Sentencing Decisions Around Quantity Thresholds: Theory and Experiment*

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Abstract

To limit sentencing disparities, offenses are typically divided into subsections with specific sentencing ranges. The classification into corresponding subsections often depends on exceeding a given quantity threshold. We study the consequences of these quantity thresholds on sentencing decisions. We argue that the threshold effect can be decomposed into two opposing mechanisms: the severity and the reference one. An experiment with Czech prosecutors shows that thresholds cause an enormous increase in harshness in sentencing, leading to sentencing disparities. We further introduce empirical measures of (in)justice and quantify the consequences of quantity thresholds on a share of just sentences.

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1 Introduction

At least since Frankel (1972) and his description of sentencing as lawless, scholars have been studying sentencing shortcomings. Sentencing disparities - treating alike cases differently and different cases alike - have become one of the primary focuses. Since then, scholars have identified various characteristics of judges, offenders, and victims that contribute to sentencing disparities (Sporer and Goodman-Delahunty, 2009). Ulmer (2012) and Ulmer and Bradley (2019) provide a comprehensive summary of the literature on sentencing disparities.

To make sentencing more consistent and principled, criminal justice systems around the world introduced various measures (Council of Europe, 1992; Clarkson and Morgan, 1995; Ashworth, 2009). Some of the measures, however, create new sources of disparities. For example, while the U.S. federal sentencing guidelines reduced the level of sentencing disparities at court level (Anderson et al., 1999), they introduced unwarranted disparities at other levels. Hofer (2019) documented that the guidelines along with mandatory minimums lead to higher racial disparities. Furthermore, as prosecutors gained more discretion, disparities were further displaced to earlier stages of criminal process, resulting in large and unjustifiable trial tax (Johnson, 2019) and in charge disparities (Shermer and Johnson, 2010; Tuttle, 2019). While judge consistency might have improved, the guidelines overall effect is considered less successful. Some even argue that the U.S. federal sentencing guidelines need to be repudiated (Tonry, 2019). The U.S. federal sentencing guidelines serve as a perfect example of how efforts to reduce sentencing disparities might unintentionally cause disparities.

In this paper, we identify a new source of sentencing disparities resulting from one of the oldest measures aimed to structure sentencing discretion: Offense subsections with specific sentencing ranges. Since the same offense can vary significantly in its factors and seriousness, many legal systems divide offenses into subsections of more or less serious behavior with specific usually overlapping sentencing ranges. Such provisions are a common measure structuring sentencers'[1] discretion especially in Europe. A finer structure of offense subsections raise a question of how to determine thresholds dividing offenses into subsections. To classify cases into a corresponding subsection, criminal codes [2] often rely on measurable and quantifiable variables such as caused damage and amount of drug possessed, so called quantity thresholds (Foulds and Nutt, 2020; Bjerk, 2017a). Figure 1 represents a structure of offenses studied in this paper.

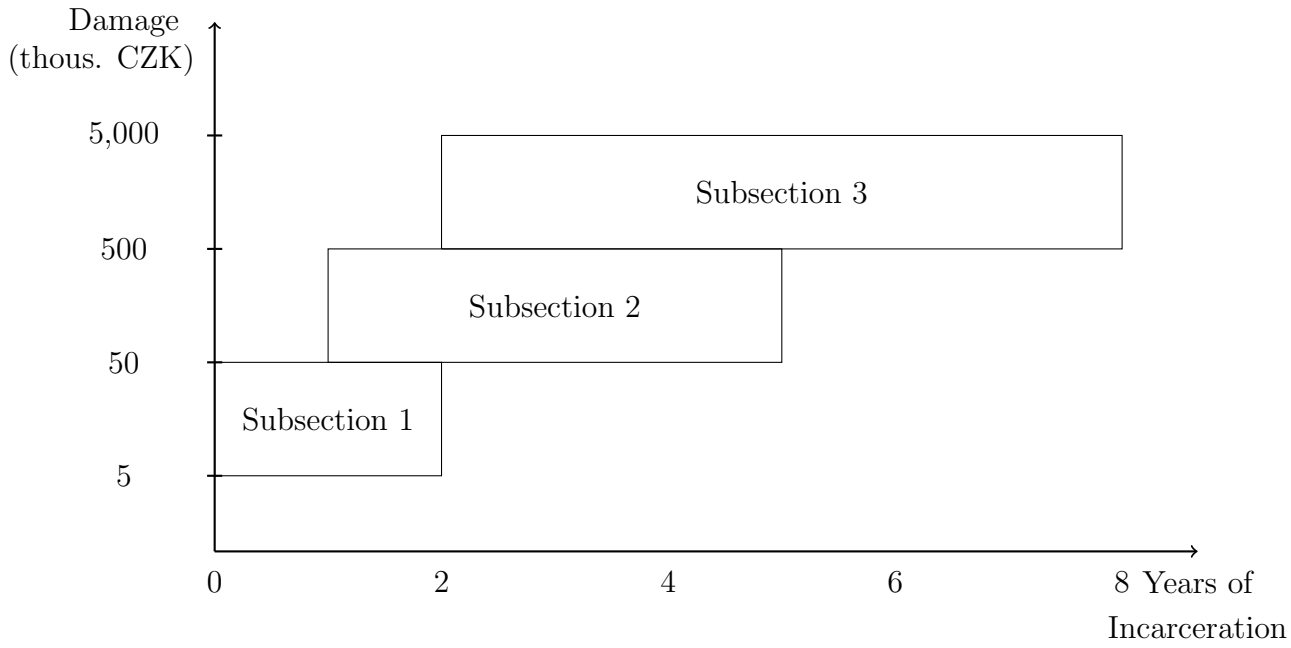
We argue that quantity thresholds are likely to introduce new form of sentencing dis-

[1]For the sake of simplicity, when applicable, we refer to both judges and prosecutors as sentencers.

[2]Throughout the text we talk about criminal code, yet most of our conclusions apply to sentencing guidelines as well.

parities. To study consequences of thresholds on sentencing decisions formally, we develop a simplified theory assuming that sentencers impose sentence within a sentencing range according to seriousness of the particular case relative to other cases sentenced within the same subsection. The proposed theory implies that thresholds can cause a sizeable sentencing disparity. Furthermore, thresholds can also lead to perverse sentencing, when more serious cases are systematically sentenced to a more lenient punishment.

Figure 1: Offense Subsections with Sentencing Ranges



Notes: This figure represents the studied problem using an example of theft. The theft offense is divided into a few subsections by strict thresholds based on caused damage (5,000 CZK, 50,000 CZK, 500,000 CZK, and 5,000,000 CZK). For each subsection, there is a specific sentencing range that determines the lower and the upper length of incarceration. In many cases, the sentencing ranges overlap and thus effectively permit perverse sentencing when (marginally) more serious case is sentenced to more lenient punishment.

The overall effect of a threshold on sentencing decisions can be decomposed into two opposing effects: the *severity* and the *reference* effects. The proposed theory allows us to describe these effects and discuss their properties. Consider two thefts that marginally differ in the amount of damage. One case - say A - is just below a threshold, whereas the other one - say B - is just above a threshold. Sentencer's consideration changes in two aspects. On the one hand, case B is sentenced according to a *higher* sentencing range. We call the change in a sentence evoked by this mechanism the *severity* effect and argue that it leads to harsher sentences. On the other hand, case B is compared to arguably more serious cases. As a result, the relative position within the sentencing range is likely to be lower. We call it the *reference* effect and argue it tends to decrease the sentence.

Depending on which effect dominates, the effect of the threshold is either positive – case B is sentenced harsher –, or negative – case B is sentenced less harsh.

To provide empirical evidence, we conduct Rachlinski-style online experiment with roughly 200 Czech prosecutors. Each participant of the experiment was presented with two vignettes, each describing a different crime case: theft and drug possession. In both cases, we implement a few scenarios that vary an amount of classifying variables (amount of methamphetamine possessed and caused damage) around thresholds. We then use the variation to estimate causal effects of thresholds. Additionally, to test for existence of the severity and the reference mechanisms, we implement two additional scenarios that introduce an isolated variation in composition of cases in an offense subsection and sentencing ranges, respectively.

The causal effect of thresholds on sentencing decisions is enormous and leads to a sizeable increase in sentences. In theft vignette we vary the amount of damage in four scenarios around two thresholds of 50,000 CZK and 500,000 CZK. To estimate the effect of the 50k threshold, we compare identical cases with marginally different damages of 48,283 CZK and of 51,283 CZK. The 50k threshold increases the average sentence by more than 10 months which represents a 50 % increase. Looking at the effect of the 500k threshold, we compare identical cases with damages of 487,092 CZK and 508,213 CZK and estimate the effect to be around 4 months that corresponds to 10 %. Interestingly, the increase in the average sentence caused by 50k threshold is not statistically different from an increase caused by increasing damage within the same subsection from 51,283 CZK to 487,092 CZK, i.e. by app. 435 000 CZK. This demonstrates the enormous size of the 50k threshold effect.

In the drug possession case, the effect of the threshold is also of a great magnitude. The average recommended sentence in a case with 147.8 g of methamphetamine was 24.4 months, while in the identical case with 151.8 g of methamphetamine it was 31 months. The 6 months increase (25 %) is in a stark contrast to a 3 % increase of the amount of drug possessed. We next make two observations about the severity and the reference mechanisms. First, the fact that the overall threshold effect is positive suggests that the severity mechanism dominates the reference one. Second, the test for the reference mechanism provides suggestive evidence that it is negative as predicted.

Finally, to provide more comprehensive evidence on sentencing disparities caused by thresholds, we propose a novel parametric measure of (in)justice. Consider two cases and corresponding sentences A and B and suppose that the case B is marginally more serious. We define sentence B to be *just*, if it is not more lenient that sentence A and it is not too (unreasonably) harsh compared to the sentence A. Consequently, there are two reasons of why a sentence B might not be considered just: (i) sentence B is more lenient than

sentence A (*type I injustice*); and (ii) sentence B is too harsh (*type II injustice*). Using these definitions, we quantify the shares of just decisions in our experiment. The results generally follow the ones of the average recommended sentence suggesting that due to thresholds, almost identical cases are viewed and treated differently by prosecutors.

Our simplified theory does not allow us to predict the exact magnitude of the effects and provide more detailed discussion regarding heterogeneinty of the effect. To do so, we would need more strict assumptions of how exactly sentencers arrange cases within the sentencing range. However, we still can derive interesting implications. The reference effect is a linear combination of an increase in the lower limit and in the upper limit, with relative position of the case in the sentencing range as a weighting coefficient. Therefore, relatively more serious cases are more sensitive to an increase in the upper limit, while less serious cases to an increase in the lower limit.

The rest of the paper is organized as follows. We first propose the theory that guides the experimental design. Then we introduce the experiment and discuss the results. In particular, we focus on treatment effect on the average recommended sentence. Next, we introduce the novel measures of (in)justice and apply these measures on the experimental data. Finally, we discuss limitations of our project and implications for future research.

2 Theory

2.1 Offenses and thresholds dividing them into subsections

Criminal codes organize offenses and corresponding sentencing ranges in different ways. In most systems, offenses are divided into subsections with specific sentencing ranges according to certain factors. A finer structure of offenses narrows down sentencers' discretion and provides them with guidance. To divide offenses, criminal codes rely on various factors, some of which are quantifiable such as amount of damages[3], amount of narcotics[4], and a number of days when the victim of an assault was not able to work.[5] Quantity thresholds have existed for centuries. For example, theft was divided into subsections with specific sentencing ranges by stolen amount at least since 1803 when the

[3]Found e.g. in English and Welsh sentencing guidelines for theft or fraud or in Russian (The Criminal Code of the Russian Federation, no. 63-FZ of 13. 6. 1996, note in article 146) or Czech criminal code (law n. 40/2009 Coll., section 138).

