THE IMPACT OF UNCERTAINTY ON THE SUPPLY OF CRIME

*Wisdom Akpalu**,** State University of New York – Farmingdale*

ABSTRACT

The formal economic model of crime developed by Becker (1968) is based on the assumption that the potential criminal knows with certainty the benefit that accrues to his/her crime. In this paper this assumption has been relaxed and the effect of penalty on supply of crime has been investigated. We found that if the probability distribution over potential returns to the crime is uniform, a very high level of penalty may completely discourage the supply of crime among criminals who are uncertain about returns to a crime. In addition, compared to a scenario where a criminal has perfect information, a criminal with incomplete information about the returns could be assigned lesser penalty for petty crimes, but be given heavier penalty if the crime involves huge returns. ***JEL Classification***: K42

INTRODUCTION

The theoretical economic model of crime formalized by Becker (1968), and later extended by several others (including Ehrlich, 1973; Heineke, 1978; and Polinsky and Shavell, 1979) over the last four decades, assumes a potential criminal faces a decision problem of maximizing an expected utility model. In addition, the model assumes a criminal could predict the returns to crime with certainty. This assumption is feasible only in some situations since criminals may not always know the returns to a crime prior to committing the crime. Cook (1980) highlighted the need to incorporate imperfect information and population heterogeneity in economic models of criminal behavior. A few studies have responded to this call by extending the existing models to incorporate over and under estimation of probability of apprehension of criminals (see Bebchuk and Kaplow, 1992; and Garoupa, 1997), and ignorance of the law or lack of perfect knowledge about legal rules and the characteristics of acts (Kaplow, 1990; Garoupa, 1997). This research contributes to this line of research by investigating the impact of uncertainty of returns to a crime on supply of violation.

Our theoretical construct assumes a criminal (say a bugler) who decides to commit a crime (break into a house) may not know with certainty the returns that may accrue to the crime. The uncertainty may be characterized by some probability distribution. Since the criminal's utility is a function of the expected spoils, he/she maximizes a non-expected utility from the illegal activity. We have found that criminals under the two scenarios (i.e., those who face certain and

uncertain returns) may supply crime at different levels for any given level of penalty. This has implications for assignment of punishment at conviction.

THE BASIC MODEL

The modeling strategy begins with the presentation of a benchmark model (i.e., the Becker model of crime) followed by a modification which accounts for uncertainty. The two results are compared and some policy implications have been presented.

Conventional model: expected utility model

Suppose an individual has an initial wealth w but could make an additional income a from a criminal activity. If caught, he/she receives penalty A per unit of the amount stolen with probability p of being caught, which is determined by the enforcement officer. Let the corresponding utility from the illegal returns if the crime is undetected and prosecuted be $u = u^S\left(w + a\right)$ and $u = u^N\left(w + a\left(1 - A\right)\right)$, respectively. Note that the utility function is well behaved with $du(.)/da > 0$ and $d^2u(.)/da^2 \leq 0$. The corresponding expected utility function may be specified as

$$Eu\left(a; w\right) = \left(1 - p\right)u^S\left(w + a\right) + pu^N\left(w - a\left(A - 1\right)\right). \quad (1)$$

The rational potential criminal will violate the regulation if and only if it is beneficial to do so (i.e., $Eu(a;w) \geq u\left(w\right)$, where $u\left(w\right)$ is the reservation utility). If the criminal is an expected utility maximizer, he/she will maximize equation (1) with respect to a. The first order condition is:

$$\frac{\partial Eu(.)}{\partial a} = \left(1 - p\right)u_a^S + pu_a^N = 0 \quad (2)$$

For analytical convenience assume the criminal has a log-linear utility function of the form $u\left(x\right) = \ln x$ so that equation (2) becomes

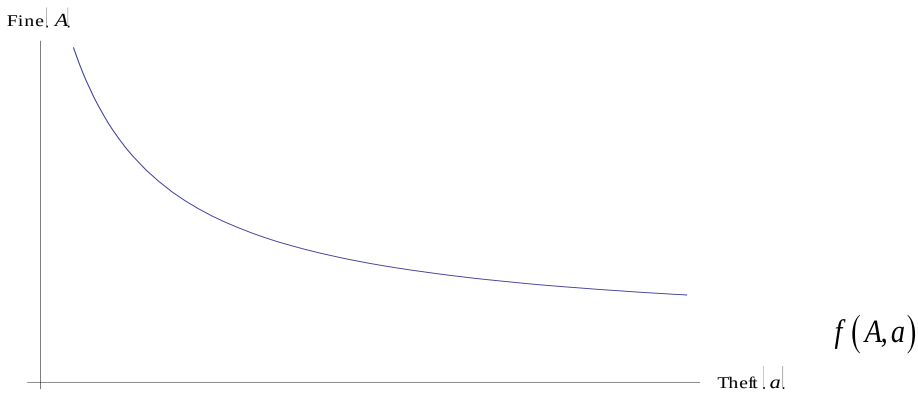
$$1 - \frac{a\left(A - 1\right)}{w} = p\mathrm{A} \Leftrightarrow a = \frac{w\left(1 - p\mathrm{A}\right)}{A - 1} \geq 0 \quad (3)$$

