MPRA

Munich Personal RePEc Archive

Criminals and risk attitude

Langlais, Eric

BETA, CNRS and Nancy University

June 2006

Criminals and risk attitude

Eric Langlais*

BETA, CNRS and University of Nancy 2

November 24, 2006

Abstract

We show that whatever the representation of criminals' preferences under risk, the assumption according to which they are strongly risk averse individuals is not consistent with the available observations establishing that criminals are more sensitive to shifts in the probability of sanction than to changes in the level of the sanction. We suggest that: 1/ while a weakening of the risk aversion assumption may be useful, the risk seeking assumption may be better suited for criminals; 2/ the relevant assumption regarding criminals' risk attitude may depend on the policy instruments that models of crime deterrence take into account; 3/ additional experiments, including both monetary penalties and non monetary sanctions would be useful in order to learn more about their sensibility to probability, monetary and non monetary sanctions.

1 Introduction

In this paper, we address the issue of the risk sensitivity of criminals. We challenge the view of Nielson and Winter (1997) who discuss the specific assumptions about criminals' preferences that would enable us to rationalize the experimental evidence afforded by Block and Gerety (1995) and Grogger (1991) (see hereafter). We show that the solution provided by Nielson and Winter in fact focus on a particular concept of risk aversion which is associated with characterizations (*e.g.* formal restrictions) that appear as quite questionable from the empirical point of view. We suggest that additional experiments, including more specifically both monetary penalties and non monetary sanctions, would be useful to take into account some neglected aspects concerning the issue of the risk attitude of criminals. Moreover, we point out that the results of these

---

experiments would have important consequences to shed some light on a long-standing controversy initiated by Becker (1968), regarding the design of socially efficient policies of law enforcement.

The rest of the paper is structured as follows. In section 2, we briefly review basic results and definitions about the concept of risk aversion. In section 3, we first show that the findings of Block and Gerety (1995) and Grogger (1991) rule out the Rothschild-Stiglitz risk aversion assumption in the strong sense for any model of criminals' preferences. In contrast, risk seeking in the strong sense fits well with the data. In section 3, we show that the SDU approach can allow us to reconcile the weaker risk aversion assumption of Arrow-Pratt with the observations only if we introduce an additional assumption on the marginal utility of wealth, which is not implied by risk aversion *per se*. Moreover, this last assumption may be not easily justified, specifically when we consider that state dependence captures the effects of non monetary sanctions. In this vein, it appears that criminals' risk attitudes may be the result of public enforcement of the law. Section 4 concludes. We suggest that some additional and more specific experiments are required in order to learn more about criminals' risk attitudes and particularly to learn more about their sensitivity to punishment and detection. We point out that the results of such experiments are of importance in economics of crime, since they are connected to empirical assessments of the trade-off between probability, fines and non monetary sanctions.

2   Risk aversion

The assumption about people's risk attitudes and preferences are an ongoing discussion in the L&E literature [1] and given that the debate is not different from the controversies in decision theory and Economics in general, it is worth to recalling some of the most well established results. Risk aversion is a usual behavioral assumption in economics as a basic motivation explaining the existence of market exchanges such as in insurance or financial markets. Nevertheless, both theoretical works and accumulated experimental evidence in the area of decision theory and economics of risk show first that the concept of risk aversion is by no means a commonplace concept, and second that the Expected Utility model which is the framework of textbook economics is the least relevant representation of individual preferences.

On the one hand, there exist several alternative *intrinsic* definitions of this behavioral assumption (see Cohen (1995) for a survey). By "intrinsic", we mean that each definition is designed to capture a specific behavioral concept, independently of any particular representation of individual's preferences under risk that could be used for practical purposes. For example, the two well known

---

[1] Polinsky and Shavell (1979) and Nielson (1998) study the implications of criminals' risk aversion for the enforcement of law. More recently in tort law, several papers by Bigus (2006), Eide (2005), Nell and Richter (2003), Teitelbaum (2006) or Zivin, Just and Zilberman (2006) use different approaches to study the functioning of liability rules when both offenders and victims are risk averse individuals.

definitions suggested by Arrow-Pratt[2] and by Rothschild-Stiglitz[3], are from a basic conceptual point of view two different concepts of risk aversion. As a result turning to the issue of characterizing risk aversion in the context of a specific axiomatically-based model allowing the representation of individual preferences, it is now well known for example that these two concepts of risk aversion require a distinguishable set of restrictions (see Cohen (1995)) unless we confine ourselves to the Expected Utility model where they are both equivalent to the concavity of the utility index of the decision maker.

