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Social Sensitivity and Criminal Behavior: A Theoretical Approach

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Economic theory analyzes criminal behavior as a problem of rational choice in allocating time between "riskless" legal and risky illegal activities. There is agreement in the literature about the existence and possible effect of non-pecuniary consequences of illegal activity (Palmer (1976)). However, most texts (Becker, 1968, Ehrlich, 1973, Sjoquist, 1973 and others) bypass the issue by introducing a monetary equivalent of non-pecuniary effects. A systematic analysis of their effects requires their explicit introduction into utility functions a la Block and Heineke (1975) who analyze what they call "ethical costs." Another way to view non-pecuniary attributes, which is the one adopted in this paper, is to treat them as two possible variables of dichomotic nature: (1) The one time decision of becoming involved in criminal activity; and (2) the consequence of being apprehended or not.[1]

We concentrate on the individual's moral and social sensitivity to participation criminal activity.

I. The Model

Assume that the individual has a utility function U of the following type:

$$U = U(X, S, M) \qquad (1)$$

where:

X—total income of the individual.

C—denotes number of criminal offenses committed. $C \leq \bar{C}$, where $\bar{C}$ stands for an exogenous contraint on the number of offenses.

S—denotes the number of apprehensions and convictions. S is introduced into the utility function to represent the social sensitivity of the individual in addition to the possible disutility caused by being punished.

M—is a dichotomic variable having a value 0 or 1.

$M = 0$ implies the individual does not commit any crime.

$M = 1$ implies that the individual commits at least one crime.

thus

$$M = M(C) \quad \text{where}$$

$$M(C) = \begin{cases} 0 & \text{when } C = 0 \\ 1 & \text{when } C > 0 \end{cases}$$

M is introduced to the utility function to represent the individual's moral compromise in committing the first crime. The arguments in the utility function (X, S, M) depend on the actual number of committed crimes (C) which is not determined directly by the individual. C is a stochastic variable whose distribution is determined by C_I the number of crimes he intends to commit and by P_S the probability of being apprehended in every

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[1]This approach was used by Allingham and Sandmo (1972) in the context of tax evasion.

offense, P_S is assumed to be constant for a given number of apprehensions (S). Since C is a stochastic variable, the optimal behavior of the individual is assumed to be derived from the maximization of his expected utility:

$$\underset{C_I}{\text{Max}}\ E\{U[X(C), M(C), S(C)\} \quad (2)$$

To focus attention on the psycho-sociological aspects of criminal behavior we start with an individual who has not committed any crime. He can remain law abiding or plan a series of crimes C_I. The following utility function can thus be formulated.

$$U[X(C), S(C), M(C] = \alpha.\beta\ V(X(C)) \quad (3)$$

where:

$$\alpha \equiv 1 \quad \text{if } S = 0$$

and

$$\beta \equiv 1 \quad \text{if } M = 0.$$

The special form of the utility function in (3) provides a system that is convenient for the analysis of comparative statics. α and β can be interpreted as the social and moral sensitivity coefficients respectively. $\alpha = 1$ and $\beta = 1$, means that the individual has no social and moral sensitivity. Values below 1 imply that the individual feels anxiety about his potential criminal activity and apprehension. This behavior is determined by:

$$\text{Max}[V(X(0)), \underset{C_I < \bar{C}}{\text{Max}}\ W(C_I)]$$

where:

$$W(C_I) = \beta\Big[(1 - P)^{C_I} V(X(C_I)) + \alpha P \sum_{j=1}^{C_I} (1 - P^{(j-1)} V(X(j - 1))\Big] \quad (4)$$

Since C and C_I are discrete variables, the function W is not differentiable. Our objective is, first, to find conditions for maximum utility, and, second, to analyze the properties and implications of the optimal solution. It is more convenient to use differential calculus, and rewrite equation (4) above in its continuous form:[2,3]

$$W(C_I) = \beta\Big[e^{-PC_I} V(X(C_I)) + \alpha \int_0^{C_I} Pe^{-Ph}\ V(X(h))dh\Big] \quad (4')$$

Maximize W with respect to C_I:

$$\frac{\partial w}{\partial C_I} = \beta[-Pe^{-PC_I} V + e^{-PC_I} V_X X_C + P\alpha\, e^{-PC_I} V] = 0 \quad (5)$$

where:

$$V_X = \frac{\partial V}{\partial X}$$

$$X_C = \frac{\partial X}{\partial C}$$

V and V_X are evaluated at the point $X(C_I)$, and X_C is evaluated at the point C_I. From equation (5) we get the following first order condition:

$$\beta e^{-PC_I} P(1 - \alpha) V = \beta e^{-PC_I} V_X X_C.$$

Since e^{-PC_I} is positive for any finite value of C_I and we assume $\beta \neq 0$, thus:

$$P(1 - \alpha) V = V_X X_C$$

The left hand side of equation (6) represents the expected loss of utility, as a result of possible apprehension from committing one additional crime. The right hand side represents the additional utility of one extra crime if not apprehended. Equation (6′) has the same meaning as equation (6), except that expected marginal utilities are conditional upon the non-apprehension of the individual up to the point C_I^*.

