

Complementary use of administrative and criminal fines in enforcing environmental regulations

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Abstract

It is often claimed that not all environmental crimes are enforced as courts tend to select only cases, which merit criminal prosecution, dismissing many minor violations. This paper studies whether administrative fines for minor violations are efficient to use in addition to criminal fines. Under which circumstances is this complementary use preferred to relying only on criminal fines? The developed theoretical model shows that administrative fines for minor violations are an efficient instrument if (1) the enforcement costs of administrative fines are sufficiently low (compared to criminal enforcement costs), (2) there are enough middle-abatement-cost firms which commit minor violations, and (3) the difference between the marginal expected criminal and administrative fines is small enough. Under these circumstances, the marginal social benefits of decreased emissions and enforcement costs associated with the administrative-criminal fine scenario outweigh the marginal social costs of increased abatement costs.

Keywords: environmental law; criminal fines; administrative fines; enforcement

JEL Classifications: K14; K23; K32

1. Introduction

On average only 3% of all pollution incidents are prosecuted in the United Kingdom (UK), while it is 63% of the more serious incidents. In the Flemish region, the prosecution rate is on average 12%, while on average in 62% of cases the public prosecutor dismisses the case (Faure and Svatikova 2009, 1-38).

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These two jurisdictions have until the mid-2009 relied only upon the criminal law to enforce their environmental regulations. In other words, the environmental agency itself had no power to impose civil administrative fines upon the violator but instead had to forward the case to the prosecutor's office (or prosecute itself as is the case in the UK). This brings up a question of what happens with all those violations, which do not merit entering the prosecution process but still merit enforcement. In contrary to the UK and the Flemish Region, the environmental agency has had the power to impose an administrative fine or an administrative order (the non-compliance of which was fined) in Germany and the Netherlands, respectively (Faure and Svatikova 2009, 1-38). This might prove to be a feasible alternative to a trial. Nevertheless, the European Commission tends to favor the criminal law scenario, which can be seen from its recent promulgation of a directive on the protection of the environment through the use of criminal sanctions.¹ Under this directive, the enforcement of environmental law through criminal law has been strengthened and harmonized, hence the Member States are in a way forced to enforce certain environmental directives through criminal law. The type and the level of the sanction are at the discretion of the Member States.

This paper studies the effects of using administrative fines in addition to criminal fines when enforcing environmental regulations. The scope of these administrative fines is limited to minor violations, while for serious environmental harms criminal law with its severe sanctions, such as for example imprisonment, is needed (Bowles, Faure, and Garoupa 2008, 389-416; Polinsky and Shavell 1984, 89-99). The main question analyzed in this paper is whether and when the use of administrative fines is socially desirable compared to relying only on criminal fines for minor offences. Administrative fines in this paper are defined as monetary fines imposed by the environmental agency itself, rather than by a judge. Thus from the perspective of a firm, the only difference between being imposed a criminal or an administrative fine is its marginal expected monetary value. Put differently, who imposes the fine does not matter for the firm. This is not the case from the perspective of the government, where the procedural differences between the criminal and administrative fines matter. The fact that it is the environmental agency itself that imposes the administrative fine might increase the probability of sanctioning, which in turn increases the expected fine and hence the level of enforcement *ex ante*. In

¹ Directive 2008/99/EC, *Official Journal* L328/28 of 6 December 2008

addition, the costs of the administrative procedure might differ from the criminal procedure where strict standards of evidence apply and the courts are involved.²

This paper disregards non-monetary sanctions as well as the stigmatizing and reputational effects of a criminal sanction within the scope of these minor environmental violations. Non-monetary sanctions in criminal law, such as imprisonment are rarely used for environmental violations, and the less for minor harms.³ In administrative law, different types of non-monetary sanctions exist. The “softest” non-legal sanctions are warnings and recommendations, through which the environmental agencies try to induce compliance. In addition, there are administrative orders, such as enforcement, prohibition or stop notices, which are designed to force the companies to stop harmful activities. However, none of these could substitute criminal law for the more serious cases. The company might also be made to carry out remedial works to offset its harm (on this for the UK see (Ogus and Abbot 2002, 283-298); Environmental Protection Act 1990; Environment Agency Enforcement and Prosecution Policy 2008). The most severe non-monetary administrative sanctions are the suspension or revocation of licenses, which could be said to have the highest deterrent effect on companies. However, these are rarely used and hence, the threat might not be credible (Ogus and Abbot 2002, 283-298). The main sanction used for firms that are found in violation, is a criminal or an administrative fine. With regard to stigma and reputational effects, there is a debate in the literature whether sanctions for environmental violations carry with them the stigmatizing and reputational effect. Several authors argue they do (Arora and Cason 1996, 413-432; Cohen 1992, 1054-1108). Others claim it is only the legal sanctions that matter (Karpoff, Lott, and Wehrly 2005, 653-676).

The model developed in this paper compares two scenarios: 1) the world where all environmental violations are enforced through criminal fines and 2) the world where minor violations are enforced through administrative fines, while criminal fines are imposed for more serious violations. As already mentioned, this represents the reality quite well, as some countries, such as the UK and the Flemish Region did until recently, use scenario 1, while others, such as Germany and the Netherlands, scenario 2.

