

Murat C. Mungan and Jonathan Klick\*

# Discounting and Criminals' Implied Risk Preferences

**Abstract:** Conventional wisdom holds that potential offenders are more responsive to increases in the certainty than increases in the severity of punishment. In standard law enforcement models, this assumption implies that criminals are risk seeking. We add to the existing literature by showing that offenders who discount future monetary benefits can be more responsive to the certainty rather than the severity of punishment, even when they are risk averse, and even when their disutility from imprisonment rises proportionally (or more than proportionally) with the length of the sentence.

**Keywords:** certainty of punishment, severity of punishment, deterrence, risk attitudes, discounting

**JEL Classification:** K00, K10, K14, K40, K42

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## Introduction

The conventional wisdom in the law enforcement literature is that potential offenders are more responsive to increases in the certainty than increases in the severity of punishment. This presumption dates back at least 250 years to Beccaria's influential work,<sup>1</sup> and appears to be endorsed by scholars of law as well as economics. Within the Beckerian model, this presumption implies that criminals are risk seeking. This assumption runs counter to standard models where individuals are assumed to be risk averse. A number of articles have

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1 See ch. 27. in Beccaria and Voltaire (1953). *Dei delitti e delle pene*, the original work by Cesare Beccaria was published in 1764.

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\*Corresponding author: Jonathan Klick, Law School, University of Pennsylvania, Philadelphia, PA, USA, E-mail: jklick@law.upenn.edu

Murat C. Mungan, College of Law, Florida State University, Tallahassee, FL, USA; Department of Economics, Florida State University, Tallahassee, FL, USA, E-mail: mmungan@law.fsu.edu

identified conditions under which this presumption and risk aversion can coexist by stepping outside the simple Beckerian (Becker 1968) framework.<sup>2</sup> This note adds to this literature by showing that offenders who discount future monetary benefits can be more responsive to the certainty rather than the severity of punishment, even when they are risk averse, and even when their disutility from imprisonment rises proportionally (or more than proportionally) with the length of the sentence.<sup>3</sup>

Specifically, we consider cases where the criminal may have to delay the enjoyment of the gains from his crimes until after he serves his sentence. A classic example is a thief who buries his loot before being caught by law enforcers and digs it out after serving his sentence. If the criminal discounts future monetary gains, increases in the probability and severity of punishment have asymmetric effects on his expected utility. While an increase in the probability of punishment increases the odds that the criminal will delay consumption, an increase in the severity of the sanction only further increases the amount by which the criminal discounts future gains. The former effect is greater than the latter, because discounting occurs at a diminishing rate.<sup>4</sup>

These observations are most closely related to Block and Lind (1975) and Polinsky and Shavell (1999). Block and Lind (1975) consider criminals who are risk averse in wealth but “risk takers in sentences” (Block and Lind 1975:481). The latter assumption is equivalent to the case where “the disutility of imprisonment rises less than proportionally with the sentence” as in Polinsky and Shavell (1999).<sup>5</sup> Both studies demonstrate that risk-seeking behavior over sentences provides a rationale as to why criminals respond more to the certainty, rather than the severity, of punishment. We focus on the observation that even if criminals’ disutility from imprisonment does not rise less than proportionally

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<sup>2</sup> See, e.g. Brown and Reynolds (1973), Polinsky and Shavell (1999), Neilson and Winter (1997), Block and Lind (1975), Pyne (2012), and Mungan and Klick (2014).

<sup>3</sup> Block and Lind (1975) and Polinsky and Shavell (1999), reviewed below, supply similar rationales when disutility from imprisonment rises less than proportionally.

<sup>4</sup> We are referring to exponential, rather than hyperbolic, discounting, which is the standard time-consistent form of discounting used in most mainstream economic analyses. To see that exponential discounting occurs at a diminishing rate, consider an annual discount rate of 0.2. If an instrument pays \$100 in a year, it is valued at \$80, but if it pays the same amount in 2 years, it is valued at \$64. Hence, discounting occurs at a diminishing rate: the discount associated with the first year is \$20, whereas it is less, namely, \$16 in the second year. Hyperbolic discounting would generate the same results, because it also implies discounting at a diminishing rate.