[2]In the appendix we show that under certain conditions, the discrete model obtains the same results as the continuous model.

[3]Note that $e^{-PC_I} + \int_0^{C_I} Pe^{-Ph}\, dh = 1$, i.e., the sum of probabilities of all possible events is one.

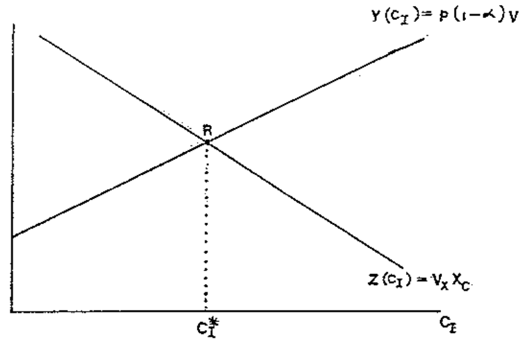

Figure 1

The first and second order conditions for maximal utility are shown diagrammatically in Figure 1.

The first order conditions are satisfied at point R; thus C_I^* is the optimal solution. The curve $Y(C_I) \equiv P(1 - \alpha)V$ is obviously upward sloping, since V is a positive function of X which is a positive function of C_I. The curve $Z(C_I) \equiv (V_X S_C)$ is plotted as a downward sloping line, however it can be upward sloping as well. The slope of $Z(C_I)$ is as follows:

$$\frac{dZ(C_I)}{dC_I} = V_{XX} X_C + V_X X_{CC}. \quad (7)$$

Since we have not introduced a specific assumption about the sign of X_{CC} it is possible that $Z(C_I)$ will be upward sloping when X_{CC} is positive and sufficiently large. The second order conditions are satisfied when Z intersects Y from left to right. For the sake of simplicity assume:

$$\frac{dZ(C_I)}{dC_I} < \frac{dY(C_I)}{dC_I} \quad \text{for all } C_I. \quad (8)$$

This assumption assures both the second order condition and the uniqueness of the solution.[4,5] The condition for the existence of a maximum is that $Z(0) \geq Y(0)$.

The problem analyzed above can also be illustrated as in Figure 2. Point A in Figure 2

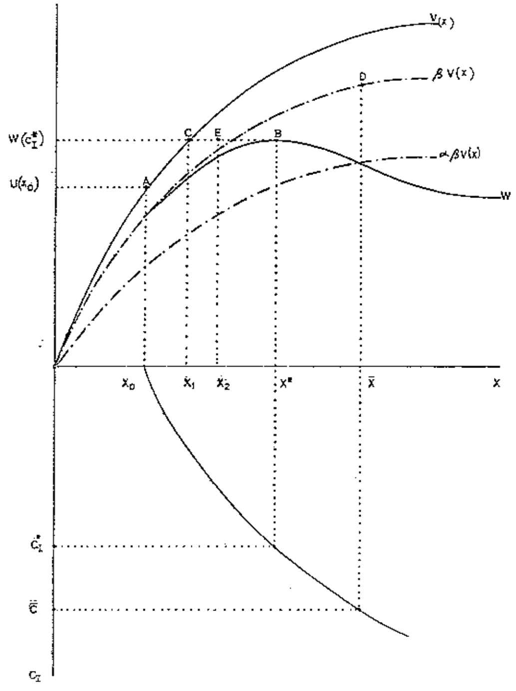

Figure 2

represents the utility level of the law abiding individual whose income is X_0. Point B represents the maximum value of $W(C_I)$. When the levels of α_0 and β_0 are given, our individual will plan to commit C_I^* crimes. However, if A were to represent a higher utility than the expected utility at B, the individual would rather refrain from criminal activity. X_1 in Figure 2 represents the level of legitimate income which yields the same level of utility

[4]The second order condition is:

$$\frac{d^2w}{dC_I^2} = e^{-PC_I}\left[\left(\frac{\partial Z}{\partial C_I} - \frac{\partial Y}{\partial C_I}\right) - P(Z(C_I) - Y(C_I))\right] < 0.$$

At C_I^*, $Z(I) - Y(C_I) = 0$, and according to the assumption exposed by equation (8) $(\partial Z/\partial C_I) - (\partial Y/\partial C_I) < 0$, thus $W(C_I^*)$ is a maximal value.