[4]Set e.g. by the United States Federal Sentencing Guidelines (Drug Quantity Table in section §2D1.1.) and in Norway (Norway sets up specific sentencing range for offenses involving a very substantial amount, see e.g. sections 232 and 233 of Norwegian Criminal Code) or Slovak criminal code (law n. 300/2005 Coll, s. 135

[5]E.g. in Slovakia (Slovak criminal code s. 123/4) and the Czech Republic (Decision of the Czechoslovak Supreme Code n. Tpjf 24/85 [R 16/1986 tr.])

Criminal Code of the Austrian Empire set thresholds for thefts at 25 and 300 ducats.[6]

Implementation of offense subsections and corresponding sentencing ranges varies across criminal justice systems. Some criminal justice systems vary only the upper limits of sentencing ranges (e.g. France) and leave the lower one at no incarceration for all offense subsections, whereas others set both the lower and the upper limits for each subsection individually. Additionally, criminal justice systems differ in sentencers' discretion to impose a sentence below and above the prescribed sentencing range (Kert et al., 2015; Kaspar, 2020). As for the usage of quantity thresholds, their typical domain are drug-related offenses (Leader-Elliott, 2012; Sentencing Council, 2011). Despite their popularity, many view them as problematic. In particular, Fleetwood (2011) argued that factors like the role in drug-trafficking capture offense seriousness than drug amounts. Furthermore, the amount of drug may be easily manipulated, including by law enforcement officers (Travova, 2019).

While specific sentencing ranges for offense subsections divided by quantity thresholds provide guidance to sentencers, they might also introduce new source of disparities. Virtually identical cases – such as theft of 299 (henceforth case A) and 300 (case B) ducats – fall in two subsections with different sentencing ranges, resulting in possibly different sanctions. Sentencing ranges serve as the rudimentary signpost of how severe sanction is expected from sentencers, as it considers seriousness in absolute term. The composition of cases within a corresponding subsection, defined by a quantity threshold, provide natural reference group within which criminal acts are compared with each other and are ordered by their seriousness. Using the terminology of von Hirsch (2017), the sentencing ranges serve as cardinal and the subsection composition as ordinal guidance for sentence imposition. We build on his notion and conceptualize the consequences of sentencing two virtually identical cases in two subsections with different sentencing ranges and composition.

Upon crossing the quantifiable threshold, sentencers' consideration changes in two aspects. On the one hand, case B is sentenced according to a higher sentencing range. We call the change evoked by this mechanism the *severity* effect. On the other hand, case B is also compared to arguably more serious cases with its subsection and thus the relative position within the sentencing range is lower. We call it the *reference* effect.

The mechanisms differ in their effect on the sentencing decision. To demonstrate the mechanisms, consider two policy changes that isolate the mechanisms. Suppose that sentencing ranges change, but composition of offense subsection remains the same. Then only the severity mechanism is active. Sentencers' reaction to such a change can be imagined as adapting the initial distribution of cases arranged by their seriousness to

[6]Section 153 and 159.

the new sentencing range. Thus, if a sentencing range for a specific offense subsection is increased (either the lower or the upper limit is increased), sentences imposed for such offense are likely to increase on average as well.[7]

On the contrary, if only the composition of cases within offense subsections changes – more or less severe cases are added or removed – positions of specific case are transposed within the offense subsection. If the change in the composition points in one direction, the effect of reference mechanism should be straightforward. If less serious cases than the current ones are added to an offense subsection, sentences for the current ones should increase since all current cases suddenly rank as relatively more serious within the offense subsection. Severity and reference mechanisms generally affects sentencing consideration in opposite directions. Depending on which effect dominates, the threshold either increases (B is sentenced to harsher sentence) or decreases (A is sentenced to harsher sentence) the sentence. The latter leads to perverse sentencing when more serious cases are punished more leniently.

Literature studying consequences of thresholds on sentencing is limited, with only few studies on the United States and on Russia. Using observable data from the United States, Bjerk (2017b) documented that judges imposed different sentences to offenders with drug amount 10 % above and below quantity thresholds. However, the effect became smaller or disappeared completely once he controls for other observed characteristics such as weapons charge. Studying the threshold for 10 years mandatory minimums, Tuttle (2019) found an important increase upon crossing the threshold. The effect was largely driven by prosecutorial discretion.

Effects on mandatory sentences cannot by easily generalized to lower limits of sentencing ranges. When a criminal act in continental setting is classified within an offense subsection, in large majority of cases the sentence is imposed within the sentencing range set for the relevant subsection. Yet mandatory minimums were imposed to less than half of drug offenders who were eligible for it at sentencing (United States Sentencing Commission, 2011, Chapter 8). Mandatory minimums examined by Bjerk (2017b) are also rather high (5 and 10 years). Lower limits of sentencing ranges are in contrast usually several months or few years high, possibly eliciting different judicial and prosecutorial strategies. This is corroborated by Bjerk (2017b), who suggested that bunching just below thresholds was due to the negotiations between prosecutors and defendants, which confirms his earlier research (Bjerk, 2005). Tuttle (2019) similarly concludes that prosecutors are the key players determining whether or not a mandatory minimum will be imposed. Since most criminal justice systems around the world have less developed plea-

[7] These increases do not have to be the same for all offenses, given that sentencers are likely considering ordinal proportionality (von Hirsch, 2017) across all offenses; the severity mechanism operates likely at inter-offense level as well.

bargaining system than the U.S. (Johnson, 2019), the prosecutions hold less power and as a result cannot similarly influence sentencing outcomes around thresholds. Altogether in other systems prosecutors, offenders, and judges have less opportunities and less power to place the case above or below the threshold and they have less incentive to do so.

Finally, Skugarevskiy (2017) examined sentencing for drug offenses in Russia, where he finds that crossing a threshold of 100 grams for cannabis or 2.5 grams for heroin leads to an increase of 0.84 years of imprisonment. However, he examines legislative provisions which are wrongly structured and as a result, the effect of thresholds will be distorted. The main issue is a missing overlap of sentencing ranges for individual subsections. For offenses below the threshold, the sentencing range is 0-3 years of imprisonment, while above the threshold the sentencing range is 3-10 years. Such provisions assume that every offense over the threshold is at least as serious as every individual offense with drug quantity below the threshold, ignoring vast array of possible mitigating or aggravating factors. Such legislative provision introduces unwarranted disparities by definition, disabling the quantification of thresholds' role in properly designed systems.

2.2 Stylized Framework

We next introduce a framework that formalizes the previous thoughts on a role of thresholds in sentencing decisions. Suppose that an offense can be fully characterized by two random variables with a joint probability distribution function $f_{X,T}(x,t)$, where X represents factors of the offense and T is a classifying variable (e.g. amount of drugs possessed).

A sentencing process is a two-stages rule that for any offense (x,t) assigns a sentence s. The rule is characterized by a set of thresholds $\tau \in \mathcal{T} = \{\tau^{[0]}, \tau^{[1]}, \tau^{[2]}, \ldots\}$ and corresponding sentencing ranges, i.e. intervals $\rho(\tau) = (\rho^{-}(\tau), \rho^{+}(\tau))$ that restricts the space for possible sentence.[8] In the first stage, the rule classifies an offense (x,t) into an corresponding subsection $\tilde{\tau}$ by comparing the realization of the classifying variable t with the set of thresholds. In the second stage, the rule suggests a sentence s based on: (i) a sentencing range of the corresponding offense subsection $\rho(\tilde{\tau})$; (ii) a relative seriousness of the particular case within the corresponding subsection measured by both factors x and the classifying variable t.

Definition 1 (Sentencing Rule)**.** Suppose an offense (x,t). Then the sentence s assigned

[8] Abusing the notation, we use τ as both the value of the upper limit of the classifying variable for a given subsection and as a label of that subsection itself.

to this case is determined by the following two-steps *sentencing rule*:

$$\tilde{\tau} = min(\tau \in \mathcal{T} | \tau \geq t) \tag{D 1.1}$$

$$s = \rho^{-}(\tilde{\tau}) + G(x, t; q(\tilde{\tau}))(\rho^{+}(\tilde{\tau}) - \rho^{-}(\tilde{\tau})), \tag{D 1.2}$$

Function $G(x, t; q(\tau))$ – relative seriousness – determines a relative position of an offense (x, t) within a sentencing range of a subsection τ with a reference seriousness $q(\tau)$. The reference seriousness $q(\tau)$ captures the notion that the same offense is likely to be viewed as less serious when compared to a composition of more serious cases and *vice versa*. Since we assume that the recommended sentence must be within the corresponding sentencing range, function G is bounded between 0 and 1.

We further assume three properties of G. First, keeping everything else the same, as factors x of an offense increase, so does its relative position within the sentencing range. In particular, we rely on a weak version of that property. Second, the same holds for a classifying variable t. Third, as the reference seriousness $q(\tau)$ increases (e.g. more serious cases are added to a subsection), the same offense is view less serious and will be positioned lower in the sentencing range. Assumption 1 introduces the properties formally.

Assumption 1 (Relative seriousness)
For any offense (x, t), any $\epsilon > 0$, and for any two levels of reference seriousness of q and q' such that $q < q'$, the following hold

$$G(x, t; q(\tau)) \leq G(x + \epsilon, t; q(\tau)) \tag{A 1.1}$$

$$G(x, t; q(\tau)) \leq G(x, t + \epsilon; q(\tau)) \tag{A 1.2}$$

$$G(x, t; q') < G(x, t; q) \tag{A 1.3}$$

To avoid less intuitive and trivial cases, we assume that sentencing ranges are harsher in higher subsections. In particular, we assume that at least one of the limits of the sentencing ranges increases, as we move to a more severe sentencing range. Since this seems to be true in all criminal codes we know, this assumption is mostly technical and not controversial.

Assumption 2 (An Increase of Sentencing Ranges)

$\forall \tau, \tau' \in \mathcal{T} : \tau < \tau'$, *the following holds*

$$\rho^-(\tau) \leq \rho^-(\tau') \tag{A 2.1}$$

$$\rho^+(\tau) \leq \rho^+(\tau') \tag{A 2.2}$$

$$(\rho^-(\tau') - \rho^-(\tau)) \times (\rho^+(\tau') - \rho^+(\tau)) > 0 \tag{A 2.3}$$

The aim is to use the introduced framework to study a situation in which existence of a threshold causes that two marginally different cases – cases that differ only in the classifying variable – are sentenced according to different subsections. We next introduce a theorem that defines the problem formally and provides a solution to it.

Theorem 1 (Difference in Sentencing)**.** Suppose a set of thresholds $\mathcal{T}$ and two cases of the same offense (x, t) and $(x, t + \epsilon)$, where $\epsilon > 0$, but $\epsilon \to 0$, i.e. two cases that marginally differ in the value of the classifying variable t. Suppose further that $\exists \tau \in \mathcal{T}$ such that $t < \tau < t + \epsilon$.[9] Then,

$$\Delta s = \underbrace{\Delta\rho^- \left(1 - G(x, t; q(\tilde{\tau}_1)\right) + \Delta\rho^+ \left(G(x, t; q(\tilde{\tau}_1))\right)}_{\text{severity effect}} + \underbrace{\Delta G \left(\rho^+(\tilde{\tau}_2) - \rho^-(\tilde{\tau}_2)\right)}_{\text{reference effect}}, \tag{T 1.1}$$

where $\tilde{\tau}_1 = min\{\tau | \tau > t\}$ and $\tilde{\tau}_2 = min\{\tau | \tau > t + \epsilon\}$, $\Delta\rho^- = \rho^-(\tau_2) - \rho^-(\tau_1)$, $\Delta\rho^+ = \rho^+(\tau_2) - \rho^+(\tau_1)$, $\Delta G = G(x, t + \epsilon; q(\tilde{\tau}_2)) - G(x, t; q(\tilde{\tau}_1))$.

