

Khadjavi, Menusch

Article — Accepted Manuscript (Postprint)

Deterrence Works for Criminals

European Journal of Law and Economics

Provided in Cooperation with:

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

Suggested Citation: Khadjavi, Menusch (2018) : Deterrence Works for Criminals, European Journal of Law and Economics, ISSN 0929-1261, Springer, Berlin, Vol. 46, Iss. 1, pp. 165-178, <https://doi.org/10.1007/s10657-015-9483-2>

This Version is available at:

<https://hdl.handle.net/10419/234046>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by-nc-nd/3.0/de/>

Deterrence Works for Criminals

Menusch Khadjavi*

University of Kiel

Kiel Institute for the World Economy

November 5, 2014

Abstract

Criminal law and economics rests on the expectation that deterrence incentives can be employed to reduce crime. Prison survey evidence however suggests that a majority of criminals are biased and may not react to deterrence incentives. This study employs an extra-laboratory experiment with criminals in a German prison to test the effectiveness of deterrence and compares it with data of student subjects. Subjects either face potential punishment when stealing, or they can steal without deterrence. We confirm Gary Becker's deterrence hypothesis that deterrence works for criminals (and similarly for students). We observe significantly more risk-seeking criminals than students, although the vast majority (80.77%) of criminals behaves risk-neutral or risk-averse.

Keywords: crime, stealing, deterrence, prison, inmates, risk, extra-laboratory experiment, artefactual field experiment

JEL: C72, C91, C93, K42

* Correspondence: Kiel Institute for the World Economy, Kiellinie 66, 24105 Kiel, Germany: e-mail contact: menusch.khadjavi@ifw-kiel.de; phone: +49 431 8814 631.

I am grateful to the *JVA für Frauen* in Vechta and especially Petra Huckemeyer and Elsbeth Lübke for their dedicated cooperation and to the *Kriminologischer Dienst* in Lower Saxony for its permission to conduct this study. Funding and guidance for this experiment was provided by the chair of Andreas Lange at the University of Hamburg. Sarah Mörtenhuber and Jan Papmeier provided excellent research assistance.

1 Introduction

Since Gary Becker's (1968) seminal paper, criminal law and economics assume that welfare loss from crime can be minimized by optimal deterrence policy. The underlying assumption that individuals react to incentives and changes in expected payoffs constitutes the deterrence hypothesis. A number of empirical tests of the deterrence hypothesis have been criticized for their estimation techniques and issues of simultaneity, data collection, data aggregation, and possible incapacitation bias (Levitt and Miles, 2007; notable exceptions include Levitt, 1997; Corman and Mocan, 2000; Fisman and Miguel, 2007).

For this reason experimental economic studies have recently focused on investigating crime and deterrence in controlled environments. Recent studies provide evidence that an increase in the expected punishment decreases criminal activity of *students* (e.g. Abbink et al., 2002; DeAngelo and Charness, 2012; Khadjavi, forthcoming; Nagin and Pogarsky, 2003; Rizzolli and Stanca, 2012; Schildberg-Hörisch and Strassmair, 2012).

Representing a certain social status, university students are only one and not the most usual target of deterrence incentives. Anderson (2002) presents results from a prison survey and formulates doubt about the effectiveness of deterrence incentives for criminals. He argues that there are two necessary conditions for the deterrence hypothesis to hold for criminals: (1) sufficient information about probabilities and punishment and (2) rational behavior. A great majority of criminals in his survey study appeared uninformed and ignorant of deterrence measures. Accordingly, he questions the effectiveness of stricter deterrence policy to curtail crime.

This study directly investigates stealing decisions of *prison inmates*¹ in an extra-laboratory experiment that was set up in a women’s penitentiary² in Northern Germany.³ We use experimental methods to disentangle the two conditions discussed by Anderson (2002). By creating an environment with complete information, we are able to uncover potential rationality biases of criminals. This innovation is important as criminals are a major target group of deterrence policy.

The finding is in the title: in our controlled environment with complete information, deterrence incentives work to reduce stealing of criminals. That is, we confirm that deterrence incentives work for a major target group of deterrence policy. This work thus does not support Anderson’s (2002) concern that criminals are systematically irrational. As a robustness check, we also replicate the effectiveness of deterrence with student subjects, providing external validity of former results of deterrence experiments with students in the literature.

This article is organized as follows; section 2 introduces the experimental design and its predictions. The procedures of this study, especially regarding the experiment in prison, are discussed on section 3. Section 4 presents the results and section 5 concludes.

¹ In this paper we use the terms ‘inmate’, ‘prisoner’, and ‘criminal’ synonymously to describe the subjects drawn from the prison population of our study, assuming that the vast majority of prisoners were convicted rightfully. Cases of wrongfully convicted individuals nevertheless occur periodically, so that we do not intend to make any judgments about the guilt of any specific prisoner in our study.

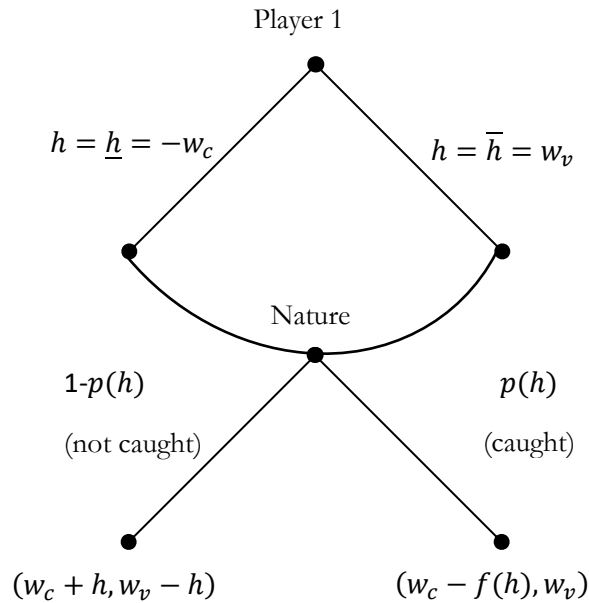
² We acknowledge that men account for the majority of prisoners. Still current statistics report more than 625,000 female prisoners worldwide (Walmsley, 2012). We therefore see no reason to disregard studies with prisoners on the grounds that the subjects are female.

