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Empirical Analysis of Sanctions for Environmental Offenses*

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ABSTRACT

Sanctions are a crucial part of enforcing environmental regulations. We discuss the determinants and the levels of monetary penalties for environmental offenses found in practice. Three major categories of variables are distinguished: the circumstances of the offense, the characteristics of the offenders, and the indirect political and institutional effects. Some general trends emerge: fines increase with the harm caused by the offense and fines are higher for repeat offenders as well as for intentional offenses. Also, the studies discussed indicate that political and institutional factors matter. The empirical studies provide some initial insights into the objective functions of courts and agencies.

Keywords: Enforcement; Environmental violations; Monetary penalties; Empirical analysis.

JEL Codes: K42 Illegal behavior and the enforcement of law; Q5 Environmental economics.

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1 INTRODUCTION

In order to have an effective and efficient environmental policy, it is necessary to complement the legislation with a well-thought-out monitoring and enforcement strategy. Without monitoring and enforcement, the regulation's target group will have little or no incentive to comply with the rules and the environmental objectives are not likely to be met. Over recent years an extensive theoretical literature on the monitoring and enforcement aspects of environmental regulations has emerged as can be seen from the literature overviews by Cohen (1999) and by Polinsky and Shavell (2000). However, the volume of empirical studies has been lagging behind and still not much is known about the use and the impact of various instruments used by environmental agencies and courts. An overview of empirical research on the effectiveness of monitoring and enforcement in deterring firms and individuals from violating environmental regulation is provided by Cohen (2000).

In this review, we focus on the determinants of the monetary penalties imposed for violations of environmental regulation aimed at firms. This implies that both corporations and their managers or employees can be prosecuted and penalized. Moreover, the elements that influence the imposed penalty reveal the considerations taken into account by governmental agencies and courts. Thus, the empirical studies provide insight into the enforcers' objective functions.

In Section 2 we provide some general background on the motivation of using penalties against environmental violators. Section 3 describes the categories of variables that might influence the sanction that is imposed. Next, a summary of empirical findings is presented in Section 4. Section 5 concludes.

2 GENERAL BACKGROUND

First we discuss a simple model of environmental compliance and enforcement in order to place the role of monetary sanctions into a larger framework. Next, we briefly go over the main elements of the expected violation costs faced by a violator.

2.1 A Simplified Model

In order to understand the determinants and levels of penalties for environmental violations, we need to look at the compliance decisions by firms and their managers as well as the monitoring and enforcement decisions by the regulator.

2.1.1 Firms' Compliance Decision

First, we turn to the compliance decision of a rational, profit-maximizing firm that is confronted with environmental regulation. The basic model is based on work by Becker (1968) and Harford (1978), among others (for an overview see Eide, 2000).

A profit-maximizing firm will aim at minimizing all costs associated with the environmental regulation in place. Thus, the firm selects the level of violation $v \geq 0$ such that the sum of the compliance costs $C(v)$ and the expected violation costs $pV(v)$, with p representing the probability of detection,[1] is minimized:

$$\min_v TC = \min_v \{C(v) + pV(v)\} \tag{1}$$

The compliance costs C are assumed to be a continuously decreasing function of the size of violation v. The expected violation costs are determined by the probability p that the violation is detected and by the size of the violation costs $V(v)$ that are assumed to be continuously increasing in the level of the violation v. As we discuss in Section 2.2, violation costs consist of many aspects, including monetary sanctions, reputational effects, or clean-up requirements. Thus, the concept of violations costs is defined as all negative consequences associated with a violation and as such includes more than the formal sanctions imposed by third parties. The firm fully complies with the regulation if its compliance costs to perfectly comply are lower than or equal to the expected violation costs for all levels of violation:

$$C(0) \leq pV(v) \quad \forall v \tag{2}$$

If inequality (2) does not hold, the firm decides to violate the regulation and selects a level of violation $v > 0$ such that the marginal compliance cost equals the marginal expected violation cost:

$$C'(v) = pV'(v) \tag{3}$$

Several empirical studies examine the influence of monitoring and enforcement actions on firms' compliance levels. Examples of such studies are Magat and Viscusi (1990), Nadeau (1997), Helland (1998b), and Shimshack and Ward (2005) studying the US paper and pulp industry, Arora and Cason (1996) for programs voluntarily entered by corporations in the US; Deily and Gray (1991) and Gray and Deily (1996) for the US steel industry; Laplante and Rilstone (1996) for the Canadian pulp and paper industry; Dasgupta *et al.* (2000) for the industry in Mexico; Dasgupta *et al.* (2001) for industrial polluters in Zhenjiang, China; Kang and Lee (2004) for the manufacturing industry in Korea; Earnhart (2004a, b, 2007) for large municipal wastewater treatment facilities in Kansas; Keohane *et al.* (2009) for the US electric power industry; and Nyborg and Telle (2006) and Telle (2009) for plants belonging to the chemical, basic metals, pulp and paper, and other non-metallic minerals industries in Norway. Cohen (1999, 2000) provides a review of this strand of literature. He concludes that although empirical studies have demonstrated the effectiveness of monitoring and enforcement activities, it is difficult to derive strong policy implications from these studies since the scope of each empirical

[1] In this type of simple model, the probability of detection typically coincides with the probability of inspection as well as with the probability of sanctioning. Obviously in reality this assumption does not hold: not all violations are detected during inspections and not all detected violations are sanctioned.

study is necessarily limited. A thorough discussion of these results falls outside the scope of this paper since we focus on the determinants of the imposed penalties and on the objectives functions of the enforcing authorities.

2.1.2 Regulator's Sanctioning Decision

Next, we investigate the determination of the optimal sanction level (i.e., the optimal level of violation costs) by the regulator. What level and type of sanction is optimal crucially depends on the objective function of the regulator. Theoretically the optimal monitoring and enforcement strategy, i.e., the optimal combination of the probability of detection and the fine structure, have already been studied and determined by, among others, Polinsky and Shavell (1979, 1992), Cohen (1987), Rasmusen (1995), and Garoupa (2001). These authors have found that the optimal fine typically increases with the harm caused and the cost of levying the fine while it decreases with the probability of detection and penalization. Determining the optimal detection probability, however, is less straightforward and often ambiguous. It depends, among other things, on the fixed and variable inspection costs, the harm caused, the firms' reactions, and the legally allowed penalties.

We focus briefly on three important, yet distinct, objective functions for the regulator: (i) social welfare maximization, (ii) deterrence maximization, and (iii) providing justice. For a discussion of other regulatory objectives for environmental enforcement such as the maximization of net political support[2] see Firestone (2002, 2003).

Social welfare maximization implies that the regulator balances compliance costs with environmental damages $D(v)$. Thus, as noted in the simple model discussed above, in equilibrium marginal compliance costs should be equal to marginal damages and this equilibrium can only be obtained if the regulator chooses a penalty that equalizes the marginal expected violation costs to marginal damages:

$$C'(v) = D'(v) = pV'(v)$$

This social welfare maximization objective implies a harm-based approach to environmental enforcement (Polinsky and Shavell, 1994) since the sanction imposed on violators is based on the harm caused by the violation.

Maximizing deterrence implies that the costs associated with violating the rules should always be larger than the cost of compliance, as shown in expression (2). The avoided cost of compliance acts then as an estimate of the gain to the violator of breaking the rules. Arguably, in practice this gain-based approach might be more typical for agencies than the welfare-maximizing approach. As a case in point the mission statement of the US Environmental Protection Agency EPA reads "To protect human health and the environment." Also, as Firestone (2002) states, "*it may be more reasonable to view them*" (i.e., EPA enforcement employees) "*as violation-minimizing policemen whose primary goal is general deterrence rather than social welfare maximization.*"

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[2] The maximization of net political support has previously been studied, among others, by Stigler (1971) and Peltzman (1976).

Deterrence has two forms: specific and general. Specific deterrence seeks to deter the offender from re-offending by punishing the breach. General deterrence seeks to signal to others the cost of a breach, or conversely, the benefits of compliance. Moreover, once the decision to violate has been taken, the size of the violation depends only on the marginal, not the average, properties of the expected penalty function. According to the theory of marginal deterrence developed formally by Shavell (1991, 1992) and Mookherjee and Png (1994), optimal sanctions should rise with the harmfulness of acts and reach the extreme only for the most harmful acts.

Moreover, an additional objective of punishment has been to provide justice. Justice has been approached in many different ways. Most relevant in the current context are the concepts of procedural justice, retributive justice, and restorative justice.