On the other hand, there is well documented experimental evidence showing that attitude towards risk is a complex story in practise, in the sense that the typical pattern of risk attitudes is fourfold: individuals are prone to a risk seeking attitude either with small probabilities of gains or large probabilities of losses; in contrast risk aversion occurs either for small probabilities of losses or large probabilities of gains (see Tversky and Wakker (1995)). This implies that any given individual displays both risk aversion and risk seeking for a wide range of payoffs, depending on the probabilities to which these payoffs are associated in the prospects he is facing. It is also now well established that this pattern of behavior is not consistent with the Expected Utility (EU thereafter) assumption.

Experiments performed in the area of crime deterrence have come to similar conclusions. Block and Gerety (1995) and Grogger (1991) have shown that criminals exhibit more sensitivity to shifts in the probability of fine than to changes in the fine. Although this not a direct test about whether criminals are risk averse individuals or not, such a finding is not consistent with the joint assumption that criminals are risk averse and EU maximizers although this is perfectly explained by the joint assumption that criminals are EU individuals exhibiting a risk seeking behavior, as shown long ago by Becker (1968, p 178 footnote 19). For Neilson and Winter (1997), assuming risk seeking for criminals would make criminals different from the rest of the population. But as previously reminded, risk seeking is consistent with a large body of experimental evidence. Moreover, offenders who willingly undertake risks in some way look like individuals making violent sports, having dangerous hobbies and so on, who have been studied by sociologists (see the literature on *society at risk*: Beck (1992), Giddens (1991)), and who are seen as risk loving populations. Nevertheless in order to overcome what appears an uncomfortable consequence of the EU model, Neilson and Winter (1997) have argued that if criminals are either State-Dependent Utility (SDU) maximizers or Rank-Dependent Expected Utility (RDEU) maximizers, then they may be risk averse and at the same time display more sensitivity to shifts in the probability of fine than to changes in the fine as found by Block and Gerety (1995) and Grogger (1991). Once more, the relevance of the EU approach is challenged.

The purpose of the paper is to revisit the results of Neilson and Winter on

---

[2] According to the Arrow-Pratt's definition, an individual is said to be risk averse if he prefers the mean of a prospect with certainty to the prospect itself.

[3] According to Rothschild-Stiglitz's definition, an individual is said to be risk averse if between two loteries with the same mean but ranked according to the Second Stochastic order, he prefers the one which is the less risky.

two grounds. On the one hand, we distinguish between risk aversion in the strong and in the weak sense. Secondly, we explicit several conditions that are required in the SDU model to qualify their results. Finally, we discuss the relevance and consequence of these conditions in the area of the economics of crime.

3 Strongly risk averse criminals: an impossibility result

We consider the following notations: $y > 0$ will correspond to the (non random) benefit obtained by the criminal in the illegal activity, and $X = (p, -f; 1 - p, 0)$ will be the prospect he faces due to the risk of public detection, arrestation and punishment, where $f > 0$ is the monetary penalty (fine), and p the probability of detection and sanction.

For the moment, we do not focus on a specific representation of the criminal's preferences. Let us simply assume that the preferences of the criminal satisfy the usual axioms (existence, continuity, monotonicity and convergence in the sense of the first stochastic dominance order). Let us denote by V the value function representing criminals' preferences, with $V(y + X)$ being their welfare associated to y and X. Let us finally assume for ease of exposition that V is differentiable with respect to p and f. In this set up, two different concepts of risk aversion may be defined:

- risk aversion in the strong sense of Rothschild-Stiglitz - which is risk aversion to any shift in the risk X defined in the sense of the second stochastic dominance order. In order to illustrate, assume that the prospect $X' = (p', -f'; 1 - p', 0)$ with $p'f' = pf$ is less risky than X in the sense of the second stochastic order; thus, it must be that $p' > p$ and $f' < f$. As a result, if V satisfies the second stochastic dominance order, then $V(y + X') \geq V(y + X)$.