To sketch the proof, note that $\tilde{\tau}_2 > \tilde{\tau}_1$. Using (D1.2), the problem simplifies as follows[10]

$$\begin{aligned}\Delta s &= \rho^-(\tilde{\tau}_2) + G(x, t + \epsilon; q(\tilde{\tau}_2))(\rho^+(\tilde{\tau}_2) - \rho^-(\tilde{\tau}_2)) - \left(\rho^-(\tilde{\tau}_1) + G(x, t; q(\tilde{\tau}_1))(\rho^+(\tilde{\tau}_1) - \rho^-(\tilde{\tau}_1))\right) \\ &= \Delta\rho^- \left(1 - G(x, t; q(\tilde{\tau}_1))\right) + \Delta\rho^+ \left(G(x, t; q(\tilde{\tau}_1))\right) + \Delta G \left(\rho^+(\tilde{\tau}_2) - \rho^-(\tilde{\tau}_2)\right)\end{aligned}$$

Theorem 1 provides us with a clear prediction of the difference between two cases that marginally differ in the classifying variable around a threshold. The sign of the difference is, however, ambiguous, as there are two likely antagonistic effects: the *severity effect* which is always non-negative[11] and the *reference effect* which can be (and under a likely occurring circumstances will be) negative. If the effects work in opposite directions, then the sign of the overall effect depends on relative strength of these effects. We next discuss the signs of the two effects in more details.

[9] The problem can be also formulated differently. Suppose an offense (x, t) and two different sentencing rules. Thresholds in the first rule are $\tau^{[1]}, \tau^{[2]}, \tau^{[3]}$; thresholds in the later rule are $\tau^{[1]}, \tau^{[2]} + \epsilon, \tau^{[3]}$, where $\tau^{[2]} < t < \tau^{[2]} + \epsilon$. Then the problem corresponds to a question of how the same offense (x, t) will be sentenced under two sentencing rules that marginally differ.

[10] See Appendix for more details.

[11] In fact, the *severity effect* is likely to be positive.

Corollary 1 (Sign of Severity Effect)
The expression $\Delta\rho^{-}\left(1-G(x,t;q(\tilde{\tau}_1))\right)+\Delta\rho^{+}\left(G(x,t;q(\tilde{\tau}_1))\right)$ *– the severity effect – is always non-negative.*

To see that the *severity effect* is always non-negative, note that assumption 2 implies that $\Delta\rho^{-}$ and $\Delta\rho^{+}$ are non-negative and since $G(x,t;q(\tau))\in(0,1)$, the *severity effect* must be non-negative, too. Furthermore, the *severity effect* is zero only in two specific cases: (i) $\Delta\rho^{-}=0$ and $(G(x,t;q(\tilde{\tau}_1)))=0$, i.e. the lower limits of the sentencing ranges are the same and the case (x,t) is the least serious case in its subsection; and (ii) $\Delta\rho^{+}=0$ and $(G(x,t;q(\tilde{\tau}_1)))=1$, i.e. the upper limits of the sentencing ranges are the same and the case (x,t) is the most serious case in its subsection. Therefore, in what follows we consider the *severity effect* positive.

Corollary 2 (Sign of Reference Effect)
If $q(\tilde{\tau}_1)\leq q(\tilde{\tau}_2)$*, then expression* $\Delta G\left(\rho^{+}(\tilde{\tau}_2)-\rho^{-}(\tilde{\tau}_2)\right)$ *– the reference effect – is negative.*

Note that the sign of the *reference effect* corresponds to the sign of ΔG, as any sentencing range $(\rho^{+}(\tilde{\tau})-\rho^{-}(\tilde{\tau}))$ is positive by definition. To determine the sign of $G(x,t;q(\tilde{\tau}_2))-G(x,t;q(\tilde{\tau}_1))$ note that assumption 1 implies that as long as $q(\tilde{\tau}_1)<q(\tilde{\tau}_2)$, i.e. the reference seriousness of the lower subsection is lower than the reference seriousness of the higher substitution, the reference effect is negative.

2.2.1 Implications

The framework introduced allows us to discuss how the structure of the thresholds shapes sentencing more generally. In some countries, such as in France, the sentencing ranges are organized so the lower limit of the sentencing range is the same across more (all) offense subsections and only the upper limit increases for subsections for higher values of classifying variables. Our framework helps us to understand how the final sentences will differ in this system compared to a system in which both the lower and the upper limits increase for subsections for higher values of classifying variables.

Let us denote the two systems as α and β and assume an offense that has two subsections. The thresholds are identical in both systems ($\mathcal{T}^{\alpha}=\mathcal{T}^{\beta}$), Furthermore, the upper limits of sentencing ranges are the same in both systems, $\rho^{+}_{\alpha}(\tau)=\rho^{+}_{\beta}(\tau)\ \forall\tau$. The two systems differ only in the lower limit of the sentencing ranges. In particular, in the α system, the lower limits of sentencing ranges remain the same for both subsections $\rho^{-}_{\alpha}(\tau^0)=\rho^{-}_{\alpha}(\tau^1)$, while the β system, the sentencing range is increasing. Additionally, we assume that for τ^0 both systems have the same lower limits of the sentencing range. Therefore, $\rho^{-}_{\alpha}(\tau^O)=\rho^{-}_{\alpha}(\tau^1)=\rho^{-}_{\beta}(\tau^0)<\rho^{-}_{\beta}(\tau^1)$. See figure 2 represents the structure of both systems. Note that neither of the systems violates our assumption 2.

Figure 2: Two different structures of sentencing ranges

Notes: This figure graphically compares two structures of sentencing ranges in subsections. The left panel represents a system in which the lower limits of the sentencing ranges are the same in all subsections (French-like system), while the right panel represents a system in which both the lower and the upper limits increase in *higher* subsection.

Our framework implies that the severity effect is weaker in the α (French-like) system. Consequently, the expected difference between two marginally different sentencing decisions around the threshold is lower and a probability of a perverse sentencing is higher. This follows from theorem 1 and the fact that $\Delta\rho_\alpha^- = 0 < \Delta\rho_\beta^-$. This comparative statics assumes that the $G(x, t; q(\tau))$ is the same in both systems.

Whether and how fast the lower limits of sentencing ranges grow with higher subsection of an offense should reflect policy makers concerns regarding the type of injustice the sentencing system can introduce. If she is more concern that the structure of criminal code would cause perverse sentencing, i.e. less severe case will be sentenced to longer incarceration, then the lower limits should be increasing with higher subsection. On the contrary, if the concern is that slightly more severe case will be sentenced to unreasonably harsher punishment, then the lower limit should remain the same (or grow slower) across different subsections.

3 Experiment with Prosecutors

The aim of our experiment is twofold. First, we quantify the consequences of thresholds on the average recommended sentence in a controlled environment with professional sentencers. Despite of the insights of the theoretical model, the sign and the magnitude of the effect is an empirical question. Second, we design an experimental treatment to test for existence of the severity and the reference mechanisms.

3.1 Background

Czech criminal justice system is a typical continental legal system alike to the German one. Criminal code and Code of Criminal Procedure establish rules with higher courts's jurisprudence playing only quasi-precedential role, as precedents are not binding. Criminal code defines both offenses and sentencing ranges for either the entire offense or for its subsections. As there are no sentencing guidelines, judges have wide discretion as to what type of sanction and of what quantity to impose. Plea bargains are rare, resulting in judges imposing sentences in virtually all criminal cases.

Prosecution's role in sentencing consists in recommendation of sanctions and in wide possibilities to appeal against a sentence. While until 2019 practices of prosecutors diverged as to whether they would recommend a sanction already in the indictment or only in the closing argument, from 2020 they are obliged to recommend a specific sanction together with the indictment. Prosecutors can file an appeal arguing either an error of law or fact was made; no specific level of an error (i.e. substantial or palpable) is required. Judges are highly incentivized to appease both the defendant and the prosecutor so that both sides waive their rights to an appeal. Should there be no appeals, judges can issue a simplified judgment and do not have to provide a detailed written reasoning. Prosecutors are well aware of these powers as they have employed them in 2016 to achieve a high increase in fine imposition rate (Drápal & Dušek, 2020).

Regarding mentality, Czech Prosecutors are not law-and-order punitive players. That was documented by Prosecutor General's Office that in order to reduce high prison population in the Czech Republic suggested lower sentencing ranges. Regarding organizational structure, while Prosecutor General can issue binding orders in general matters (such as regarding recommendation of a specific sentence), it generally cannot interfere with individual cases. This is also due to a fourth-level hierarchical structure of prosecution copying the judicial structure. District courts dealing with vast majority (98 %) of cases, regional courts trying the most serious cases and serving as appeal courts against decisions of district courts, high courts serving as appeal courts against decisions of regional courts and Supreme Court deciding on appeals in legal matters. The head of a higher

prosecution office can directly influence only the cases dealt by a prosecution office of one lower level, making regional prosecution offices (the 2nd from the bottom in hierarchy) the most important for influencing every-day practice. Heads of each prosecution service influence sentence recommendations directly as they approve all indictments and sentence recommended. The Prosecutor General thus has only a limited role in influencing sentencing practices of first-level prosecutors.

Prosecutors are appointed by a Minister of Justice following a proposal by the Supreme Prosecutor after serving at least 3 years as assistants to a prosecutor, a judge or an attorney and after passing a professional exam. Prosecutors have tenure and they can be removed only via disciplinary proceedings if they commit blatant mistakes. While we focus on sentencing, prosecutors' duties include overseeing investigations, filing indictments, and participating at court hearings. Anecdotal evidence suggest that prosecutors pay more attention to the guilt decision than to the one on sentence.

3.2 Experimental Design

The theoretical framework helps us to design scenarios of criminal cases with varying parameters in such a way, the results are informative about the size and magnitude of effect caused by the thresholds and existence of the two proposed mechanisms. To estimate the overall effect it is enough to rely on the existing legislation and vary the amount of the classifying variable so that two presented cases differ only marginally but are sentenced according to different offense subsections. A comparison between the average recommended sentences then yields causal estimates of the effect of thresholds on sentencing.

Theorem 1 implies that to test for the reference or severity effects requires that the other mechanism is muted. To test for the severity effect, the reference effect must be suppressed and *vice versa*. To attain such comparison, we introduce hypothetical legal framework that varies the sentencing ranges and offense compositions, respectively. In particular, to test for the reference effect, one needs to compare scenarios, in which two identical cases are sentenced according to subsections with the same sentencing ranges, but with a different structure of cases. We generate the variation by adjusting the thresholds and thus effectively adding more severe criminal cases into the subsection. Similarly, to test for the severity effect, we compare two scenarios for which the relative position among other cases remain the same, but the upper limits of the sentencing ranges differ. To minimize inconsistency in the criminal code in these hypothetical situations, we rely only on small changes in sentencing ranges. Such changes increase the credibility of hypothetical scenario, as the hypothetical scenario resembles the existing legislation known to prosecutors, but it also suppresses the predicted effect. Tests for the reference and the

severity effects are implemented in the drug possession case.

3.3 Implementation of Experimental Design

To approach prosecutors we partnered with the Prosecutor General's Office of the Czech Republic. The invitation to participate in the survey was sent by a deputy to the Prosecutor General. Initially 1257 prosecutors were invited to participate and 206 prosecutors responded to the first vignette and 194 to both of them. Each of the participant received a unique link, enabling us to eliminate duplicate answers from the same prosecutors. Additionally, the unique link allows us to match the experimental data with anonymized administrative data containing basic information about prosecutors such as their gender, age, time at bench, position in organization of prosecutors, alma mater, and whether they were members of the communist party up to the 1989 Velvet Revolution.

Participants are not a representative sample of the population of prosecutors. Compared with the population of prosecutors, our sample contains a higher proportion of female respondents, those who work at the Prosecutor General's Office, and the participants are, on average, younger. It is likely that the overrepresentation of the Prosecutor General's Office's prosecutors is caused by higher willingness to comply with the request of their direct superior. The descriptive statistics are presented in Appendix in Table 6.