— Procedural justice incorporates a theory of procedural fairness for civil dispute resolution (see e.g., Solum, 2004). It can be seen as protecting human dignity by ensuring that individuals are made aware of how and why they are being treated unfavorably, and by enabling them to participate in the decision-making process. Thus, it refers to specific legal doctrines that express fundamental principles about the fair treatment of persons and the procedures needed to ensure fair treatment.
— The concept of retributive justice in ethics and law is based on the principle "*Let the punishment fit the crime*" such that the severity of the penalty for a violation should be reasonable and proportional to the severity of the infraction (see e.g., Zaibert, 2006). The violation's level of severity might be determined by the amount of harm caused by the offense, the unfair advantage gained by the violator, or moral imbalance the crime caused, depending on the circumstances.
— Restorative justice, on the other hand, is concerned with making the victim whole[3] and reintegrating the offender into society. For a thorough discussion on restorative justice see Braithwaite (2002).

Finally, sanctioning decisions are often modified in order to take account of the 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. Thus, if courts and agencies want to avoid convicting innocent parties or acquitting guilty parties, safeguards need to be built into the sanctioning system to minimize the effects of these different types of errors. Examples of such safeguards are the use of warnings for small and first-time offenders (see, for instance, Rousseau, 2009), the practice of requiring evidence of a crime "beyond reasonable doubt" (see, for instance, Andreoni, 1991; Lando, 2009), the possibility of retesting samples for small violation sizes (Rousseau, 2007) and lowering the fine imposed under the assumption of risk aversion (Polinsky and Shavell, 2000).

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[3] "Making the victim whole" is defined by Mac Namara and Sullivan (1973) as restoring the victim to pre-crime conditions by *"restoring the victim's losses of money or property, and/or providing compensation for loss of life, physical injury (with consequent loss of earning power and the costs of medical care), and the pain and suffering resulting from criminal assaults"*.

Additionally, decision makers often have imperfect information on which to base their decisions (Bebchuk and Kaplow, 1992; Garoupa, 1998; Polinsky, 2006). Bebchuk and Kaplow (1992), for instance, showed that it may not be optimal to set the sanction at the highest possible level when individuals have imperfect information on the probability of detection. Also, Botelho *et al.* (2005) found a considerable degree of misinformation with respect to firms' own emissions and environmental regulations in the Portuguese pulp and paper industry. Moreover, the study found that informed firms have a higher probability of compliance than uninformed firms. When firms have imperfect information on the legislation and their own situation, unintentional violations are likely to occur. Moreover, Polinsky and Shavell (1991) show that when offenders are wealth constrained, this limits the effectiveness of monetary sanctions and promotes the use of non-monetary sanctions such as imprisonment or firm closure.

We concentrate further on the factors determining monetary sanctions in practice since they can give us insight into the various elements included in the objective function used by the courts and administrations.

2.2 Expected Violation Costs

Several factors determine the expected costs to firms of violating environmental rules: the probability of detection as well as various negative effects associated with the violation such as reputational effects, difficulties in obtaining licenses, fines, or even firm closure. We briefly discuss these different cost elements. In the remainder of this paper we focus on agency and court behavior regarding the determination of the monetary penalty level.

2.2.1 Probability of Being Sanctioned

A first important determinant is the probability of incurring the violation costs. This probability depends crucially on the monitoring strategy and on the structure of the sanctioning process. Due to the repeated contacts between the agency's inspection strategy and the firms' compliance decisions, these two decision variables have been estimated simultaneously by, among other studies, Gray and Deily (1996), Nadeau (1997), and Helland (1998b). As expected, these studies show that greater enforcement leads to greater compliance, while greater compliance leads to less enforcement. The theoretical analysis by Harrington (1988) of the agency's inspection decisions shows that the regulator can increase deterrence by targeting firms that are more likely to be in violation. Several empirical papers have estimated the link between past compliance and expected inspections and have found some evidence of targeting. Investigation of environmental monitoring practices shows that targeting occurs based on: (1) the compliance status in the last quarter(s) (Stafford, 2002 for US waste regulation; or Rousseau, 2007 for the Belgian textile industry), (2) the predicted compliance status of the firm (Gray and Deily, 1996 for the US steel industry; or Laplante and Rilstone, 1996 for the Canadian pulp

and paper industry), or (3) warnings previously issued (Eckert, 2004 for the Canadian petroleum industry).

2.2.2 Types of Enforcement Actions

Before we turn to the actual violation costs, it is important to formally define the types of enforcement actions the regulator can bring. Environmental agencies commonly make a distinction between administrative, civil, and criminal enforcement actions (see US EPA Website[4]).

— Administrative actions are enforcement actions taken by an (environmental) agency under its own authority, without involving a judicial court process. An informal administrative action is generally any communication from an agency that notifies the regulated entity of a (potential) infringement and, most often, asks for some remedial action. Formal administrative actions by an agency are, for instance, the issuance of an administrative remedial order (either with or without penalties) or the suspension of a firm's environmental license to bring about compliance.
— Civil judicial actions are formal lawsuits, filed in court, against persons, or entities that have failed to comply with statutory or regulatory requirements or with an administrative remedial order.
— Criminal judicial actions are formal lawsuits, filed in court, against an entity, or person through a criminal prosecution, depending on the nature and severity of the violation. Importantly, only criminal court convictions can result in the imposition of a prison sentence.

It is essential to note that the availability, exact definition, and terminology used to indicate the different actions used to enforce environmental violations crucially depend on the institutional context in different countries. For the US, Firestone (2002, 2003) studies the elements that influence the agency's choice between the different enforcement actions. He finds that a violator's culpability is a highly significant predictor of criminal treatment. This suggests that when the EPA selects the appropriate type of enforcement action, it is motivated by specific deterrence considerations embodied in social welfare maximization or by a desire to disable or incapacitate serious violators. Further an empirical study by Glicksman and Earnhart (2007) provide additional insights into the comparative effectiveness of administrative and civil fines on environmental performance in the US. Focusing on the chemical and allied products industry, their study shows that administrative fine-related specific deterrence is more effective than civil fine-related specific deterrence. However, civil fines are found to be significantly more effective than administrative fines in terms of their general deterrence.

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[4] http://www.epa.gov/compliance/basics/enforcement.html

2.2.3 Violation Costs

Next, we turn to the actual violation costs that can consist of, among other things, monetary sanctions, non-monetary sanctions, the expected consequences for future inspection probabilities, social sanctions, and informal sanctions. For an overview of the theoretical and empirical issues associated with the violation costs for environmental crime we refer to Cohen (1992). Monetary sanctions, i.e., fines, are the main focus of this contribution since they are most frequently imposed in practice.[5] Monetary sanctions are therefore discussed in more detail in Section 3, which follows.

Besides monetary sanctions, courts and administrations also have access to non-monetary sanctions such as firm closures, temporary cessation orders, suspension of environmental permits, clean-up requirements, and prison sentences. When it comes to non-monetary sanctions in the (law &) economics literature, most of the attention is given to prison sentences (see, for instance, Polinsky and Shavell, 1984; Shavell, 1987; Kaplow, 1990; Garoupa and Klerman, 2004). However, empirical studies concerning non-monetary sanctions for environmental violations are extremely scarce, though some exceptions exist. Cohen (1992) provides empirical evidence on monetary sanctions as well as prison sentences imposed on over 100 US firms between 1984 and 1990. Although the evidence in Cohen (1992) is not overwhelming, the findings are consistent with the notion that imprisonment and fines are substitutes. A more recent study is made by Blondiau and Rousseau (2009), who examine the criminal judges' choice between imposing monetary and non-monetary sanctions in environmental case law for Belgium between 2004 and 2006. They find larger firms are closed down significantly less often than smaller firms, which indicates that the social cost of sanctions is an important component into the consideration of which type of penalty is imposed.

Furthermore, managers and employees can comply with the rules out of a feeling of social responsibility. When such an individual does not follow these social norms, he or she can feel remorse, guilt, or can even obtain a social stigma, which negatively affects the concerned individual. The role of social norms in compliance decisions is studied by, for instance, Posner and Rasmusen (1999), Lai *et al.* (2003), and Bénabeou and Tirole (2006).