- risk aversion in the weak sense of Arrow-Pratt - that is being better off with the expected outcome of the prospect $E(X)$ rather than accepting the prospect X. Hence, risk aversion in the weak sense is written $V(y + X) \leq V(y + E(X))$.

In order to see how criminals' risk attitudes and the issue of their sensitivity to relative shifts in fines and the certainty of punishment are interrelated, let us consider the first definition of risk aversion. Basically, a simple mean-preserving contraction of the risk X can be generated by an increase in the probability of sanction p and a simultaneous decrease in the level of sanction f, while keeping the expected sanction unchanged to pf. Thus, assume that the mean-preserving contraction of the risk is obtained through a marginal change of p and f; as the probability increases, the fine must be set such that: $\frac{df}{dp} = -\frac{f}{p}$; moreover if V satisfies the second stochastic dominance order, then when the criminal faces this contraction of risk, his satisfaction level must increase with p such that $\frac{dV}{dp} = V_p - V_f \frac{f}{p} \geq 0$. Rearranging this inequality yields: $-V_p \frac{p}{V} \equiv e_p^V \leq e_f^V \equiv -V_f \frac{f}{V}$, meaning that he must be less sensitive to the shift in the probability of sanction than to the change in the level of the sanction. Hence a contradiction with the

empirical findings by Block and Gerety (1995) and Grogger (1991). It is worth noticing that whatever the assumption about the specific representation of the criminal's preferences, that is whether he is supposed to be an Expected utility or a State-Dependent Utility one, a Rank Dependent Utility individual or using any other model allowing the representation of his preferences, the same result will occur: risk aversion in the strong sense is not consistent with the condition $e_p^V \geq e_f^V$.

However, remark that risk seeking in the strong sense ($\frac{dV}{dp} \leq 0$) is always consistent with $e_p^V \geq e_f^V$.

In contrast, risk aversion in the weak sense may be consistent with $e_p^V \geq e_f^V$. But without any additional restrictions on the representation of preferences, it is not easy to see when it occurs. In the following section, we focus on the SDU model. In the EU model, risk aversion in the weak sense is equivalent to risk aversion in the strong sense (see also Cohen (1995)). Hence, this definitively rules out the EU model as a relevant assumption regarding criminals' preferences.

The following proposition summarizes the results:

Proposition 1 *For any representation of criminals' preferences:*

i) if they respect the second stochastic dominance order axiom, which implies risk aversion in the strong sense of Rothschild-Stiglitz, then it is not possible to support the empirical findings by Block and Gerety (1995) and Grogger (1991) that $e_p^V \geq e_f^V$.

ii) in contrast, the empirical findings by Block and Gerety (1995) and Grogger (1991) that $e_p^V \geq e_f^V$ are always consistent with the assumption that criminals are prone to a risk seeking behavior (in the strong sense of Rothschild-Stiglitz).

4 State-Dependent Utility maximizers

Assume that the preferences of a criminal satisfy the axioms of the SDU model. Then, there exist two real value functions (both being continuous, increasing and unique up to an affine transformation), denoted u_c, u_n corresponding to his utility indexes when he is respectively caught and not caught by public authorities, such that when he earns y and faces the risk $X = (p, -f; 1-p, 0)$, the criminal's ex ante satisfaction level is noted:

$$V(y + X) = pu_c(y - f) + (1 - p)u_n(y)$$

It is assumed that $u_c < u_n$ at all levels of wealth. The state-dependent representation of individual preferences encompasses cases where the state of the world affects the ability of an individual to enjoy consumption of his wealth; for example, arrestation and/or conviction of a crime with incarceration may easily be understood as states of the world where the opportunities to consume

are diminished for criminals. This may also reflect that the criminal's ability to find a new job is reduced with a criminal record, or after prison (Nielson and Winter (1997)). Even without a prison sentence, an individual who has been only suspected of a crime may experience adverse effects on his consumption opportunities through his human wealth because of reputational effects. On the other hand, the state-dependent representation may capture psychological or emotional consequences of arrestation and punishment, together with the impact on the criminal's health status in case of punishment.