² The imposition of an administrative fine with a punitive and deterrent aim is considered as a criminal charge in the sense of Article 6 of the European Convention of Human Rights (ECHR). Hence, as a criminal fine, it must meet the strict requirements of Article 6 ECHR (right to a fair and public hearing by an independent tribunal, presumed innocent until proven guilty). However, there are still important differences between the administrative and criminal procedural systems.

³ Collection of the data can be found in Faure and Svatikova (2009, 1-38). Evidence shows that imprisonment has been imposed very rarely for environmental violations.

Scenario 3 where only administrative fines would be available is not considered in this paper as criminal law is needed for serious violations. Only criminal law offers imprisonment, when environmental harm is serious and large as well as strict procedural safeguards in order to avoid judicial errors. Furthermore, jurisdiction where only administrative sanctions are imposed does not exist. This paper shows that if the enforcement costs of administrative fines are sufficiently low (compared to criminal enforcement costs), administrative fines are an efficient instrument to use for minor violations. This conclusion is stronger the higher the number of firms emitting less than the allowed upper limit for minor violations, and hence falling under the administrative fine. This is true for the middle-abatement-cost firms. Alternatively, this conclusion is also stronger the smaller the difference between the marginal expected criminal and administrative fines. Under these circumstances, the marginal social benefits of decreased emissions and enforcement costs associated with the administrative-criminal fine scenario outweigh the marginal social costs of increased abatement costs.

The main implications for the current scholarly and policy debates on the scope of administrative and criminal law enforcement are that administrative fines for minor violations are an efficient instrument only if 1) the administrative enforcement costs are indeed sufficiently lower than the criminal enforcement costs, which is sometimes debatable, 2) the emission standards delineating no violation from minor violation to serious violation have to be set such that there are enough firms falling into the middle abatement cost group of firms, and 3) the expected criminal and administrative fines do not differ greatly. If this is the case, the availability of administrative fines might deal with some of the dismissed cases, hence taking away some burden from courts, and as such increasing the level of enforcement, and thus deterrence *ex ante*.

The paper is structured as follows. Section 2 describes the basic setup and assumptions of the model. Section 3 presents the criminal fine model, where all environmental violations are enforced only through criminal law. Section 4 introduces the administrative-criminal fine model, where administrative fines are imposed for minor violations, while more serious violations are still enforced through criminal law. Impacts of the two regulatory regimes on social welfare are discussed in section 5 and compared in section 6. A sufficient condition for administrative fines to be welfare improving under different model specifications is derived in section 6. Section 7 concludes.

2. The Model

2.1 Basic Setup

The basic structure of the model employed is similar to Rousseau (2009, 191-201). We use comparative statics to see under which conditions administrative fines provide an efficient enforcement mechanism to reduce the social costs of enforcing emission standards. In this model, each firm i faces the same emission standard \bar{e} . Each firm would without any restriction on the emission level produce e_0 ($> \bar{e}$), but to reduce its emissions, it incurs a positive cost θ_i . Firms are identical and risk-neutral but differ in their abatement cost functions, and hence in the savings they generate by emitting more e_i (and having lower abatement costs).⁴ The profit from savings on abatement costs is given by $a(e_i) = \theta_i e_i^{\frac{1}{2}}$ ($a' < 0$, $a'' > 0$). If a firm violates \bar{e} , it will face a criminal fine, F_c , or an administrative fine, F_A , with a probability p_c or p_A , respectively, depending on e_i . The expected criminal fine is given by $f_c(e_i) = p_c F_c e_i$ ($f_c' > 0$, $f_c'' > 0$) and the expected administrative fine by $f_A(e_i) = p_A F_A e_i$ ($f' > 0$, $f'' > 0$). The firm will violate \bar{e} if the marginal costs of violation (= marginal expected fine) are lower than the marginal benefits of violation (= marginal profit from savings on abatement costs). The agency also sets a standard $\bar{e} + \beta$, which delineates minor from serious violations. If a firm emits above this standard, it will face criminal sanctions. How this standard is set or whether it is optimal lies outside the scope of this paper. What triggers the jump from criminal/administrative fines to only criminal is given by the seriousness of the offence, $\bar{e} + \beta$.

Assuming that not all minor violations are criminally prosecuted implies that enforcement might be sub-optimal when relying only on criminal fines. This might be due to the fact that the prosecutor has a budget and time constraint, and as the criminal prosecution has a very high standard of proof and has to follow other strict procedural standards and court litigation, the prosecutor will select cases based on their seriousness and potential success of reaching a conviction. If the evidence is weak, it is likely that the case does not merit going to court. Other reasons for dismissals include dismissals for technical and policy reasons, as well as prosecution not being in the public interest. All this decreases the probability of sanctioning for the offender, and hence renders the expected fine lower than if more cases were fined. This is where the administrative fines might come into the picture. The fact that the case does not have to be forwarded to the public prosecutor but is decided by the environmental agency itself (having a more specialized knowledge) might increase the probability of sanctioning. The probability of