Each participant in the experiment was asked to analyse and recommend a length of incarceration in two hypothetical criminal cases: (i) theft and (ii) drug possession.[12] Each case was described on one page and the wording was consulted with several practising judges, so no relevant informant is omitted. We also provided the respondents with the relevant section of the criminal code (the offense with multiple subsections) together with excerpt from jurisprudence establishing the thresholds. The participants were warned on the introductory screen that the provisions my not be in line with those in force; this comment was emphasized in italic. After the participants recommended a length of incarceration, we asked them to indicate an offense subsection according to which they impose the sentence. Since the classification of the subsection is based on quantifiable variables that were provided in the case, there is a objectively right answer. Failure to identify the correct subsections can indicate inattentive or careless responses.

In the experiment, participants were presented with an order from the head of their prosecution office to impose non-suspended prison sentence, while its length was left entirely on their consideration. Both cases were prepared in such a way that the imposition of a non-suspended prison sentence would be the most likely choice for most prosecutors due to the extensive criminal history of defendants. To select the length of imprisonment,

[12]The cases were presented in the reverse order to everyone.

participants were supposed to choose both the number of years and months of imprisonment from a drop-down menu. Their answers were not limited to the relevant length of incarceration according to the criminal code, so it was technically possible to recommend longer or shorter sentenced than possible given by the criminal code.

Each criminal case was presented in four different scenarios (i.e. four treatment arms in both cases) that differ in parameters of the cases and generates the intended experimental variation. Upon entering the platform, participants were randomized into one of the treatment arms in the first case (drug possession). The randomization into a treatment arm in the second case (theft) was independent from the first randomization. Note that since not everyone who started with the survey also finished it, the randomization based on entry does not, necessary, lead to numerically identical number of observations in each scenarios. In a between subjects design we explore the variation in length of incarceration recommended in different treatment arms.

3.4 Theft

3.4.1 Vignette description

Prosecutors were asked to recommend a length of incarceration in the following case. An offender visited his parents to help them with their computer. Once he was left alone in their home, he took advantage of his parents being logged-in in their internet banking account and of their cellphone being left at home and transferred all their money to his own account. He gambled away all of the money in the following three days. He was previously sentenced for fraud, embezzlement and he was released from a two-year prison sentence two months prior committing the offense in the vignette.

The entire vignette with text of the sections of the criminal code are presented in Appendix. We randomized participants into four treatment arms (scenarios), as captured by table 1. In the case of theft, we did not include scenarios that vary the existing legislation. Instead, we study overall threshold effects around two sequential thresholds, labelled as the 50k and the 500k thresholds.

Table 1: Scenarios: Theft

Scenario	Damage Caused (CZK)	Subsection Composition (CZK)	Sentencing Range (years of incarceration)
A	48 283	5 000 – 50 000	0 – 2
B	51 283	50 000 – 500 000	1 – 5
C	487 092	50 000 – 500 000	1 – 5
D	508 213	500 000 – 5 000 000	2 – 8

We estimate three causal effects regarding the theft case. First, a comparison of the average length of incarceration recommended in scenarios A and B yields the effect of the 50k threshold. Second, a comparison between scenarios C and D estimates the change of the length of incarceration caused by the 500k threshold. Third, to investigate what is the effect of a dramatic increase in the classifying variable, we use the fact that scenario B and C differ only in the size of the caused damage, but not in the subsection and sentencing ranges. Therefore, the comparison between the average recommended sentence estimates the causal effect of dramatic increase in damaged caused.

Finally, we are also interested in a comparison of the 50k threshold effect and the effect caused by increasing the damage almost 10times. Formally, we estimate the following $(s(C) - s(B)) - (s(B) - s(A))$ and test whether it equals to zero. The estimate provides us with a meaningful and contextual interpretation of the magnitude of the effect caused by the 50k threshold in terms of the magnitude of the classifying variable.

3.4.2 Results

Figure 3 shows the average length of incarceration recommended by prosecutors in different scenarios. The higher the damage caused is, the longer the recommended sentence is. In scenario A, the average length of incarceration is slightly above 18 months. In scenario B, the average sentence is by 10 months higher. In the remaining scenarios C and D the average sentences are approximately 41 and 46 months, respectively.

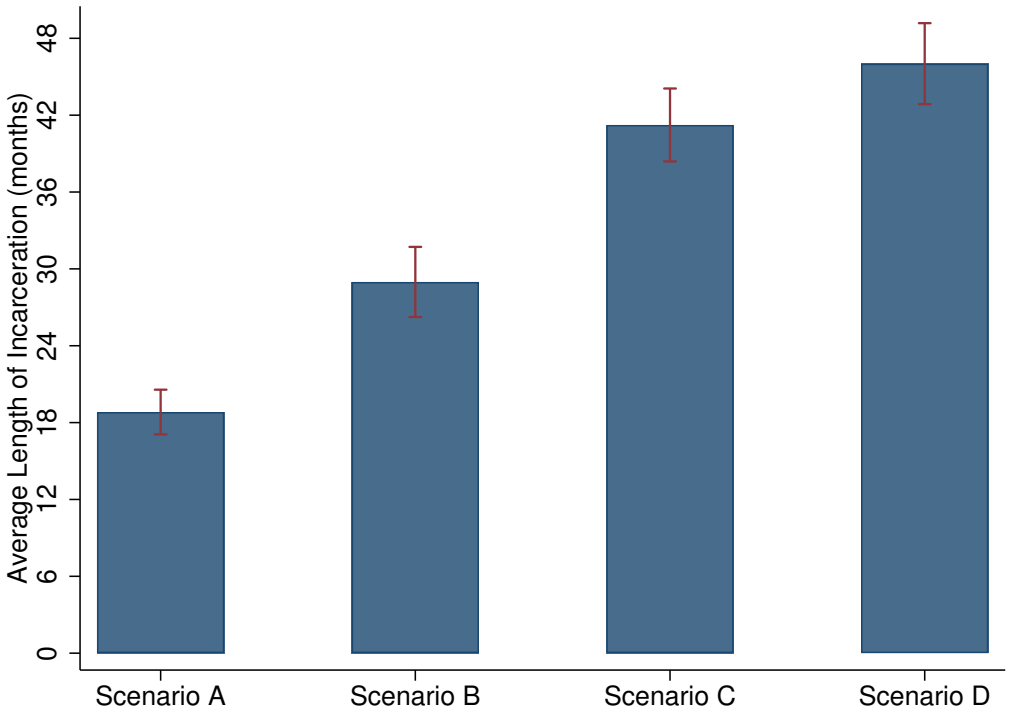
To test the effects formally, we estimate three models. Model 1 represents a simple univariate OLS regression in which the treatment effect is captured by a dummy that equals to 1 if the observation comes from the treated scenario and 0 otherwise. See equation Model 1. Model 2 extends the univariate OLS by controlling for additional characteristics of prosecutors (age, age^2, $gender$, $Hierarchy$ - position in the system of prosecutors). Finally, model C estimates a univariate OLS on a sample including a few participants who did not identify the correct subsection.

$$Sentence = \alpha + \beta Treatment + \epsilon \tag{Model 1}$$

$$Sentence = \alpha + \beta Treatment + \delta_1 Male + \delta_2 Age + \delta_3 Age^2 + \sum_{i=1}^{4} \gamma_i Hierarchy_i + \epsilon \tag{Model 2}$$

Table 2 shows three panels, each devoted to one of the three questions: the effect of 50k threshold, the effect of 500k threshold, and the effect of size of the classifying variable. Panel I presents robust evidence that the 50k threshold increases the average

Figure 3: Theft: Average Recommended Sentence by Prosecutors



Notes: The graph shows the average length of incarceration by different scenario. In scenario A, the offender caused damage of CZK 48,283, while the relevant threshold is CZK 50,000 and the sentencing range from 0 to 2 years. The average sentence in scenario A is 18.8 months. In scenario B, the offender caused damage of CZK 51,283, while the relevant threshold is CZK 50,000 and the sentencing range from 1 to 5 years. The average sentence in scenario B is 29 months. In scenario C, the offender caused damage of CZK 487,092, while the relevant threshold is CZK 500,000 and the sentencing range from 1 to 5 years. The average sentence in scenario C is 41.2 months. In scenario D, the offender caused damage of CZK 508,213, while the relevant threshold is CZK 500,000 and the sentencing range from 2 to 8 years. The average sentence in scenario D is 46 months.

incarceration by about 10 months, which represents more than 50 % increase compared to the sentence for cases just below the 50k threshold. Once we control for gender, age, and position in the hierarchy prosecutors, the point estimate is even larger. Panel II estimates the effect of the 500k threshold. Both model 1 and model 2 suggest that the 500k threshold increases the average length of incarceration by 4.5 months (app. 10 %). While the effect of the 500k threshold is smaller than the one caused by the 50k threshold, it provides additional evidence that existence of the effect is rather general and limits the external validity concerns. Finally, panel III presents evidence that increasing the damage almost 10times increases the sentence by roughly a year.

The effect of size of the damage allows us to understand the enormous effect the 50k threshold caused. Increasing a damage by 450,000 CZK (by 830 %) corresponds to additional 12 months of incarceration. This contrasts to 10 months increase of incarceration for a theft that causes higher damage by 3,000 CZK estimated in panel I. Alternatively, we can compare the 50k threshold effect to the effect causes by increasing the damage by 450,000 CZK. Formally, we run the following regression

$$\text{Sentence} = \beta_1 \text{Scenario A} + \beta_2 \text{Scenario B} + \beta_3 \text{Scenario C} + \varepsilon \tag{1}$$

and using the Wald test, we test

$$\beta_1 - 2\beta_2 + \beta_3 = 0$$

We do not reject the null hypothesis suggesting that the 50k threshold has the same effect on the absolute length of incarceration as increasing the damage by 450,000 CZK (by 830 %). Despite the probable sensitivity of the results on particular specifications and circumstances of cases, we take the results as robust evidence that the effect of thresholds on the shape of sentencing decisions is of a great importance.

3.5 Drug Possession

3.5.1 Vignette description

In the drug possession case, an offender was selling methamphetamine in front of a dance club in a town in Northern Bohemia. It was a one-time event after the offender lost his job. He was repeatedly sentenced for selling marijuana over the last 10 years and for small thefts. In four scenarios, we manipulate: (i) the amount of pure substance of methamphetamine (henceforth only methamphetamine) found on him; (ii) applicable sentencing range; or (iii) the thresholds influencing composition of cases within corre-

Table 2: Marginally Higher Amount of Damage Caused Increases Sentence Significantly

Panel I: 50k Threshold

	Model 1	Model 2	Model 3
Treatment Effect	10.153***	11.631***	10.056***
	(1.614)	(1.683)	(1.595)
Constant	18.826***	11.730**	18.826***
	(0.866)	(5.402)	(0.866)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	96	92	97

Panel II: 500k Threshold

	Model 1	Model 2	Model 3
Treatment Effect	4.789**	4.436**	3.047
	(2.110)	(2.200)	(2.272)
Constant	41.235***	22.847	41.235***
	(1.420)	(22.947)	(1.420)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	92	85	97

Panel III: Size of Damage

	Model 1	Model 2	Model 3
Treatment Effect	12.255***	11.705***	12.353***
	(1.966)	(2.073)	(1.950)
Constant	28.98***	38.615***	28.882***
	(1.361)	(7.419)	(1.338)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	101	97	102

Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel I tests the 50k threshold effect (s(B) - s(A)), panel II tests the 500k threshold effect (s(D) - s(C)), and panel III tests the effect of size of damage (s(C) - s(B)).

Model 1 represents a simple univariate OLS regression, model 2 extends the univariate OLS by controlling for additional characteristics (age, age^2, gender, position in the system of state prosecutors), model 3 a univariate OLS that includes responses of participants who did not identify the correct subsection of the paragraph.

sponding subsections. The full text of the vignette together with the text of the section and other information provided to the participants is presented both in English and in Czech in Appendix. The four scenarios that were applied are summarized in Table 3. Scenario A and scenario B are based on the existing legislation and differ marginally in the amount of the drug possessed. The difference between the length of incarceration recommended in scenario A and B represents the overall threshold effect causes by the threshold.

