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DETERRENCE EFFECTS OF FINE AND NON-FINE PENALTIES: INSIGHTS FROM LABORATORY EXPERIMENT ON COMPLIANCE ENFORCEMENT ON ENVIRONMENTAL REGULATIONS

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Abstract: Inspired by the case of environmental problems in Indonesia, this study uses laboratory experiments to observe deterrence schemes on violation of regulation that may harm environmental sustainability. This study devises an experiment design that compares the effects of fine and non-fine penalties. Comparison of fine and non-fine effects is consequential for policymaking. However, it is rarely observed in existing experimental studies on environmental issues. This study finds that fines have a stronger deterrence effect than non-fine penalties. This study also observes that violations are deterred more by the presence of inspection and penalties, instead of the magnitude of those instruments. These results provide insight for policymakers particularly in Indonesia, in which this study takes place, to mitigate violations against environmental regulations.

Keywords: Non-compliance, environmental regulation, inspection, penalty, laboratory experiment.

Introduction

People and businesses often create negative impacts on the environment because of their economic activities. In Indonesia, those impacts may include pollution generated by industries or deforestation due to excessive activities of corporates in the forestry industry. Both raise the external costs for the greater population and harm environmental sustainability. Given those problems, government interventions are necessary and have been the primary methods of dealing with negative externalities. Governments set the standards to restrain the number of emitted pollutants and to control the degree of environmentally harmful activities. Along with enacting environmental regulations, the government should design the schemes to enforce the compliance of regulated entities effectively. However, the violation of regulations remains an issue of concern.

Becker (1968) argues that compliance behavior is influenced by detection and punishment. Therefore, raising the severity of penalties or the probability of detection may deter violation against regulations. More recent empirical studies on compliance with

environmental regulations also confirm the robust deterrent effects of inspection and penalties (see, among others, Deily & Gray, 2007; Gray & Shimshack, 2011; Shimshack, 2014; Dufflo *et al.*, 2014). However, the availability of data often hinders observational testing of deterrence issues in empirical studies. Intensities of inspection and sanction are less likely to be random in observational data and people's responses to those factors are difficult to observe empirically. On the other hand, experimental methods allow controlled data generation to produce accurate information about people's behavior (Alm & Shimshack, 2014). Therefore, this method is increasingly employed to investigate the deterrence effects of enforcement schemes. Existing experimental studies have examined the compliance behavior and deterrence schemes (see, among others, Friesen, 2012; Telle, 2012; Iskandar *et al.*, 2016), and most of those studies confirm that compliance is increasing with inspections and penalties.

In general, penalties could be specified into fines and non-fines penalties. Fines are penalties in the form of financial sanctions imposed on

offenders for non-compliance or violation of regulation. Those penalties are intended to regain the economic benefit of non-compliance and to compensate for the social costs of the violation. Non-fines typically force the offenders to perform or to cease some designated actions without direct financial consequences. This type of penalty is mainly because of the economic activities of the offenders, and it may subsequently affect their accumulated benefits.

This study employs a laboratory experimental method to examine the effect of inspection and penalties in deterring violation against regulation. Differing from existing laboratory experiments on non-compliance; this study distinguishes the effect of fine and non-fine penalties. Although comparison of fine and non-fine effects is consequential for policymaking, however, this issue is rarely observed in existing experimental studies on environmental cases and it can be considered as the novelty of this study.

Methods

The laboratory experiment in this study represents a real situation in which economic agents dedicate considerable efforts on economic activities to produce profitable outcomes. Some activities may generate negative externalities for the surrounding environment; thus, the government controls those activities by enacting regulations supported with relevant deterrence mechanisms. The agents should decide whether they will act accordingly by restricting their detrimental activities at the expense of losing potential benefits.

The experimental design of this study deviates from existing experimental research on compliance behavior. The typical procedures of laboratory experiments on compliance allocate financial endowments to the experimental subjects and subsequently provide them with choices to comply with costly regulations, given potential detection and penalties (Alm *et al.*, 2014). In this study, however, the subjects are assigned tasks and rewarded according to their

performance. Given the rules and deterrence instruments, subjects decide how they will act. This design enables observation of the instruments targeting economic process instead of outcome, which is a better fit within the context of environmental problems.

The experiment deliberately avoids using terminology that will direct the attention of subjects to real environmental issues. This approach is taken to prevent the subjects from being dominantly driven by exogenous normative consideration rather than the observed economic motives and experimented deterrence mechanisms. During the experiment, the subjects are given the task of solving mathematical quizzes of simple multiplications in several rounds. In each round, the subjects are provided with 18 quizzes, and they get a financial reward for each correct answer. The experiment sets the rule limiting the maximum number of quizzes to be completed to nine; however, subjects are entitled to financial reward for all the answered questions. This setting provides the subjects with economic motive for violating the rule by answering more than they are allowed to do. Given deterrence treatment, the subjects decide whether or not they will comply with the rule. The deterrence treatment in this experiment is a combination of inspection and penalty instruments of various magnitudes.

