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The Weak Probability of Punishment for Environmental Offenses and Deterrence of Environmental Offenders: A Discussion Based on USEPA Criminal Cases, 1983–2013

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Abstract

Numerous studies observe a decrease in environmental crimes following imposition of fines or penalties potentially due to general and specific deterrent effects. Here we explore whether those deterrent effects appear plausible by estimating the probability of a USEPA criminal case occurring each year between 1983 through 2013. Our analysis shows that there is an extremely low probability of an environmental crime case being prosecuted criminally by USEPA, casting doubt that these criminal cases are sufficiently widespread to generate a deterrent effect. We suggested that alternative theoretical orientations and policy initiatives be employed in studying and responding to environmental infractions.

Introduction

Criminological, economic, and other behavioral theories, as well as regulatory policy, suggest that environmental crime can be controlled through the detection and sanctioning process that deters offenders (Beccaria 1764; Becker 1968; Bentham 1879; Posner 1985). With respect to sanctions, it is widely hypothesized that the more severe the sanction, the greater the deterrent effect the sanction should pose. Moreover, for the purpose of deterrence, criminal sanctions for environmental crimes ought to be preferred over other options, and ought to work more efficiently than other forms of sanctions (except see DeLong 2002 and O'Hear 2004). Illustrating this point, on its compliance page, the U.S. Environmental Protection Agency (USEPA) (2013) states:

EPA's criminal enforcement authorities provide EPA's strongest sanctions against polluters. Criminal penalties, with potential prison time as well as monetary fines, are critical to deter potential violators, eliminate the temptation for companies to "pay to pollute" and implement the felony provisions of our nation's environmental laws.

To facilitate criminal enforcement at the federal level nationwide, the USEPA employs 200 criminal investigators or special agents, and approximately another 150 scientists, lawyers, engineers, and other technical agents to work on criminal investigations of criminal environmental violations (USEPA 2013). This is not a large staff, especially given the number of federal laws this staff investigates, and the geographic scope of coverage of the USEPA. With respect to the availability of enforcement staff, for example, consider that New York State's Department of Environmental Conservation alone employs 241 environmental conservation officers to investigate and enforce

environmental laws (NYS DEP 2013), one can therefore surmise that the USEPA appears understaffed.

Numerous studies of the deterrent effects of criminal environmental sanctioning have been undertaken. These studies include those that examine criminal fines as well as other criminal penalties to explore the assumption that criminal sanctions deter environmental offenders (see below). In theory, rational offenders are deterred from crime when the costs of crime outweigh its rewards (Beccaria 1764; Becker 1968; Bentham 1879). Those costs may be applied directly to offenders (specific deterrence), or indirectly to potential offenders through their observation of environmental social control responses applied to actual offenders (general deterrence). Many studies exploring the deterrent effects of environmental sanctions find that criminal sanctions significantly deter both penalized as well as non-penalized facilities. In many studies, the effects discovered for criminal penalties appear quite large, and empirical results from these studies suggest that those penalties possess the ability to reduce offending substantially.

However, because criminal punishments are rarely used to control environmental crime, few offenders are actually punished criminally. As a result, the likelihood of criminal punishment remains low, and this begs the question of why criminal penalties would deter rational offenders when the probability of criminal prosecution is quite low. Rather, it would seem that rational offenders, perceiving that the probability of environmental punishment is low, would engage in a larger volume of environmental offenses.

To examine these issues the present study addresses a question that has yet to be fully explored in the criminological literature on criminal penalties for environmental offenses: What is the probability that any particular firm policed by the USEPA will receive a criminal penalty? To address this issue, we analyze data on USEPA criminal prosecutions from 1983 through 2013 available from the USEPA on its website. We use estimates of the probability of criminal prosecution to address whether the likelihood of criminal prosecution appears large enough to change the behavior of rational corporate offenders.

We begin our discussion with a brief review of prior research on deterrence and environmental crime designed primarily to illustrate potential flaws in that literature that lead to the over-estimation of the deterrent effect of environmental penalties. Following that review, we examine the context in which the USEPA endeavors to promote deterrence by examining the number of firms subject to USEPA activities, and then examine probabilities of criminal case filing against those firms annually for the time period 1983–2013. The estimation of the probability of a criminal case being filed measures an important aspect of the likelihood that criminal sanctions will deter environmental crimes that has not been addressed in prior studies.

Empirical assessments of deterrence and environmental crime

Research on the deterrent effects of environmental enforcement has produced mixed results. Whether or not researchers discover a deterrent effect for environmental social control depends on how deterrence is specified, the penalty examined, the units

of analysis employed, the industry and/or specific law examined, and the time period and nation from which the data is drawn (see details below). Studies of environmental deterrence do not employ standard measures or metrics for deterrence, making it difficult to compare studies and to generalize study results. Sometimes, deterrent effects are noted for specific laws and not others, which again limits the generalizability of environmental social control deterrence research.

Environmental crime literature reviews tend to highlight deterrence-oriented research that supports specific and general deterrence hypotheses (e.g., Gray and Shimshack 2011). Such reviews may have a limited scope and primarily have addressed the deterrence-environmental crime association in economics and public policy literature. Omitted from such literature reviews of deterrence and environmental crime are criminological studies that have rejected deterrence based arguments (e.g., Braithwaite and Makkai 1991; Makkai and Braithwaite 1994; Stretesky, Long, and Lynch 2013; Long et al. 2012; Stretesky and Lynch 2009, 2011; Weisburd, Waring, and Chayet 1995). When such studies are considered, support for deterrence-based environmental crime hypotheses is weakened. Below, we draw attention to studies that support and reject certain aspects of deterrence based arguments for environmental crime.