In this framework, risk aversion in the weak sense of Arrow-Pratt requires that both utility indexes be concave (Dehez and Drèze (1987), Jones-Lee (1974)).

According to the findings that $e_p^V = p\frac{u_n(y) - u_c(y-f)}{V(y+X)} \geq e_f^V = pf\frac{u_c'(y-f)}{V(y+X)}$, for the SDU model we must have:

$$\frac{u_n(y) - u_c(y - f)}{f} \geq u_c'(y - f) \tag{1}$$

We now prove that this inequality is always satisfied if $u_c' \leq u_n'$ at all levels of wealth. Simple calculations show that (1) may be equivalently written as:

$$\frac{u_n(y) - u_n(y - f)}{f} \geq -\frac{u_n(y - f) - u_c(y - f)}{f} + u_c'(y - f)$$

But by the concavity of u_n, we have:

$$u_n'(y - f) \geq \frac{u_n(y) - u_n(y - f)}{f}$$

As a conclusion, risk aversion in the weak sense is compatible with the finding that $e_p^V \geq e_f^V$ in the SDU model if it is also compatible with the following inequality:

$$u_n'(y - f) \geq -\frac{u_n(y - f) - u_c(y - f)}{f} + u_c'(y - f) \tag{2}$$

Given that $u_c < u_n$ at all levels of wealth, (2) is always satisfied if we also require that $u_c' \leq u_n'$ at all levels of wealth - which seems to be an implicit assumption in the analysis of Neilson and Winter (1997, fig. 2 page 100) - but it is incomplete or false otherwise as a general result.

Hence, in contrast to the claim made in Neilson (1998), the SDU does not rule out the discussion about the implications of punishment on the marginal utility of wealth. The assumption that $u_c' \leq u_n'$ at all levels of wealth means that the criminal is better off earning one additional euro in the state where he is free than earning the same euro when he is caught.

The discussion is summarized in the next proposition:

Proposition 2 *Assume that criminals' preferences respect the SDU axioms, with two utility indexes u_c, u_n corresponding respectively to the state of arrestation and punishment, and the one without arrestation, both supposed to be increasing and concave and satisfying: $u_c < u_n$ at all feasible levels of wealth; then if $u'_c \le u'_n$ at all levels of wealth, risk aversion in the weak sense of Arrow-Pratt allows to support the empirical findings by Block and Gerety (1995) and Grogger (1991) that $e_p^V \ge e_f^V$.*

In many areas of economics the assumption that $u'_c \le u'_n$ at all levels of wealth has been meaningful and useful; see for example the literature about the existence of irreplaceable commodities (see Cook and Graham (1977)) or about self-protection expenditures and the willingness to pay for safety, health and life (see Dehez and Drèze (1987), Jones-Lee (1974) for example)[4].

Is it also relevant for the analysis of dangerous or criminal behaviors? We may expect that it depends on what the state-dependent approach is supposed to capture - and specifically on what the bad state represents. To the extent that the state with arrestation and punishment is a state where the criminal may bear not only a monetary penalty but also non monetary sanctions such as imprisonment or incapacitations, it is not so obvious that one euro has more value in the good state as compared to the bad state. Given that imprisonment means a loss of income and thus a loss of consumption, the marginal utility of wealth may be larger when the criminal is in jail than when he is not. Similarly, incapacitations such as the loss of driving license or professional licences impose the burden of substantial costs (fixed transportation costs, switching costs to other activities and so on) on the individual who is punished in order to compensate for the loss of those rights, which lead to a large increase in his marginal utility in the state of arrestation and punishment. It implies that finally the assumption $u'_c \ge u'_n$ is not absurd. As a result, (2) may not be obtained in such situations.

On the contrary, the case where the bad state corresponds to the pain of death better fits the situation where marginal utility is larger in the safe state than in the bad one (as the result of a "dead anywhere effect"), explaining that (2) always occurs.