The intensity of inspection is classified as weak, moderate, and strong intensity; associated with 15%, 50%, and 85% probability of inspections respectively. The penalty is specified further into fine and non-fine types. The severity of each penalty is characterized as weak, moderate, and strong. For fine penalty, the level of severity corresponds to 15%, 50%, and 85% subtraction of the offender's reward. Fifty percent is set as the moderate value of penalty and inspection since it may equalize the expected benefit of violation and compliance when other variables are held constant. On the other hand, the severity of non-fine penalty is associated with the difficulty of the task. The calculation is not as straightforward as the fine penalty. Weak, moderate, and strong penalties

are translated into additional tasks of multiplying the numerical answer of each mathematical quiz in the next round by three, five, and seven respectively. A trial prior to the experiment concludes that additional multiplication by five reduces the chance of completing the tasks by half. Hence, number five is set as the moderate score since it can equalize the expected benefit of violation and compliance.

As the benchmark, this experiment also uses the absence of inspection and penalties as part of the treatment instruments. It represents the case of administering regulations without effective enforcement schemes. The details of deterrence instruments are summarized in Table 1.

In total, there are 32 treatments¹ referring to unique combinations of different intensities of inspection and severity of penalties. Each treatment is observed in each different round. The payoff for each subject in every round is basically the gap between the accumulated rewards of answering the quizzes and the cost of the penalty for answering the quizzes beyond the specified limit. Naturally, if the subjects adhere to the rule, they will not have to pay the penalties.

The cost of the penalty differs between fine and non-fine penalties. When the fine is applied, the cost of penalty is equal to a deducted percentage of the reward (corresponding to the severity of penalty) weighted by the intensity of inspection. In the case of a non-fine penalty, however, the cost of the penalty does not directly result in a subtraction of the reward. On the contrary, the cost is a reduction of the chance to collect more reward in the next round, due to the increasing difficulty of the task (corresponding to the severity of penalty) weighted by the intensity of inspection.

The experiment involves university students of Diponegoro University, Indonesia, as the experiment subjects. Although the external validity of laboratory experiments with students is often criticized, existing studies suggest that the difference of demographic characteristics among subjects does not change experiment results. In the same experiment settings, the results of experiments with students are largely identical to those with non-students (Alm, 2012). Furthermore, students are also part of a society that is not immune to the influence of the prevailing social values. Thus, to some extent,

Table 1: Deterrence instruments of experiment

Instruments	Magnitudes	Description	
Inspection	No Inspection	-	
	Weak	15%	
	Moderate	50%	
	Strong	85%	
Penalty	Non-Fine Type	No Penalty	-
		Weak	(X 2)
		Moderate	(X 5)
	Strong	(X 7)	
Fine Type	No Penalty	-	
	Weak	15%	
	Moderate	50%	
	Strong	85%	

¹ The treatments comprise four categories of penalty (no penalty, weak penalty, moderate penalty, and strong penalty) in combination with four categories of inspection (no inspection, weak inspection, moderate inspection, and strong inspection), and there are two types of penalty observed in this study (fine and non-fine).

students may indicate the patterns of social choices that exist in the respective society.

Students are recruited as experiment subjects using open announcement. Thirty-three students participated in the experiment that lasts for one and a half hours. During the experiment, the subjects act anonymously, and they are prohibited from communicating with each other. All instructions and information are conveyed to the subjects in written form, and the completed tasks of subjects are also collected in written form.

Results and Discussion

Since the experiment sets nine quizzes as the maximum amount, the degree of violation is indicated by the extent to which the answered quizzes exceed that limit. Violation is visibly stronger in the schemes without inspection and penalties. On the other hand, the difference of violation under various magnitudes of inspection and penalties is less obvious. General

observation also shows that violations under the non-fine penalty scheme are worse than under the fine scheme. Table 2 summarizes the average number of quizzes solved by the subjects under different treatments (a combination of different levels of inspection and penalties).

This study proceeds with the Scheirer-Ray-Hare Test (a non-parametric alternative to Two Way ANOVA) to investigate whether the variation of violation is attributable to different features of inspection and penalties. First, the test observes the effect of the presence of inspection and penalties on the violation. Second, the test analyzes the consequence of different inspection intensity and penalties severity on the violation. Third, the test examines the effect of penalty types on the violation, while controlling for the intensity of inspection.