³ Note that Block and Gerety (1995) also analyze decision making under risk of prison inmates. Their auction experiment does not involve stealing.

2 Experimental Design

The structure of our stealing game is depicted in Figure 1. It closely corresponds to the game of Schildberg-Hörisch and Strassmair (2012) with slight innovations. In the remainder of this work we will always refer to player 1 as *criminal* and player 2 as *victim*; note that our work applies this wording for easy reading while our experiment instructions and programs use a strictly neutral language. The endowments of the criminal and the victim are denoted w_c and w_v respectively. Potential criminals decide to stealing from or give to potential victims by choosing haul h , with $h \in \{-w_c, \dots, w_v\}$. Our first innovation is that we allow for stealing *and* giving and thereby try to avoid suggestiveness of the action space (motivated by findings of List, 2007 and Bardsley, 2008). All giving and neutral decisions, i.e. $h \leq 0$, are certain. Depending on the deterrence scheme, a taking decision, i.e. $h > 0$, triggers a positive probability of conviction $p(h)$ and a possible fine $f(h)$ if convicted.⁴ After a criminal has made her decision, the deterrence scheme at hand either punishes her with fine f (with probability p) or lets her keep h .

Figure 1. The Stealing Game.



⁴ Note that either p or f needs to be increasing in h to avoid marginal deterrence issues (see Stigler, 1970).

In our experimental design we set the endowments at $w_c = 2$ Taler and $w_v = 10$ Taler, and the stealing increment is 1 Taler.⁵ We employ two deterrence schemes to test the deterrence hypothesis. Scheme *NoDeter_* resembles a risk free environment and is comparable to a manipulation of the dictator game. Hence, in *NoDeter_* $f = 0$ and $p = 0$. *NoDeter_* is needed as a baseline against risky decision making. In the *DeterFine_* treatment, criminals face the risk of being fined for stealing, i.e. when choosing some $h > 0$. The probability of conviction in *DeterFine_* reads $p(h) = 0.5$ if $h > 0$ and $p(h) = 0$ if $h \leq 0$. Fine f is increasing in h , that is: $f = 1.25 - 0.25h + 0.1h^2$.

Table 1. Overview of the Deterrence Schemes.

h	Deterrence Scheme					
	<i>NoDeter</i>			<i>DeterFine</i>		
	f in EUR	p	π in EUR	f in EUR	p	$E(\pi)$ in EUR
-2	0	0	-2	0	0	-2
-1			-1			-1
0			0			0
1			1	1.10	0.5	-0.05
2			2	1.15		0.425
3			3	1.40		0.80
4			4	1.85		1.075
5			5	2.50		1.25
6			6	3.35		1.325
7			7	4.40		1.3
8			8	5.65		1.175
9			9	7.10		0.95
10			10	8.75		0.625

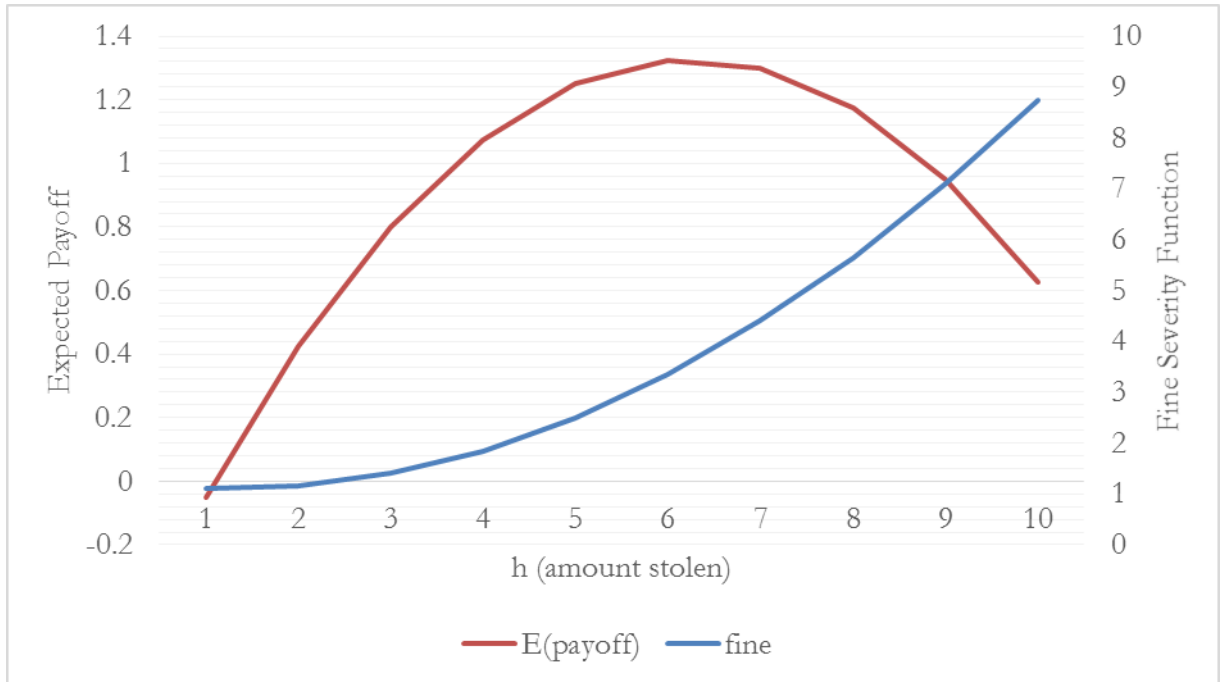
Note: Fine f is a function of stealing h , that is: $f = 1.25 - 0.25h + 0.1h^2$. Accordingly, an individual i with risk neutral, narrowly self-interested preferences maximizes her utility by choosing $h^* = 6.25 \approx 6$.