⁴ Negative marginal abatement cost is a benefit and can be viewed as a profit from savings on abatement costs. In other words, a firm saves money on not abating, which can be seen as private benefit of polluting.

detection remains approximately the same as it is still the environmental agency that monitors and investigates a violation irrespective of whether we follow a criminal or an administrative sanctioning track. Enforcement costs positively depend on the probability of detection and sanctioning, as it costs more to enforce more. However, the marginal enforcement costs per unit of the probability of detection and sanctioning might be lower for an administrative fine because of the structural differences between criminal and administrative settings. Litigation in court is expensive compared to the administrative “adjudicative” process where the firm submits to the environmental agency written representations and objections upon receiving a notice of intent. The length of the administrative proceedings tends to be shorter than those of criminal proceedings. The number of appeals and judicial reviews might also differ as the companies might resist more the imposition of a criminal rather than an administrative fine. Therefore, even though the probability of detection and sanctioning might be higher for an administrative fine (which increases the expected sanction, *ceteris paribus*), if the marginal administrative enforcement costs are sufficiently low, the total enforcement costs might be lower for administrative law.

By introducing higher expected administrative fines for minor violations, the marginal costs of violation will be higher as the marginal expected administrative fine is higher, hence firms will pollute less than if faced with lower expected criminal fines. However, this also implies higher marginal profits from savings on abatement costs (because it becomes more expensive to violate), which in turn means higher marginal abatement costs (as there will be less violation and more abatement). This under certain circumstances might show to be welfare enhancing. Social welfare is defined as the profits from savings on abatement costs minus the enforcement costs and the costs associated with emissions (harm). Expected fines are only transfers from the violator to the government, hence do not need to figure in the social welfare functions.

2.2 Assumptions

We rely upon the following assumptions:

- (i) $F_c = F_A$
- (ii) $p_c < p_A$
- (iii) linear enforcement costs: $c_c p_c$; $c_A p_A$
- (iv) wealth of a firm $w_i > F_c > F_A$

- (v) e_i is observable by the agency
- (vi) \bar{e} and $\bar{e} + \beta$ are set by the agency

Assumption (i) states that the size of the criminal and administrative fines is equal. It means that for the same level of harm, the same level of fine is imposed, regardless of whether it is a criminal or an administrative fine. This assumption is relaxed in one of the specifications of the model in section 6. Assumption (ii) is implied from the fact that the probability of sanctioning might be higher for an administrative fine because of the reasons discussed above. This together with (i) entails that the marginal expected criminal fine is lower than the marginal expected administrative fine. This might be quite plausible given the fact that many violations are not prosecuted, hence the marginal expected criminal fine *ex ante* is sub-optimal. This assumption is also relaxed in section 6. Enforcement costs are assumed to be linear (iii), and defined as the marginal costs the enforcement agency has to bear in order to increase the probability of detection and sanctioning by one unit. Hence, the enforcement costs are linearly increasing with the probability of detection and sanctioning. The probability of detection comprises the probability that a firm will be found committing a violation multiplied by the probability that it will actually be sanctioned. Assumption (iv) states that the wealth of a firm exceeds both, criminal and administrative fines. In other words, there is no insolvency problem and all firms are able to pay the fines. This might not be such an unreasonable assumption as fines for environmental violations (whether criminal or administrative) tend to be low, which generally constitutes a problem with deterrence (Rousseau 2007, 1-28). In case there is an insolvency problem, this should not have direct implications for social welfare as fines are mere transfers from the violator to the government and do not figure in the social welfare function. However, the insolvency problem has implications for deterrence, and might indirectly alter the social welfare through an increased emissions level. Assumption (v) makes monitoring and enforcement by the agency possible. All firms under this model are required to report their true emissions, which are then checked through random inspections by the environmental agencies and penalized if necessary. As long as firms believe this to be a credible threat, they will emit based on their marginal abatement costs, as discussed in section 2.1. Assumption (vi) only means that no normative conclusions are made with regard to the emissions standards. This paper employs only positive analysis and takes the emissions standards as given.

3. Basic Model with Criminal Fines

This paper compares the impact of two different regulatory schemes on the level of social welfare. The two models do not take into account past or future behavior of firms, thus they can be solved as a static welfare maximization problem. In the basic model with only criminal fines as the enforcement mechanism, the firm chooses its emissions level such that it maximizes its profit from savings on abatement costs minus the expected costs from a criminal fine. The marginal expected criminal fine is divided into three regions:

If $e_i \leq \bar{e}$ then the marginal expected fine = 0 (no penalty)

If $\bar{e} < e_i \leq \bar{e} + \beta$ then the marginal expected fine = $p_c F_c$

If $e_i > \bar{e} + \beta$ then the marginal expected fine = $p_c F_c + p_c^c F_c$

This is illustrated in Fig. 1. This represents the fact that for minor violations ($\bar{e} < e_i \leq \bar{e} + \beta$), a lower marginal expected criminal fine is imposed due to underenforcement ($p_c F_c < p_c^c F_c$).