Results of the first test presented in Table 3 indicate that the presence of inspection and the existence of both types of penalties significantly affects the magnitude of the violation. Thus, the descriptive finding that violations are worse

Table 2: Summary of experiment results (Average number of answered quizzes)

Levels of Penalty	Levels of Inspection	Types of Penalty	
		Fine	Non-Fine
No Penalty	No Inspection	18.00	18.00
	Weak	17.91	18.00
	Moderate	16.64	17.91
	Strong	16.36	16.64
Weak	No Inspection	17.91	18.00
	Weak	9.55	10.09
	Moderate	9.82	10.36
	Strong	9.82	10.67
Moderate	No Inspection	16.64	17.91
	Weak	9.00	10.36
	Moderate	10.09	10.73
	Strong	9.55	10.36
Strong	No Inspection	16.36	16.64
	Weak	9.27	10.09
	Moderate	9.27	10.09
	Strong	9.27	9.82

Table 3: The effects of inspection and penalties (Scheirer-Ray-Hare test results)

Effects	Non-Fine		Fine	
	H Value	P Value	H Value	P Value
The presence of inspection	29.56	0.00**	40.98	0.00**
The presence of penalty	47.98	0.00**	40.98	0.00**
Interaction effect	29.56	0.00**	18.26	0.00**

Note: ** significant at alpha = 0.01

with the absence of inspection and penalty (as suggested by Table 2) is statistically supported. The interaction effect is statistically significant, suggesting that the effect of penalty depends on the presence of inspection, *vice versa*. Referring to the results displayed in Table 2, the presence of penalties is only able to mitigate violation when inspection exists. Similarly, the presence of inspection may significantly lessen the violation only if penalties exist.

Results of the second test, summarized in Table 4, indicate that inspection intensity and severity of penalties (both non-fine and fine types) fail to affect violation. There is no significant difference of violation under different severity of penalties and intensity of inspection. Stronger penalties and more intense inspection do not lead to better compliance.

Combined results of the first and the second tests imply that the violation is deterred more by the presence of inspection and penalty; instead of their intensity and severity. Provided that those deterrence instruments exist and effectively in use, subjects will refrain from the violation. Supporting that argument, observation during the experiment shows that 75% of the subjects completely conform to the rule after the effective use of inspection and penalty, regardless of

their magnitude. This finding is in line with the argument of Alm *et al.* (2014) that perceived magnitude of inspection and penalty are more influential than their actual weights for people's compliance, and people tend to overestimate the intensity of inspection and overvalue the severity of the penalty.

The main focus of this study is the different effects of fine and non-fine penalties. Therefore, the third Scheirer-Ray-Hare test is conducted on the effect of different types of penalties on the violation, while considering the effect of inspection intensity. The results are presented in Table 5.

The test finds that types of penalty significantly affect the degree of violation, indicating significant difference of violation under two types of penalties. Table 2 shows that the degree of violation is lower under the scheme of fine type penalty, and the present statistical results confirm this observation. It implies that fines, which directly reduces the financial benefit of non-compliance, has a stronger deterrence effect than a non-fine penalty that restricts and impedes the operation of the offenders without visibly direct economic consequences. Although both fine and non-fine penalties can mitigate the violation against the rule, the fine lessens

Table 4: The effects of inspection intensity and penalties severity (Scheirer-Ray-Hare test results)

Effects	Non-Fine		Fine	
	H Value	P Value	H Value	P Value
The intensity of inspection	0.34	0.85	2.36	0.31
The intensity of penalty	1.56	0.46	2.36	0.31
Interaction effect	1.29	0.86	2.49	0.65

Table 5: The effects of type of penalties and inspection intensity
(Scheirer-Ray-Hare test results)

Effects	H Value	P Value
The intensity of inspection	2.63	0.27
The intensity of penalty	12.74	0.00**
Interaction effect	0.12	0.94

Note: ** significant at $\alpha = 0.01$

the violation in a higher magnitude. Additional results show that interaction effect is statistically not significant, meaning that the effect of penalty types is independent of the inspection intensity.

Conclusion

This study uses an experimental design that enables observation of deterrence instruments directed at influencing economic activities of economic agents, which provides a more suitable setting for the issues of compliance with environmental regulations. This approach also allows to distinguish the deterrence effects of the fine and non-fine penalties. In general, this study confirms that the presence of inspection and both types of penalties significantly restrain violation against regulation. However, the significance of penalties is conditional to the presence of inspection, *vice versa*. On the other hand, inspection intensity and severity of penalties do not affect the degree of violation. It means that violation is deterred more by the presence of inspection and penalty, instead of the magnitude of those instruments. This study finds that fine, which regains the economic benefit of non-compliance from the offenders, has a stronger deterrence effect than non-fine penalty that prevents detrimental economic activities of the offenders.

This study offers an interesting insight that policymakers particularly in Indonesia, in which this study takes place, can rely more on fines instead of non-fine penalties. Policymakers may set the intensity of inspection and severity of fine at a moderate level to minimize the cost of enforcement. However, regulated entities should be convinced that both penalties and inspection

schemes exist and are effectively in use.

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