



# The impact of fine size and uncertainty on punishment and deterrence: Theory and evidence from the laboratory<sup>☆</sup>

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## ABSTRACT

Increasing punishment is typically considered first choice to boost deterrence of unwarranted behavior such as false financial statements, asset misappropriation, stealing, or corruption. However, if there is uncertainty on a potential violator's guilt, judges' and juries' willingness to impose punishment may decrease in its magnitude. Thus, increasing the magnitude of punishment may backfire, when the reduced punishment probability is anticipated by potential violators. Based on a theoretical model, our paper is the first to analyze the interdependency of violation and punishment behavior in a laboratory experiment, and to contrast it to the standard partial equilibrium perspective on deterrence that considers the punishment probability to be independent of the fine size. Varying both the magnitude of fines and the degree of uncertainty shows that, in case of legal uncertainty, the deterrent effect of higher fines is far less pronounced than if the punishment probability was exogenous.

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## 1. Introduction

Illegal behavior imposes an enormous burden on society. Examples for such behavior range from asset misappropriation by employees and false financial statements by companies to corruption in bureaucracies or any other kind of criminal behavior. At the company level, estimated losses from asset misappropriation by own employees add up to about 5% of businesses' annual revenues (Association of Certified Fraud Examiners, 2014). The overall costs of crime and justice including defense measures such as alarm systems are tremendous (Cohen, 2005). As a consequence, institutions that reduce the occurrence of illegal behavior are key to the wealth and well-being of nations (Acemoglu and Johnson, 2005).

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In his seminal paper on crime and punishment, [Becker \(1968\)](#) pointed out that deterrence of criminal behavior is increasing in the expected punishment, and many empirical studies suggest that crime rates are in fact decreasing in fines and in the probability of apprehension (e.g. [DeAngelo and Hansen, 2014](#); [Hansen, 2015](#); [Haselhuhn et al., 2012](#); [Levitt, 1998](#); see [Chalfin and McCrary, 2017](#), for a recent review of the literature). The deterrent effect of higher fines, though, is only straightforward when fines and conviction probabilities can be seen as independent choice variables. Otherwise, high fines may backfire when they violate the fairness considerations of judges, who may then be reluctant to convict a defendant.

The willingness to convict suspects, however, does not only depend on the perceived adequacy of fines, but also on the degree of uncertainty that someone is actually guilty. In case of uncertainty, decision makers know that they can make two mistakes, convicting innocent defendants (usually referred to as type I errors) and releasing guilty defendants (type II errors). As, for a given level of uncertainty, any reduction in type I errors leads to a certain incline of type II errors, the conviction probability in case of actual guilt depends on the relative weight judges or juries put on these two error types. This weight in turn depends on the interplay of fine size and uncertainty as many people might be unwilling to impose fines in general and large fines in particular when they have strong doubts about a defendant's guilt. If this effect is strong enough and anticipated by potential violators, higher fines may even lead to lower deterrence ([Andreoni, 1991](#); [Feess and Wohlschlegel, 2009](#)). It is the effect of this interdependency of fines and uncertainty on the frequency of punishment and illegal behavior that we are interested in.

To the best of our knowledge, we are the first to develop a theoretical model and a laboratory experiment to distinguish between the *partial* and *total effects* of fines and uncertainty: For partial effects, we follow the overwhelming part of the literature which considers the impact of fines and uncertainty under the simplifying assumption that the violation frequency (when considering judges) or the punishment frequency (when considering violators) is given. Our theoretical analysis confirms the intuition that higher fines reduce both the violation and the punishment frequencies, while higher uncertainty increases the violation frequency, but reduces the punishment frequency.

Results are less straightforward, however, when considering total effects. To see this, suppose that judges are aware that higher uncertainty increases the violation incentives. This, in turn, increases the judges' willingness to punish compared to the case in which the number of violators is given. Hence, total effects differ from partial effects not only with respect to their size, but possibly even with respect to their sign. Our theoretical model allows to fully capture and compare partial and total effects. For total effects, we find that a higher fine size leads to a lower punishment frequency, whereas the total impact of the fine size on the violation frequency is ambiguous. Higher legal uncertainty leads to a higher violation frequency, but the impact of uncertainty on the punishment frequency is ambiguous. Thus, for the impact of the fine size on the violation frequency and for the impact of uncertainty on the punishment frequency, it cannot be taken for granted that partial and total effects go in the same direction.

Based on our theoretical model, we design a laboratory experiment that allows distinguishing between the partial and total effects of legal uncertainty and the magnitude of fines. Due to a lack of suitable field data, we are not aware of any empirical analysis of the interdependency of violation and punishment decisions, so that conducting a laboratory experiment seems particularly useful in this context. In our experiment, participants are randomly assigned to one of two roles, *V* ("violators") and *J* ("judges"), and pairs consisting of one participant *V* and one participant *J* are matched. For each pair, there is a fixed amount of money designated for donation to a charity. First, participant *V* decides whether or not to take this money for himself. If it is not taken, it may still disappear due to a random event, and this creates uncertainty. Then, each participant *J* observes whether the money is still available or has disappeared. Finally, each participant *J* decides whether or not to punish his randomly assigned participant *V* if and only if he observes that the money has disappeared. Note that with uncertainty participant *J* cannot be sure whether the money has been "stolen" by participant *V* or disappeared randomly.

Each participant makes four different decisions characterized by combinations of a fine (high or low) and a degree of uncertainty (high or zero). To distinguish between partial and total effects, we employ a strategy method design in which players of one type can condition their behavior on the behavior of the other type. In a first treatment, players *J* condition their punishment behavior on the violation frequency, while players *V* decide unconditionally whether to take the money. In the second treatment, players *V* condition their violation behavior on the punishment frequency, and players *J* decide unconditionally whether to punish. We then calculate partial as well as total effects: For instance, the partial effect of the fine size on player *J*'s punishment behavior is calculated by comparing the punishment frequencies that would have occurred if the violation frequencies were the same for different fine sizes. For the total effect, we compare the punishment frequencies for the different fine sizes and the corresponding *actual* violation frequencies.

Since the frequencies of type I and type II errors are determined endogenously by the decisions of players *V* and *J*, the interdependency of violation and punishment decisions is captured by our experiment. In particular, for a given probability that the money disappears without being taken, the risk of making a type I error in case of punishment is strictly decreasing in the number of actual violators. Analogously, the risk of making a type II error in case of no punishment increases in the violation frequency. Thus, for a given punishment frequency, each number of violators translates into a probability for error types.

Our experimental results are fully in line with the theoretical predictions. For partial effects, we confirm that higher fines reduce both the violation and the punishment frequencies. Uncertainty increases the number of violations and decreases the punishment frequency. As outlined above, total effects are theoretically less straightforward, but our empirical findings are again in line with our model: First, a higher fine leads to a significant reduction in the punishment frequency if and only if there is legal uncertainty. Second, the total deterrent effect of the fine size is less pronounced than the partial effect, since

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