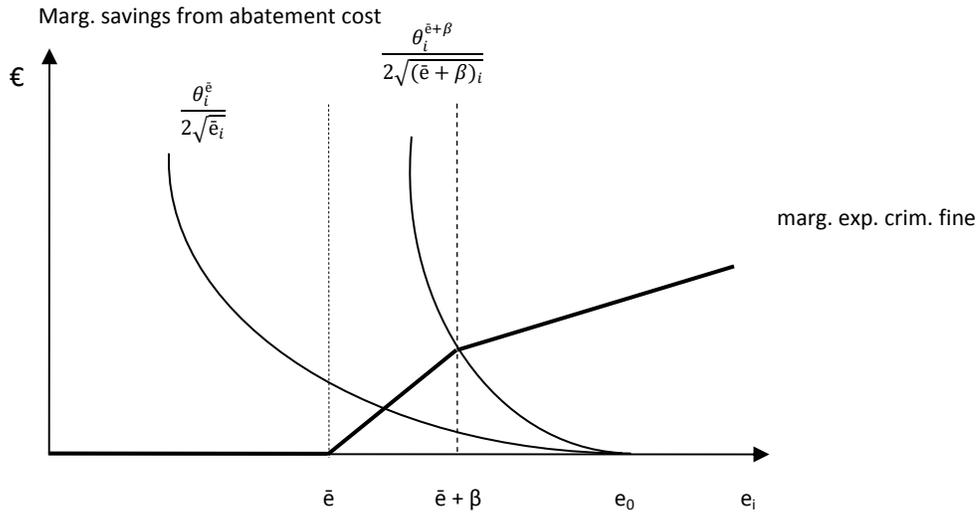


Fig. 1. Decision to violate under the criminal fine model

Firms falling under each region will maximize their profits correspondingly.

$$\text{Firm}_i \quad \max_{e_i} \pi = \max_{e_i} \left[\theta_i e_i^{\frac{1}{2}} - p_c F_c e_i \right] \quad (1)$$

$$\frac{\partial \pi}{\partial e_i} = \frac{\theta_i}{2\sqrt{e_i}} - p_c F_c = 0 \quad (2)$$

$$e_i = \left(\frac{\theta_i}{2p_c F_c} \right)^2 \quad (3)$$

Thus the optimal strategy for a firm is to comply with the emission standard and emit \bar{e} (firms are not going to emit less than necessary) if the marginal expected criminal fine is larger than the marginal benefits from savings on abatement costs ($p_c F_c > \frac{\theta_i^{\bar{e}}}{2\sqrt{\bar{e}_i}}$). However, if the marginal expected criminal fine is smaller than the marginal benefits from abatement costs savings, the firm will violate the standard \bar{e} and emit $e_i > \bar{e}$, depending on its abatement cost parameter θ . This implies that only firms with sufficiently low θ will comply, otherwise it is more beneficial for firms to violate and pay the fine, which is proportional to their emissions level exceeding the allowed \bar{e} . If their emissions exceed $\bar{e} + \beta$, the firm faces higher marginal expected fine, $p_c F_c + p_c^c F_c$ instead of only $p_c F_c$. In that case the optimal emissions level is e_i^c .

From (3), it can be implied that the level of emissions is increasing with the level of abatement cost θ , and decreasing with the level of marginal expected criminal fines.

Proposition 1: *When firm i only faces criminal fines, its emissions e_i are determined as follows*

If $\theta_i \leq \theta_i^{\bar{e}}$ then $e_i = \bar{e}$

If $\theta_i^{\bar{e}} < \theta_i \leq \theta_i^{\bar{e}+\beta}$ then $e_i = \left(\frac{\theta_i}{2p_c F_c} \right)^2$

If $\theta_i > \theta_i^{\bar{e}+\beta}$ then $e_i^c = \left(\frac{\theta_i}{2(p_c F_c + p_c^c F_c)} \right)^2$

Based on this optimal emissions strategy of individual firms, the social welfare function SW_c is defined as the sum of individual profits from savings on abatement costs minus the total enforcement costs incurred by the enforcement agency minus the total emissions level. Expected fines are excluded from consideration as these are mere transfers. Social welfare under the criminal fine model SW_c can be divided into three parts: SW_c for firms with $\theta_i \leq \theta_i^{\bar{e}}$ (compliant firms), SW_c for firms with $\theta_i^{\bar{e}} < \theta_i \leq \theta_i^{\bar{e}+\beta}$ (non-compliant firms committing minor violations), and SW_c for firms with $\theta_i > \theta_i^{\bar{e}+\beta}$ (non-compliant firms committing serious violations). What is of interest for the comparison of the SW_c with the administrative-criminal fine model, developed in the next section, is the SW_c for the non-compliant firms committing minor violations. This is because the SW_c for compliant firms and serious violators in the criminal fine model is identical to the SW_A for compliant firms and serious violators in the administrative-criminal fine model. If a firm complies with \bar{e} , there is no penalty imposed under any of

the regulatory regimes. If a firm violates above $\bar{e} + \beta$, it will always face the same marginal expected criminal fine. Thus only the SW_c for the non-compliant firms emitting below $\bar{e} + \beta$ is expressed.

$$SW_c = \theta_i e_i^{\frac{1}{2}} - c_c p_c - e_i \quad (4)$$

$$SW_c = \theta_i \left[\left(\frac{\theta_i}{2p_c F_c} \right)^2 \right]^{\frac{1}{2}} - c_c p_c - \left(\frac{\theta_i}{2p_c F_c} \right)^2 \quad (5)$$

$$SW_c = 2p_c F_c \theta_i^2 - 4p_c^3 F_c^2 c_c - \theta_i^2 \quad (6)$$

Next we discuss the impact on the behavior of firms and the implications for the social welfare when administrative fines are introduced for minor violations.

