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## The effect of type-1 error on deterrence

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### ABSTRACT

According to a conventional view, type-1 error (wrongful conviction) is as detrimental to deterrence as type-2 error (wrongful acquittal), because type-1 error lowers the pay-off from acting within the law. This view has led to the claim that the pro-defendant bias of criminal procedure, and its high standards of evidence, can be explained by the negative effect on deterrence of type-1 error. Adding new insights to some points made in the literature, we present a different view of the effect of type-1 error on deterrence, which seems incompatible with the claim. We thereby show that type-1 errors may not only lead to over-deterrence or to the chilling of socially benign acts, rather than to under-deterrence, but also to a socially desirable increase in deterrence or to a socially desirable lowering of activity levels. Moreover, since type-1 and type-2 errors are defined as court errors, i.e. as conditional on deterrence, their effects on deterrence depend on the likelihood of adjudication. For harm-based sanctions, harm is a condition for adjudication, and so for tortious acts or for certain criminal acts, the effect of type-1 error is proportional to the likelihood of harm. Since harm occurs more rarely and for some crimes not at all when the lawful act is chosen, type-1 error conditional on adjudication affects deterrence less than type-2 error, and for some crimes not at all. For the latter crimes, type-1 errors concerning the identity of the offender may still be thought to either affect deterrence or to chill socially benign activities. However, we show, contrary to claims in the literature, that type-1 errors concerning identity do not in themselves lower deterrence and we argue that chilling of socially benign activities is not a general phenomenon and so cannot explain the high evidentiary standards of criminal law that apply uniformly.

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### 1. Introduction

A conventional view, commonly associated with [Png \(1986\)](#),<sup>1</sup> is that erroneous court convictions lower deterrence to the same extent as erroneous acquittals. The idea is that if  $\epsilon_1$  is the likelihood that the court sanctions a defendant who acted lawfully<sup>2</sup> (type-1 error) and  $\epsilon_2$  is the probability that the court does not sanction a defendant who acted unlawfully (type-2 error), the increase in the expected probability of a sanction from acting unlawfully is  $(1 - \epsilon_2 - \epsilon_1)$ , where the two types of error enter symmetrically. In the words of [Garoupa and Rizzolli \(2012, p. 225\)](#):

... wrongful convictions and wrongful acquittals are equally bad in their effect on deterrence. At the margin, one further wrongful

conviction induces as many individuals to switch behavior from compliance to noncompliance as one further wrongful acquittal

Following this logic, it has been argued<sup>3</sup> that society's strong concern for avoiding type-1 error can be explained by a concern for deterrence.<sup>4</sup>

The quote expresses a widely held belief, which is perhaps surprising when it is well-known that type-1 errors may lead to over-deterrence rather than under-deterrence, and to lower levels of dangerous activities. Both of these exceptions to the conventional view are mentioned by [Polinsky and Shavell \(2007, p. 429\)](#) in their overview of the enforcement literature. Moreover, it is well-known, as analyzed recently by [Kaplow \(2011, 2011a, 2012\)](#) and [Mungan \(2011\)](#), that type-1 error may chill socially desirable activities.<sup>5</sup>

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<sup>1</sup> See also, e.g. [Posner \(1973\)](#), [Polinsky and Shavell \(2007, p. 427–430\)](#), [Garoupa and Rizzolli \(2012\)](#), and [Nicita and Rizzolli \(2014\)](#).

<sup>2</sup> Or with due care.

<sup>3</sup> For instance by [Posner \(1973\)](#) and [Garoupa and Rizzolli \(2012\)](#).

<sup>4</sup> For another economic explanation not based on the conventional view, see e.g. [Hylton and Khanna \(2007\)](#).

<sup>5</sup> This may appear to be an activity level effect but we shall distinguish the two effects by defining the activity level effect in a narrow sense.

The co-existence of the conventional view with contradictory findings suggests the need for reconsidering the effects of type-1 and type-2 error on behavior. In this article, we address the following questions: When does type-1 error lead to over-deterrence rather than under-deterrence? Might type-1 error lead to greater efficiency (better incentives)? When type-1 errors lower deterrence, is the effect as great as the effect of type-2 error? Does it make a difference whether type-1 error concerns what the defendant did or his or her identity? In answering these questions, we partly reformulate and modify existing results and partly contribute new insights. We conclude that society's preference for avoiding type-1 errors cannot be explained by their effect on deterrence, because society's preference is present also for crimes where type-1 errors are unlikely to significantly affect primary behavior.

We begin (in Section 2) by addressing the logic of the conventional view. We note a reason why the seemingly compelling logic of the conventional view may not hold: while an increase in type-1 error lowers the pay-off from the lawful act in comparison to the pay-off from the unlawful act, and so may lead to under-deterrence, the increase may also lower the pay-off from the legal act in comparison to the pay-off from another, even safer, yet inefficiently costly act, and so may lead to over-deterrence. We argue that this is the logic underlying not only results by [Craswell and Calfee \(1986\)](#) and [Shavell \(1987, p. 79–83\)](#) that type-1 errors may in some circumstances lead to over-deterrence, but also [Kaplow's \(2011, 2011a, 2012\)](#) findings concerning the chilling of socially benign acts.<sup>6</sup> We demonstrate by way of numerical examples a result that we believe has not been sufficiently emphasized in the literature, namely that whether an increase in type-1 error leads to over-deterrence (chilling) or to under-deterrence may depend on the size of the expected sanction, i.e. on the level of the sanction and the probability of type-2 error. Moreover, by the same logic we demonstrate a result that to our knowledge has not been mentioned in the literature, namely that a prevalent kind of type-1 error may lead to a socially desirable increase in deterrence when the expected sanction is set too low.