Table 3: Scenarios in Drug Possession Case

Scenario	Amount Possessed (grams)	Subsection Composition (grams)	Sentencing Range (years of incarceration)
A	147.8	1.5 – 150	1 – 5
B	151.8	150 – 1500	2 – 10
C	147.8	1.5 – 300	1 – 5
D	147.8	1.5 – 150	1 – 8

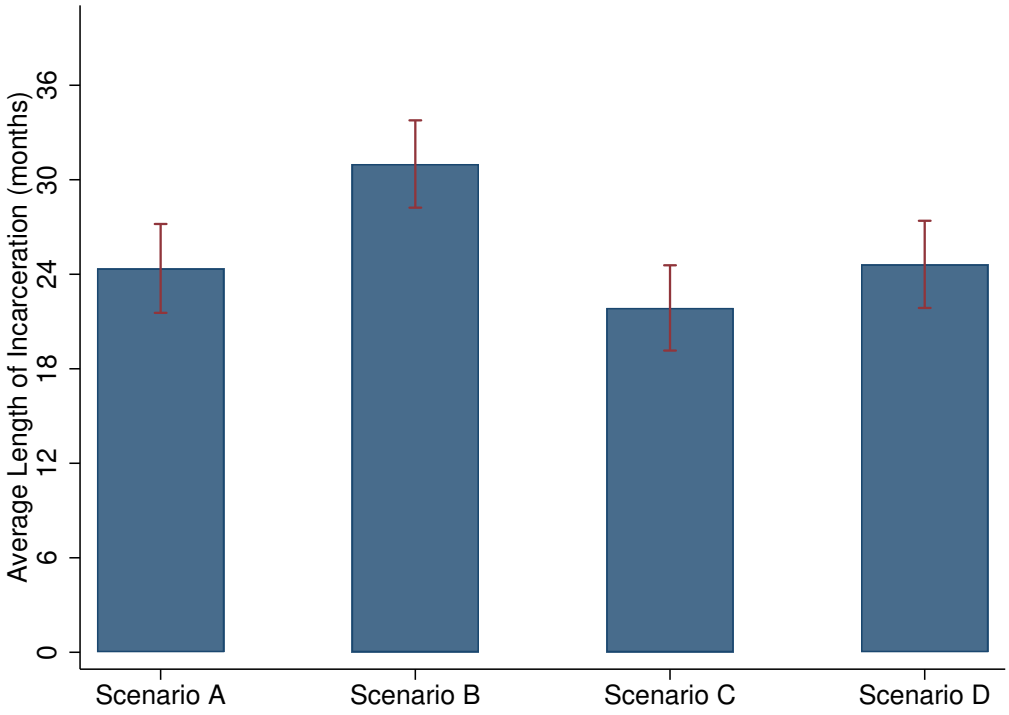
Scenarios C and D introduce alternative legal framework. In particular, in scenario C we move the threshold of classifying variable from 150 g to 300 g of methamphetamine and thus effectively add relatively more severe cases in the relevant subsection. It follows that a comparison between A and C scenarios captures a reference mechanism. In scenario D, we move the upper limit of the sentencing range and thus evoke the severity mechanism. Note, however, that the magnitude of the reference and severity mechanisms estimated here are only fractions of the whole reference and severity effect that work in the overall threshold effect.

3.5.2 Results

Figure 4 shows the average sentence recommended by prosecutors in different scenarios. In scenario A, the average length of incarceration is slightly more than 2 years and in scenario B longer by more than 6 months. The figure also reveals that the lowest average sentence is in scenario C, slightly more than 22 months and finally, the scenario D is almost identical with the one in scenario A.

Table 4 shows results from formal tests of three hypotheses; panel I tests the overall threshold effect, panel II tests for the reference mechanism, and panel III tests for the severity mechanism. Similarly to the first case, each panel shows results from three empirical models: (i) a simple univariate OLS regression. Conveniently, in all three panels the treatment dummy equals to zero for observations from scenario A.; (ii) OLS model controlling for additional characteristics of prosecutors. See equation Model 1.;

Figure 4: Drug Possession: Average Recommended Sentence by Prosecutors



Notes: The graph shows the average length of incarceration recommended by prosecutors in four scenarios of the drug possession case. In scenario A, the offender was caught with 147.8 grams of methamphetamine, while the threshold is 150 g and sentencing ranges from 1 to 5 years of incarceration. The average sentence in scenario A is 24.4 months. In scenario B, the offender was caught with 151.8 grams of methamphetamine, while the threshold is 150 g and sentencing range from 2 to 10 years of incarceration. The average sentence in scenario B is 31 months. In scenario C, the offender was caught with 147.8 grams of methamphetamine, while the threshold is 300 g and the sentencing range from 1 to 5 years of incarceration. The average sentence in scenario B is 21.9 months. In scenario D, the offender was caught with 147.8 grams of methamphetamine, while the threshold is 150 g and sentencing ranges from 1 to 8 years of incarceration. The average sentence in scenario B is 24.6 months. The lines represent 95 % confidence intervals.

(iii) a univariate OLS on a sample including a few participants who did not identify the correct subsection.

Panel I of Table 4 provides convincing evidence that the threshold increases the length of incarceration by around 6 months, which represents approximately a 25 % increase of the length. Employing different models the point estimates of the treatment effect range from 5.2 to 6.6 months. The results thus provide robust evidence that two almost identical cases (the difference is 3 grams of methamphetamine (2.7 %)) were recommended to a significantly different length of incarceration.

Panel II of the Table 4 shows suggestive evidence of the reference mechanisms. All three specifications provide similar negative point estimates, suggesting that by increasing the threshold for classifying variable from 150g to 300g the sentence decreases by 2.5 - 3 months. The effect represents approximately a 10 % decrease in the length of incarceration. Since only one point estimate is statistically significant, we consider the results only as suggestive evidence.

Finally, three specifications in panel III test for the severity mechanism and suggest the null results. To understand why the severity mechanism is rather negligible, it is important to realize that it does not test the full severity effect, but rather existence of the mechanism. The average sentence in scenario A is located around a fourth of the possible interval (a year above the minimum of the sentencing range and 3 years below the maximum of the sentencing range) so increasing the upper limit of the sentencing range further has only a limited impact.[13] Importantly, since the overall threshold effect is sizeable and positive, our framework implies that the full severity effect must be sizeable and positive, too.

Studying the average effect masks a substantial heterogeneity in prosecutors behavior. Panel A and B of figure 8 in Appendix show histograms of all decisions in scenarios A and B, respectively. Most of the recommended length in scenario A are concentrated in the lower part of the sentencing range of 1 to 5 years and 9 of the prosecutors even recommended the minimum length. In scenario B, the pattern is similar, as none of the prosecutor recommended a sentence above the middle length of the sentencing range (72 months) and 23 (38 %) of the prosecutors recommended the minimum of 24 months. Interestingly, two prosecutors recommended a sentence below the minimum.[14]

[13]It may be deemed as a shortcoming of the experimental design. However, at the time of preparing the experimental design, we did not know what the average sentence in the scenario A would be.

[14]Furthermore, the figure shows that prosecutors tend to round the length to years which is in line with previous research Dhami et al. (2020).

Table 4: Marginally Higher Amount of Drugs Possessed Increases Sentence Significantly

Panel I: Effect of Threshold

	Model 1	Model 2	Model 3
Treatment Effect	6.629***	5.870***	5.240**
	(1.969)	(2.229)	(2.016)
Constant	24.370***	41.876	25.379***
	(1.407)	(25.440)	(1.449)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	103	98	108

Panel II: Reference Effect

	Model 1	Model 2	Model 3
Treatment Effect	-2.506	-2.573	-3.516*
	(1.944)	(1.974)	(2.003)
Constant	25.379***	42.851	25.379***
	(1.407)	(26.304)	(1.449)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	98	96	102

Panel III: Severity Effect

	Model 1	Model 2	Model 3
Treatment Effect	0.257	-0.808	-0.009
	(1.969)	(2.095)	(1.993)
Constant	24.370***	40.990***	25.379***
	(1.407)	(8.204)	(1.448)
Controls	No	Yes	No
Only if Correct Subsection	Yes	Yes	No
N	105	102	112

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel I tests the overall threshold effect (s(B) - s(A)); panel II tests the reference effect (s(C) - s(A)); and panel III tests the severity effect (s(D) - s(A)).

Model 1 represents a simple univariate OLS regression, model 2 extends the univariate OLS by controlling for additional characteristics (age, age^2, gender, position in the system of state prosecutors), model 3 a univariate OLS that includes responses of participants who did not identify the correct subsection of the paragraph.

4 Measure of Justice

4.1 Just Sentence and Its Measure

To provide insights beyond differences in the average recommended sentences, we propose a measure of justice that quantifies the probability that an observed sentence is just. Suppose two sentences in potentially different cases. A necessary requirement to consider the sentences *just* is that the more serious case leads to harsher sentence, but not too (unreasonably) much. We build on this notion to define *just* sentences and then to introduce an empirical measure of justice.

We first define *just* sentence formally. Using the notation introduced earlier, consider a case (x, t) with a corresponding sentence s_1. Given this sentence s_1, we ask whether a different sentence s_2 in a potentially more severe case $(x + \delta_x, t + \delta_t)$, with $\delta_x \geq 0$ and $\delta_t \geq 0$ is *just* or not. We say that the sentence s_2 is *just* if it is: (i) at least as harsh as s_1; and (ii) is not unreasonably harsher. In other words, we take a random pair of cases and corresponding sentences and compare whether and by how much the sentence in more serious case is harsher. The sentence in more serious case is *just* if it is reasonably harsher. To avoid a normative stance on what is considered reasonably and unreasonably harsher sentence, the definition is parametric.

Definition 2 (Just Sentence)**.** Given a sentence s_1 in a case (x, t) and a tolerance parameter $\eta \geq 1$, we say that a sentence s_2 of a case $(x+\delta_x, t+\delta_t)$, where $\delta_x \geq 0$ and $\delta_t \geq 0$ is *just* if the two following conditions are satisfied:

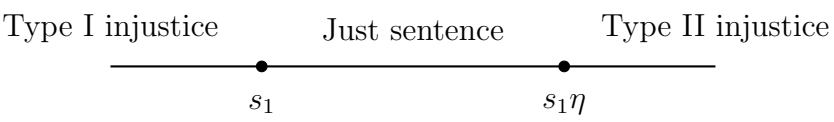
$$s_1 \leq s_2 \tag{D 2.1}$$

$$s_2 \leq s_1\eta. \tag{D 2.2}$$

The tolerance parameter η captures what is considered reasonably harsher sentence and what is not. Importantly, the definition says that a sentence s_2 can be called *just* only if there is a tolerance parameter η and a sentence s_1 to which s_2 is compared. In other words, the justice sentencing is viewed relative to other sentence and a tolerance parameter. Without these, the definition is meaningless.

The definition 2 implies that sentence that is not considered *just*, can be of two types. Depending on which condition is not satisfied, we distinguish two types of *unjust* sentences. If condition D 2.1 is not satisfied and the more severe case leads to more lenient sentence, then we talk about *type I injustice*, whereas if condition D 2.2 is not satisfied and the sentence s_2 is too harsh, we talk about *type II injustice*. Figure 5 graphically represents the idea.

Figure 5: Just Sentence



Notes: Given a tolerance parameter η and sentencing decision s_1, then depending on position of s_2 we talk about a *just* sentence, *type I injustice*, or *type II injustice*.