4. Model with Administrative and Criminal Fines

In the administrative-criminal fine model, administrative fines are introduced for minor violations, i.e. for firms that emit up to the level $\bar{e} + \beta$ ($\beta > 0$). Thus firms that were compliant under the criminal fine model are still compliant under this scenario, while firms emitting up to $\bar{e} + \beta$ will no longer face a criminal fine but a higher expected administrative fine (higher because the probability increases). Firms that emit above $\bar{e} + \beta$ will still face criminal fines as under the criminal fine model. Hence the marginal expected fine under administrative-criminal fine model is also divided into three regions:

If $e_i \leq \bar{e}$ then the marginal expected fine = 0 (no penalty as under the criminal fine model)

If $\bar{e} < e_i \leq \bar{e} + \beta$ then the marginal expected fine = $p_A F_A$ (administrative fine imposed)

If $e_i > \bar{e} + \beta$ then the marginal expected fine = $p_c F_c + p_c^c F_c$ (criminal fine imposed)⁵

Firms falling under each region will maximize their profits similarly as under the criminal fine model. Their decisions are illustrated in Fig. 2.

⁵ Note that $p_c^c \neq p_c$. Firms emitting above $\bar{e} + \beta$ under the administrative-criminal fine model face the same marginal expected criminal fines as these firms under the criminal model. Hence, $p_c F_c + p_c^c F_c = p_A F_A$ and correspondingly $p_c^c = \frac{p_A F_A - p_c F_c}{F_c}$.

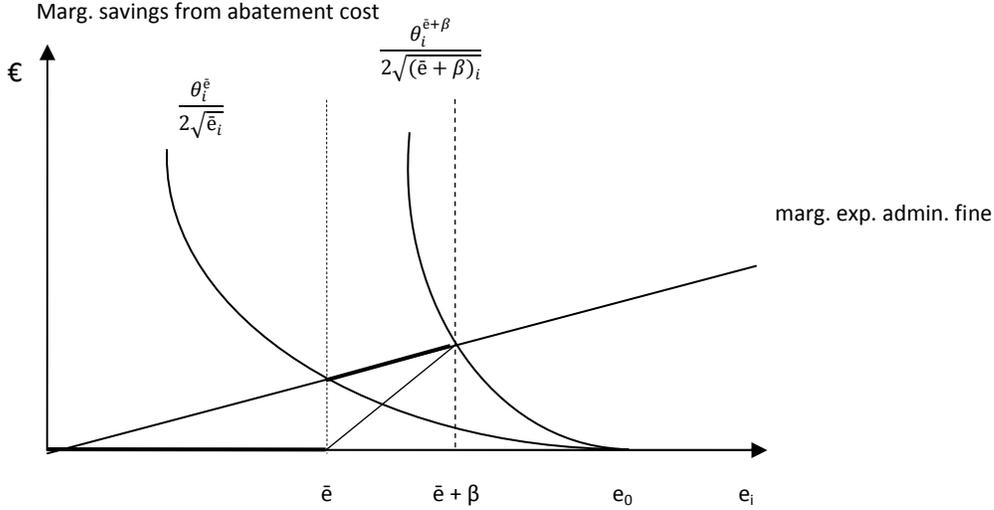


Fig. 2. Decision to violate under the administrative-criminal fine model

Thus once again, firms will optimize their level of emissions according to their abatement cost parameter θ and the corresponding marginal expected fine (1). Optimal emissions level for firms facing only administrative sanctions ($e_i \in [\bar{e}; \bar{e} + \beta]$) is e_i^A , and the optimal emissions level for firms facing criminal sanctions ($e_i \in [\bar{e}; \bar{e} + \beta]$) is e_i^C .

Proposition 2: *When firm i faces an administrative or a criminal fine, its emissions e_i are determined as follows*

If $\theta_i \leq \theta_i^{\bar{e}}$ then $e_i = \bar{e}$

If $\theta_i^{\bar{e}} < \theta_i \leq \theta_i^{\bar{e}+\beta}$ then $e_i^A = \left(\frac{\theta_i}{2p_A F_A}\right)^2$

If $\theta_i > \theta_i^{\bar{e}+\beta}$ then $e_i^C = \left(\frac{\theta_i}{2(p_C F_C + p_C^C F_C)}\right)^2$