Also, some informal negative consequences are also connected to violating environmental regulation. Large and repeated violators run the risk of getting a bad reputation. The bad publicity associated with the detection of environmental violations can influence behavior of consumers, employees, and investors. Empirical evidence of these reputational effects can be found in several studies. As an example, Muoghalu *et al.* (1990) found that a firm's stockholders suffer a 1.2% loss in market value (about 33 million $)

[5] For instance, in Billiet *et al.* (2009) the monetary fine is by far the most important criminal sanctioning instrument used and it is imposed in over 95% of the convictions. The data set studied in Billiet *et al.* (2009) includes over 1000 criminal cases for environmental crime in Belgium between 2004 and 2006. Another example can be found in Brickey (2008), who reports that in the US approximately two-thirds of the defendants in criminal environmental cases between 1995 and 2001 were sentenced to pay a fine. Also for the UK, Macrory (2006) showed that 96% of the sentences handed down against corporations in Magistrates' Courts were financial penalties.

when it is publicly announced that a suit has been filed against a firm for violation of solid waste management laws. Konar and Cohen (2001) also found that a firm's asset value is seriously reduced as a result of poor environmental performance. Heinkel *et al.* (2001) showed that polluting firms are held by fewer investors, when the group of ethical investors actively excludes socially irresponsible investments; thus reducing stock prices and increasing the cost of capital for polluting firms. More recently, Karpoff *et al.* (2005) study the effect on market value for publicly traded firms in the US that were investigated for, accused of, or settled charges of environmental violations for 1980–2000. Although the authors find that firms that violate environmental laws suffer statistically significant losses in the market value of firm equity, these losses were of similar magnitudes to the legal penalties imposed, implying a minor role for reputational sanctions.

Finally, Decker and Pope (2005) point to strategic complementarities of firms' compliance decisions. Firms often choose their level of environmental compliance strategically and the theoretical model shows that compliance decisions among firms are strategic complements, i.e., increased compliance by one firm will positively influence the compliance rate of its rival. In their empirical analysis they indeed find that the compliance rates of competitors in the same industry have a positive and significant effect on a regulated firm's compliance behavior for the chemical, petroleum refining, and pulp and paper industry in the US.

3 IDENTIFICATION OF DETERMINANTS OF MONETARY SANCTIONS

With respect to penalty setting, three major categories of information are taken into account in sentencing (see Fox and 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; and
— 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 mentioned before, even though the formal objective function is likely to be known, the actual objective function of the enforcing authority might deviate from it. Thus, the factors determining monetary sanctions in practice provide us with clues concerning the objective function actually used by the enforcing authority. Moreover, this will allow us to discuss the expected signs for the different variables included in the empirical studies summarized in Section 4.

3.1 Circumstances of the Offense

Several attributes of the environmental violation are likely to have a sizeable influence on the penalty that is imposed. We distinguish three categories related to (i) the harm caused, (ii) the gain received from the offense, and (iii) intent. We can expect that harm-related factors are more likely to be significant for enforcers who take social welfare and/or justice considerations (especially retributive and restorative justice) into account, while these factors should have a minor impact when deterrence is the enforcer's main focus. In contrast, gain-related factors are expected to matter more for enforcers' maximizing deterrence or, in some instances, focusing on retributive justice and to be unimportant for enforcers focusing on social welfare. Thirdly, intent-related factors can be interpreted as estimating the likelihood that an error occurred and as taking the effect of imperfect information into account. When it is clear that an offense occurred through deliberate actions and with the intent to break the rules, the probability that an error happened as well as the probability that the offense came about due to insufficient information is likely to be negligible.

3.1.1 Harm-Related Factors

The first group of harm-related factors considers the actual or potential extent of the damage. The seriousness of the offense increases when: (a) the pollutant was noxious, widespread or pervasive, or liable to spread widely or have long-lasting effects; (b) extensive cleanup, site restoration, or animal rehabilitation operations were required; or (c) other lawful activities[6] were prevented or significantly interfered with (see, e.g., US Sentencing Commission 1993, 2008; UK Sentencing Advisory Panel, 2000). Since environmental damage depends on the particular geographical and temporal contexts of the violation, the characteristics of the physical environment such as surface water quality or air quality also matter. The seriousness of the offense is likely to increase if human health, animal health, or flora were adversely affected, especially where protected species or nature conservation sites were affected. Also, the presence of third parties might imply that the violation was potentially more damaging to other persons and thus the sanction might be higher.

Before arriving at a conclusion concerning the seriousness of the offense, the court should take account of mitigating factors since they reduce the importance of the violation. Such mitigating factors include, among other things, the defendant's prompt reporting of the offense and ready cooperation with the enforcement authorities; the fact that the defendant took steps to remedy the problem as soon as possible; and a timely plea of guilty. Moreover, the way the violation is discovered matters: voluntary reports can be expected to result in lower penalties since the actions to avoid additional harm could start sooner than in situations where the inspection agency discovers the violations on its own or receives third-party complaints.

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[6] For instance, noise levels produced by the offender put off customers of a neighboring restaurant.

When harm-related factors are significant in an empirical analysis, we can expect that the level of the fine increases for more serious violations. Thus, aggravating factors should have a positive impact on the fine imposed, while variables measuring mitigating circumstances should have a negative impact. The results for empirical studies investigating the impact of these, and other, factors on fine levels are discussed in Section 4.

3.1.2 Gain-Related Factors

Next, we discuss some gain-related factors. When courts or agencies aim at maximizing deterrence, it is important that the sentence takes full account of any economic gain achieved by the offender by failure to take the appropriate precautions; it should not be cheaper to offend than to prevent the occurrence of an offense. Conversely, the expense of any remedial action already taken by the defendant might lead the court to reduce the level of the fine it would otherwise have imposed. To maximize deterrence or to achieve justice, penalties should ensure that a firm gains no financial benefit from its illegal emissions and should closely approximate the pollution abatement costs that the firm has avoided. Thus, statistically significant results for gain-related factors in the empirical studies discussed in Section 4 can indicate that deterrence considerations as wells as justice considerations are taken into account by the enforcing authorities.

3.1.3 Intent-Related Factors

Finally, we look at the intentionality of the offense, since this gives a signal of the likelihood that errors occurred as well as the likelihood that the offenders had insufficient information to make correct decisions. In order to avoid wrongful convictions and to lessen the impact of unavailable information, the court should consider the culpability of the defendant in bringing about, or risking, the relevant environmental harm. Among the factors that may reduce the culpability of a defendant are the fact that the defendant played a relatively minor role in the execution of the offense, or had relatively little personal responsibility for it; the fact that the defendant genuinely and reasonably lacked awareness or understanding of the regulations specific to the activity in which he was engaged; or the fact that the offense was an isolated lapse.

Any of the following factors may be taken to enhance the culpability of a defendant (see UK Sentencing Advisory Panel, 2000): (a) the offense is shown to have been a deliberate or reckless breach of the law, rather than the result of carelessness; (b) the defendant has acted from a financial motive, whether for profit or cost saving; (c) the defendant has failed to respond to cautions from the relevant regulatory authority; (d) the defendant has ignored relevant concerns voiced by employees or others; (e) the defendant is shown to have had knowledge of the specific risks involved; and (f) the defendant's attitude toward the environment authorities was dismissive or obstructive. Also, the cause of the incident (human error, technical error, poor storage or other) can give an indication of who was responsible (Earnhart, 2000).

Intentional violations are expected to bring about higher penalties compared to accidents or unforeseeable circumstances. The more intentional the offense, the more certain the courts and agencies can be that no errors occurred and that the defendant willingly and knowingly violated environmental regulations (and thus should indeed be sanctioned). The variables making intent and culpability more likely should therefore have a positive effect on the level of the fine for the empirical studies discussed in Section 4.

3.2 Characteristics of the Offender

The relevant characteristics of the individual or firm can be captured by several variables. We distinguish three groups of factors related to (i) the wealth of the defendant, (ii) the social cost of imposing a sanction, and (iii) intent-related factors associated with the specific characteristics of the offender.

3.2.1 Wealth-Related Factors

As mentioned before, the magnitude of the fine is constrained by the means of the individual or company concerned. Ability to pay is a factor correlated with financial health as well as, to some extent, size. This implies that firms or individuals with less means are more likely to receive lower fines and more likely to face non-monetary sanctions. As mentioned by, among others, the US Sentencing Commission (1993, 2008) and the UK Sentencing Advisory Panel (2000), in the case of a large company the fine should be substantial enough to have a real economic impact which, together with the bad publicity resulting from prosecution, will create sufficient pressure on management and shareholders to tighten regulatory compliance and change company policy (i.e., increase deterrence). Relevant to a harm-based perspective, it should be recognized that where pollution on a substantial scale has been occasioned by a large company, it is only the company itself (rather than individual directors) that will have the financial means to meet a fine proportionate to the degree of damage that occurred.