In Section 3, we demonstrate that when type-1 and type-2 errors are defined as court errors (as they typically are), i.e. as errors conditional on adjudication, type-1 errors affect deterrence less than type-2 errors and sometimes not at all. The point is that when errors are conditional on adjudication, and when adjudication is less likely when the legal (rather than the illegal) act has been committed, the effect of type-1 errors conditional on adjudication must be lower than the effect of type-2 error conditional on adjudication. Thus, when the sanction is harm-based, as is the case for tortious acts or for certain criminal acts, type-1 errors conditional on adjudication affect deterrence less than type-2 error, since harm occurs more rarely (and sometimes never), when the lawful act is chosen.

Section 4 addresses activity level effects. We note that type-1 error may affect activity levels in either a socially desirable or undesirable direction, depending on whether the activity entails a negative or a positive externality.

Section 5 addresses mistakes involving not what a person did (or a given act's legality) but the identity of the offender. Our discussion here relates to an argument raised in [Lando \(2006\)](#), that mistakes of identity do not lower deterrence,<sup>7</sup> because a person may be convicted of a crime committed by someone else whether or not the person commits a crime himself. According to this argument, type-1 error may increase rather than decrease deterrence if criminals are more likely than non-criminals to be wrongfully convicted of crimes committed by others, as some evidence suggests.<sup>8</sup>

**Table 1**  
No type-1 error, high type-2 error.

Act	Benefit	Sanction	Probability of sanction	Expected net-benefit
<i>l</i>	5	40	0	5
<i>m</i>	10	40	0	10
<i>h</i>	30	40	.6	6

We discuss two objections that may be raised against this argument. First, [Garoupa and Rizzolli \(2012\)](#) claim that the argument overlooks the positive link between the number of type-1 and type-2 errors, which they term the 'equilibrium constraint'. We argue that there is no such constraint, since type-1 and type-2 errors may be negatively correlated, as when the standard of proof is varied. We show that policy changes that affect the number of type-1 errors while holding the number of type-2 errors constant have no effect on deterrence. Second, it follows from [Kaplow's analysis \(2011, p. 1122–1128\)](#) that mistakes of identity may chill desirable acts. We note that [Kaplow](#) only argues that this may happen, not that it will generally happen, and for serious crimes such as murder or assault, we question whether this is a typical effect. Moreover, we note that in some settings type-1 errors may be more likely to chill socially undesirable than socially desirable acts.

Section 6 discusses the role of how one defines type-1 and type-2 error. We discuss alternative definitions, and provide reasons for defining errors as conditional on adjudication.

In Section 7 we demonstrate that one or more of the qualifications to the conventional view mentioned in this article apply to the examples that have been used in the literature to illustrate it.

In Section 8 we summarize our results as well as our reasons for being skeptical about the idea that deterrence effects (whether positive or negative) can explain society's choice of evidentiary standards in criminal law. Our main reason is that society's preference for avoiding type-1 errors exists also in cases where sanctions are harm-based implying that type-1 errors cause no significant direct effects on deterrence (and often no chilling of socially benign acts).

## 2. When do type-1 errors lead to over- rather than under-deterrence?

[Craswell and Calfee \(1986\)](#) and [Shavell \(1987\)](#) demonstrate that legal uncertainty is likely to lead to over-deterrence if the level of uncertainty is not too high, the standard of due care or the legal rule is set near the socially optimal level, and the sanction is at an optimal level. [Kaplow \(2011, 2011a, 2012\)](#), on the other hand, emphasize that type-1 error may lead to the chilling of socially benign activities. We now present a simple example to illustrate how the size of the expected sanction may determine whether type-1 error leads to over-deterrence (or chilling) or to under-deterrence. The example also suggests a sense in which the chilling effect is a special case of over-deterrence.

Consider a setting of three potential acts of low (*l*), medium (*m*), and high (*h*) risk, where the acts *l* and *m* are lawful while *h* is unlawful. Suppose that adjudication is certain, and that as indicated in [Table 1](#): the benefit from *l*, *m* and *h* are 5, 10, and 30, respectively; the sanction is 40; the probability of type-2 error is 40%, and the probability of type-1 error when committing *m* is initially zero. We assume throughout that there is no possibility of wrongful conviction if *l* is chosen. Under these assumptions, the expected net-benefits are 5, 10 and  $30 - (.6 \times 40) = 6$ , for *l*, *m*, and *h*, respectively. Thus, *m* is the preferred choice.

When instead the probability of type-1 error (for the act *m*) is 20%, the net benefits are as shown in [Table 2](#). Note that the preferred act is now *h*; an increase in the probability of type-1 error has led to

<sup>6</sup> See also [Mungan \(2011\)](#).

<sup>7</sup> See also [Friedman and Wickelgren \(2006, p. 82\)](#) and [Schrag and Scotchmer \(1994\)](#) for comments to the same effect.

<sup>8</sup> See [Martin \(2002\)](#).

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