The impact of this regulatory regime on social welfare can also be divided into three parts. First part consists of social welfare of the compliant firms ($\theta_i \leq \theta_i^{\bar{e}}$), second part of the non-compliant firms that face an administrative fine ($\theta_i^{\bar{e}} < \theta_i \leq \theta_i^{\bar{e}+\beta}$), and lastly, the non-compliant firms that face a criminal fine ($\theta_i > \theta_i^{\bar{e}+\beta}$). As the first and last parts of the social welfare function are the same for both, criminal fine model and administrative-criminal fine model, what interests us when comparing the impact on social welfare of the two regulatory regimes is the region of the medium-abatement cost firms, $\theta_i^{\bar{e}} < \theta_i \leq \theta_i^{\bar{e}+\beta}$. Hence, the relevant social welfare function SW_A corresponding to this region is the following:

$$SW_A = \theta_i e_i^{A\frac{1}{2}} - c_A p_A - e_i^A \quad (7)$$

$$SW_A = \theta_i \left[\left(\frac{\theta_i}{2p_A F_A} \right)^2 \right]^{\frac{1}{2}} - c_A p_A - \left(\frac{\theta_i}{2p_A F_A} \right)^2 \quad (8)$$

$$SW_A = 2p_A F_A \theta_i^2 - 4p_A^3 F_A^2 c_A - \theta_i^2 \quad (9)$$

In the next sections we discuss the impacts of the two regulatory regimes on social welfare and determine a sufficient condition for administrative fines to be socially desirable.

5. Impacts of the criminal fine and administrative-criminal fine models on social welfare

5.1 Impact on emissions

The two regulatory regimes in question will have a different impact on the level of emissions. This is true only for firms with abatement cost functions belonging to $\theta_i \in [\theta_i^{\bar{e}}; \theta_i^{\bar{e}+\beta}]$ (medium-abatement cost) and holds under the assumption (i) and (ii), $p_c F_c < p_A F_A$. The optimal emissions level for firms with medium-abatement cost function under the criminal fine model is $e_i = \left(\frac{\theta_i}{2p_c F_c} \right)^2$, while it is $e_i^A = \left(\frac{\theta_i}{2p_A F_A} \right)^2$ under the administrative-criminal fine model (Proposition 1 and 2). Hence, if $p_c F_c < p_A F_A$, it follows that $e_i > e_i^A$. Under the administrative-criminal fine model, firms will emit less than under the criminal fine model, the extent depending on the relative size of the marginal expected criminal and administrative fines.

5.2 Impact on abatement and enforcement costs

However, this positive effect on the level of emissions might be offset by the increase in the abatement and enforcement costs. Higher marginal expected fines also imply higher marginal profits from savings on abatement costs, and hence higher marginal abatement costs firms have to incur in order to optimize their emissions strategy (higher marginal profits from savings mean higher marginal negative costs).

Marginal profits from savings under the criminal fine model equal $\frac{\theta_i}{2\sqrt{e_i}}$, while marginal profits from savings under the administrative-criminal fine model (for $\theta_i \in [\theta_i^{\bar{e}}; \theta_i^{\bar{e}+\beta}]$) equal $\frac{\theta_i}{2\sqrt{e_i^A}}$. As $e_i > e_i^A$, it

follows that marginal profits from savings on abatement costs are lower under the criminal fine model.

This could be interpreted such that firms have to spend less on abatement costs in order to optimize their emissions strategy, which is to emit more than under the administrative-criminal fine model. Thus

having higher abatement costs under the administrative-criminal fine model can be viewed as having a negative impact on social welfare.

Other important costs that might be increased under the administrative-criminal fine model are the enforcement costs (assumption iii). As these depend on the unit costs of enforcement, c_c and c_A , as well as on the probabilities of detection, p_c and p_A , their impact on social welfare is ambiguous. If the enforcement costs of criminal fines are higher than those of administrative fines, the social welfare under the administrative-criminal fine model might be improved. If the opposite is true, the social welfare might be decreased. If the enforcement costs are the same for both types of fines, the impact on social welfare will depend on the direction of the opposing effects on the emissions level and the abatement costs. Different specifications of enforcement costs and their impact on social welfare will be discussed in the next section.

6. Comparison of the criminal fine model with the administrative-criminal fine model

This section evaluates the overall impact on social welfare and determines a sufficient condition for administrative fines to be welfare improving. Different specifications of the model will be discussed.

6.1 Sufficient condition for administrative fines to be welfare improving

As mentioned in the previous section, the impact of administrative fines as compared to the use of criminal fines on social welfare is ambiguous. This comes from the fact that administrative fines have a positive effect on the level of emissions, while a negative effect on abatement costs, and possibly also on enforcement costs. However, it will be shown that under certain conditions, administrative fines do have an overall positive impact on social welfare.