Finally, remark that under the assumptions that both utility functions are convex and satisfy $u_c < u_n$ at all levels of wealth, (1) is always satisfied without the need of additional conditions.

5 Concluding remarks

It is not sufficient to remove the EU assumption in order to reconcile the risk aversion assumption for criminals with the experimental evidence showing that they have more sensitivity to the probability of being caught than to fines. In

---

[4]It implies for example that prevention activities and/or the willingness to pay for a reduction in the risk of mortality are not inferior goods.

this note, we have shown that the concept of risk aversion in the strong sense is definitively ruled out, and that with risk aversion in the weak sense, additional assumptions (specific to the each peculiar representation of preferences) are required to fit these observations. Nevertheless, we have shown with examples based on two well known alternatives to the EU assumption that these additional conditions may have some shortcomings.

With the SDU approach, the issue is the meaning of the non monetary aspects of punishment in the bad state (prison and incapacitations, or pain of death) which governs the marginal utility in the bad state. Such an additional assumption is questionable both from a descriptive or from an empirical point of view. On the other hand, it is worth recalling that the risk seeking assumption (in the strong sense) is always consistent with more sensitivity to frequency than to severity of sanctions, whatever the representation of criminals preferences.

Casual observations about criminals' behavior, *e.g.* committing an illegal act or an offence, possibly with violence (homicide, murder), seem to reveal that the criminals willingly undertake a risky and dangerous activity both for other people and for themselves (although there exists also a risk of being caught and punished) - thus, they are prone to a risk seeking attitude. Moreover, for offences such as non compliance to speed limits or driving under the influence of alcohol or drugs, the offender willingly exposes himself to a risk of accident and personal injury; in the same spirit, for thefts or murders, the offender runs the risk that the victims undertake selfdefensive activities that result in personal injury for the criminal. But textbooks in economics of uncertainty teach that risk averse people *also* undertake risky activities. From the modeler's point of view, it is worth pointing out that criminals' risk attitude (risk aversion *versus* risk seeking) may be endogenously determined, as a result of the choice of instruments in law enforcement policies (probability of arrestation, monetary fines, non monetary sanctions).

There are several implications regarding the literature on L&E. First, there is a lack of direct and robust evidence on the issue of criminals' risk attitude: indirect observations such as those revealed by Block and Gerety (1995) or Grogger (1991) are not tests of the hypothesis of risk seeking *versus* the risk aversion one for criminals. These studies simply definitively rule out the risk neutrality assumption and the strong risk aversion one. Second, the existing experiments do not consider the existence of non monetary sanctions. Our claim is that the monetary equivalent of non pecuniary sanctions (such as imprisonment, incapacitation and so on) is not a perfect substitute to the monetary wealth of the criminals. This reflects that the marginal utility of wealth in the state with arrestation is not the same as the marginal utility in the state of freedom. Thus, whether criminals and offenders are more sensitive to the probability of arrestation than to the level of fines may be contingent to the presence (and the choice in term of level or intensity) of some non monetary sanctions in case of arrestation and punishment. Hence additional experiments including both monetary and non monetary sanctions are required in order to challenge the robustness of the findings by Block and Gerety (1995) or Grogger (1991).