Theoretically, studies of deterrence assume that rationally calculating corporations can be deterred by financial penalties that affect their bottom line (for critical assessment of these assumptions and an empirical study testing these assumptions see Stafford 2006). In theory, when penalties exceed the rewards of an

environmental crime, the offense should be deterred. This general assumption is complicated by issues related to the perception of rewards and punishments by potential offenders (Earnhart and Friesen 2013; Friesen 2012). In more general terms, criminologists have found inconsistent evidence with respect to deterrence across a wide variety of crimes, and literature reviews on this issue performed decades apart indicate that the effect of punishment on crime is, at best, small (Paternoster 1987, 1989, 2010).

In addition to empirical criticism, one can also critique the theoretical premise of deterrence (Paternoster 2010). It is difficult, for example, to separate deterrent effects from other effects that may also cause crime to decline (Paternoster 1987, 2010). With respect to the study of deterrence among environmental offenders, other issues must also be considered. For example, one of the problematic aspects of studies of deterrence and environmental crime is that penalty rates are low among samples of environmental offenders, and, as with any study of crime that employs official offending data, suffers from under-reporting of offending. It is highly unlikely that given the small number of criminal sanctions for environmental offenders and the potential extent of undiscovered and unreported corporate environmental offenses, that the real deterrent effects of criminal penalties can be determined from extant literature. Because criminal penalties for environmental offenses are rare, prior estimates of the deterrent effects of criminal penalties on environmental offenders are likely to be quite sensitive to missing cases, while environmental data is likely to under-report environmental offenses (Bennear 2008; de Marchi and Hamilton 2006; Lynch, Stretesky, and Hammond 2000).

Bennewer (2006), for example, found that several factors affected self-reporting of environmental offenses, and that changes in environmental laws over time also reduced the number of reportable offenses that could produce the appearance of a decline in environmental crime over time. Moreover, given that criminal environmental sanctions are rare and may vary by the type of offense examined or even the location of environmental crimes, it becomes difficult to generalize from deterrence research on environmental crime.

Nevertheless, in the literature there are several studies that support environmental social control deterrence hypotheses. Shimshack and Ward (2005), for instance, discovered a rather large deterrence effect that has been well cited in the literature as an example of the deterrent effects associated with financial penalties for environmental crimes. Shimshack and Ward examined the impact of environmental enforcement spillover effects—that is the deterrent effect of fines on non-fined companies—for water pollution violations generated by financial penalties. Their results suggest that non-fined companies reduce their violation rates by two thirds following the fining of an offending company. This empirical result is large, and if correct and generalizable, indicates that fines ought to play a significant role in the reduction of water pollution violations.

The effect noted by Shimshack and Ward relates to general deterrence, or the idea that a penalty changes the behavior of potential violators (even though the penalty was applied to an actual—not potential—offender). In a recent study, Earnhart and Friesen (2013) employed an experimental scenario design to assess the assumptions of

this general deterrence argument. In contrast to general deterrence expectations, Earnhart and Friesen found an “experiential” effect—or what is more generally called a specific deterrence effect—that a punishment changes the behavior of those to whom it is applied more than it changes the behavior of potential offenders. Similarly, Harrington (2013) found that certain environmental policy goals are only met when companies that violate environmental regulations are subject to high levels of environmental enforcement.

How does one explain the large effect shown in Shimshack and Ward’s analysis? One possible explanation is that actors in non-offending companies have knowledge of environmental penalties and endeavor to maintain compliance in response to fines issued to offending corporations. That issue was specifically examined by Thornton, Gunningham, and Kagan (2005). In their study, Thornton and colleagues asked corporate decision makers about their knowledge and responses to environmental penalties levied against other facilities. They found that 63% of facility respondents reported taking some compliance action related to knowledge of an environmental action taken against other firms. Only 42% of respondents, however, reported being aware of “signal” or important fines levied against other facilities. This may mean that the respondents over-generalized from penalties against other firms. More importantly, these findings do not suggest that knowledge of non-compliance penalties affect firms that are in non-compliance. Rather, it was found that firms already in compliance were more likely to enhance their compliance routines when other firms are penalized. Thus, it appears that fines do not generally have important consequences for firms that are in

states of non-compliance, but rather, enhance conformity among firms that already adhere to environmental regulations.

One of the assumptions of deterrence based arguments related to environmental fines is that there is an optimal fine that can be identified that will generate the largest deterrent effect. In exploring this issue with respect to pollution emissions, Rousseau and Telle (2010) found that they were unable to accurately predict an optimal fine amount because fine amounts are nonlinear and produce different responses over the range of the response curve. In addition, the authors' research suggests that there is an unexplained interaction between fine amounts, emission levels and economic production. Thus, while fines may generate some deterrence, it is unclear how large a fine must be to generate deterrence or to produce an optimal effect, and how other factors interact to affect compliance.