From (6), the overall social welfare for the criminal fine model (for $\theta_i \in [\theta_i^{\bar{e}}; \theta_i^{\bar{e}+\beta}]$) is as follows

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} (2p_c F_c \theta_i^2 - 4p_c^3 F_c^2 c_c - \theta_i^2) d\theta \quad (10)$$

From (9), the overall social welfare for the administrative-criminal fine model (for $\theta_i \in [\theta_i^{\bar{e}}; \theta_i^{\bar{e}+\beta}]$) is as follows

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} (2p_A F_A \theta_i^2 - 4p_A^3 F_A^2 c_A - \theta_i^2) d\theta \quad (11)$$

A sufficient condition for

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_C < \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A \quad (12)$$

is (proven in Appendix)

$$c_A < \frac{p_C^3 F_C^2}{p_A^3 F_A^2} c_C - \frac{I(p_C F_C - p_A F_A)}{2H p_A^3 F_A^2} \quad (13)$$

where $I = \frac{\beta^3}{3} + \bar{e}^2 \beta + \bar{e} \beta^2$ and $H = \theta_i^{\bar{e}+\beta} - \theta_i^{\bar{e}}$

and $I > 0, H > 0$. Parameters $c_A, c_C, p_A, p_C, F_A, F_C > 0$.

Proposition 3: *If condition (13) is satisfied, then $\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_C < \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A$. This condition will be more likely satisfied (1) the higher c_C , (2) the higher H , and hence the difference between $\theta_i^{\bar{e}+\beta} - \theta_i^{\bar{e}}$ with $\beta > 0$, and (3) the higher the relative ratio of the marginal expected sanctions $\frac{p_C F_C}{p_A F_A}$, hence the smaller the difference between the marginal expected criminal and administrative fines.*

This implies that the complementary use of administrative fines is more efficient (1) the higher the marginal criminal enforcement costs are as compared to the marginal administrative enforcement costs, (2) the more medium-abatement cost firms there are in the population, and (3) the closer the marginal expected criminal and administrative fines are. Thus when designing enforcement policies, the regulators might want to look at the actual enforcement costs of imposing an administrative *vis-à-vis* criminal fine, whether there are enough medium-abatement cost firms committing these minor violations for which an administrative fine would be imposed, and try to keep the underenforcement by criminal law to the minimum. If underenforcement is an issue with respect to minor environmental violations, introducing administrative fines with a higher probability of sanctioning provides incentives *ex ante* to decrease the overall level of emissions, which is regarded as positive from the societal point of view.

Furthermore, it should be noted that the model has ignored the institutional costs of having two enforcement agencies under the administrative-criminal scenario.⁶ These costs include coordination across agencies, the reallocation of competences as well as the regulatory responses. These costs might be negligible if they are incurred irrespective of whether the environmental agencies have the power to impose administrative fines or not. Put differently, the fact that the administrative agency acquires greater competences might not in itself be costly, while the actual costs related to the imposition of the administrative fine are accounted for in the model as part of the administrative enforcement costs. In contrary, if these institutional costs are substantial, this would affect the desirability of having two enforcement agencies instead of one.

Next sub-sections will discuss the implications for different parameter specifications.

6.2 Marginal expected criminal and administrative fines

When $p_c F_c = p_A F_A$, a sufficient condition for $\int_{\theta_i^e}^{\theta_i^{e+\beta}} SW_c < \int_{\theta_i^e}^{\theta_i^{e+\beta}} SW_A$ is

$$p_c c_c > p_A c_A \quad (14)$$

This basically confirms that when marginal expected fines are the same, what matters for social welfare are the enforcement costs. If $p_c = p_A$, then the marginal enforcement costs are $c_c > c_A$. The same holds if $p_c < p_A$, as hypothesized.

When $p_c F_c > p_A F_A$, a sufficient condition for $\int_{\theta_i^e}^{\theta_i^{e+\beta}} SW_c < \int_{\theta_i^e}^{\theta_i^{e+\beta}} SW_A$ is

$$c_A < \frac{p_c^3 F_c^2}{p_A^3 F_A^2} c_c - \frac{I\left(\frac{p_c F_c}{p_A F_A} - 1\right)}{2Hp_A^2 F_A} \quad (15)$$

This represents a mirror situation where the marginal expected administrative fines are smaller than the marginal expected criminal fines. This might be the case if the environmental agency imposes much lower administrative fines F_A for minor violations than are the criminal fines F_c imposed by courts ($F_A < F_c$), or if the strategy of the environmental agency is to use a soft approach to enforcement, e.g. negotiations or issuing a warning, rather than to fine the offender ($p_A < p_c$). If this is the case, the efficiency of administrative fines is still conditional upon sufficiently low c_A and sufficiently high region of

⁶ Thanks to Prof. Nuno Garoupa for pointing this out.

middle-abatement cost firms, but the marginal expected criminal and administrative fines must differ greatly enough.

6.3 Probability of detection is the same for criminal and administrative fines

When $p_c = p_A$, which might be a plausible assumption under certain circumstances, a sufficient

condition for $\int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_c < \int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_A$ is

$$c_A < \left(\frac{F_c}{F_A}\right)^2 c_c - \frac{I(F_c - F_A)}{2Hp^2 F_A^2} \quad (16)$$

This assumption might be satisfied if in the end there is not much of a difference between the probability of sanctioning under criminal and administrative law. It implies that when the probabilities of detection and sanctioning for administrative and criminal fines are the same, what matters is the relative size of the fines. Hence, the issue at stake is the question of nature of the punishment, i.e. the desirability of a (higher) punitive sanction for serious violations. This makes the question of which agency enforces the regulations irrelevant.