Having defined *just sentence* and types of injustice, we next introduce empirical measures. To fit our experimental design, we consider the following situation. There are N^A sentencing decisions in a case $A = (x, t)$ denoted as s_i^A (e.g. a theft case with damage of 48,283 CZK). There are also N^B decisions in cases $B = (x + \delta_x, t + \delta_t)$ denoted as s_j^B (e.g. a theft case with damage of 51,283 CZK).

We introduce three empirical measures based on a similar logic. We compare each sentence s_i^A to each sentence s_j^B (i.e. $N^A \times N^B$ comparisons) a quantify frequency of $\frac{s_j}{s_i}$ being less than 1, between 1 and η, and higher than η. The obtained figures corresponds to the measure of justice $\mathcal{M}^J(\eta)$, the measure of *type I injustice* $\mathcal{M}^I$, and *type II injustice* $\mathcal{M}^{II}(\eta)$. Note that *type I injustice* does not depend on the tolerance parameter η. Intuitively, our measures quantify the probability that for a randomly observed pair of sentences s_i^A and s_j^B, the latter will be less severe, reasonably harsher, or unreasonably harsher compared to the former. The following definition introduces all three measures formally.

Definition 3 (Measures of Justice and Injustice)**.** Suppose that there are N^A decisions in a case $A = (x, t)$ denoted s_i^A and N^B decisions in cases $B = (x + \delta_x, t + \delta_t)$ denoted as s_j^B, in which $\delta_x \geq 0, \delta_t \geq 0$. Then for a given parameter η, the measure of justice $\mathcal{M}^J(\eta)$, measure of type I injustice $\mathcal{M}^I(\eta)$, and measure of type II injustice $\mathcal{M}^{II}(\eta)$ are defined as follows

$$\mathcal{M}^J(\eta) = \frac{\sum_{i\in I}\sum_{j\in J}\mathbf{1}\left[1 \leq \frac{s_j^B}{s_i^A} \leq \eta\right]}{N^A \times N^B} \qquad \text{(Measure of Justice)}$$

$$\mathcal{M}^I = \frac{\sum_{i\in I}\sum_{j\in J}\mathbf{1}\left[\frac{s_j^B}{s_i^A} < 1\right]}{N^A \times N^B} \qquad \text{(Measure of Type I Injustice)}$$

$$\mathcal{M}^{II}(\eta) = \frac{\sum_{i\in I}\sum_{j\in J}\mathbf{1}\left[\eta < \frac{s_j^B}{s_i^A}\right]}{N^A \times N^B}. \qquad \text{(Measure of Type II Injustice)}$$

Prior we quantify the measures for the experimental cases, we mentioned two properties. First, the sum of the measures equals to 1 for any given tolerance parameter η.

Second, the higher the tolerance parameter η is, the higher the *measure of justice* is. Intuitively, as we increase the tolerance parameter, even harsher sentences are considered just (or tolerated). Naturally, by increasing the tolerance parameter, the measure of *type II injustice* decreases.

4.2 Measure of Justice in Experiment

We calculate the introduced measures for sentences recommended by prosecutors in our experiment. In particular, we focus on the threshold effect in the drug possession case, the 50k and the 500k thresholds effects in the theft case, and the size effect in the theft case. For each of these comparisons we calculate type I injustice and two measures of justice with tolerance parameters of 1.5 and 2. Finally, we report an approximation of how tolerance the society must be, to evaluate at least half of the sentences as *just*.

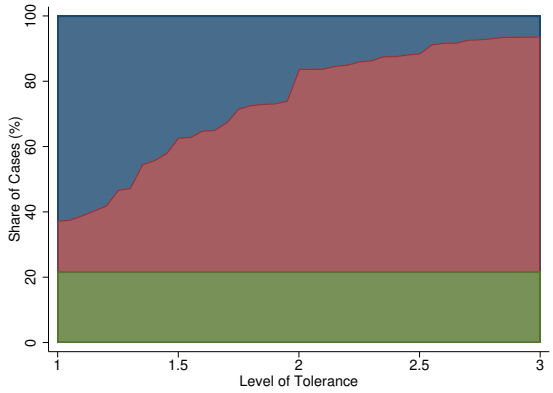
Table 5: Measures of (In)Justice in Experiment

	Type I injustice	$\mathcal{M}^J(1.5)$	$\mathcal{M}^J(2)$	$\left(\mathcal{M}^J\right)^{-1}(0.5)$
Drug Possession	0.21	0.41	0.62	1.75
Theft (50k threshold)	0.15	0.38	0.62	1.85
Theft (500k threshold)	0.33	0.49	0.63	1.55
Size of Damage	0.15	0.41	0.65	1.70

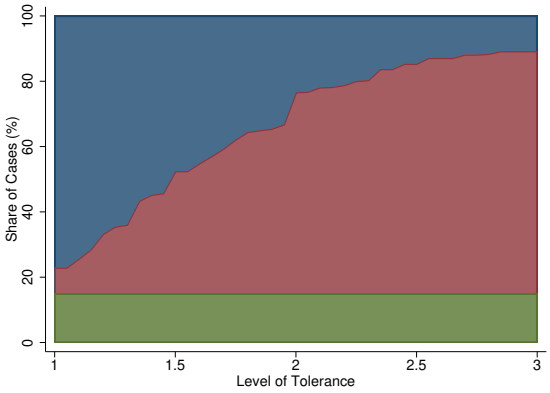
Table 5 shows the results. The *type I injustice* is highest in the 500k threshold comparison, as a third of the more severe cases were sentenced to more lenient sentence. That suggests that these two cases (theft cases with a damage of 487,092 CZK and 508,213 CZK) are perceived the most similar among all four pairwise comparisons. The second column implies that if the society tolerates that more severe case is sentenced to a by 50 % longer incarceration, then the share of *just* sentences is around 40 % for most of the comparisons, with exception for the 500k threshold. Once the tolerance parameter is two, roughly two thirds of cases are considered fair in all four comparisons. Note, however, that the interpretation differs. For example the 50k threshold effect and the 500k threshold effects differ dramatically in the measure of *type I injustice*, and since the measures sum to the 1 for any η they also differ in the *type II injustice*.

Finally, an inverse function of *measure of justice* evaluated at 0.5 says how tolerant one has to be (i.e. what the η must be) to reach 50 % probability that from a randomly observed pair of sentences s_i^A and s_j^B, the latter is considered a just sentence. For example, the first row that compares a drug possession case with 148.8 grams and drug possession case with 151.8 grams and reveals that to reach 50 % of just decisions, one has to consider 75 % longer incarceration for 3 grams of methamphetamine as a just sentence. This is

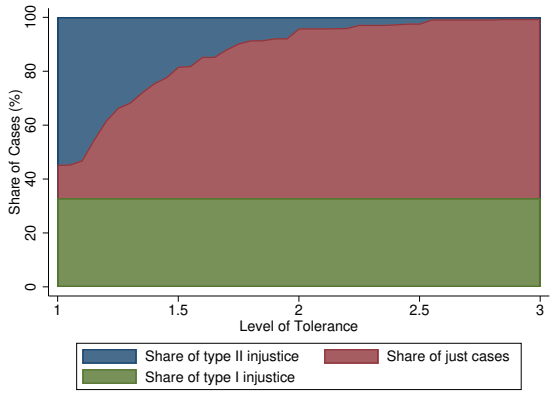
Figure 6: Measures of (In)Justice in Experiment



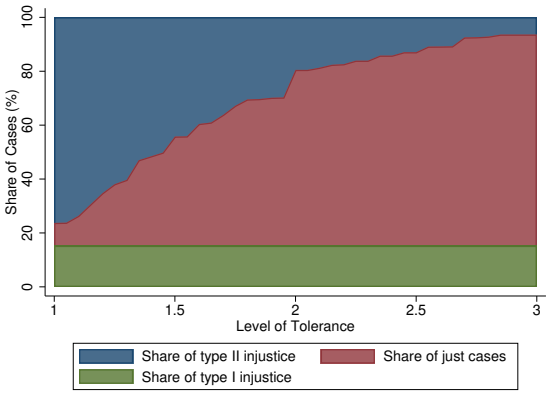
(a) Panel A: Drug Possession



(b) Panel B: Theft (50k threshold)



(c) Panel C: Theft (500k threshold)



(d) Panel D: Theft (Size of Damage)

Notes: Panel A shows a measure of justice for the case of drug possession (scenario A vs. B). Panel B shows a measure of justice for the case of theft around the 50k threshold. Panel C shows a measure of justice for the case of theft around the 500k threshold. Panel D shows a measure of justice for the case of theft of size of damage.

additional evidence that the threshold has an enormous effect not only on the average sentence recommended. Figure 6 shows measure of justice and injustice for four main comparisons.

5 Discussion

The search for an optimal measure providing sufficient guidance to sentencers necessarily includes a certain trade-off. Measures envisioned to reduce sentencing disparities will likely introduce certain amount of new ones. As we show, the extent of new disparities might be enormous and the disparities introduced by dividing offenses into subsections

with specific sentencing ranges might strongly limit the benefits of guidance provided by such structure. The difference in sentences imposed for identical thefts around a threshold (48,283 and 51,283 CZK scenarios) was similar to the difference in sentences imposed for identical thefts at the opposite sides of one offense subsection (51,283 and 487,092 CZK). In other words, stealing more by 3,000 CZK leads to a similar increase in sentence as stealing more by 435,000 CZK. Any criminal justice system striving for principled sentencing cannot tolerate such disparity.

We have developed a theory that allows us to explain how thresholds influence sentencing around them and what could happen given a change in the sentencing ranges and offense subsection composition. The theory implies that a difference between two sentences can be decomposed into two opposing effects. The severity effect captures what the difference if only the sentencing range change, but the composition of case in a subsection remain the same. On the contrary, if the sentencing ranges remain unchanged, but the composition of the cases changes, we talk about the reference effect. In line with our results each mechanism is expected to influence all cases within a subsection in the same direction, yet the size of the effect likely differs.

Our simplified model does not provide us with an exact magnitude of the effects. To obtain more nuance predictions we would need to impose more restricted assumptions on the sentencers' behavior and in particular on the function G. However, based on our model, we still can make two observations. First, consider a question of whether increasing the lower or the upper limit of the sentencing range will lead to higher effect. Our theory gives a clear guidance. Suppose both the lower and the upper limits increase, the severity effect is then a linear combination of an increase of the lower limit and the upper limit with a relative position of the case within the sentencing range $G(.)$ as a weight. Therefore, sentences in more serious cases $G(.) > 0.5$ are more sensitive to increases in the upper limit, while less serious cases $G(.) < 0.5$ to the lower limits. Empirically most of the sentences seem to be clustered in the lower part of the sentencing ranges close to the lower limit (Drápal, 2020; Sutela, 2020). It is thus consistent with our model that increasing the lower limit would lead to a higher increase in the average sentence.

Second, comparing two cases within the same sentencing ranges, the magnitude of the effect on these two cases depends on the current position of the case within the sentencing range. This follows from the same intuition, as the first implication. The closer to the upper limit of the sentencing range, the higher effect of an increase of the upper limit. This effect can be shaped by sentencers' practice not to exploit the full sentencing range. For example, Italian judges counter the punitive tendencies of the legislator by imposing sentences close to the lower limit of the sentencing range (Corda, 2016), limiting the

severity mechanism caused by increasing the upper limit of sentencing range.

Structure of offense subsections with sentencing ranges substantially shapes sentencing. Yet there is a lack of scholarship regarding how the subsections and ranges should be constructed. What classifying variables should divide offense subsections, into how many subsections, and should some classifying variables be quantifiable? To what extent sentencing ranges for individual subsections should overlap? Providing answers to these questions seems necessary to understand how offense subsections should influence sentencers.