3.2.2 Social Sanctioning Costs

For smaller companies, courts and agencies can bear in mind that a very large fine may have a considerable adverse impact on the firm's financial health; thus leading to a substantial social cost of imposing sanctions. A crippling fine may close down the company altogether, with employees being thrown out of work, and with repercussions on the local economy. Alternatively, a large fine may make it even more difficult for the company to improve its procedures in order to comply with the law. Similar considerations apply to non-profit-making organizations, which do not have shareholders.

3.2.3 Intent-Related Factors

Personal mitigating factors, including the defendant's good environmental record, may also matter. Firms from industries with bad reputations for environmental compliance

can then be expected to receive higher penalties (Hawkins, 1984; Kagan and Scholz, 1984). Previous convictions for similar offenses or a failure to respond to previous sentences should be treated as a factor that increases the sentence, but not to an extent that would be disproportionate to the facts of the case. As shown in theory by Polinsky and Rubinfeld (1991) and Emons (2007), among others, under certain circumstances it is optimal to fine repeat offenders more heavily.

3.3 Indirect Determinants of the Penalty

The final category of determinants is related to the legal institutions and procedures that are associated with the enforcement of environmental regulations. Penalties should typically increase with the costs that are associated with the sanctioning procedure in order to confront (potential) offenders with all external costs associated with a violation. As, for instance, Polinsky and Shavell (2000) state that the optimal fine should rise with the enforcement costs. Moreover, different courts can have different objectives. Political factors influencing sanctioning decisions include the composition of regional and federal government and the political party dominating city council. Changes in the political environment might change, among other things, the preferences of administrations, budget allocation rules, policy priorities, or sentencing guidelines. Consequently these changes might have an impact on the penalty imposed on environmental violators.

4 EMPIRICAL EVIDENCE ON THE LEVEL AND DETERMINANTS OF MONETARY PENALTIES

First we summarize the descriptive information on the level and type of monetary penalties that can be found in the empirical literature. Next, we discuss several empirical estimations of penalty functions for environmental offenses.

4.1 Data and Descriptive Information

When it comes to data sources on environmental enforcement, the Environmental and Compliance History Online (ECHO) database provided by US EPA is a widely known and extensive data set.[7] This online database (previously called DOCKET) provides, among other things, data on the enforcement actions of the agency. From 2001 onwards all judicial cases, which were filed in court, had a settlement entered or were concluded can be searched. Moreover, the database includes administrative enforcement cases in which a complaint or a proposed order is issued, a final order is issued, or an enforcement action is closed. It is also possible to study the outcomes of enforcement cases with respect to the federal penalty assessed or agreed to or the value of the complying actions. Further, a summary is provided for each case containing information on the exact law (articles) that was (were) violated and a description of the main case characteristics.

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[7] The ECHO database is accessible from www.epa-echo.gov.

Surprisingly, at least to our knowledge, no such publicly available data set exists in Europe. Aggregated data on administrative and criminal fines imposed in European countries do exist at various administrations and in governmental statistics, but this aggregation typically leads to a major loss of information on individual case characteristics. However, in 2011 a database with Belgian criminal and administrative sanctioning decisions will be put online.[8] The data set consists of 1034 sentences of seven Courts of First Instance in East and West Flanders (Belgium) and 122 sentences of the Court of Appeal in Gent (Belgium) concerning the complete environmental case law from 2003 till 2007 (Billiet *et al.*, 2009). For the administrative track, 624 fining decisions of the environmental administration (Brussels Environmental Institute) are included concerning the complete case law from 2004 till 2006.

We now discuss some descriptive information on enforcement strategies for environmental violations in Europe, Canada, and the US. A summary of the data discussed in this section is provided in Table 2 at the end of the section.

4.1.1 Europe

Billiet and Rousseau (2005) and Rousseau (2007) investigate the enforcement actions taken after or during inspections that found Flemish textile firms in violation. The data set contains information on some 1800 inspections performed in the textile industry between 1992 and 2003 in Flanders (Belgium). During approximately 40% of the inspections one or more violations were observed. The Flemish environmental agency can issue advices, warnings, or notices of violations when a (possible) violation is detected. An advice is given to recommend firms to make sure that the present situation of compliance with regulations continues in the future, e.g., it notifies firms of recent legislation that will become effective shortly. A warning, on the other hand, is provided to instruct firms to end the present situation of noncompliance and abide with all appropriate laws, decrees, and permits. If a warning is not heeded, the next detected infraction might actually bring penalties. A notice of violation (NOV)[9] formally documents a violation and a copy is routinely send to the Public Prosecutor and is thus the start of the criminal sanctioning procedure. The agency can also use administrative sanctions such as proposing to suspend or withdraw a firm's environmental permit. No permit withdrawal occurs in the sample.

Billiet and Rousseau (2005) and Rousseau (2007) also analyze what happens after an inspection uncovers a violation and focus, more specifically, on the monetary penalties imposed (see Table 1). In the majority (72 %) of the cases no enforcement action was

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[8] This database is collected within the SBO-project *"Environmental law enforcement: A comparison of practice in the criminal and administrative tracks"* (see www.environmental-lawforce.be).

[9] Internal regulations of the Flemish environmental inspection agency state that civil servants do not always have to issue a notice of violation when violations are discovered. They have the power to evaluate the situation and use their professional competences to decide on the level of precaution and care displayed by the firm. However, a warning will always be sent to the firm if a violation was detected.

Table 1. Enforcement actions (Billiet and Rousseau, 2005; Rousseau, 2007).

Noncompliant during inspection	Enforcement action taken		Information on follow-up[a]		Legal consequence		Average monetary penalty
709	NOV	140	Info	69	Court of Appeal	2	€7.165
					First instance	15	€3.754
					Settlement	16	€260
					Dismissal	36	0
			No info	71			
	Warning	38					0
	Advice	21					0
	No action	510					0

[a]Billiet and Rousseau (2005) process the information received by the Flemish inspection agency on the follow-up on NOVs by the Prosecutor's Office.

taken. This does not mean that the agency only reacts to 28 % of total violations. Several visits might be necessary — during which the firm is in violation — to formally prove the violations. It is also plausible that a firm's violation will continue for quite some time after a notice of violation accompanied by a warning has been issued. Compliance takes time. Requesting a new or extended license can take months. Building a new water purification station can even take years. Throughout this period, the agency is likely to pay some follow-up visits. During these visits they continue to find the firm in violation, but take no further action (because previous actions are underway).

In the sample studied by Billiet and Rousseau (2005), only 25% of the 28% cases where an inspection uncovered a violation were actually brought to trial. In 23% of the cases a settlement was negotiated and the remaining cases (52%) were dismissed without further consequences (see Table 1).

The average monetary penalty in the sample for settlements is 260 Euros, the average fine at the courts of first instance is €3.754 (with a minimum fine of €131 and a maximum fine of €20.000 imposed) and the average fine at the Court of Appeal is €7.165. The monetary penalty for violating environmental regulations in Flanders is apparently limited compared to the estimated compliance costs[10] in the textile sector (Rousseau and Proost, 2005). The expected monetary sanction, combining fines and settlements, after

[10] Rousseau and Proost (2005) performed a firm survey to estimate abatement costs for water pollution in the Flemish textile sector. For instance, cost estimates (NPV) for building a water purification station ranged from 1 million Euros to 4.7 million Euros. For the whole range of reported technologies, the average cost per technology equals about 775.000 Euros with a minimum reported cost of −111.000 Euros (water recuperation technique) and a maximum of 12 million Euros (new dyeing technology).

a violation was detected equaled only €214. Since in 60% of the inspections no violations were uncovered, firms must have other motivations besides monetary sanctions to comply with environmental policies. Typically, the environmental agency starts with more lax instruments only to move up to harsher ones and thus it proceeds through the different stages of an enforcement pyramid (Ayres and Braithwaite, 1995) until it has secured an offender's compliance. This threat of harsher punishment (e.g., firm closure) can be sufficient to make firms comply.