Corresponding to the description and Figure 1 above, a potential criminal i maximizes expected utility $\max_{h_i} U_i = (1 - p(h_i))u_i(w_i + h_i) + p(h_i)u_i(w_i - f(h_i))$ where $u_i(\cdot)$ denotes the

⁵ Additionally, both players were endowed with 7 Taler (which were needed to rule out negative payoffs).

Bernoulli utility function. In *NoDeter* criminals do not face any risk, such that the maximization problem collapses to $\max_{h_i} u_i = w_i + h_i$. The standard game theoretic (pure money-maximizing, risk neutral) prediction is that she chooses the maximum haul, $h_{NoDeter}^* = \bar{h} = w_v = 10$ Taler. In *DeterFine* a criminal maximizes her expected payoff by stealing $h_{DeterFine}^* = 6.25$ Taler which for the available increments rounds to 6 Taler. It is an important and novel feature of our design that we do not predict the extreme case of no stealing in *DeterFine*, but offer an interior solution. If the deterrence hypothesis holds for criminals, then we should find $h_{NoDeter} > h_{DeterFine}$. Table 1 provides an overview of the two deterrence schemes and Figure 2 depicts the calibration of *DeterFine*.

Figure 2. The Calibration of *DeterFine* with Respect to Expected Payoff and the Fine.



As alternatives to pure money-maximization, behavioral economic research produced a number of models of other-regarding, social preferences. Such social preferences are likely to play a role

in our experiment.⁶ Inequality-aversion models of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) yield a direct prediction for sufficiently inequality-averse subjects in *NoDeter*. Player 1 (the criminal) has the opportunity to establish equality of payoffs by stealing 4 Taler from player 2 (the victim). Hence, not only can we identify pure money-maximization (by observing $h_{NoDeter}^* = 10$ Taler as noted above), but we can also identify inequality-averse subjects by observing $h_{NoDeter}^{inequality\ aversion} = 4$ Taler.

As noted above, a point prediction for pure money-maximization under risk-neutrality is straightforward for *DeterFine* ($h_{DeterFine}^* = 6.25 \approx 6$ Taler). Likewise, we can formulate directions in which stealing should move for risk-averse ($h_{DeterFine}^{risk-averse} < 6.25$ Taler) and risk-seeking individuals ($h_{DeterFine}^{risk-seeking} > 6.25$ Taler).⁷ The sentiment in seminal contributions by Becker (1968) and Gottfredson and Hirschi (1990) tends to characterize criminals as more risk-seeking than non-criminals. Accordingly we can test whether there are a greater percentage of prisoners than students making a risk-seeking decision in *DeterFine*.

Formulating a prediction for a combination of risk preferences and inequality aversion is far more complicated as it requires assumptions on how social and risk preferences interact with each other. Understanding such interdependencies is located at the frontier of current behavioral economic research (see Brock et al., 2013; Cappelen et al., 2013), but goes beyond the scope of this paper. This is why we refrain from formulating any point predictions for *DeterFine* under inequality aversion.

⁶ In our experiment we observe decision making in a one-shot stealing game with only player 1, the criminal, making an active decision. Hence, we concentrate on distributional preferences and can neglect intention-based models, for instance on reciprocity (e.g. Dufwenberg and Kirchsteiger, 2004).

⁷ See Figure A.1 in Appendix A for point predictions of optimal stealing in *DeterFine* for a number of simple risk parameters using u^α .

3 Procedures

The five experimental sessions with prisoners were conducted at *JVA für Frauen* (penitentiary for women) in Vechta, Germany, on June, 14 2012.⁸ Inmates serve sentences ranging from a couple of days to life sentences. Three weeks before the experiment, official invitations were distributed in the prison. The invitations included information on the nature of the experiment, that participation is strictly voluntary, and that we guarantee absolute anonymity.⁹ As cash is forbidden in German prisons, we followed the suggestion of the responsible state institution to offer either a jar of instant coffee or a pack of tobacco as show-up fees (worth approx. 5 EUR). Prison subjects received individual phone credit depending on their decisions in the experiment. We set up a mobile computer laboratory with laptops and separation walls in the prison's gymnasium.

The four sessions with female students were conducted in the experimental economic laboratory at –BLANK– three weeks later, in the first week of July, 2012. Female students for our lab sessions were recruited from the subject pool via ORSEE (Greiner, 2004). The payment vehicle for students was a sum of cash consisting of a 5-EUR show-up fee and money determined by the decisions made in the experiment.

The stealing game was the first game of a sequence of games within a session. All decisions were made one-shot without feedback and all games were paid out. Subjects learnt about the content of the next game only after the current game was over. All participants made their decisions as

⁸ Further information (in German) on the JVA für Frauen in Vechta: www.jva-fuer-frauen.niedersachsen.de.

⁹ Despite our efforts to ensure credible anonymity, one may argue that some inmates may have acted in response to a demand effect. That is, some inmates may abstain from stealing as they believe that their actions will be traced. If this effect was present, it would work against finding a difference between *NoDeter* and *DeterFine*. Note that a decrease in stealing from *NoDeter* to *DeterFine* of the same subject cannot occur in our between-subject design.

player 1. It was only at the end of the experiment that subjects were informed about the outcome of the games and randomly matched and selected as being either player 1 or player 2.