As noted above, one of the problems when studying environmental deterrence is that the behavior of all facilities is an unknown. The available data only records known violations, and there may be unknown violators among the sample population. It is, therefore, not possible to accurately estimate deterrence effects for all facilities since some portion of the facilities assumed to be in compliance may actually be in noncompliance because their infractions are unknown to regulators. In order to accurately know whether or not firms change their behavior following a fine, the data must be 100% valid. Any missing cases increases the estimate of the deterrent effect unless the process of discovering violations is the result of a random inspection and discovery process, in which case the violation rate among the inspected and

uninspected facilities should be equivalent. Thus, it would appear that the only way to know about the deterrent effects of fines would be to use a randomized experimental method. Unless such a method is employed, facilities have different probabilities of being selected for inspection and discovery of violations, which biases the estimate of the deterrent effect.

The general assumptions of deterrence theory are specified as invariant across individual firms and their decision makers. That is to say, the assumption behind deterrence theory is that a penalty that is greater than the reward from a crime always results in deterrence because economic actors are rational and behave in a similar way. In a recent experimental study, this assumption was tested by Friesen (2012). Friesen examined whether a penalty would always change the behavior of potential offenders in the expected direction. To do so, she identified corporate actors in the study as risk-averse, risk-neutral, and risk-loving. Friesen hypothesized that the effects of penalties would vary across these groups because each had a different level of risk aversion. For example, Friesen hypothesized that an increase in the probability of detection along with a decline in penalties would lead some risk-aversers to switch from compliance to a violation, while risk-neutral and risk-lovers would continue to violate the law. In assessing respondents' risk position, Friesen found that 83% were risk averse, 13% were risk neutral, and that 4% were risk lovers. In multivariate tests, she confirmed the above hypothesis concerning increased risk of detection when penalties declined, and found that the effect of increasing fines had a larger impact than increasing the likelihood of detection. The outcome, however, varied across risk position, and indicated

that the effects of deterrence were not uniform across experimental firm respondents. Our interpretation of these results is that the likelihood of deterrence occurring is variable across firms, and the combination of the likelihood of detection and penalties interact with firm risk position to affect the likelihood of deterrence. In other words, not all firms are deterred by the same conditions. This implies that the more general assumption of deterrence theory related to uniformity in response to conditions that ought to generate deterrence, do not necessarily exist. Moreover, the effectiveness of fines is conditioned by the risk of detection, so that increasing one or the other may not generate significantly more deterrence. Banerjee, Iyer, and Kashyap (2003) observed differences across industries with respect to a firm's environmental orientation and environmental strategy. They discovered that regulatory forces appear antecedent to management's perceived relationship between environmental issues and financial health in industries with high environmental impact (measured as pharmaceutical, utility, chemical, and manufacturing industries), but not among industries with moderate environmental impact (measured as service, consumer products, and food industries). Variability in penalty applications and penalty structures as well as variability in the certainty of detection may help explain why studies sometimes find or reject deterrence hypotheses. In order to act as a deterrent, environmental penalties must have certain features that facilitate rational decision making on behalf of potential offenders. One of those features is the predictability of environmental penalties. In an article that addresses these issues, Karpoff, Lott, and Wehrly (2005) found that "legal penalties are idiosyncratic and difficult to predict" (p. 654). Other research indicates that

environmental decision making is impacted by size of a corporation, and that larger corporations are more difficult to deter (Gunningham, Thornton, and Kagin 2005).

Other studies suggest that factors beyond the forms of deterrence associated with the enforcement of environmental statutes matter more in controlling corporate environmental offending. In a 2003 study, Kagin, Gunningham, and Thornton found that a number of factors have effects on environmental compliance in the paper pulp sector. These factors included political pressure and tightened regulations, but also included pressure from local communities and environmental organizations. Kagin and colleagues argue that the effects of environmental law and regulation eclipses traditional instrumental impacts such as deterrence to include interactions between environmental compliance and social pressures (see also, Gunnington, Kagin, and Thornton 2004). Similar arguments have been applied to other environmental issues of compliance (Hauck 2008).

Support for deterrence arguments have also been found in studies in various nations. Almer and Goeschi (2010) suggest that criminal punishments for environmental crime produce deterrent effects across German states. Their analysis shows an effect for imprisonment, although no effect for convictions, meaning that only the most serious social control response produced a deterrent effect. Imprisonment, however, is a rare response for environmental crime, indicating that while such an effect may have a significant deterrent effect, such an effect is unlikely to occur given the rarity of sentences of imprisonment for environmental offenders (see also, Billet and Rousseau 2011). Telle (2009) found that the threat of inspections reduced serious environmental

violations but not emissions in a study of Norwegian corporations. International studies have drawn attention to the effect of innovations in monitoring environmental compliance and offenses including poaching of wildlife (Smith, Adhern, and McDougal 1998). One example is the use of satellite surveillance in monitoring deforestation. In their study on deforestation and the use of satellite surveillance in Brazil, Assunção, Gandour, and Rocha (2013) found that this new technology and its combination with a system of fines reduced deforestation crimes by 75%.