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Appendix

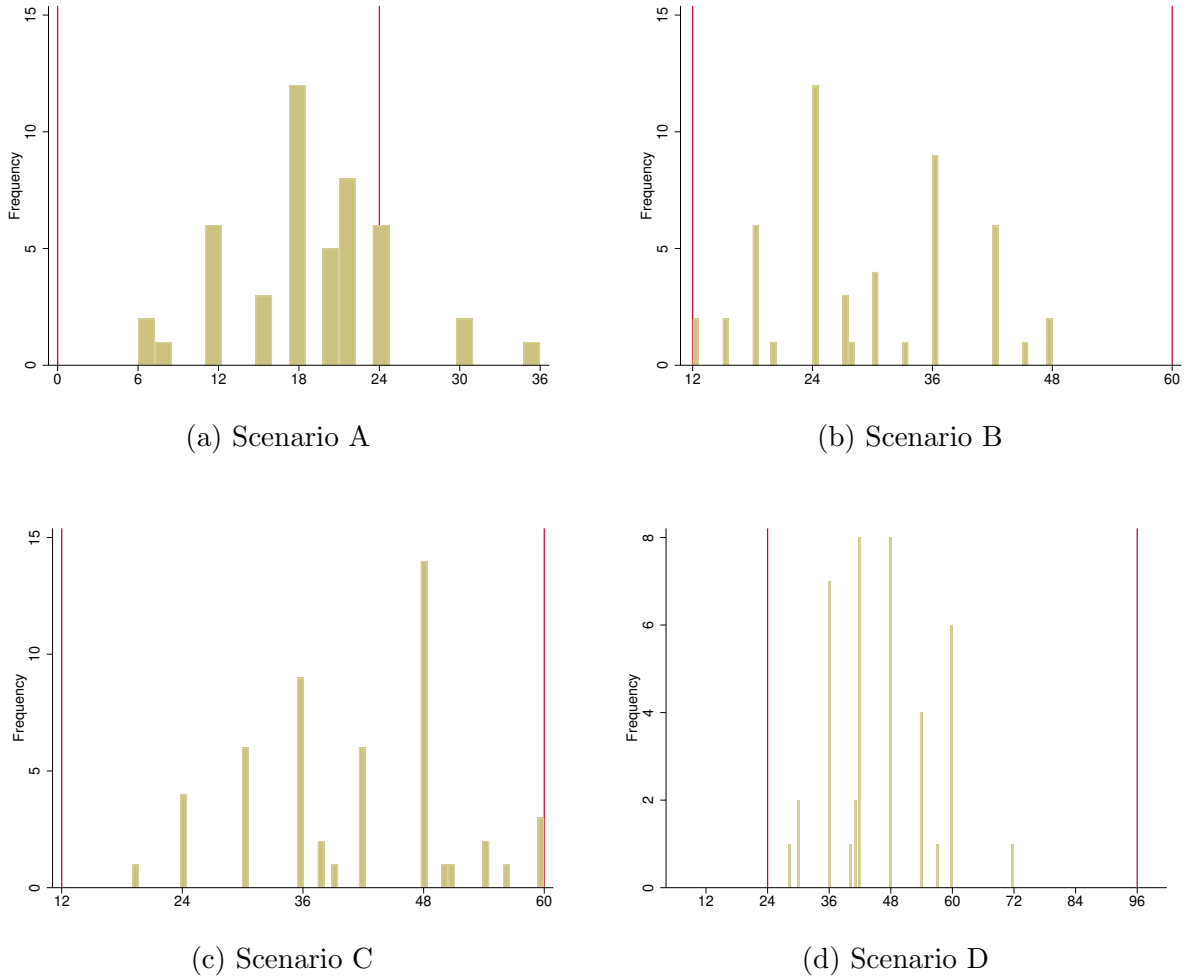
Theory

We show that the equation T 1.1 holds. To simplify notation, label two cases A and B and define three differences $\Delta G = G(B) - G(A)$, $\Delta\rho^- = \rho^-(B) - \rho^-(A)$, and $\Delta\rho^+ = \rho^+(B) - \rho^+(A)$. Then according to the definition 1 the difference in sentences $\Delta s = s(B) - s(A)$ equals to

$$
\begin{aligned}
s(B) - s(A) &= \rho^-(B) + G(B) * \big(\rho^+(B) - \rho^-(B)\big) - \big(\rho^-(A) + G(A) * \big(\rho^+(A) - \rho^-(A)\big)\big) \\
&= \rho^-(B) + G(B) * \big(\rho^+(B) - \rho^-(B)\big) - \\
&- \big((\rho^-(B) - \Delta\rho^-) + (G(B) - \Delta G) * \big((\rho^+(B) - \Delta\rho^+) - (\rho^-(B) - \Delta\rho^-)\big)\big) \\
&= \Delta\rho^- * (1 - G(B) + \Delta G) + \Delta\rho^+ * (G(B) - \Delta G) + \Delta G * (\rho^+(B) - \rho^-(B)) \\
&= \Delta\rho^- * (1 - G(A)) + \Delta\rho^+ * (G(A)) + \Delta G * (\rho^+(B) - \rho^-(B))
\end{aligned}
$$

□

Figure 7: Theft: Individual Sentences Recommended by Prosecutors



(a) Scenario A

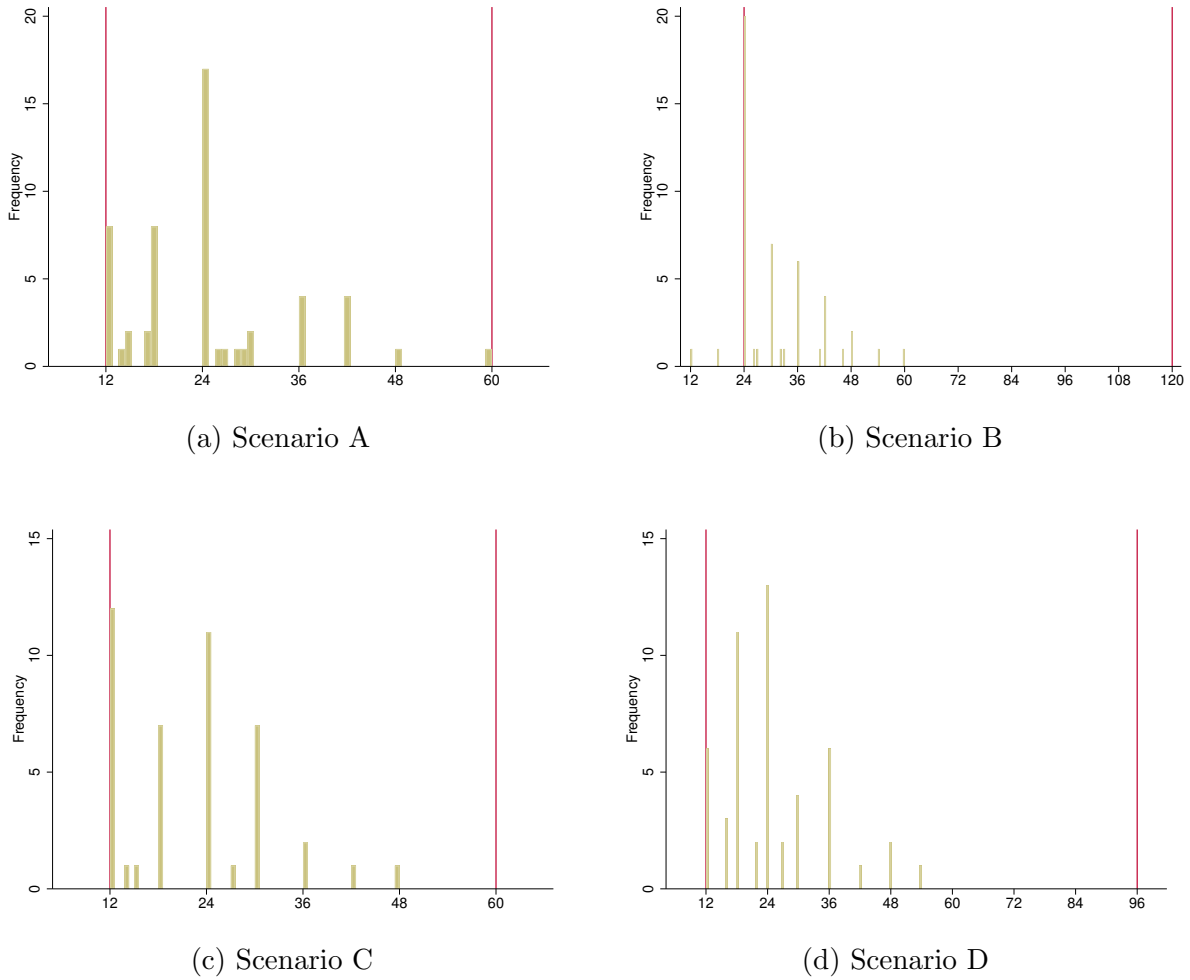
(b) Scenario B

(c) Scenario C

(d) Scenario D

Notes: Each panel represents a histogram of individual recommended sentences in the case of theft. In scenario A, prosecutors recommended sentences in a case with a damage of 48,283 CZK. In scenario B, the prosecutors recommended sentences in a case with a damage of 51,283 CZK. In scenario C, prosecutors recommended sentences in a case with a damage of 487,092 CZK. Finally, in scenario D, prosecutors recommended sentences in a case with a damage of 508,213 CZK. Red vertical lines mark the upper and low limits of the corresponding sentencing range. See table 1.

Figure 8: Drug Possession: Individual Sentences Recommended by Prosecutors



(a) Scenario A

(b) Scenario B

(c) Scenario C

(d) Scenario D

Notes: Each panel represents a histogram of individual recommended sentences in the drug possession case. In scenario A, prosecutors recommended sentences in a case with 147.8 g. In scenario B, the prosecutors recommended sentences in a case with 151.8g. In scenario C, prosecutors recommended sentences in a case with 147.8 g and a composition of more serious cases. Finally, in scenario D, prosecutors recommended sentences in a case 147.8 g and higher upper limit of the sentencing range. Red vertical lines mark the upper and low limits of the corresponding sentencing range. See table 3.

Table 6: Descriptive Statistics

Panel A: Drug Possession

	A	B	C	D	not in experiment	H_0
Number of Observations	58	50	44	54	1049	
Male	41 %	42 %	34 %	52 %	55 %	0.001
Communist Party	10 %	18 %	10 %	15 %	14 %	0.841
Age	46.3	47.8	45.2	47.3	49.1	0.002
Tenure Exam	18.5	19	16.6	20.3	20.4	0.066
Tenure Oath	16.2	16.6	13.8	16.4	17.1	0.071
Alma Mater						
Brno	38 %	38 %	32 %	38 %	34 %	0.529
Prague	34 %	40 %	43 %	46 %	42 %	0.662
Plzen	16 %	8 %	11 %	2 %	9 %	0.799
Olomouc	5 %	4 %	7 %	4 %	7 %	0.840
NSZ	10 %	6 %	9 %	9 %	4 %	0.012
VSZ	3 %	2 %	14 %	2 %	8 %	0.147
KSZ	16 %	14 %	20 %	17 %	24 %	0.025
OSZ	70 %	78 %	57 %	72 %	64 %	0.114

Panel B: Theft

	A	B	C	D	not in experiment	H_0
Number of Observations	46	51	51	46		
Male	43 %	27 %	51 %	54 %		
Communist Party	20 %	16 %	6 %	13 %		
Age	48	46.6	47	46.2		
Tenure Exam	19.8	19	18.4	18.5		
Tenure Oath	16.7	18.9	15.9	15.2		
Alma Mater						
Brno	37 %	37 %	37 %	35 %		
Prague	39 %	41 %	37 %	48 %		
Plzen	7 %	14 %	10 %	4 %		
Olomouc	9 %	0 %	8 %	4 %		
NSZ	11 %	14 %	4 %	9 %		
VSZ	4 %	2 %	4 %	9 %		
KSZ	15 %	14 %	20 %	20 %		
OSZ	70 %	71 %	73 %	63 %		

Notes: The H_0 column reports p-value of two-sided t-test under the null that the sample value equals to the population (universe of all active prosecutors) value.