Finally, the results of these complementary studies will be important for

the economics of crime, since they focuse on some aspects which have been previously neglected for example in the literature about law enforcement policies. Polinsky and Shavell (1979) show that criminals' risk aversion may well explain why less than maximal fines may be socially worth contradicting the classical result obtained by Becker (1968) for risk neutral criminals. But Nielson (1998) has shown that when criminals display state dependent risk aversion and are more sensitive to probability than to fines, Becker's result still holds, *e.g.* maximal fines are always optimal, thus suggesting that risk aversion does not matter to explain the findings of Block and Gerety (1995) and Grogger (1991). On the other hand, it is also well known since Polinsky and Shavell (1984) that it is generally not optimal to supplement fines with imprisonment unless the maximal possible fines (and the marginal cost of imprisonment) are low enough, strengthening the beckerian view. The point is that the analysis of non monetary sanctions assumes that the monetary equivalent of the pain of imprisonment or any other non monetary sanction is a perfect substitute to the criminals' wealth. In contrast, assuming the imperfect substitutability between wealth and the monetary equivalent of the pain of imprisonment (as it holds when the criminals' marginal utility of wealth is smaller in the state of imprisonment than in the state without imprisonment) implies that non monetary sanctions have indirect costs in utility terms for criminals, such that in the state of arrestation they face a specific trade-off between the fines and the non monetary sanction which also affects the trade-off probability/fines. Thus putting pieces together, it is easy to understand the consequences for the design of optimal law enforcement policies. Assume for example that criminals display state dependent risk aversion and are more sensitive to fines than to probability, because the use of a non monetary sanction in case of arrestation entails for criminals a marginal utility of wealth larger than in the state of freedom. Then it may become socially optimal to use non monetary sanctions and to set a probability as large as possible before that fines reach their maximal level. This challenges Nielson's (1998) and Becker's (1968) results. Once more, empirical and experimental studies would be useful in order to establish which view is the more likely.

Bibliographic references

Beck U. (1992), *Risk Society: Towards a New Modernity*, London, Ed. Sage.

Becker G. (1968), Crime and punishment: an economic approach, *Journal of Political Economy*, **76**, 169-217.

Bigus J. (2006), Tort liability and probability weighting function according to Prospect Theory, paper presented at the 2006 *American Law & Economics Association Annual Meeting*.

Block M. and Gerety V. (1995), Some experimental evidence on differences between student and prisoner reactions to monetary penalies and risk, *Journal of Legal Studies*, 123-138.

Chateauneuf, A., and Cohen, M. (1994), Risk seeking with diminishing marginal utility in a non expected utility model, *Journal of Risk and Uncertainty,*

9, 77-91.

Chew S., Karni E., and Safra Z. (1987), Risk aversion in the theory of expected utility with Rank Dependent preferences, *Journal of Economic Theory*, **42**, 370-381.

Cohen M. (1995), Risk aversion concepts in expected and non-expected utility models, *Geneva Papers on Risk and Insurance Theory*, **20**, 73-91.

Cook P. and Graham D. (1977), The demand for insurance and protection: the case of irreplaceable commodities, *Quarterly Journal of Economics*, **41**, 143-156.

Dehez P. and Drèze J. (1987), State-dependent utility, the demand for insurance and the value of safety, in Drèze: *Essays on economic decisions under uncertainty,* Cambridge University Press.

Eide (2005), Accident liability with Rank Dependent Expected Utility, paper presented at the *22nd Annual Meeting of the European Association of Law & Economics, 2005.*

Giddens A. (1991), *Modernity and Self-Identity*, Standford University Press.

Jones-Lee M. (1974), The value of changes in the probability of death or injury, *Journal of Political Economy,* **82**, 835-849.

Grogger J. (1991), Certainty vs. severity of punishment, *Economic Inquiry*, **29**, 297-309.

Neilson W. and Winter H. (1997), On criminals' risk attitude, *Economics Letters*, **55**, 97-102.

Neilson W. (1998), Optimal punishment schemes with state-dependent preferences, *Economic Inquiry*, **36**, 266-271.

Nell, M. and Richter A. (2003), The design of liability rules for highly risky activities - Is strict liability superior when risk allocation matters?, *International Review of Law and Economics*, **23**, 31-47.

Polinsky M. and Shavell S. (1979), The optimal trade-off between the probability and magnitude of fines, *American Economic Review*, **69**, 880-891.

Polinsky M. and Shavell S. (1984), The optimal use of fines and imprisonment, *Journal of Public Economics*, **24**, 89-99.

Teitelbaum J. (2006), A unilateral accident model under ambiguity, paper presented at the 2006 *American Law & Economics Association Annual Meeting.*

Tversky A. and Wakker P. (1995), Risk attitudes and decision weights, *Econometrica*, **63**, 1255-1280.

Zivin, J., R. Just and D. Zilberman (2006), Risk aversion, liability rules and safety, *International Review of Law and Economics*, forthcoming.