From equation (3), the criminal is in equilibrium if the marginal net benefit from engaging in the criminal act (i.e., $\frac{w-a\left(A-1\right)}{w}$) equates the marginal cost of the illegal activity (i.e., the expected fine, $p\mathrm{A}$). The comparative static analyses of equation (3) with respect to the risk of detection, the severity of punishment and initial endowments are:

$$\frac{\partial a}{\partial \mathrm{A}}=\frac{-w(1-p)}{A-1}<0; \qquad \frac{\partial a}{\partial p}=\frac{-w\mathrm{A}}{A-1}<0; \qquad \frac{\partial a}{\partial w}=\frac{1-pA}{A-1}>0 \tag{4}$$

From equation (4), increasing the risk and the severity of punishment will discourage violation (i.e., $\frac{\partial a}{\partial p}<0$ and $\frac{\partial a}{\partial \mathrm{A}}<0$ respectively), and higher initial endowment increases violation (i.e., $\frac{\partial a}{\partial w}>0$). The graphical illustration of the relationship between fine or penalty and optimal supply of crime (theft) is given by Fig. 1.

Figure 1
Relationship Between Fine And Theft If Returns To Crime Are Certain.



From the figure, for any given level of wealth and probability of detection, optimal supply of violation will decrease as penalty increases.

Modified specification: non-expected utility model

Now consider a situation where the criminal faces uncertainty with regards to returns to the crime. Let $q(a_i)$, with $q_a > 0$, be the probability density function defining the distribution of the potential returns. The criminal's non-expected utility function can be specified as

$$Ev(a;w) = (1-p)v^s\left(w + \int_0^a a_i q(a_i)da_i\right) + pv^n\left(w + \int_0^a a_i q(a_i)da_i - aA\right),$$

(5)

Maximizing equation (5) with respect to a gives

$$\frac{\partial Ev(.)}{\partial a} = (1-p)v_a^s + pv_a^n = 0$$
$$v_a^s = p\left(v_a^s - v_a^n\right)$$

(6)

Similarly, using the specific form of the utility function (i.e., $u(x) = \ln x$) and assuming that $q(a_i)$ is uniformly distributed (i.e., $q(a_i) = \frac{a_i}{a}$) equation (6) becomes

$$\left(1/3\right)a^3 - A\left(2/3\, p + 1\right)a^2 + wa + pAw = 0$$

(7)

The comparative static analyses of equation (7) with respect to the risk of detection, the severity of punishment and initial endowments are

$$\frac{\partial a}{\partial w} = \frac{1+pA}{6aA(2p+3) - \left(w+a^2\right)}; \quad \frac{\partial a}{\partial A} = -\frac{3a^2(3+2p) - pw}{6aA(3+2p) - \left(w+a^2\right)};$$

and

$$\frac{\partial a}{\partial p} = -\frac{3A\left(2a^2 - 3w\right)}{6aA(3+2p) - \left(w+a^2\right)},$$

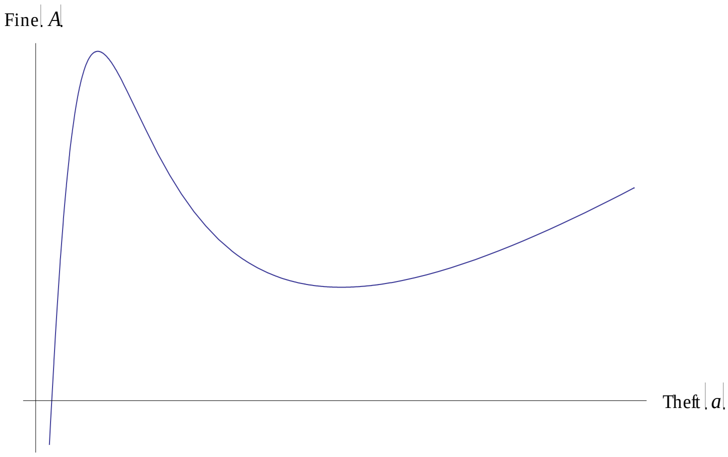
(8)

The signs of the comparative statics cannot be determined a priori indicating that increasing e.g. the severity of punishment marginally may not necessary decrease supply of violation if returns to crime are uncertain. Due to the nature of the complexity of equation (7) the algebraic solutions for the equilibrium level of the crime activity is not tractable. As a result, a graphical illustration is preferred. Fig. 2 presents the relationship between fines and amount stolen.

From the figure, very low levels of fine (below $\underline{A}$) or a high level of fine corresponding to the peak of the function (i.e., $\bar{A}$) generate singular optimal violation. However, moderate levels of fine (i.e., between $\underline{A}$ and $\bar{A}$) generate multiple equilibrium levels of violation. For analytical convenience we assume only the downwards sloping portion of the function (between $\underline{A}$ and $\bar{A}$) is

admissible since it is unreasonable for a criminal to increase his/her level of crime if penalty increases.