90 inmates and 92 students participated in our experiment, yielding a total of 182 subjects. We employed a between-subject design: a subject either participated in *NoDeter* or in *DeterFine*. No subject participated in the experiment more than once. We used *Taler* as the experimental currency, with 1 EUR equal to 5 Taler. Sessions lasted about 45 minutes each. Average earnings in the stealing game were 12.76 Taler for students and 12.79 Taler for prisoners. Including the show-up fees, average earnings in prison were approx. 14.40 EUR compared to approx. 13.20 EUR in the student lab. We used z-Tree (Fischbacher, 2007) to program and run our experiment.¹⁰

4 Results

In our between-subject design we had 40 students and 38 prison inmates in our *NoDeter* treatment and 52 students and 52 inmates in the treatment with deterrence, *DeterFine*. Figure 3 provides an overview of the results. On average inmates stole 4.34 Taler in *NoDeter* and 3.08 Taler in *DeterFine*. This difference is statistically significant at $p = 0.0643$ (two-tailed Mann-Whitney test). Testing the deterrence hypothesis, i.e. $h_{NoDeter} > h_{DeterFine}$, the one-tailed Mann-Whitney test yields $p = 0.03215$. Hence, deterrence works for criminals: they steal significantly less with punishment incentives in place.

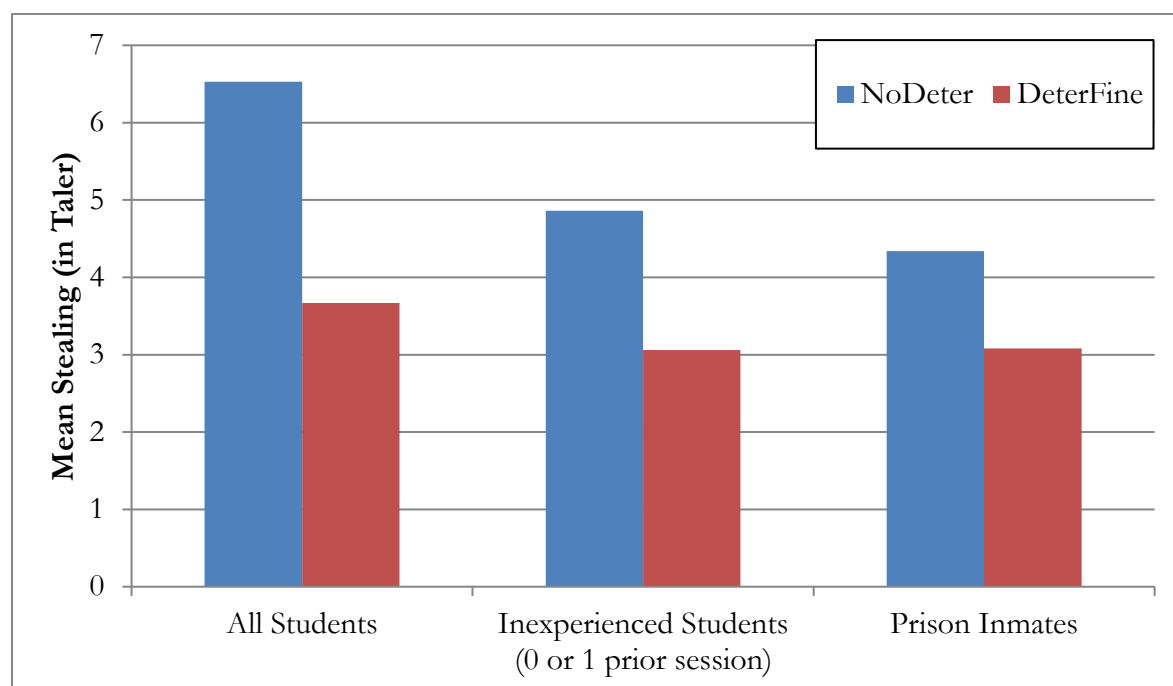
The treatments with students replicate results of earlier deterrence experiments with students and act as a robustness check. Students decided to steal an average amount of 6.53 Taler in *NoDeter* compared to 3.67 Taler in *DeterFine* (different at $p < 0.000$, two-tailed Mann-Whitney test). Using

¹⁰ Figures A.2 and A.3 in Appendix A display the monitors used for the two treatments.

our design, we thus replicate the result in the literature that deterrence works in the conventional lab with students:

Result 1. *Criminals in our study react to deterrence incentives. We provide support for Gary Becker's deterrence hypothesis.*

Figure 3. Mean Stealing of Students and Prison Inmates.



We will next analyze the distribution of stealing of the two subject group and between the two treatments. For both prisoners and students we find that a majority does *not* steal the maximum amount in *NoDeter*. As *NoDeter* is a manipulation of the dictator game, we confirm evidence on pro-sociality of prison inmates in the dictator game by Chmura et al. (2010) and Birkeland et al. (forthcoming), with the difference that we examine females. We thereby fill a small gap in this literature.