Ogus and Abbot (2002) explore the deterrence effectiveness of using administrative penalties in the context of UK environmental regulation policy. Although some evidence suggests that the environmental agency in the UK fails to prosecute, the normal response to Category 1 ("major") incidents is prosecution. However, only 23% of such incidents, where the offender was identified, led to such action being taken and in 17% of cases, no action was taken at all. With regard to Category 2 ("significant") incidents, prosecution or formal cautions are the possible responses. In only 27% of cases where the offender was identified was either action taken and in 30% of cases, no action was taken at all.[11] The recommended response to Category 3 ("minor") incidents, which is a warning letter or in some cases a formal caution, was frequently not complied with. Out of the five regions that provided data, warning letters or notices were issued in 4–29% of cases, with prosecutions or formal cautions being the response to another 2–10% of incidents. Between 1998 and 2007, the yearly average level of fines imposed by courts ranges from £2.786 in 1998 to £12.315 in 2006 (Environmental Agency 1999, 2007). According to Ogus and Abbot (2002), the amounts imposed are low relative to the profitability of the violation.

4.1.2 Canada and US

Canada

Eckert (2004) examines the use of inspections and warnings to enforce environmental regulations for petroleum storage sites. Between 1983 and 1998, some 3,182 inventory inspections, 1,567 violations, 1,531 warnings, and 36 prosecutions were initiated. However, the data do not include information on sanctions.

Foulon *et al.* (2002) study whether public disclosure programs can create incentives for pollution control in addition to the incentives normally set in place through traditional means of enforcement such as fines and penalties. Their empirical analysis uses data from the pulp and paper industry in Canada (BOD and TSS). Over the period 1987–1996, 24 pulp and paper plants were in operation in British Columbia but only the data from 15 plants were used for the estimation. Some 126 prosecutions against the plants were included in the sample; however, only 17 of these resulted in a fine being imposed. The empirical analysis provides evidence that the public disclosure of environmental performance creates additional and strong incentives for pollution control.

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[11] Some of the other cases were pending or no information on the outcome was obtained.

United States

In the US regional and national EPAs use a mixture of fines, injunctions, civil prosecutions, and even criminal prosecutions against recalcitrant violators. Russell *et al.* (1986) collected information on court cases between 1978 and 1983 and reported average state penalties per notice of violation (NOV) of $370. Again, the level of average fines after a violation was detected is low compared to compliance costs. Cohen (1992) reported average fines for firms sentenced between 1984 and 1990. He divided his sample into firms that were sentenced under the Criminal Enforcement Act of 1984 (CEA)[12] and those sentenced under the previous law. The data analyzed by Cohen (1992) showed that punitive sanctions increased after the CEA was in place. Average corporate fines increased from $49.986 to $182.332, while the median fine increased from $27.500 to $50.000. This increase was clearly more than the inflation over the period 1984–1990.

Helland (1998a) provide some further anecdotal evidence. For instance, data from Louisiana (1995–1996) found an average fine per NOV of $619 and an average fine of $45.080.[13] Next, to state fines, the EPA has several other methods of sanctioning. In EPA region 5,[14] 1995–1996 judicial actions resulted in an average penalty of $283.487. In addition notices of violations are often used in court cases when individuals bring legal action against paper mills for damages. Besides, mills in repeated violation are pressured into installing new and more costly abatement technology. The Region 5 data for 1995–1996 put the average cost of correcting violations for which the authorities have obtained injunctive relief at $1.310.848. These figures confirm that the average fine is well below the average costs of compliance. Non-monetary sanctions such as remedial and corrective actions are thus needed besides monetary penalties to induce compliance.

Magat and Viscusi (1990) deal with water pollution caused by the US pulp and paper industry. Based on the discharge reports (by firms and states), as well as on the findings of inspections, the EPA takes enforcement actions against violators. Informal actions include telephone calls, warning letters, and notices of violation, as well as inspections. If these measures do not achieve the intended results, the control agencies can proceed with formal actions such as administrative orders, permit revision, formal listing of companies as ineligible for government contracts, grants and loans; and, finally, civil and criminal judicial responses. During the period 1975–1985, the EPA commenced 64 judicial actions in the pulp and paper industry. Of these, 42 cases resulted in fines that varied from $1.500 to $750.000, with an average of $89.437.

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[12] The CEA increased the statutory maximum penalty for corporate offenders to $100.000 for each misdemeanor count and $500.000 for each felony count (or misdemeanors resulting in death). In most cases, the changes included in the CEA represented significant increases in statutory maximum fines, which prior to the CEA were often set at $5.000–$10.000. (Cohen, 1992).

[13] Not all NOV lead to a fine. Thus, the average fine per NOV is substantially below the average fine.

[14] EPA region 5 serves Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin, and 35 Tribes.

Table 2. Overview of data on the level of fines for environmental violations.

Country	Type	Period	Sector	Fine amounts	Description
Belgium	Criminal	1990–2000	Textile	€3.765	Average per conviction in first instance
Billiet and Rousseau (2005)	Criminal	1990–2001	Textile	€7.165	Average per conviction in appeal
Rousseau (2007)	Criminal	1990–2002	Textile	€260	Average per settlement
Billiet *et al.* (2009)	Criminal	2003–2007	Overall	€5.183	Average per conviction in first instance
	Criminal	2003–2008	Overall	€8.111	Average per conviction in appeal
	Administrative	2004–2006	Overall	€3.628	Average per initial conviction
	Administrative	2004–2007	Overall	€9.891	Average per conviction in appeal
Czech Republic	n.a.	1988–1991	Overall	$2.222	Average per corporate conviction[a]
Earnhart (2000)				$35	Average per employee conviction
UK	Criminal	1998	Overall	£2.786	Average per conviction
Environment Agency (1999)		1999	Overall	£4.750	Average per conviction
Environment Agency (2007)		2000	Overall	£10.472	Average per conviction
		2004	Overall	£10.497	Average per conviction
		2005	Overall	£10.121	Average per conviction
		2006	Overall	£12.315	Average per conviction
		2007	Overall	£10.508	Average per conviction
Canada	Court cases	1987–1996	Pulp and paper	$34.250	Average per conviction
Foulon *et al.* (2002)					

(*Continued*)

Table 2. (*Continued*).

Country	Type	Period	Sector	Fine amounts	Description
US					
Magat and Viscusi (1990)	Civil	1975–1985	Pulp and paper	$89.437	Average per conviction
Russell *et al.* (1986)[b]	Court cases	1978–1983	Overall	$370	Average per NOV
				$1.764	Average per conviction
Cohen (1992)	Criminal	1984–1990	Overall	$49.986	Average per corporate conviction (pre-CEA)
				$182.332	Average per corporate conviction (post-CEA)
				$17.168	Average per individual conviction (co-defendant firm)
Louisianna	n.a.	1995–1996	Overall	$619	Average per NOV
Mentioned in Helland (1998a)				$45.080	Average per conviction
Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	n.a.	1995–1998	Overall	$1.558	Average per NOV
				$283.487	Average per conviction
EPA mentioned in Helland (1998a)					

[a] As a reference level, the average monthly wage in 1990 in the Czech Republic was about $135.

[b] Annual averages for the states Colorado, Connecticut, Indiana, Kentucky, Minnesota, Nebraska, Nevada, New Jersey, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Virginia, and Wisconsin.

n.a. = No information available.

4.2 Penalty Functions

In this section the results of several studies that estimate the factors determining the monetary penalty functions for environmental violations are described. While the overview aims to be exhaustive, this cannot be guaranteed. The expected sign of the impact of the factors is discussed in Section 3. In this section the most interesting signs of statistically significant[15] variables estimated in the studies are commented on. Estimated coefficients[16] are not included in this overview and the interested reader is referred to the original studies.

We first discuss some European studies before turning to the US enforcement policy.

4.2.1 Europe

First we look at a study of criminal fines in Belgium and next at a study of administrative fines in the Czech Republic.

Criminal Penalties

We start by looking at a Belgian study analyzing the jurisprudence of the Court of Appeal in Ghent for the period 1990–2000 concerning discharge permits and environmental permits. Billiet and Rousseau (2003) and Rousseau and Billiet (2005) examine the fines pronounced by the Court of Appeal as well as the fines that were initially imposed by the courts of first instance for these cases. The fines pronounced in first instance or in appeal were explained as a function of factors related to the offense, to the offender, and some other relevant factors. Fines imposed by the courts of first instance are significantly higher when the defendant had criminal record, or for infractions on the Environmental Permit Decree or the Labor Safety Law compared to other legislation. Also, significantly higher fines were imposed by the Court of Appeal when third parties were harmed, or when the offense was intentional. Fines in appeal were significantly lower for infractions of the Law on Surface Waters and for cases that started before 1994.