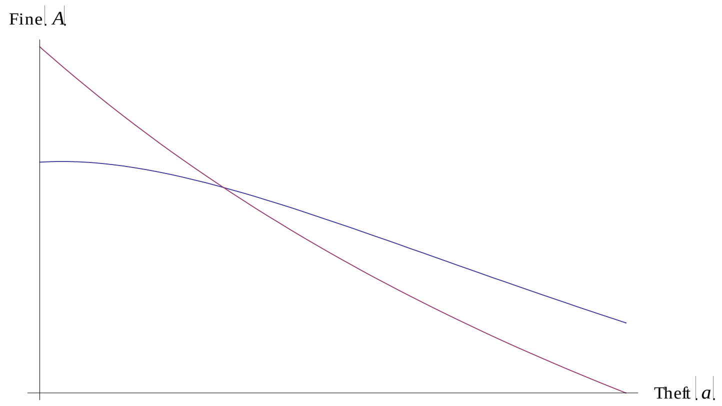
Figure 2
The Relationship Between Fines And Supply Of Crime
If Returns To Crime Are Uncertain.



PENALTY AND SUPPLY OF CRIME

In this section, the relationship between supply of violation and penalty for the two scenarios are examined. From Fig. 3, for any given level of risk of detection and wealth, any level of fine slightly higher than $\bar{A}$ may completely discourage criminals who are uncertain about returns to the criminal activity but not those who are certain.

Figure 3
The Relationship Between Fine And Supply Of Crime
If Returns To Crime Are Certain Or Uncertain.



Furthermore, very low penalties (below the crossing point of the two curves, i.e., A^*) may encourage criminals who are uncertain about returns to the crime more than those who are certain about the returns. Conversely, a criminal who is certain about the returns to a criminal activity must receive higher penalty if the returns to the criminal activity is very low (i.e., lower than a^*), and vice versa. From the figure, suppose the value of the crime is a_H, the fine must be higher if the individual has incomplete information about the returns to the crime (i.e., $A_H > \underline{A}$). On the other hand, if the value of the item stolen is lower than the threshold value (e.g., $a_L < a^*$), the criminal should receive a lower penalty (i.e., $\bar{A} < A_L$) if he/she has imperfect information. Moreover, the extent to which the penalty must exceed or fall short of that of the perfect information scenario should depend on the probability distribution over the potential returns to the crime, which in turn depends on the level of information the criminal has. Based on the assumed probability distribution, if the criminal has near perfect information, the penalty difference under the two scenarios must be small, and must be large if he/she has poor information.

The general policy implication is that, if the probability distribution over potential spoils is assumed to be uniform, for petty crimes (say petty theft) a criminal may be assigned lesser penalty if he/she has incomplete information about the returns to the crime. On the other hand, for serious crimes or crimes involving huge returns (say bank robbery) a criminal who has a priori information on the returns to the crime (say an employee who knows how much there is in the volt) must receive a lower punishment than a bank robber who has incomplete information.

CONCLUDING REMARKS

The neoclassical economic model of crime has been extended to address crimes with uncertain outcomes. If returns to crime are uncertain, there is probability distribution over potential spoils. We have found that, given a uniform probability distribution over potential spoils, if fines are higher (lower) than a threshold value, criminals with incomplete (complete) information about potential returns to their crime will be less (more) likely to commit the crime. Indeed criminal justice systems must assign fines that take into consideration the magnitude of the crime as well as the amount of a priori information the criminal has about the potential gains from the crime. For petty crimes, the penalty should be lower for a criminal who has imperfect information relative to the counterpart who has complete information. For serious crimes or crimes involving large returns, however, the criminal with perfect information must receive lesser penalty.

REFERENCE

Bebchuk, L. A., and Kaplow, L., 1992. “Optimal Sanctions When Individuals Are Imperfectly Informed about the Probability of Apprehension,” *Journal of Legal Studies* 21: 365-70.

Becker, G., 1968. “Crime and Punishment: an Economic Approach”, *Journal of Political Economy* 76(2): 169-217.

Cook, P., 1980. “Research in Criminal Deterrence: Laying the Groundwork for the Second Decade”, In Vol. 2 *Crime and Justice: A Review of Research*, edited by Norval Morris and Michael Tonry. Chicago: University of Chicago.

Ehrlich, I., 1973. “Participation in illegitimate activities: a theoretical and empirical investigation”, *Journal of Political Economy* 81: 521–564.

Garoupa, N.,1997. " The Theory of Optimal Law Enforcement", *Journal of Economic Surveys* 11(3): 267-95.

Heineke, J.M., 1978. ‘Economic model of criminal behaviour: an overview’, in J.M. Heineke (ed.), *Economic Model of Criminal Behaviour*, Amsterdam: North Holland Publishing Company.

Kaplow, L., 1990. “Optimal deterrence, uninformed individuals, and acquiring information about whether acts are subject to sanctions”, *Journal of Law, Economics and Organization* 6: 93-128.

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

Acknowledgement: The author is thankful to Worku T. Bitew, Ametefee Normanyo, Anatu Mohammed and three anonymous referees of this journal for their invaluable comments. This research was supported by Environmental Economic Research & Consultancy (EERAC).