<sup>5</sup> See Polinsky and Shavell (1999:3) and Block and Lind (1975:481) listing reasons for why disutility may rise less than proportionally.

due to direct effects of imprisonment (e.g. loss of liberty),<sup>6</sup> the indirect effect of imprisonment on a criminals' enjoyment of wealth can cause him to be more responsive to increases in the probability rather than the severity of punishment. We formalize this observation with a simple modification of the Beckerian model of law enforcement.

## Model and analysis

The potential offender's utility is assumed to be a function of his criminal gains ( $m$ ) and the sentence ( $s$ ) he expects to serve if convicted for his criminal act.<sup>7</sup> It is assumed that the criminal will have to delay the consumption of his monetary gain from crime until he serves his sentence. The value of consumption of criminal gains is allowed to depend on  $s$ , because the criminal may discount future consumption relative to present consumption. To simplify the analysis it is further assumed that the disutility from punishment and the utility from future criminal gains are additively separable.<sup>8</sup> These assumptions are captured by the utility function  $V(s, m) = \delta^s u(m) - y(s)$  where  $u$  denotes the utility from monetary criminal gains ( $m$ ),  $\delta$  is the offender's discount rate and  $y(s)$  denotes the disutility from serving a sentence of  $s$ . The probability of conviction is  $p$ . Given this notation, and setting  $u(0) = y(0) = 0$ , a potential offender commits crime if:

$$W \equiv p(\delta^s u(m) - y(s)) + (1 - p)(u(m)) > 0 \quad (1)$$

This decision-making criterion implies the following proposition:

**Proposition:** *Potential offenders are more responsive to increases in the probability rather than the severity of punishment even when the direct disutility from punishment does not rise more than proportionally with the length of the sentence. Furthermore, this result does not depend on the offender's risk attitude over monetary gains.*

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<sup>6</sup> See Polinsky and Shavell (1999:3) discussing why criminals' disutility from imprisonment may *not* rise less than proportionally.

<sup>7</sup> To simplify the analysis we assume that the sanction does not have a monetary component.

<sup>8</sup> This assumption is not necessary. In particular, a more general utility function of the form  $U(i(s), m(s))$  with  $U_i < 0$  and  $U_m > 0$ , where  $i$  is the identity function, which implies the same results.

**Proof:** The responsiveness of an offender with respect to increases in the probability and severity of punishment are, respectively, given by

$$E_p = -\frac{dW}{dp} \frac{p}{W} = [y(s) + (1 - \delta^s)u(m)] \frac{p}{W} \quad (2)$$

and

$$E_s = -\frac{dW}{ds} \frac{s}{W} = [y'(s) - \ln(\delta)\delta^s u(m)] \frac{ps}{W} \quad (3)$$

Hence,  $E_p > E_s$  iff

$$[y(s) - sy'(s)] > -u(m)[(1 - \delta^s) + s \ln(\delta)\delta^s] \quad (4)$$

The left-hand side of eq. (4) is non-negative when  $y'' \leq 0$ . Next, let  $f(s) = (1 - \delta^s)$ , then  $f'(s) = -[\ln(\delta)\delta^s]$ , and  $f''(s) = -[\ln(\delta)^2\delta^s] < 0$ . Hence,  $f(s) = (1 - \delta^s) > -s \ln(\delta)\delta^s = sf'(s)$ , due to the concavity of  $f$ . Accordingly, the right-hand side of eq. (4) is always negative, and therefore the inequality in eq. (4) holds regardless of the shape of  $u$ . ■

The proof of this proposition also reveals a simple corollary, namely that a potential offender can be more responsive to increases in the probability rather than the severity of punishment even if his direct disutility from imprisonment rises slightly more than proportionally with the length of the sentence. This follows, because for any negative value on the right-hand side of inequality (4) one can find a slightly convex  $y$  that would make the left-hand side of (4) negative but still greater than the right-hand side of (4).

## Conclusion

A number of articles in the law enforcement literature have identified rationales as to how criminals may respond more to increases in the probability rather than the severity of punishment, and yet be risk averse with regard to monetary outcomes. This note provides a simple addition to the rationales previously identified. It shows that when criminals discount future enjoyment of wealth they can be more responsive to increases in the certainty than the severity of punishment. Moreover, it shows that this rationale is independent of the shape of criminals' direct disutility from imprisonment, and thereby broadens the conditions under which such rationales exist. It also provides some predictions regarding when we are likely to see this sensitivity differential. Namely, if the differential is due to discounting, it should be more pronounced for property crimes such as theft than for violent or purely destructive crimes.

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