Probabilities of detection

Above we reviewed some of the studies on deterrence and environmental crime. While the results in that literature are mixed, it is fair to say that the evidence appears to often be interpreted as favoring deterrence based hypotheses. At the same time, the extant literature has several limitations which should lead researchers to be cautious concerning reaching conclusion about the extent to which environmental social control deters environmental crime. One of the limitations of deterrence based research has been its failure to address whether one of its central assumptions, the probability of detection and punishment, appears large enough or sufficient to generate deterrence. This assumption has been addressed with respect to perceptions of deterrence via the use of surveys (e.g., Earnhart and Friesen 2013; Friesen 2012). Survey research with corporate respondents appears to suggest that corporate actors are likely to respond to the punishment of corporate violators by improving compliance. What such surveys and other studies have neglected, however, is whether the real probability of enforcement is

logically sufficient to maintain deterrence, and whether enforcement is mathematically sufficient to generate the volume of deterrence prior studies have identified as occurring. Criminological research on corporate and environmental crime has shown that the actual level of punishment of corporate offenders is quite low (Reiman and Leighton 2010; Friedrichs 2009). In the empirical literature, the deterrent effects attributed to environmental punishment are, in contrast, quite high. Based on perceptual studies and survey research, this would mean that the perception of punishment for environmental violations must be extraordinarily high to explain the difference between the actual level of environmental punishment and its deterrent impacts. If this is true, then this outcome contradicts one of the central assumptions of deterrence theory—that actors behave rationally.

Prior studies have identified a similar problem called the “Harrington Paradox” (Harrington 1988). The Harrington Paradox notes that despite violations of the assumptions of deterrence theory (low levels of punishment), corporations nevertheless adhere to environmental law. Specifically, Harrington argued that three factors that appear in environmental enforcement contradict the assumptions of deterrence theory. First, the likelihood of official monitoring of environmental compliance is low. Second, if a violation is detected, the likelihood of punishment is low. Third, in comparison to the costs of environmental compliance, the costs of penalties are low. Given these three conditions and based on the assumptions of deterrence theory, rational corporate actors should prefer offending over compliance if the deterrence argument is correct. Recent

studies suggest that additional attention to this issue is required (Nyborg and Telle 2006).

To illustrate this dilemma, below we examine an estimation of the probability of enforcement by examining the likelihood of a criminal penalty being imposed by the USEPA for each year of activity from 1983–2013. The question we address is whether the probability of criminal enforcement appears sufficient in the context of the assumption of rational offenders included within deterrence hypotheses. Based on the premises of deterrence theory, we assume that rational offenders have knowledge of the probability of detection and the likelihood that criminal penalties result. Following the deterrence argument, if the real probability of detection and punishment is low, then one would expect that rational actors would be quite likely to violate the law precisely because the probability of punishment and the consequences of punishment are small. If, however, the probability of punishment is low and yet a large number of corporations refrain from committing environmental crimes as the extant literature suggests, then the theoretical explanation of the effect of environmental punishment on corporate behavior requires modification because corporate actors are not behaving rationally. Absent the central assumption of a rational actor, it is unclear why corporate actors adhere to law from a deterrence perspective.

In the section that follows, we take up an estimation of the probability of detection of corporate environmental offending employing USEPA data on environmental punishment. We make no assumption about the volume of offending and believe such an estimation cannot be made because USEPA estimates of offending suffer from

under-reporting. Studies of official street crime data have long illustrated that the volume of offending is significantly higher than police/official data indicate (Pepper, Petrie, and Sullivan 2010; Mosher, Miethe, and Hart 2010). Few studies of this issue appear in the environmental crime literature. Extant literature suggests, however, under-reporting by corporations of self-reported offending of environmental violations (Environmental Integrity Project & Galveston-Houston Association for Smog Prevention 2004; Telle 2013; U.S. General Accounting Office 2001).

Estimating the probability of detection, Part I: Effect estimates from prior studies and USEPA staff/offender ratios

In order to determine the probability of detection for an environmental offense, it is first necessary to estimate the population of potential offenders. Potential offenders include all firms/companies the USEPA regulates. In its most recent survey of employers, the U.S. Census Bureau's Department of Commerce indicates that in 2008, there were 5,930,132 "employer firms" (i.e., firms with payroll employees) in the United States (U.S. Census Bureau 2013). Of those firms, 2,312,368 have five or more employees. We note this outcome since some federal reporting requirements for environmental data are restricted to companies with five or more employees, and hence we assume that these firms are most likely to be policed/investigated by the USEPA. If we assume that these 2,312,368 firms operate, on average, 5.5 days per week, that's an average of 286 days of operation per firm per year, or a total of 661,337,248 total

business days for all firms annually. Earlier, we noted that the USEPA employs approximately 200 criminal investigators to examine environmental offenses. This means that for 2.312 million firms with five or more employees there is one criminal investigator for every 11,562 firms. With respect to business days, there is one investigator per 3,306,686 business days of operation. These figures already indicate that the volume of potential offenders will be difficult to surveil, especially since they are distributed across the 50 states. To contextualize the figures presented above, we compared the investigator/firm ratio to a detective/citizen ratio. We employ New York City for this comparison. New York City employs about 5,400 detectives to investigate criminal offenses among its population of 8.337 million. Since about 964,000 of those New York City residents are below the age of 10 and unlikely to be involved in crime, they can be eliminated as persons who are typically investigated by detectives (just as we eliminated businesses with fewer than five employees from the firm count). Thus, in New York City there is one detective per 1,365 people over the age of 10, or about 8.5 times as many investigators per 100,000 population for street crimes in New York City as the USEPA has available to investigate environmental crime (per 100,000 firms) across the United States. These data indicate that relative to efforts to control and detect street crime, environmental crime investigation staffs are significantly smaller. Thus, one would expect that given the reduced probability of detection and investigation for environmental crimes, the deterrent effects of environmental crime enforcement might be less than for street crime enforcement. Police elasticity effects for crime are rather small and in general, a 10% increase in police presence produces a reduction in

crime of less than 3% (for discussion see, Kovandzic and Sloan 2002, who found an effect of 1.4%).