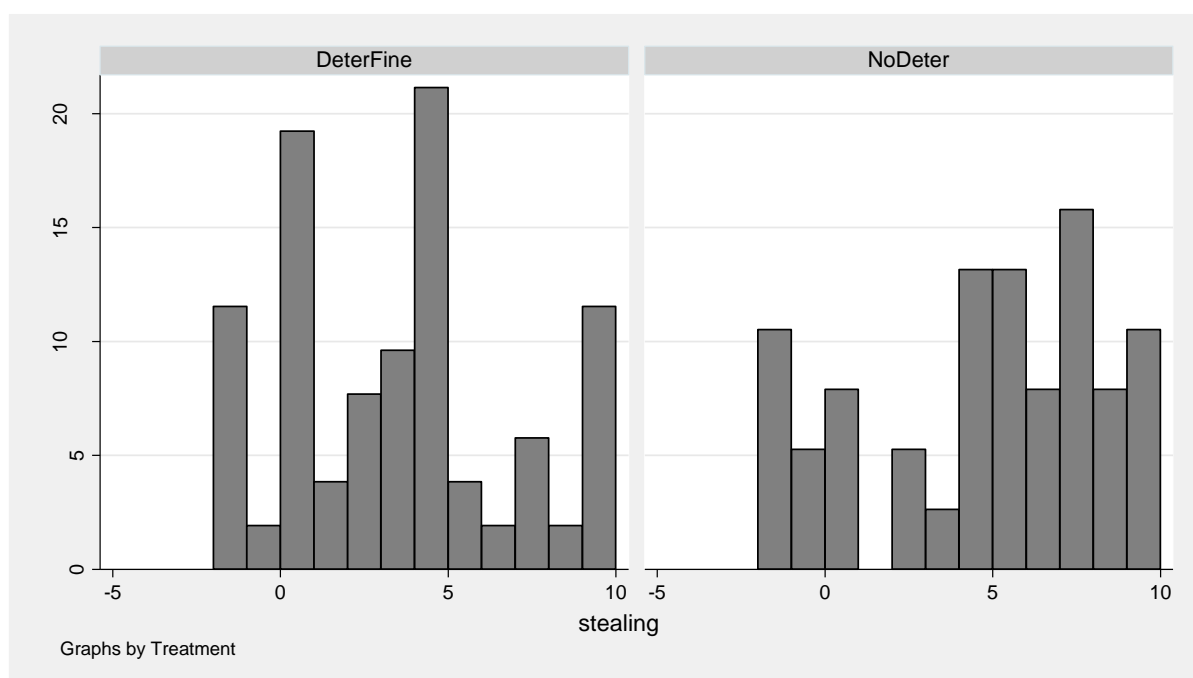
The histogram of the stealing distribution of students in *NoDeter* (on the right-hand side of Figure 5) exhibits two peaks: one at 4 Taler and another one at 10 Taler. As formulated in Section 2, these two peaks represent subjects deciding in accordance with our point predictions for inequality aversion (4 Taler) and pure money-maximization (10 Taler). Hence, we find support for inequality aversion as formulated by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). We do not observe such pronounced peaks for decisions of prisoners in *NoDeter* (on the right-hand side of Figure 4).

The stealing decisions of prisoners in *DeterFine* exhibit three peaks however (on the left-hand side of Figure 4). One at 0 Taler, representing subjects who decide to refrain from stealing completely in the light of deterrence, one at 4 Taler, and one at 10 Taler. For students in *DeterFine* we only find a single peak at 4 Taler. As formulated in Section 2, risk-neutral subjects should steal 6 Taler while risk-seeking subjects should steal more than 6 Taler in *DeterFine*. As depicted in Figures 4 and 5, there are 19.23% of prisoners compared to 3.85% of students who behave as risk-seekers in *DeterFine*. A two-sided Fisher's exact test rejects the null hypothesis of equal frequencies ($p = 0.028$). We find support for the sentiment of Becker (1968) and Gottfredson and Hirschi (1990) that criminals are more risk-seeking:

Result 2. *The criminals in our study behave more risk-seekingly than students.*

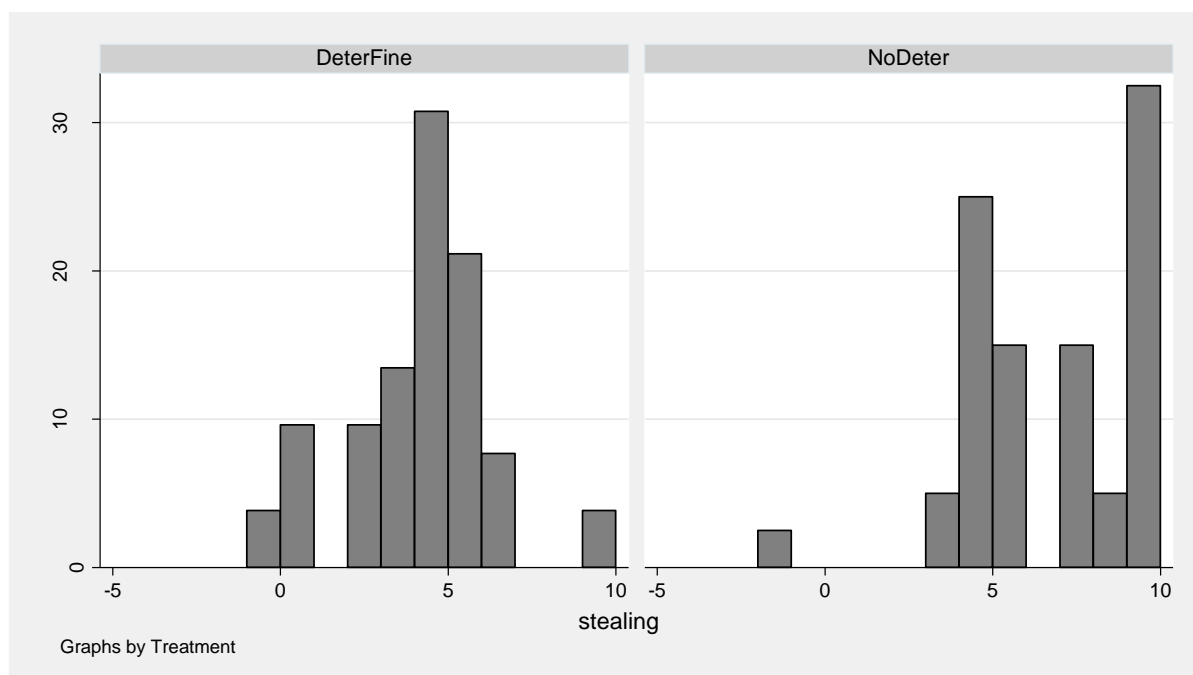
The stealing distributions of prisoners in *NoDeter* and *DeterFine* differ significantly based on a Kolmogorov-Smirnov test ($p = 0.022$). The same is true for the stealing distribution of students in *NoDeter* and *DeterFine* (Kolmogorov-Smirnov test, $p < 0.000$). It appears that stealing 4 Taler is a focal point in almost all setups. While we find evidence for inequality-averse subjects in *NoDeter*, it is not clear what subjects stealing 4 Taler in *DeterFine* are motivated by inequality aversion or a combination of social and risk preferences.