Vignettes

Introduction Screen[15]

Welcome!
We ask you to participate in a scientific study, in which we explore sentencing decisions.

On the following screens we present two hypothetical criminal cases. Presented legal provisions, according to which you will decide, might not correspond to the current legal provisions. Your task will be to recommend the length of the sentence.

After that we will present you a questionnaire. Your answers are and will remain fully anonymous and will be used only for research purposes. Your participation should not take up more than 10 minutes of your time.

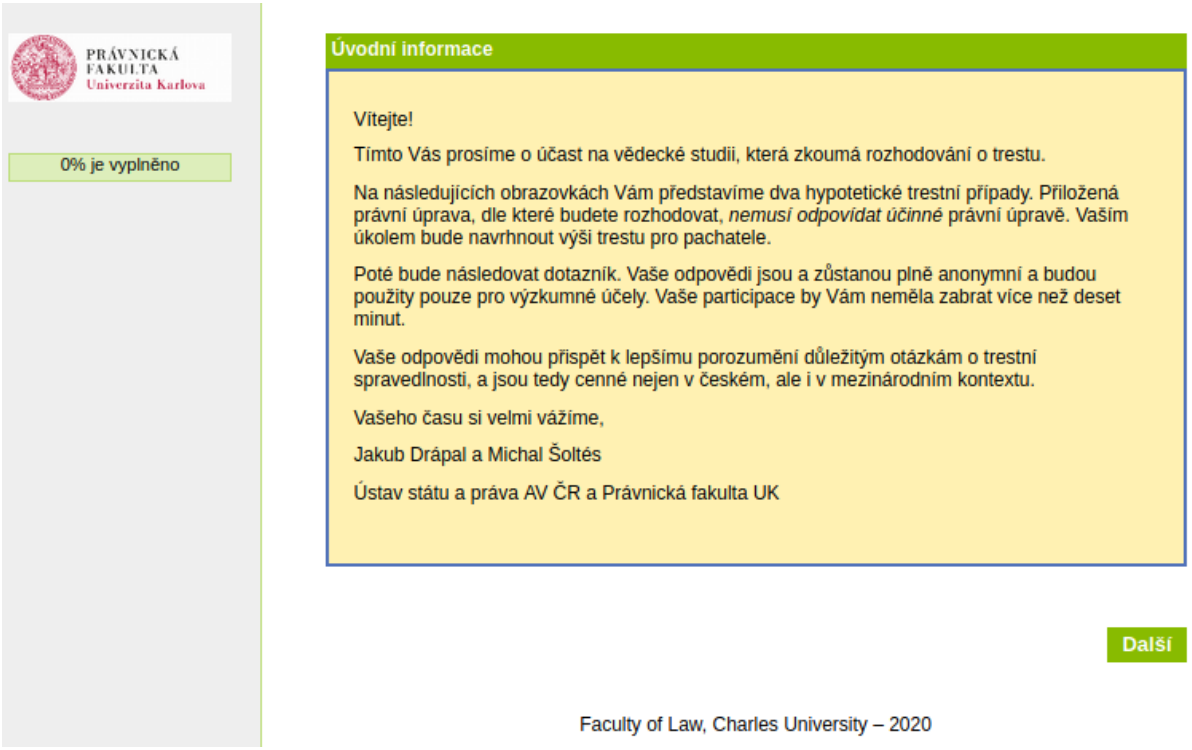
Your answers might contribute to the better understanding of important criminal justice issues that are significant not only for the Czech Republic, but for the international audience as well.

We highly value your time.

Jakub Drápal and Michal Šoltés
Institute of State and Law, the Czech Academy of Sciences and Faculty of Law, Charles University

[15] See figure 9

Figure 9: Vignettes: Introduction Screen



Drug distribution[16]

Pavel Nový (born 14. 5. 1984, unemployed, resident of Chomutov) was arrested by policemen in front of dance club in Chomutov while selling methamphetamine, which he bought a day earlier in Prague. According to a lab report the amount of methamphetamine found on the offender (in his pockets and in the car parked in front of the dance club) contained [amount] of pure substance of methamphetamine.

A month prior to the arrest Mr. Nový lost his job with financial troubles ensuing. While looking for job in Prague, he came by chance across an old acquaintance, who offered him a one-time possibility to earn some money by selling drugs.

Nový was in the last 10 years thrice sentenced for distribution of marijuana. Probation period of the last sentence elapsed for years ago during which he was not found in breach of the conditions. Two and a half year ago he was sentenced for burgling several residential houses and apartments to a probation; he was not found in breach. Half year ago he was sentenced for a small theft in a supermarket to a community sentence, which he carried out.

Even though he did not cooperate with the police in the beginning, he plead guilty and there is no doubt regarding his guilt as well as the legal classification of the offense.

Head of Your prosecution office told you during a preliminary discussion that You should recommend non-suspended prison sentence based on offender's criminal record and the amount of drugs found on him. He left the decision on the length of the non-suspended prison sentence entirely on You.

Offense Section: Unauthorised Production and other Disposal with Narcotic and Psychotropic Substances and Poisons

(1) Whoever produces, imports, exports, transports, offers, provides or sells or otherwise arranges for another or handles for another narcotic or psychotropic substances, products containing narcotic or psychotropic substances, precursors or poisons (meaning 1.5-150 grams of pure substance of methamphetamine according to the jurisprudence of Czech Supreme Court), without an authorisation,

[16] See figure 10

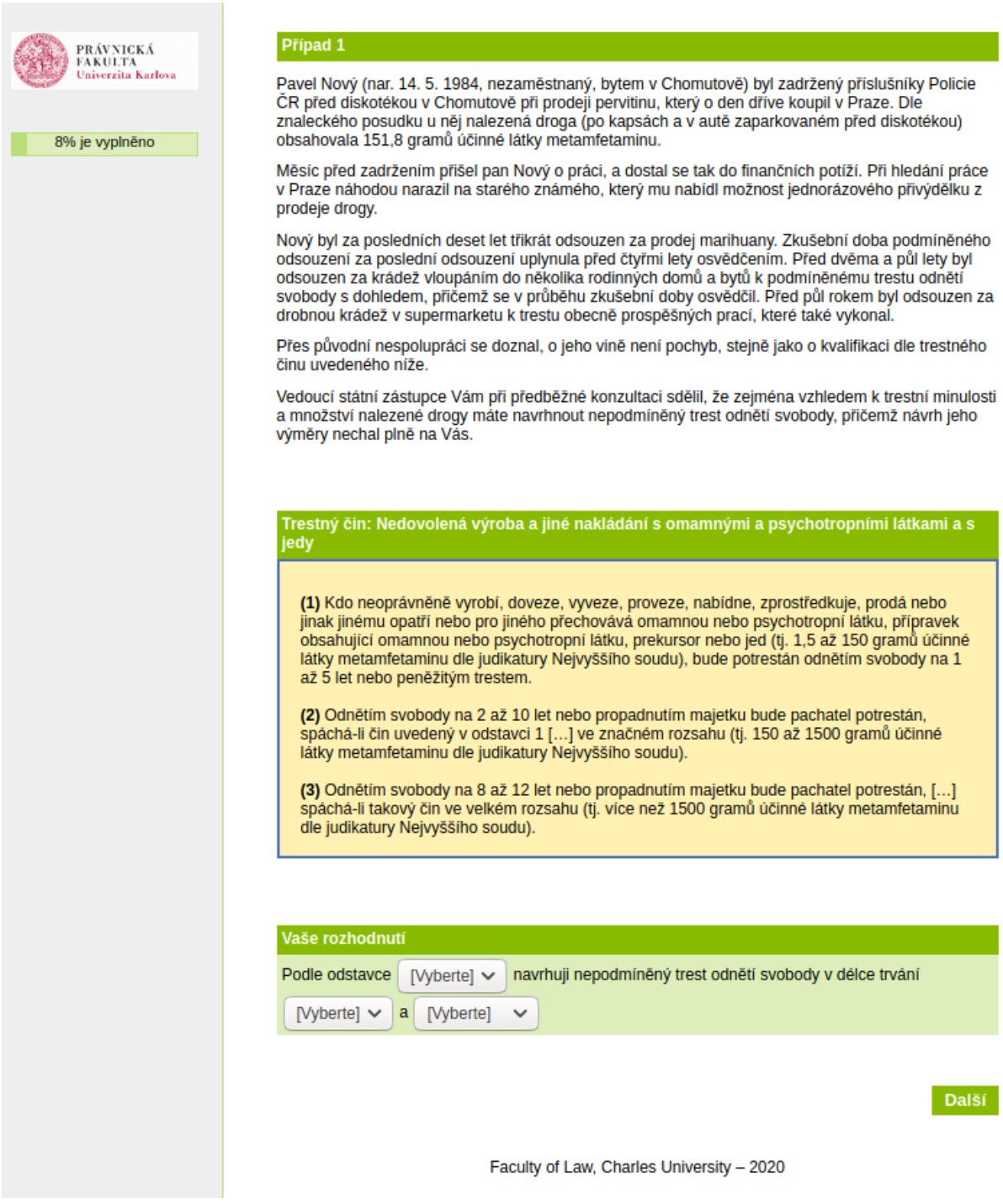
shall be sentenced to imprisonment for one to five years or to a pecuniary penalty.

(2) An offender shall be sentenced to imprisonment for two to ten years or to confiscation of property, if he/she commits the act referred to in Sub-section (1) [...] in a considerable extent (meaning 150-1500 grams of pure substance of methamphetamine according to the jurisprudence of Czech Supreme Court).

(3) An offender shall be sentenced to imprisonment for eight to twelve years or to confiscation of property, if he/she [...] commits such an act in a large extent (meaning more than 1500 grams of pure substance of methamphetamine according to the jurisprudence of Czech Supreme Court).

Your decision According to the subsection [Choose] I recommend a non-suspended prison sentence in the length of [Choose] years and [Choose] months.

Figure 10: Vignette 1: Drug Distribution



Vignette 2: Theft[17]

Karel Pokorný (born 5. 10. 1978, unemployed), visited his parents in a morning before they left for work to help them update software on their home computer. He stayed in their apartment even after they left it for their job to finalize the update.

He made use of the fact that his parents were logged in into internet banking and that a text message with confirmation code is send to their family cellphone which they leave at home. He entered a payment order via which he transferred all of his parents' money to his own account and he confirmed the payment by a control code. He thus caused to his parents a damage of [amount]. He gambled away all of the money in a local casino on slot machines.

Pokorný has 8 previous convictions for fraud, embezzlement and theft, out of which he was sentenced thrice for fraud in the last five years. He has served the last sentence (non-suspended prison sentence of two years) two months prior to this event.

He plead guilty, he did not compensate his parents and there is no doubt regarding his guilt as well as the legal classification of the offense.

Head of Your prosecution office told you during a preliminary discussion that You should recommend non-suspended prison sentence based on offender's criminal record. He left the decision on the length of the non-suspended prison sentence entirely on You.

Offense Section: Theft

(1) Whoever misappropriates a thing of another by taking possession of it, and thus causes damage not insignificant on property (meaning CZK 5,000-50,000) of another shall be sentenced to imprisonment for up to two years, to prohibition of activity or to confiscation of a thing or other asset value.

...

(3) An offender shall be sentenced to imprisonment for one year to five years or to a pecuniary penalty, if he/she causes larger damage (meaning CZK 50,000-

[17] See figure11

500,000) by the act referred to in Sub-section (1).

(4) An offender shall be sentenced to imprisonment for two to eight years, if he/she [...] causes substantial damage (meaning CZK 500,000-5,000,000) by such an act.

(5) An offender shall be sentenced to imprisonment for five to ten years, if he/she [...] causes by the act referred to in Sub-section (1) extensive damage (meaning more than CZK 5,000,000).

Your decision According to the subsection [Choose] I recommend a non-suspended prison sentence in the length of [Choose] years and [Choose] months.

Figure 11: Vignette 2: Theft