Prior research on the deterrent effects of environmental enforcement on environmental compliance demonstrate varied results, but indicate that the deterrent effect of enforcement is generally higher than those found for street crime. Nadeau's (1997) study of noncompliance among pulp/paper plants (1979–1989) indicated that a 10% increase in the threat of enforcement increased compliance by 4–5%. Deily and Gray (2007) and Gray and Deily (1996) discovered significant enforcement effects for steel mill compliance with environmental regulations. Specifically, Deily and Gray discovered that an enforcement action at a steel mill plant increased compliance by 33%. Studying paper mills, Gray and Shadbegien (2005) found that an enforcement action at a plant increased compliance by 10%. Other studies find deterrent effects for specific activities such inspections (Magat and Viscusi 1990; for additional studies and results see, Gray and Shimshack 2011).

The very large deterrent effects discovered above seem implausible given what is known about corporate crime in general. Regulatory violations among corporations are widespread (Baucus and Near 1991), a fact that has been known since Sutherland first examined the behavior of corporations with respect to regulatory violations and published those results in the later 1930s and 1940s. Studies indicate that non-compliance is significantly higher among large firms (Baucus and Near 1991) meaning that there may be significant variability in the effect of deterrence across businesses by size (for discussion of limitations of measurements of environmental crime data see

Burns, Lynch, and Stretesky 2008; Gibbs and Simpson 2009, who specifically note that the “real world” data outcomes appear “confusing,” pp. 103–105).

While the results from some prior studies may show a statistically significant deterrent effect for environmental enforcement, those studies have failed to address the policy related implications of those results with respect to the actual increase in punishment needed to reduce crime extrapolated from those estimates. For example, if as some previous studies suggest, a 10% increase in the threat of environmental enforcement increases compliance between 4–5%, then tremendous changes must be made in environmental criminal enforcement to reduce the volume of environmental crime. Assuming a very low rate (20%) of environmental offending among corporations and a USEPA rate of 1 enforcement agent per 11,562 firms, USEPA agent employment would need to increase by a factor of 4 (300%) to lead to a decline in environmental crime of about 54%. Those additional enforcement cases would, of course, require the expansion of other personnel in the criminal process, such as judges, attorneys, chemists, lab technicians, and so on to handle the additional case load. The financial costs of such an approach, therefore, would be substantial.

Estimating the probability of deterrence Part II: EPA data on criminal enforcement case ratios

Having demonstrated that there is less environmental enforcement than street crime enforcement yet more deterrence associated with environmental enforcement

than street crime enforcement, we turn to additional examinations of the probability of environmental deterrence. To do so, in this section we examine the probability of a criminal case filing for an environmental crime relative to the potential number of offenders (i.e., corporations). Table 1 shows the number of criminal enforcement cases filed by the USEPA from 1983–2013 for more than twenty federal statutes. While that table includes twenty offense categories, one category “other” includes a variety of miscellaneous federal laws under which USEPA criminal actions have been filed. Thus, the number of laws enforced by the USEPA is substantially more than 20.

[Table 1 About Here]

What Table 1 displays over time is minimal criminal enforcement activity by the USEPA—that is, a relatively small number of criminal case filings. From 1983–2013, or over 31 years, the USEPA completed only 583 criminal enforcement cases according to its website. That is an average of 18.8 cases per year spread out over more than 20 statutes and 50 states. Stated differently, that is an average of 0.94 cases per year/per regulation, or an average of 0.0188 cases per year/per regulation/ per state. Moreover, as indicated in Table 1, there are five federal laws listed for which there has never been a completed criminal case, and seven additional laws for which the total number of criminal prosecutions is less than 10 over the 31 year time period. Thus, over one-half of the laws listed in Table 1 have been criminally enforced fewer than 10 times in 31 years. For these crimes, the odds of being prosecuted criminally by the USEPA are miniscule. For these 11 case types, the total number of prosecutions over 31 years comes to only 37, or 0.108 per year/per law, and only 0.00216 per year/per law/per

state. For the remaining 10 laws, there are 547 criminal enforcement cases files, or 1.765 per year/per law. In neither instance is there a large number of filed cases.

[Figure 1 About Here]

Figure 1 provides a graphical depiction of USEPA criminal cases from 1983 through 2013 by year. Interestingly, Figure 1 illustrates that from 1986 through 2003 (an eighteen year consecutive time frame spanning four presidential administrations) the USEPA completed fewer than five criminal cases each year. Figure 1 also suggests that environmental offending is somehow different than street crime and is not shaped by the same factor(s) that contributed to the widely discussed 1990s “crime drop.” That is, while official counts of street crime sharply dropped to record declines during the 1990s, official counts of USEPA criminal cases during this same time frame fail to illustrate a similar distribution. Next we employed USEPA criminal enforcement data to calculate deterrence probabilities.