Figure 4. Histograms of the Amount Stolen (h) by Prisoners in the two Treatments.



Note: The width of each bar equals 1. Based on a Kolmogorov-Smirnov test, these two distributions are different from each other at $p = 0.022$.

Figure 5. Histograms of the Amount Stolen (h) by Students in the two Treatments.



Note: The width of each bar equals 1. Based on a Kolmogorov-Smirnov test, these two distributions are different from each other at $p < 0.000$.

5 Concluding Remarks

In line with current extensions of experimental economic research to criminals (Chmura et al., 2010; Birkeland et al., forthcoming; Khadjavi and Lange, 2013; Cohn et al., 2013), this study tests the effectiveness of deterrence incentives for prisoners. This aim is of central importance for law and economic policy. If this target group of policy does not react to incentives in the desired way and reduces criminal activity – a central assumption in all deterrence policy – then this policy may be ineffective to reduce crime.

We confirm that deterrence incentives mitigate stealing behavior of inmates. Anderson (2002) discusses that both lack of information on the incentive structure and systematical biases may cause the deterrence hypothesis to fail for criminals. This is one of the reasons why the randomized and controlled approach of experimental research is useful here. In our experiment inmates receive complete information about the deterrence incentives – and they react to these incentives. Our finding therefore does not support the conjecture of criminals' decision making to be systematically biased and ignorant of deterrence incentives.

Likewise, we find that the majority of prisoners hold social preferences as they do not behave in accordance with pure money-maximization. While we do find that prisoners behave more risk-seeking than students, the group of risk-seeking prisoners is far from a majority (19.23%). These findings can be regarded as reassuring for policy makers who rely on the deterrence hypothesis and for researchers who invite student subjects for experimental studies on criminal behavior.

References

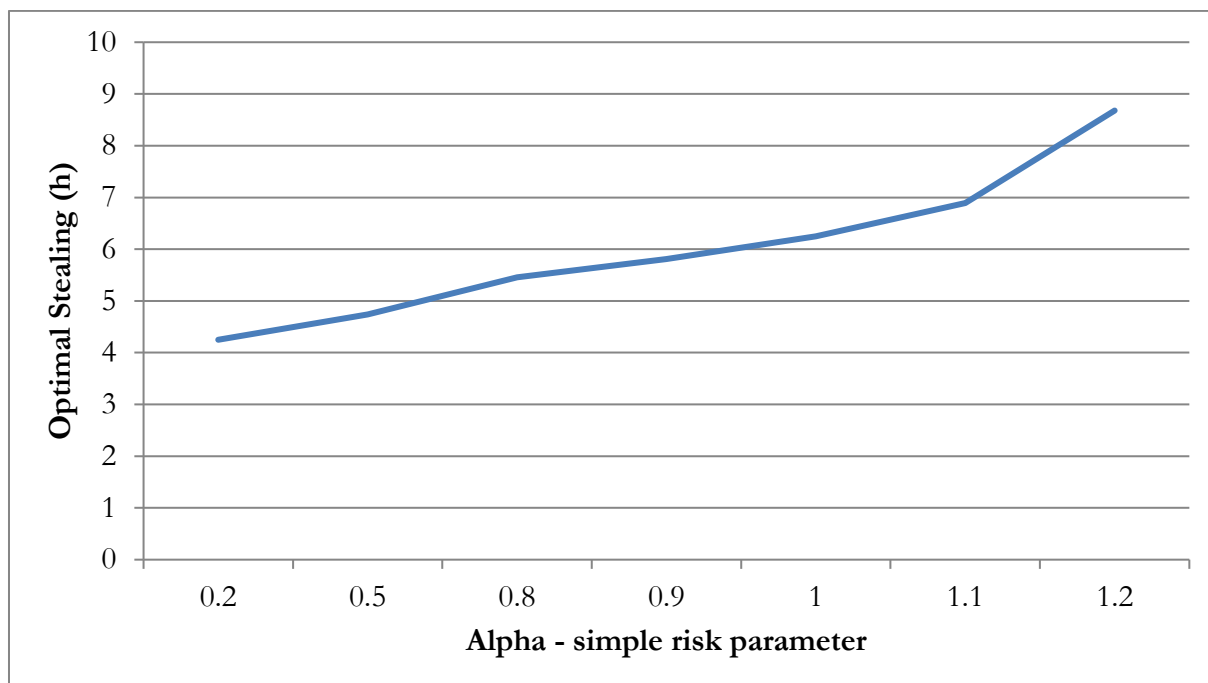
- Abbink, K., B. Irlenbusch and E. Renner (2002). "An Experimental Bribery Game". *Journal of Law, Economics and Organization*, vol. 18, pp. 428-454.
- Anderson, D.A. (2002). "The Deterrence Hypothesis and Picking Pockets at the Pickpocket's Hanging". *American Law and Economics Review*, vol. 4, pp. 295-313.
- Bardsley, N. (2008). "Dictator game giving: altruism or artifact?". *Experimental Economics*, vol. 11, pp. 122-133.
- Becker, G.S. (1968). "Crime and Punishment: An Economic Approach". *The Journal of Political Economy*, vol. 76, pp. 169-217.
- Birkeland, S., A.W. Cappelen, E.Ø. Sørensen and B. Tungodden (forthcoming). "An experimental study of prosocial motivation among criminals". *Experimental Economics*.
- Block, M.K. and V.E. Gerety (1995). "Some experimental evidence on differences between student and prisoner reactions to monetary penalties and risk". *Journal of Legal Studies*, vol. 24, pp. 123-138.
- Bolton, G.E. and A. Ockenfels (2000). "ERC: A Theory of Equity, Reciprocity, and Competition". *American Economic Review*, vol. 90, pp. 166-193.
- Brock, J.M., A. Lange, and E.Y. Ozbay (2013). "Dictating the Risk: Experimental Evidence on Giving in Risky Environments". *American Economic Review*, vol. 103, pp. 415-437.
- Cappelen, A., J. Konow, E.Ø. Sørensen, and B. Tungodden (2013). "Just Luck: An Experimental Study of Risk-Taking and Fairness". *American Economic Review*, vol. 103, pp. 1398-1413.
- Chmura, T., C. Engel, M. Englerth and T. Pitz (2010). "At the Mercy of the Prisoner Next Door – Using an Experimental Measure of Selfishness as a Criminological Tool". MPI Bonn 2010/27.
- Cohn, A., M.A. Maréchal and T. Noll (2013). "Bad Boys: The Effect of Criminal Identity on Dishonesty". University of Zürich, Working Paper No. 132.