Even though in principle institutional factors should not matter, the analysis showed that the judging decisions in the Court of Appeal are based on different characteristics than the judging behavior in the courts of first instance. Contrary to the rulings in first instance, the appeal judges explicitly take the intentions of the violator as well as the harm caused to third parties into account. Thus, more than lower courts, higher courts tend to preserve the core principles and values of the laws submitted to them.[17]

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[15] We report statistically significant results up to a 10% level of significance.

[16] These coefficients would not be informative without additional information on the specific estimation exercise such as the exact explanatory variable, the econometric method used, complete enumeration of all included variables, reports on possible simultaneously estimated functions, and some indication of the explanatory power of the model.

[17] The backbone of Belgian criminal law is a criminal code from 1867, centered on nineteenth century ideas of guilt as the reason for punishment and of the necessity to limit the *ius puniendi* to essentials, mainly the integrity of the human life and being and the protection of individual property. It is very interesting to note that this *rationale*, a typical criminal law *rationale*, surfaces in the results of Billiet

Administrative Penalties

Other European studies using data on water-damaging accidents in the Czech Republic between 1988 and 1991 were performed by Earnhart (1997, 2000). These studies analyze administrative sanctions. In addition to corporate penalties (such as remediation requirements or mandatory cleanup) and employee fines, this database includes extensive details on accidents including date, location, cause, type of contaminant, economic classification of the responsible party, and resulting damages.

Earnhart (1997) analyzed the different enforcement strategies implemented under two political regimes, i.e., a communist versus a democratic regime. The driving forces behind penalty decisions included in the study divide into five main categories: information on preventive effort and cause of the violation, measured damages, environmental factors, regional factors, and political influence. The estimated monetary administrative fines under the communist regime significantly increased when the level of measured damages increased, and when the violation involved oil or chemical contaminants. The fines were decreasing when the cause of the violation was transport related, when the estimated remediation costs were increasing, and when defendants were military or foreign entities. Under the democratic regime, the estimated fines significantly increased when a human error caused the violation, when the level of remediation costs increased, and when regional surface water quality was higher. Fines still decreased, but to a lesser extent, when defendants were military or foreign entities.

The most interesting result in Earnhart (1997) is the strong effect of political influence on penalty decisions. This is demonstrated by the preferential treatment granted to military and foreign entities under communism and the diminished preference shown during the democratic period.

Earnhart (2000) uses the same data set to examine enforcement rules in two dimensions: first, the proper combination of corporate and employee penalties; and second, the choice of a strict versus negligence liability rule.[18] Authorities can impose two types of corporate penalties: monetary administrative fines and remediation requirements. According to the Water Administration Act, the monetary fine depends on the following factors: the quantity and nature of the harmful substance, the level of damages, the sensitivity of and the degree of protection granted to the affected water, remediation efforts, and other circumstances. In addition, authorities may impose monetary fines on employees that help cause an accident, unless the employees' actions represent a criminal offense in which case they are criminally prosecuted. All three penalty types can be used simultaneously if needed (Earnhart, 2000).

The results indicate that the choice of administrative penalty depends on the links between accident causes and negligence. For the communist, centrally planned regime, the results support the hypotheses that a negligence rule guides both corporate and employee penalties and that the different abilities to penalize internally prompt different

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and Rousseau (2003). Criminal courts are and remain houses of criminal law, not of environmental law.

[18] A strict liability rule imposes penalties whenever damages are caused, while a negligence rule imposes penalties only when preventive efforts are insufficient compared to established benchmarks.

applications of public sanctions against workers. For the democratic, market regime, they support the hypotheses that a strict liability rule guides corporate penalties, that a negligence rule guides employee penalties, and that application of public employee sanctions varies across industries. The tested hypotheses followed from a principal–agent analysis of enforcement in both regimes. The differences in corporate liability rules follow from the need to motivate firms to internalize environmental costs linked to production levels in a market setting, whereas in a centrally planned economy, planners set production levels. The differences in employee sanctions depend on the ability of firms to penalize their employees internally.

4.2.2 United States of America

Now we investigate the enforcement practices in the US and discuss several empirical studies of the imposed penalty for environmental offenses. We divide these studies according to the type of penalties they are dealing with: first, we discuss the determinants of criminal penalties, next those of civil and/or administrative penalties and finally we look at those studies that investigate the number of enforcement actions imposed (rather than the level of the penalties).

Criminal Penalties

We only found a couple of studies dealing with the level of criminal monetary sanctions in the US. Cohen (1992) studies the monetary fines imposed on firms sentenced between 1984 and 1990. While we focus on the monetary criminal fines in this overview, the study by Cohen also provides data on the other penalties that might be imposed such as prison sentences. He found that the type of violation clearly had a considerable impact on the size of the criminal fine imposed on convicted firms or on individuals convicted as codefendants. Moreover, offenses resulting in large clean-up costs led to significantly higher fines and large firms received higher fines than small firms. Slightly surprising, firms found guilty after trial did not receive higher sanctions than those that pled guilty. It also appears that individual sanctions are complements to corporate sanctions.

White (2006) uses a data set of all asbestos claims that were filed in court between 1987 and 2003 in the US to investigate how forum shopping and procedural innovations affect asbestos trial outcomes. The phenomenon of forum shopping refers to the strategic choice of where to file lawsuits: plaintiffs have an incentive to file in states that have favorable legal rules and in jurisdictions within these states that have particularly favorable judges and juries. The analysis estimates the factors that influence whether the defendant was found liable, the amount of compensatory damages (if positive), whether the defendant had to pay punitive damage if found liable, the amount of punitive damages (if positive), and the amount of expected total damages. The determinants include plaintiff-specific variables such as the plaintiff's alleged disease, the plaintiff's age at trial, whether the plaintiff smoked and the number of defendants as well as trial-specific variables including state or federal court, state in which trial occurred, the county in which trial occurred, and the number of claims that were consolidated before trial.

White (2006) estimates both the compensatory and punitive damages paid when a defendant was found liable. Her results indicate that forum shopping and procedural innovations such as consolidated, bifurcated, and bouquet trials[19] have contributed to the growth of the asbestos mass tort both directly by raising damage awards and indirectly by raising settlement levels and the number of claims filed. Compensatory damage awards were significantly higher when plaintiffs had bifurcated or bouquet trials. Also, when two or three defendants were at trial rather than one, plaintiffs received higher compensatory damages. However, for four or more defendants, compensatory damages per plaintiff decreased again, which may reflect the fact that with a large number of defendants, jurors may have difficulty in deciding which one should be held liable.

Civil and/or Administrative Penalties

Two studies deal with oil spills in coastal waters. Epple and Visscher (1984) focus on oil spills by tank ships and tank barges in the US between 1973 and 1977. The law makes the polluter responsible for the cost of cleaning up a spill in all cases and also provides for a civil penalty for intentional spills resulting from negligence. Epple and Visscher seek to determine the extent to which the frequency of imposition of sanction and the severity of sanctions vary with the resources devoted to enforcement, characteristics of spills, and characteristics of polluters. The data clearly confirm the increase in penalties and enforcement of cleanup as spill size increases, as the vessel size increases and as coast guard enforcement effort (man hours per transfer) increases.

Following Epple and Visscher (1984), Cohen (1987) uses the same data set on the US Coast Guard's oil spill prevention program and describes how the optimal enforcement strategy can be derived from the principal–agent literature. His analysis shows that the optimal penalty should depend on the environmental damage, on the cleanup costs and on the probability of detection. The Coast Guard's enforcement policy consists of a combination of detection, monitoring, and penalties. Failure to report a discharge of oil is a criminal offense that then carried a maximum penalty of $10,000 and/or one year jail. The polluter is responsible for removal costs plus a penalty of $5,000 stated in the law. However, the actual fines imposed have generally been much less. Comparable to Epple and Visscher (1984), the penalty was found to increase with vessel size, spill size, and the level of enforcement. An important result from the analysis is that most "effort" variables (cleanup, cause) are significant. Thus, the US Coast Guard clearly used a negligence standard as opposed to a strict liability standard in its penalty assessment.