The probability of criminal enforcement over this time period must be calculated relative to the number of potential offenders or the number of firms that could potentially violate an environmental law criminally. Earlier, we estimated that the number of firms the USEPA could potentially police was 2,312,368 firms. Thus, we can estimate the aggregate likelihood of a criminal prosecution for those firms across time as follow: 2,312,368 firms times 31 years, divided into 583 criminal cases; or 0.00008% or 8 chances in 1,000,000. Deterrence probabilities are broken down by year and displayed in Table 2. Those data indicate that the deterrence probability related to a case being filed against any firm is always less than 1/1,000% (0.0001) in each of the thirty one

years examined. As this calculation indicates, the probability of a criminal action for an environmental offense is quite low—less than 6 in 10,000 firms at the peak of criminal prosecution. Such a threat could only provide deterrence if the perceived threat of punishment was extraordinarily magnified over the real threat of punishment. Given that corporations are deemed to be rational actors, which is the basis of deterrence in theory, such an exaggerated perception of the threat of punishment violates the theoretical assumptions of the model, and indicates that the effort to explain the effect of punishment on corporations requires a new theoretical grounding since corporations do not appear to be perceiving the situation rationally. Earlier, we reviewed Friesen’s research, which suggested that 4% of corporate actors are risk lovers. Assuming generalizability of Friesen’s sample, of the 2.31 million firms identified earlier, it could be inferred that approximately 92,494 (4%) would be classified as “risk lovers.” If we assumed that all criminal violations charged in any given year (mean of approximately 19 cases per year) occurred only among risk lovers, and no other firms violated the law in ways that would result in criminal charges, the probability of being charged with a criminal violation for risk lovers would still be only 19 per 92,494, or 20.2 per 100,000 per year (0.00002 per firm), a sufficiently low level of risk that might certainly appeal to risk lovers and fail to change their behavior.

Alternative estimates can be derived from the U.S. Department of Justice (DOJ). The U.S. DOJ Environmental Crime Section (2013) website notes that from 1998 through 2013, it completed criminal cases against 373 corporations and 1,005 individuals. Following the same method employed above, the 2.31 million firms over 16

years would have a 0.00001 probability of having a criminal case finding against them. This estimate, while still quite small, is ten times greater than the probability of a criminal charge for the entire 31-year time period estimated from USEPA data. The difference between the USEPA and DOJ estimates may indicate that by the late 1990s, the probability of a criminal case being filed against environmental defendants had increased. Despite that increase, however, the likelihood of a criminal charge remains small.

[Table 2 About Here]

In part, the potential deterrent effect of these criminal prosecutions may, as studies reviewed above suggest, be due to the probability of the most extreme outcome, imprisonment, occurring. Data on years of incarceration for DOJ cases from 1998 through 2013 are available on DOJ's website. The U.S. DOJ data indicates that in its criminal prosecutions, 1,005 individuals were charged and received a total of 729 years of incarceration. That's an average of 8.7 months of incarceration per conviction for individuals. In contrast, the Bureau of Justice Statistics estimates that the average prison sentence in the United States for street crime for the same time period was 59 months, or 6.8 times the average sentence length for an environmental offender (for comparisons see Billiet and Rousseau 2014). Prior literature has found that that environmental crimes have the potential to harm thousands of victims per offense, and perhaps hundreds of thousands of victims per offense (Lynch 2013) while street crime typically harm slightly more than one victim per offense. Thus, these data seem to suggest an inverse association between number of victims and sentence length.

Discussion

In the preceding sections we have examined the literature on environmental crime and deterrence. Prior studies of environmental crime have reported that criminal and civil punishments yield significant deterrent effects (Almer and Gosschl 2010; Earnhart and Friesen 2013; Gray and Shimshack 2011; Harrington 2013; Shimshack and Ward 2005). Theoretically, such effects are expected because rational offenders with sufficient information about the threat and likelihood of punishment can be deterred from environmental crime when the threats of punishment outweigh the rewards of crime. Our analysis of the use of criminal sanctions by the USEPA since 1983 suggests that the likelihood of criminal punishment is quite small and that few corporations are punished criminally, and that few individuals receive significant penalties such as jail time. We also referred to similar data for the surveillance and punishment of street crime, which indicated that the likelihood of surveillance and punishment for environmental crime is significantly smaller than those likelihoods for street crime. Yet, in the literature estimates of the deterrent effects for environmental punishment and surveillance are greater than estimates of deterrence for street crime (Shimshack and Ward 2005). If the deterrence estimates in the environmental crime literature are accurate, they indicate that it takes far less punishment to deter environmental criminals than street criminals. Nevertheless, because so few environmental offenders receive criminal punishments, criminal punishments have small aggregate effects on environmental crime, and producing a meaningful drop in environmental crime through criminal enforcement would require extensive commitment of resources by the USEPA

for hiring additional investigators, laboratory personnel, legal staff and technicians to increase the likelihood of criminal punishments.

Prior studies also indicate that while criminal punishments appear to yield significant deterrent effects for environmental crimes, they have little impact on the volume of pollution generated by polluting industries. Prechel and Zheng (2012) found that corporations with high capital dependence had higher pollution rates and that fine amounts did not deter pollution. Stretesky and colleagues (2013) employed fixed effects regression models to examine within company variations in toxic emissions to assess the impact of large monetary fines on toxic releases. The model controls for forms of specification error (omitted variable bias) common to other deterrence based assessments. Their results showed that large monetary penalties have very small deterrent effects on toxic releases. Harrington (2012) found pollution prevention practices in the United States have had limited success. In studying the impacts of pollution prevention (P2) policies, Harrington found that some P2 threats actually increased the likelihood of environmental violations. In a related study, Harrington (2013) found that P2 policies designed to decrease toxic emissions were only effective when firms were subject to high levels of enforcement, a situation our data suggests is not widespread. In a 2007 study, Gray and Shadbegian found that regulatory responses to pollution impacted compliance but not emissions (see Gray and Shimshack 2011, for an opposing opinion on deterrence and toxic emissions).