6.4 Size of the criminal and administrative fine is equal

When $F_c = F_A$, what matters for the level of expected fines are the probabilities of detection and

sanctioning. A sufficient condition for $\int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_c < \int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_A$ to hold is

$$c_A < \left(\frac{p_c}{p_A}\right)^3 c_c - \frac{I(p_c - p_A)}{2HFp^3} \quad (17)$$

Based on (17) what matters are the relative probabilities of detection and sanctioning. Hence, the efficiency of administrative fines is a question of enforcement, i.e. which agency (the criminal law machinery or the administrative agency itself) investigates and imposes the fine.

6.5 Enforcement costs for criminal and administrative fine are equal

When $c_c p_c = c_A p_A = y$, what matters for social welfare are the marginal expected fines. A sufficient

condition for $\int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_c < \int_{\theta_i^{\bar{\theta}}}^{\theta_i^{\bar{\theta}+\beta}} SW_A$ to hold is

$$y > \frac{I}{2H(p_c F_c + p_A F_A)} \quad (18)$$

This implies that there is an inverse relationship between the enforcement costs and the marginal expected fines. The higher the total marginal expected fines, the easier it is to satisfy this condition for efficiency.

7. Conclusion

To conclude, this paper added to the debate on whether a single instrument, criminal law, or multiple instruments, criminal and administrative law should be used to enforce environmental regulations. This is particularly relevant when we consider the problem of low prosecution rates. In this case, administrative law might prove to be a good alternative sanctioning mechanism. A model has been developed comparing the use of criminal fines alone with a model of complementary use of criminal and administrative fines. It was shown that situations exist when administrative fines provide an efficient instrument to use for minor violations. This is the case when the enforcement costs of administrative fines are sufficiently low (compared to the criminal enforcement costs), if there are enough middle-abatement-cost firms and if the difference between the marginal expected criminal and administrative fines is small enough. Under these circumstances, the social costs of increased abatement costs due to higher expected administrative fines are outweighed by the social benefits from savings on enforcement costs and decreased emissions. The main variables of interest for regulators are hence the relative enforcement costs, probabilities of detection and sanctioning and the size of the fines under criminal and administrative law. How these variables interact among each other has been shown in the different parameter specifications. What still needs further attention is a model where stigma and reputational effects play a role, as well as the case where insolvency problem exists. This would give a slightly different dynamic to the model presented here.

Besides the debate on the scope of criminal and administrative law in enforcing environmental regulations, another question opens up with regard to decriminalization. This model could be also used to show how procedural differences might lead to decriminalization for efficiency reasons. However, implications of 're-classifying' certain crimes as administrative offences is an area for further research.

Appendix

We would like to compare social welfare under the criminal fine model SW_c with the one under the administrative-criminal fine model SW_A . We have

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} (2p_c F_c \theta_i^2 - 4p_c^3 F_c^2 c_c - \theta_i^2) d\theta$$

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} (2p_A F_A \theta_i^2 - 4p_A^3 F_A^2 c_A - \theta_i^2) d\theta$$

Which can be rewritten as

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} (2p_c F_c \theta_i^2) d\theta - \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} 4p_c^3 F_c^2 c_c d\theta - \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta$$

$$= 2p_c F_c \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta - 4p_c^3 F_c^2 c_c \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} d\theta - \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta$$

The same goes for SW_A and we have

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A = 2p_A F_A \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta - 4p_A^3 F_A^2 c_A \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} d\theta - \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta$$

Let

$I = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} \theta_i^2 d\theta$ and $H = \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} d\theta = \theta_i^{\bar{e}+\beta} - \theta_i^{\bar{e}}$, both I and H are positive constants, and we have

$c_A, c_c, p_A, p_c, F_A, F_c > 0$. We can rewrite

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c = 2p_c F_c I - 4p_c^3 F_c^2 c_c H - I$$

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A = 2p_A F_A I - 4p_A^3 F_A^2 c_A H - I$$

Let $p_c F_c = x$ and $p_A F_A = \alpha x$, where $\alpha > 1$ if $p_c F_c < p_A F_A$ and $\alpha = 1$ if $p_c F_c = p_A F_A$.

$$\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c < \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A$$

For this inequality to hold,

$$\begin{aligned} 2xI - 4x^2 p_c c_c H &< 2\alpha x I - 4\alpha^2 x^2 p_A c_A H \\ I(1 - \alpha) &< 2Hx(p_c c_c - \alpha^2 p_A c_A) \\ c_A &< \frac{p_c c_c}{\alpha^2 p_A} - \frac{I(1 - \alpha)}{2Hx\alpha^2 p_A} \\ c_A &< \frac{p_c^3 F_c^2}{p_A^3 F_A^2} c_c - \frac{I(p_c F_c - p_A F_A)}{2Hp_A^3 F_A^2} \end{aligned}$$

We can now state that this is a sufficient condition for $\int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_c < \int_{\theta_i^{\bar{e}}}^{\theta_i^{\bar{e}+\beta}} SW_A$.

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