Next, we discuss two more studies dealing with water regulation in Louisiana and in Georgia. Kleit *et al.* (1998) study the civil penalties issued to water polluters by the Louisiana (US) Department of Environmental Quality in 1994. The study by Kleit *et al.* (1998) confirms that civil penalties are more likely to occur, and are likely to be higher, the more severely a firm violates the regulation. Penalties are also likely to be higher

[19] Consolidated trials are simultaneous trials of multiple plaintiffs' claims before the same jury. Bifurcation refers to the practice of dividing trials into multiple phases with the possibility to settle between each phase. Bouquet trials are consolidated trials of a small group of plaintiffs selected from a large group of claims (White, 2006).

if a firm has a previous record of environmental violations. The only counterintuitive result is the negative effect on the penalty imposed for firms who neglect to submit a monitoring report. Political influence seems to play a minor role. Despite the small estimated coefficients, it is still interesting that the positive and significant sign of some of the political dummies is consistent with the rent extraction hypothesis, which claims that politicians might use regulation to expropriate rents in the industrial market. However, the authors were unable to establish whether agencies or oversight committees make the threats to extract rents.

Next, Oljaca *et al.* (1998) estimated an administrative penalty function for water quality violations of private firms in Georgia (US) between 1986 and 1995. The authors focus on penalties levied through consent decrees. A consent decree contains mostly a monetary settlement provision combined with an order to undertake or cease specific actions. Thus, the penalties examined cover those cases where a sufficiently cooperative climate exists for both firm and regulator to avoid the expense of more formal sanctions. The study found that the seriousness of the infraction and historical compliance records strongly influence penalty levels, while the intentionality of violations and the method of discovery[20] do not. The fact that a violation required immediate action was a more important factor in determining penalties than whether of not the firm followed reporting requirements. Also, the model confirms the assumption of increasing fines for repeat offenders. Moreover, firm size matters. The results suggest that very small firms with fewer than 10 employees received lower penalties, while very large firms with over hundred employees were not treated differently from medium-sized firms.

We now turn to studies dealing with environmental justice considerations. Environmental justice advocates have suggested that penalties for violating environmental violations are systematically lower in poor and minority areas. The empirical analysis performed by Ringquist (1998) shows, however, that such penalties are not smaller in these areas. Ringquist (1998) investigated civil cases concerning the US Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act filed between 1974 and 1991 using data from EPA's DOCKET database. The level of the total penalty imposed is explained by variables relating to equity concerns, case characteristics, judge attributes, district political environment, and national political institutions. Thus, Ringquist (1998) found that civil environmental fines are higher for Fortune 500 firms, repeat offenders, published cases, multiple-location violations, in states with strong polluting industries, and in states where political elites are more supportive of environmental protection. Fines are lower for violations of the Clean Water Act and Clean Air Act as opposed to other legislation included in the sample, lower during the Reagan and Bush administrations, and rise as the number of violations increases.

Atlas (2001) starts by criticizing the work by Ringquist (1998) and an earlier study by Lavelle and Coyle (1992) and shows that their results on penalties in minority communities might be unreliable due to incorrect interpretation of the original data set. He then re-estimated the penalty function for civil judicial cases from 1985 to 1991 included in the DOCKET database. With respect to racial characteristics, the analyses performed by

[20] Discovery of a violation could happen following complaints by citizens, inspections by the agency, or self-reports by the violator.

Atlas (2001) consistently revealed a modest relationship with penalties: penalties tended to be higher as the presence of minorities increased. However, the factors that influenced penalties most were the case characteristics such as the type of violation, how and when the case was concluded, whether the case involved multiple locations, and whether the defendant was a public entity — with public entities receiving lower fines.

Lynch *et al.* (2004) determine whether monetary penalties (collected from the ECHO database) assessed against petroleum refineries for environmental violations differ depending on the racial, ethnic, and income characteristics of communities surrounding the penalized refinery. In the period between 2001 and 2003 the US EPA and state regulatory agencies assessed fines that ranged between $0 and $9.999.999. Nearly 50% of all fines were for amounts less than $15.000. The control variables used to explain the level of monetary penalties imposed are community demographics, the compliance and enforcement history, case characteristics, company and facility characteristics, and the political and economic climate.

Lynch *et al.* found mixed evidence of inequality depending on the type of data representing community demographics (census tracts versus ZIP codes). The racial, ethnic, and income characteristics of census tracts surrounding the penalized refineries were not related to penalty amounts. However, refineries situated within the boundaries of Hispanic and low-income ZIP codes tended to receive smaller penalties than refineries located in non-Hispanic and more affluent ZIP codes. Further, firms with higher annual sales received significantly higher penalties, while firms with more employees received lower penalties. Cases led by the federal agency EPA resulted in higher penalties compared to cases led by state agencies. Finally, for the estimation based on ZIP codes, penalties in states with a democratic governor were significantly higher than in other states.

Further, Helland (2001) examines the political determinants of the EPA's litigation strategy between 1977 and 1997. He studies the government's choice of which cases to settle, which to litigate and how much to accept as a settlement. The ultimate resolution of a case is the result of a sequence of conditional choices. The decision to settle a case rather than proceed to trial is conditional on the expected outcome of the trial. In this model trial outcomes are assumed to be exogenous. Helland (2001) uses data derived from EPA's enforcement DOCKET database, which tracks civil and administrative enforcement cases under all environmental statutes. In the sample 94.5% of the 10,478 cases are settled and 5.5% are litigated. Of these litigated cases EPA wins only 28.5%.

Helland found that the probability to go to trial rather than to settle is negatively influenced by the level of court costs, by administrative cases compared to civil cases, when preferences of the oversight committee in the House are less conservative, or when those in the Senate are more conservative and when the variance of the expected award is higher. The probability of a trial is significantly higher when the case involves an injunction and increases with the expected outcome at trial. Moreover, the administration variables are all significant.

He also found that the probability that the EPA wins is determined by the type of law violated and by the administration.[21] The EPA is significantly more likely to win cases

[21] Helland (2001) distinguishes five administrative periods in his data set: Carter (1977–1980), Gorsuch (1981–1983), post-Gorsuch–Reagan (1984–1988), Bush (1989–1992), and Clinton (1993–1997).

involving a violation of the Clean Air Act, the Clean Water Act, the Emergency Planning and Right-to-Know Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Resource Conservation and Recovery Act, and the Toxic Substances Control Act.[22] The Clinton administration had a 14% lower success rate than average. This suggests that this administration might have been pursuing more difficult cases than its predecessors.

The settlement amount estimated by Helland is a negative function of the expected outcome at trial and of the variance of the expected award at trial. The settlement amount increases with the number of defendants suggesting economies of scale in settling. Also, the lowest settlement amounts occurred during the Clinton administration, followed by the post Gorsuch–Reagan period and finally by the Bush period.

The results of Helland (2001) suggest that the amount awarded to EPA at trial mainly depends on the law violated, the type of violation, and the administration. The award was significantly higher when the offender discharged pollution without a permit, when the offender failed to pre-treat discharge, or when the offense dealt with a wetland violation. Also, the award increased with the number of facilities involved. Given that the case makes it to trial and EPA wins, the Clinton administration had the highest expected award and this expected award was almost 18% higher than that expected for the average case in the sample. If they won, the Bush administration was also awarded an amount at trial that was estimated to be 16% higher than the average amount. The period (1981–1983) when the EPA was led by Anne Gorsuch also showed higher awards at trial (17%) and combined with the probability of winning, Gorsuch's EPA has a higher expected award at trial than any other period. Helland observes that this finding is consistent with a litigation strategy aimed at reducing transaction costs so as to increase enforcement of pollution laws.

Number of Enforcement Actions

The compliance and enforcement decisions for US integrated steel plants were studied by Deily and Gray (1991) for the period 1977–1986 and by Gray and Deily (1996) for the period 1981-1989. The data include the number of enforcement actions directed toward each plant each year. These actions include inspections, letters, phone calls, and enforcement orders. No data on fines were available. Firm characteristics had significant impacts on enforcement, although the signs were not always as expected. The results in Deily and Gray (1991) indicated that the US EPA directed fewer enforcement actions toward plants with a high predicted probability of closing and plants that were major employers in their community. Gray and Deily (1996) found that compliance behavior influenced enforcement decisions: steel plants anticipated to be in compliance faced less enforcement. Further enforcement decisions were influenced as expected: regulators directed less pressure toward plants expected to close and toward plants in attainment areas, while exerting more pressure on large polluters.

