the effective criminal sanction combining fine, monetary equivalent of prison term and removal of illegal gains	X	
LN(ADMIN-SANCTION)	= logarithm of the level of the effective administrative fine		X
Explanatory variables			
Characteristics of the offence			
OFFENCES	= total number of proven offences	X	X
NATURE	=1 if offence damaged ecosystem, fauna or flora; =0 else	X	
HEALTH	=1 if offence 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 offence was technical; =0 else		X
WASTE	=1 if offence related to illegal waste disposal; =0 else	X	X
SOILWATER	=1 if offence related to soil or groundwater pollution; =0 else	X	X
NOISE	=1 if offence related to noise pollution; =0 else	X	
ODOURAIR	=1 if offence related to odor nuisance; =0 else	X	X
ASBESTOS	=1 if offence related to asbestos removal; =0 else		X
AIRPLANE	=1 if offence related to airplane noise; =0 else		X
LN-FORFEIT	= logarithm of amount of removed illegal gains	X	
Characteristics of the offender			
CORPORATE	=1 if offender is legal person; =0 else	X	X
PROFESSIONAL	=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
PREV-WARNING	=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	
Control variables			
BRUGGE	=1 if verdict from the court of Brugge; =0 else	X	
GENT	=1 if verdict from the court of Gent; =0 else	X	
KORTRIJK	=1 if verdict from the court of Kortrijk; =0 else	X	
OUDENAARDE	=1 if verdict from the court of Oudenaarde; =0 else	X	
WESTHOEK	=1 if verdict from the court of Ieper or Veurne; =0 else	X	
YEAR2004	=1 if verdict was pronounced in 2004; =0 else	X	
YEAR2005	=1 if verdict was pronounced in 2005; =0 else	X	X
YEAR2006	=1 if verdict was pronounced in 2006; =0 else	X	X