As noted earlier, some studies in the extant literature suggest that the deterrent impact of environmental enforcement is large. Assuming that result is true, one wonders

why forty years after the establishment of the USEPA there is any environmental crime at all. If environmental enforcement deterred environmental crime at the rates suggested in some of the extant literature (e.g., 33%), one would suspect that the current volume of environmental crime would be very minimal. Indeed if, as some literature suggests, the elasticity for environmental crime deterrence were only 5%, and we extrapolated that effect across forty years of the USEPA's existence, the environmental crime rate today should be only about 12.3% of what it was in 1973. This is difficult to believe.

As noted above, the larger issue is that while the literature suggests that environmental enforcement encourages compliance with environmental rules, it has little effect on other outcomes such as the volume of pollution. As Stretesky and colleagues (2013) argued, these facts indicate that environmental enforcement does little to slow the economic treadmill of production and the destruction of the ecosystem. Extending that argument, we suggest that it is not the inherent violation of environmental law that ought to draw the attention of researchers, or whether the enforcement of environmental law deters offenders; rather, greater attention ought to be paid to the construction and purpose of environmental law—that is, whether, in its current form, environmental laws are stringent enough to protect the environment, humans and other species from harm. This is, we suggest, a much different question than whether we can construct laws in ways that deter offenders.

We draw attention to this issue because deterring offenders by punishing the most egregious violators of environmental law does little to address the pressing

ecological issues we face in the modern era—the mass destruction of the ecosystem. As Stretesky and colleagues (2013) have argued, the enforcement of environmental regulations does little to control pollution because it fails to impede production. According to the Toxic Release Inventory, in 2011 U.S. manufacturers reported generating 22.8 billion pounds of hazardous and toxic waste. There is reason to believe that the real total is significantly higher than the volume reported (see, e.g., instances of underreporting detailed in Environmental Integrity Project & Galveston-Houston Association for Smog Prevention, 2004; United States Government Accounting Office, 2001). Researchers ought to be concerned not simply with the quantity of illegal waste, but with the fact that the law allows too much toxic waste to be emitted legally. It is the legal and well as the illegal toxic waste that is the source of the contemporary problem of ecological destruction, and the problem is determining when or what level of polluting should be considered deviant or criminal.

Our point is that the problem of ecological destruction is not one that is confined to illegal toxic waste, nor is the problem of ecological destruction one that relates to the efficiency of environmental law enforcement's ability to control illegal toxic waste or to deter offenders. Rather, the problem is that the law fails to regulate the constant expansionary tendencies of the economic treadmill of production and the vast quantity of legal waste being produced. The real problem is that the law accepts the economic assumption that continuous economic growth is a reasonable and ecological sound assumption. This growth assumption, central to the continuous development of capitalism, endangers both ecological and public health, and it is growth of production

capacity and capitalism that the law must endeavor to control if the law is to serve as an effective mechanism for protecting ecological and public health (Stretesky et al. 2013). In addressing this issue, researchers must keep in mind that the traditional focus on the deterrent aspects of environmental law and social control harbors a subjective bias that preferences growth of production over public and ecological health. In the bigger picture, the problem of protecting ecological and public health is not a legal issue but an economic issue, one that must be examined from a theoretical orientation capable of addressing the nature of harm done to the ecosystem and how that harm prevents the ecosystem from reproducing healthy conditions for the maintenance of life (Lynch et al. 2013).

Conclusion

The literature examining the efficacy of current environmental sanctions includes several studies that support deterrence-based crime control strategies. Moreover, the Environmental Protection Agency appears to openly rely on deterrence theoretical frameworks to guide and justify its responses to environmental harms (USEPA 2013). However, data from this study provide reason to give pause when considering this approach and its assumptions. In an examination of thirty-one years of USEPA data, this study finds that the United States handed about 18 federal criminal cases of environmental crimes each year; for a sizable subset (>50%) of this time frame, fewer than five criminal cases were handed out annually. Moreover, analyses uncovered five different environmental laws for which no criminal investigation has been conducted since at least 1983. Those results suggest that there are few criminal prosecutions, and

that those few prosecutions are not rationally sufficient to produce deterrence. When these figures were considered alongside the number of potential violators and opportunities for violation, an estimated likelihood of criminal prosecution of 8 in 1,000,000 was obtained. By year, we estimated a deterrence probability of less than 6 in 10,000 in all years studied. USEPA data also suggests that, on average, those charged with environmental crimes serve about 8.7 months behind bars. What this data seems to imply, is that the rational offender would continue to violate environmental law in pursuit of monetary gain, rather than desist to avert penalty. These findings seem contradictory to prior studies that observe large deterrence effects associated with these relatively few sanctions. In sum, this study suggests the use of alternate theoretical frameworks, and in turn, policy changes, to understand and ultimately put an end to the form of environmental degradation associated with adverse environmental consequences of corporate behavior.