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[22] The DOCKET database lists eight laws: Clean Air Act, CERCLA or Superfund, Clean Water Act, Emergency Planning and Right-to-Know Act, Federal Insecticide, Fungicide, and Rodenticide Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, and Toxic Substances Control Act. All these laws are included as dummies in the analysis to control, among other things, for the fact that certain laws did not exist throughout the full sample.

Recently, Deily and Gray (2006) used the same data set (1981–1989) to investigate enforcement decisions made by the Occupational Safety and Health Organization (OSHA) and EPA and its effect on firm compliance for steel plants during the 1980s. In sum, the results suggest that both OSHA and EPA targeted plants with a greater likelihood of violations and provide no evidence that they were deterred from enforcing regulations at plants with higher compliance costs. However, EPA enforcement shows greater responsiveness to the economic impact of a plant's closing, thus indicating that EPA is more sensitive to political costs than OSHA.

Next, Nadeau (1997) focuses on the length of time that plants in the US pulp and paper industry spend in violation of air pollution regulation between 1979 and 1989. The paper explicitly separates the effect of monitoring (i.e., determining the firms' compliance status) and enforcement activities (e.g., administrative orders, legal actions, and penalties). More specifically, the analysis investigates the number of administrative, civil, and criminal enforcement actions directed at firms found in noncompliance. The estimated number of enforcement activities increases with the plant size, the plant's potential amount of emissions, and during the period when the EPA was led by William Ruckleshaus.[23] Less enforcement pressure was directed toward plants expected to be in compliance and toward plants in attainment areas. The estimation of the number of enforcement actions is used by Nadeau (1997) to estimate the effect of EPA policy on the duration of noncompliance spells. As a case in point, the author found that a 10% increase in enforcement responses implied a 4.7% reduction in the length of violation. The results implied that the EPA's monitoring and enforcement policy was effective at returning violators to compliance quickly.

Finally, Earnhart (2004b) studied the effectiveness of government interventions for BOD[24] wastewater discharges by large municipal wastewater treatment plants in Kansas between 1990 and 1998. Even though the analysis focuses on the level of environmental performance at the polluting facilities, it also includes an estimation of the number of enforcement actions taken by the EPA and the state environmental agency. These enforcement actions include consent orders, corrective actions, remediation requirements as well as administrative, civil, or criminal fines. The estimated model in Earnhart (2004b) had, however, a very low explanatory power[25] and only the variables representing the cumulative EPA inspections in the preceding year and the unemployment rate turned out to be positively and significantly correlated with the number of enforcement actions taken by the federal and state environmental agencies.

4.3 General Observations

The limited number of empirical studies investigating the determinants of monetary penalties for environmental violations is striking. Moreover, the geographical scope of

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[23] William Ruckleshaus succeeded Anne Gorsuch as administrator of the EPA and claimed that he would restore the credibility of the agency by increasing activities.

[24] Biological oxygen demand.

[25] The adjusted pseudo R^2 for the model was 0.069 (Earnhart, 2004b).

the studies is limited as well, since the majority deals with US data with the exception of two European data sets (one for Belgium and one for the Czech Republic). The EPA's online database ECHO — previously called DOCKET — has proved to be an important data source as it is used in almost half of the US studies examining the level of the monetary penalties. Moreover, few recent data sets are analyzed: 10 out of the 17 studies discussed analyze data on penalties imposed no later than 1991 and only two studies include data later than 2000.

Second, we discuss the importance of the different categories of penalty determinants. Concerning the circumstances of the offense, it is noteworthy that every study includes 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, 1996) include an estimate of the compliance costs for the firms; however, this variable was statistically not significant. The important implication is that the analyses performed so far do not allow us to establish whether gain-related factors influence the level of monetary fines. For this reason, it is difficult to assess whether agencies and courts aim at maximizing deterrence when making sanctioning decisions.

The evidence derived from the included harm-related variables makes it clear that penalty amounts routinely increase with the seriousness of the violation. This is confirmed by all studies included in this overview. 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 in order to limit the harm caused were found to lower the penalty. The statistical significance of harm-related factors points to enforcers who take social welfare and/or justice considerations into account when deciding on the penalty for environmental offenses.

Intent-related factors were also found to matter in the empirical studies. Several studies 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. When the enforcing authority receives a strong signal of the culpability of the offenders and the intentionality of the offense, they can be certain that the offense occurred willingly and knowingly and that the offender indeed deserves to be penalized. Thus, the positive and statistically significant relation between intent-related factors and the level of the penalty might indicate that enforcers are unwilling to make errors and thus try to minimize the number of incorrect convictions.

The characteristics of the offender also seem to matter. Studies typically find significant results for the variables relating to the size of the offending firm. 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. As mentioned in Section 3, the size of the firm can be seen as a proxy for the defendant's ability to pay the required compliance costs, for the size of the harm caused by the offense, for the defendant's know-how and expertise, for the potential repercussions on the local economy if the fine imposed forces the defendant to close down, or the defendant's ability to pay adequate compensation when substantial

harm was caused. These various contradicting interpretations imply that the influence of the defendant's size on penalty levels is ambiguous and makes it likely that different effects dominate the result depending on the specific circumstances of the cases under consideration.

Furthermore, penalties and thus deterrence significantly increase for repeat offenders. All studies that include variables for the presence of a criminal record, the number of past violations or the past compliance status found this result. Thus enforcers seem to assume that the intentionality of the offense is more likely when they are dealing with repeat offenders. After all, one potential source of an accidental offense, namely imperfect information, is no longer present when the defendant was previously found in noncompliance.

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, in the Czech Republic military and foreign firms were preferentially treated during the communist regime 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) as well as the difference in the decisions made by different enforcers (e.g., the factors determining the fine differ between the court of first instance and the court of appeal in Billiet and Rousseau, 2005).

5 CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Empirical evidence on monetary sanctions imposed for environmental offenses is increasing but still far from abundant. A major barrier is the lack of suitable databases. However, the increasing general dispersion of computers and electronic file management systems provides hope of an easier access to data collections in the nearby future. However, existence of data sets is not enough; they must also be available to scholars. The growing body of data to be analyzed will then enable researchers to more easily compare different enforcement instruments and to identify universal trends to be found in studies for different countries and different types of regulation.

The currently available studies looking at the determinants of the fines imposed for environmental offenses are inadequate to capture the objectives of judges and administrations with a sufficient level of confidence. Still, some general trends emerge: fines increase with the harm caused by the offense, for repeat offenders as well as for intentional offenses. This provides some evidence of social welfare and justice concerns revealed by enforcers as well as a possible aversion to wrongfully convict defendants.

Generally, empirical studies take the broad outline of the environmental regulatory and institutional context into account, but to a much lesser extent the details and refinements habitually found in practice such as the level of discretion available to specific enforcing authorities. This implies that policy advice and discussions with legal scholars based on these empirical studies is not always straightforward. The lack of transparency about the actual rules and procedures in different countries and settings makes it difficult to explain

the divergence between actual sanctions and optimal sanctions derived in theoretical models.

In terms of future research, the study of the determinants of monetary penalties should be set into a larger framework. The effectiveness as well as the determinants of penalties should be studied. Crucial in this respect is the systematic comparison of actually imposed fines and theoretical optimal fines for the cases under investigation (Cohen, 1987 is a notable exception). Moreover, the complete set of violation costs including moral considerations, non-monetary, and informal sanctions should be studied simultaneously in order to get a complete picture of the enforcement of environmental violations. This would allow investigating the following research questions: How is the trade off between the different aspects of the environmental violations costs? Are particular types of sanctions targeted at particular circumstances? When are prison sentences used in practice? What is the effect of "naming and shaming" policies on the type and level of monetary sanction that is imposed?

Another interesting research topic involves the study of how enforcement decisions vary for different types of policy instruments such as comparing enforcement of emission standards with enforcement of emission taxes in practice. It is advisable to look at the complete regulatory chain and not at a partial picture. Rousseau and Proost (2005), for example, argue that violations of certain instruments such as technology standards are more easily to detect and to prove than violations of instruments such as emission taxes. The type of policy instrument is therefore likely to influence the probability as well as the level of the sanction imposed on offenders.

Finally, not only the sanction but also probability of conviction should be studied (see Helland, 2001, for an exception). The cases brought to trial are likely to be a biased subgroup of all detected violations. Thus, the identification of the factors determining the probability of trial as well as the probability of conviction at trial is equally important in determining the deterrence effect of monitoring and enforcement of environmental regulations.

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