- Corman, H. and H.N. Mocan (2000). "A Time-Series Analysis of Crime, Deterrence, and Drug Abuse in New York City". *The American Economic Review*, vol. 90, pp. 584-604.
- DeAngelo, G. and G. Charness (2012). "Deterrence, expected cost, uncertainty and voting: Experimental evidence". *Journal of Risk and Uncertainty*, vol. 44, pp. 73-100.
- Dufwenberg, M. and G. Kirchsteiger (2004). "A theory of sequential reciprocity". *Games and Economic Behavior*, vol. 47, pp. 268-298.
- Fehr, E. and K.M. Schmidt (1999). "A theory of fairness, competition, and cooperation". *Quarterly Journal of Economics*, vol. 114, pp. 817-868.
- Fischbacher, U. (2007). "Z-Tree: Zurich Toolbox for Ready-made Economic Experiments". *Experimental Economics*, vol. 10, pp. 171-178.
- Fisman, R. and E. Miguel (2007). "Corruption, Norms, and Legal Enforcement: Evidence from Diplomatic Parking Tickets". *Journal of Political Economy*, vol. 115, pp. 1020-1048.
- Gottfredson, M.R. and T. Hirschi (1990). *A general theory of crime*. Stanford: Stanford University Press.
- Greiner, B. (2004). "An Online Recruitment System for Economic Experiments", in: Kremer, K. and V. Macho (eds.), *Forschung und wissenschaftliches Rechnen 2003*. GWDG Bericht 63, Göttingen: Ges. für Wiss. Datenverarbeitung, pp. 79-93.
- Khadjavi, M. (forthcoming). "On the Interaction of Deterrence and Emotions". *Journal of Law, Economics, and Organization*.
- Khadjavi, M. and A. Lange (2013). "Prisoners and their Dilemma". *Journal of Economic Behavior and Organization*, vol. 92, pp. 163-175.
- Levitt, S.D. (1997). "Using Electoral Cycles and Police Hiring to Estimate the Effect of Police on Crime". *The American Economic Review*, vol. 87, pp. 270-290.
- Levitt, S.D. and T.J. Miles (2007). "Empirical study of criminal punishment". In: Polinsky, A.M. and S. Shavell (eds.), *Handbook of Law and Economics, Volume 1*. Chapter 7. Amsterdam: Elsevier.

- List, J.A. (2007). "On the Interpretation of Giving in Dictator Games". *Journal of Political Economy*, vol. 115, pp. 482-493.
- Nagin, D.S. and G. Pogarsky (2003). "An experimental investigation of deterrence: cheating, self-serving bias, and impulsivity". *Criminology*, vol. 41, pp. 167-194.
- Rizzolli, M. and L. Stanca (2012). "Judicial Errors and Crime Deterrence: Theory and Experimental Evidence". *Journal of Law and Economics*, vol. 55, pp. 311-338.
- Schildberg-Hörisch, H. and C. Strassmair (2012). "An Experimental Test of the Deterrence Hypothesis". *Journal of Law, Economics, and Organization*, vol. 28, pp. 447-459.
- Stigler, G.J. (1970). "The Optimum Enforcement of Laws". *Journal of Political Economy*, vol. 78, pp. 526-536.

Appendix A – Complementary Figures

Figure A.1. Point Predictions of Optimal Stealing (h) Depending on Risk Preferences in *DeterFine*.



Note: The results were obtained by using mathematical software to solve our model with different alpha parameters of u^α .

Figure A.2. Z-tree Monitor in *NoDeter* (translated from German into English).

Task 1	
There are 9 Taler in your account. In the account of the other person, there are 17 Taler . Please decide how many Taler you would like to transfer from the account of the other person to your account.	
Transaction	Your choice
-2 Taler From your account to the other person's account	<input type="checkbox"/>
-1 Taler From your account to the other person's account	<input type="checkbox"/>
0 Taler Nothing will change	<input type="checkbox"/>
1 Taler From the account of the other person to yours	<input type="checkbox"/>
2 Taler From the account of the other person to yours	<input type="checkbox"/>
3 Taler From the account of the other person to yours	<input type="checkbox"/>
4 Taler From the account of the other person to yours	<input type="checkbox"/>
5 Taler From the account of the other person to yours	<input type="checkbox"/>
6 Taler From the account of the other person to yours	<input type="checkbox"/>
7 Taler From the account of the other person to yours	<input type="checkbox"/>
8 Taler From the account of the other person to yours	<input type="checkbox"/>
9 Taler From the account of the other person to yours	<input type="checkbox"/>
10 Taler From the account of the other person to yours	<input type="checkbox"/>
<input type="button" value="Continue"/>	

Figure A.3. Z-tree Monitor in *DeterFine* (translated from German into English).