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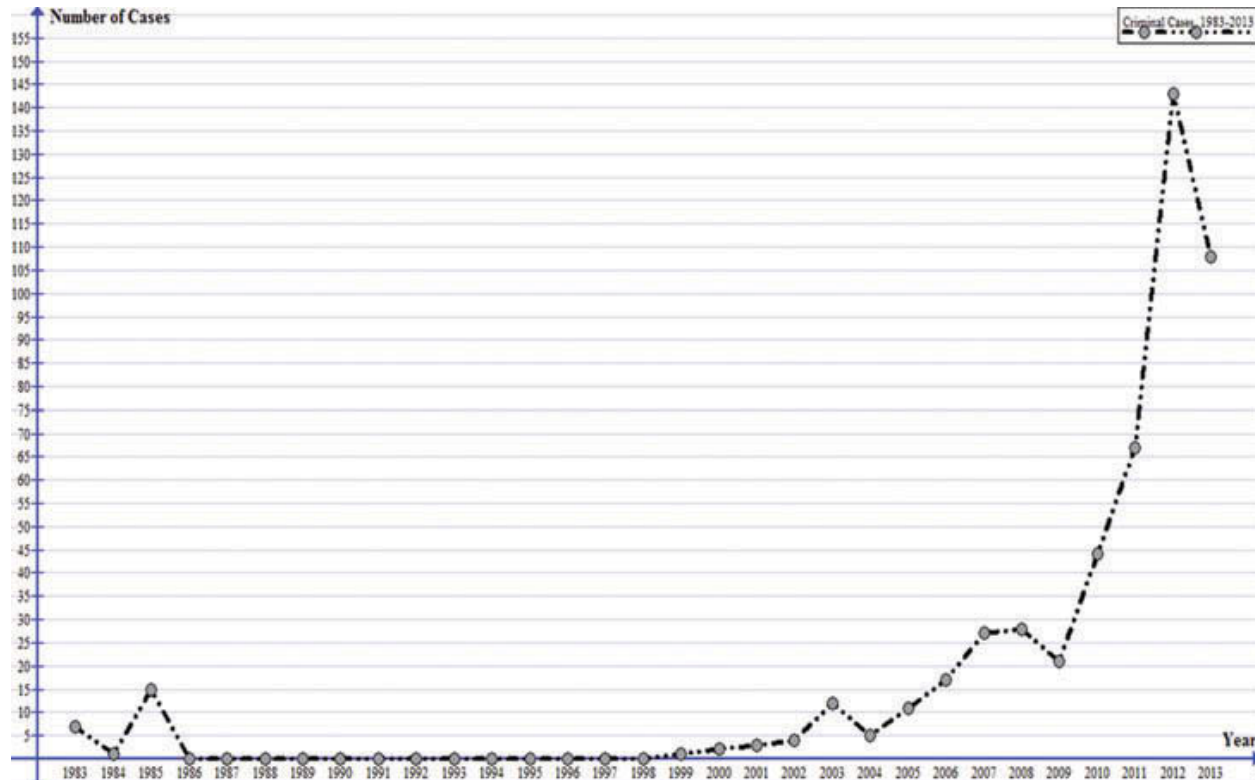
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Table 1. USEPA federal criminal environmental cases by law, 1983–2013 (N = 31 years).

Law	Acronym	Total	Annual Average
1. Act to Prevent Pollution from Ships	APPS	15	0.5
2. Clean Air Act	CAA	70	2.3
3. Clean Water Act CWA 152 4.9			
4. Comprehensive Environmental Response & Liability Act	CERCLA	9	0.3
5. Emergency Planning & Community Right to Know	EPCRA	0	0
6. Endangered Species Act	ESA	3	0.1
7. Federal Facilities & Public Lands	FEDFS/PL	0	0
8. Federal Insecticide, Fungicide and Rodenticide Act	FIFRA	23	0.7
9. Hazardous Materials Transportation Act	HMTA	1	0.0
10. The International Convention for the Prevention of Pollution from Ships	MARPOL	16	0.5
11. Marine Protection, Research, & Sanctuaries Act	MPRSA	0	0
12. Migratory Bird Treaty Act	MBTA	7	0.2
13. Occupational Safety & Health Act	OSHA	0	0
14. Oil Pollution Act	OPA	0	0
15. Other —		28	0.9
16. Resource Conservation & Recovery Act	RCRA	62	2.0
17. Rivers and Harbors Appropriation Act	RHAA	4	0.1
18. Safe Drinking Water Act	SDWA	4	0.1
19. Title 18, U.S. Criminal Code —		180	5.8
20. Toxic Substance Control Act	TSCA	9	0.3
TOTAL		583	18.8

Figure 1. USEPA criminal cases by year, 1983–2013.



**Table 2. Deterrence probabilities by year, USEPA criminal cases, 1983–2013. Year
Deterrence probability**

1983 0.0000035	1999 0.0000047
1984 0.0000005	2000 0.0000010
1985 0.0000075	2001 0.0000013
1986 0.0000000	2002 0.0000018
1987 0.0000000	2003 0.0000053
1988 0.0000000	2004 0.0000022
1989 0.0000000	2005 0.0000048
1990 0.0000000	2006 0.0000074
1991 0.0000000	2007 0.0000117
1992 0.0000000	2008 0.0000121
1993 0.0000000	2009 0.0000096
1994 0.0000000	2010 0.0000198
1995 0.0000000	2011 0.0000204
1996 0.0000000	2012 0.0000662
1997 0.0000000	2013 0.0000500
1998 0.0000000	