Task 1			
<p>There are 9 Taler in your account. In the account of the other person, there are 17 Taler.</p> <p>Please decide how many Taler you would like to transfer from the account of the other person to your account.</p>			
Transaction	Probability of success	Fine if unsuccessful	Your choice
-2 Taler From your account to the other person's account	100 %	-	<input type="checkbox"/>
-1 Taler From your account to the other person's account	100 %	-	<input type="checkbox"/>
0 Taler Nothing will change	100 %	-	<input type="checkbox"/>
1 Taler From the account of the other person to yours	50 %	1,10 Taler	<input type="checkbox"/>
2 Taler From the account of the other person to yours	50 %	1,15 Taler	<input type="checkbox"/>
3 Taler From the account of the other person to yours	50 %	1,40 Taler	<input type="checkbox"/>
4 Taler From the account of the other person to yours	50 %	1,85 Taler	<input type="checkbox"/>
5 Taler From the account of the other person to yours	50 %	2,50 Taler	<input type="checkbox"/>
6 Taler From the account of the other person to yours	50 %	3,35 Taler	<input type="checkbox"/>
7 Taler From the account of the other person to yours	50 %	4,40 Taler	<input type="checkbox"/>
8 Taler From the account of the other person to yours	50 %	5,65 Taler	<input type="checkbox"/>
9 Taler From the account of the other person to yours	50 %	7,10 Taler	<input type="checkbox"/>
10 Taler From the account of the other person to yours	50 %	8,75 Taler	<input type="checkbox"/>
<input type="button" value="Continue"/>			

Appendix B – English Translations of the Instructions

General Instructions for Participants

Welcome to the Study!

Thank you for participating in our study today. You will be able to earn a considerable amount of money. It is therefore important that you read these instructions carefully.

It is prohibited to communicate with other participants during the study. Should you have any questions please raise your hand and an instructor will come to answer them. If you violate this rule, we will have to exclude you from the study and from all payments.

During the experiment you will make decisions **anonymously**, other participants will not learn about your decisions.

In any case you will earn [*Field: a pack of coffee or a pack of tobacco; Lab: 5 Euros*] for participation in this experiment. The additional earnings depend on your decisions [*Field: and will be paid to your phone account*]. During the study your earnings will be calculated in Taler. At the end of the experiment your earned Taler will be converted into Euros at the following exchange rate:

1 Taler = 0,20 €.

The study consists of five independent tasks. Your decision in a task does not have any impact on the other tasks.

The instructions for the five tasks will be handed out one after another. You will first receive instructions for task 1 and then make your decision at the computer terminal. After this task 1 is done.

Thereafter you will receive instructions for task 2 and again make your decision at the computer terminal. This procedure continues until the end of the study. In the end we will also ask you to answer some general questions.

At the end of the study you will receive your payment. Your payment is the sum of payments from all five tasks. All earned Taler will be converted to Euros and paid to you [*Field: in addition to a pack of coffee or tobacco*]. Hence you will get

Your total payment

=

Your payment from task1, 2, 3, 4 and 5 + [*Field: a pack of coffee or tobacco, Lab: 5 EUR*]

All payments will be done separately, without any other participant being able to see what you have earned. Apart from the instructor nobody will know what you have earned.

Instructions for Task 1

[The Stealing Game, NoDeter Treatment:]

In task 1 you need to decide how many Taler to transfer between your account and the account of another participant who is randomly matched with you. You will not receive information on the identity of the other participant. Neither will the other participant receive information on your identity.

At the end of the experiment one half of the participants will be randomly selected to be person 1, the other half will be person 2. Your own decision will count if you are selected as person 1. If you are selected as person 2, you will receive your payment in accordance with the decision of a person 1 who is matched with you.

There are 9 Taler in your account while the account of the other person holds 17 Taler.

You are able to decide freely how many Taler you would like to transfer between the account of the other person and your own account. That is, you are able to transfer up to 2 Taler from your account to the account of the other person (transfer “-2”) or up to 10 Taler from the account of the other person to your account (transfer “10”).

For example, if you decide to transfer -2 Taler, you will receive 7 Taler in this task while the person who is matched with you will receive 19 Taler. If you decide to transfer 7 Taler, then you will receive 16 Taler in this task and the matched person will receive 10 Taler.

In summary, your transfer between the account of the other person and your own account may be between “-2” and “10”.

Please make a decision on the screen to decide how many Taler to transfer to your account from the account of person 2.

Instructions for Task 1

[The Stealing Game, DeterFine Treatment:]

In task 1 you need to decide how many Taler to transfer between your account and the account of another participant who is randomly matched with you. You will not receive information on the identity of the other participant. Neither will the other participant receive information on your identity.

At the end of the experiment one half of the participants will be randomly selected to be person 1, the other half will be person 2. Your own decision will count if you are selected as person 1. If you are selected as person 2, you will receive your payment in accordance with the decision of a person 1 who is matched with you.

There are 9 Taler in your account while the account of the other person holds 17 Taler.

You are able to decide freely how many Taler you would like to transfer between the account of the other person and your own account. That is, you are able to transfer up to 2 Taler from your account to the account of the other person (transfer “-2”) or up to 10 Taler from the account of the other person to your account (transfer “10”).

If you decide to transfer Taler from the account of the other person to your own account, this transfer will only be successful half of the times, i.e. the probability of success is 50 %. If the transfer is not successful, you will have to pay a fee that is shown on your screen.

For example, if you decide to transfer -2 Taler, you will receive 7 Taler in this task while the person who is matched with you will receive 19 Taler. If you decide to transfer 7 Taler and your transfer is successful, then you will receive 16 Taler in this task and the matched person will receive 10 Taler. If your transfer is not successful, then you will receive the initial 9 Taler minus the fee and the person who is matched with you keeps 17 Taler.

In summary, your transfer between the account of the other person and your own account may be between “-2” and “10”.

Please make a decision on the screen to decide how many Taler to transfer to your account from the account of person 2. Mind the respective fee in case your transfer is not successful.