[5]This assumption is not necessary. If it does not hold, the solution might not be unique or the global maximum might be obtained for $C_I \rightarrow \infty$ (or for $C_I = \bar{C}$). Nevertheless, the model can be easily extended to treat these cases, which we are not analyzing here.

as that obtained at point B. Thus, $X_1 - X_0$ is the additional legitimate income which would prevent the individual from committing crimes. $X^* - X_1$ is the amount of income he is willing to forfeit in order to avoid the consequences of illegal activity. Recalling that C_I is exogenously constrained by $\overline{C}$ (thus $X \leq \overline{X} = (\overline{C})$), we can interpret $\overline{X} - X_2$ in Figure 2 as the maximum amount that the criminal is willing to sacrifice in order to insure that he is not arrested, e.g., by paying bribes to the chief of the police.

II. Comparative Statics

A change in α

The parameter α has an important role in determining C_I^* for an individual. Bearing in mind that α represents the social sensitivity of a potential criminal, one can easily see from equation (6) that the greater α is (the less the social sensitivity) the larger C_I^* is. This relationship is presented in Figure 3.

Each Y curve in Figure 3 is defined for a different level of α. The higher the level of α the lower the level of the Y curve, hence the larger number of planned crimes C_I. For some low enough α, $\alpha = \alpha_m$, the Y curve will be of the type Y^0, i.e., it will intersect Z at $C_I = 0$. If the actual social sensitivity of an individual is high enough so that the his $\alpha \leq \alpha_m$, he will not commit any crime. The number of planned crimes is limited by $\overline{C}$; there exists some $\overline{\alpha}$ for which $C_I^* = \overline{C}$. Thus, if the individual is sufficiently socially insensitive so that $\alpha \geq \overline{\alpha}$ then $C_I^* = \overline{C}$, which is a corner solution. If an individual is absolutely insensitive ($\alpha = 1$), the Y curve will overlap the horizontal axis, and $C_I^* \rightarrow \infty$ but the actual number of planned crimes will still be $\overline{C}$.

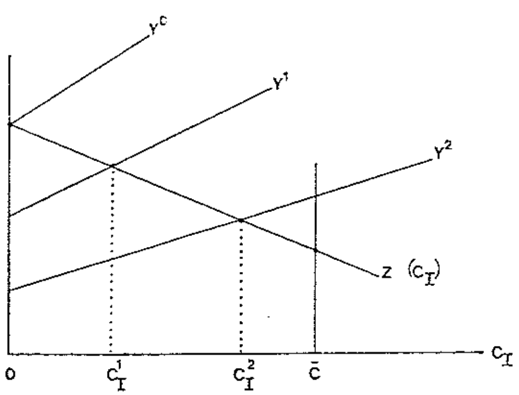

Figure 3

A comprehensive view of the above arguments is provided in Figure 4. The curve denoted by $M(\alpha)$ in quadrant I is the locus of optimal points for all α's. In quadrant III we measure the relationship between C_I^* and α. Keeping in mind that the individual always has the option of being law abiding, then if the maximum expected utility he obtains for a given α falls short of $V(X_0)$ (X_0 being the legitimate income), he will remain law abiding. Hence, point B represents a "breakeven point" and there is an α_B which generates this optimal level of criminal activity. For any $\alpha < \alpha_B$, *ceteris paribus*, $C_I^* = 0$. The only relevant range of the curve $C_I^*(\alpha)$ in quadrant III is between points R and S.

A change of β

The parameter β measures the moral sensitivity of an individual; it reflects the "conscience barrier" against committing a crime.

In equation (4), β appears as a constant multiplier and does not affect C_I which maximizes W. In quadrant III of Figure 4, the curve $C_I^*(\alpha)$ is not affected by a varying β.[6] However the level of $M(\alpha)$ in quadrant I is a function of β, and shifts vertically by the same proportion as the change of β. This changes the "breakeven point" level of $\alpha = \alpha_B$. For example, if β increases to β' (the individual is less morally sensitive), curves $\beta V(X)$ and $M(\alpha)$ in Figure 4 shift upwards to levels $\beta' V(X)$ and $M'(\alpha)$ respectively. Point B shifts to B' and α_B (quadrant III) falls to α'_B. The

[6] In the general case where W is not proportional to β, the solution of $\mathrm{Max}_{C_I}\ W(C_I)$ is affected by the argument of moral sensitivity.

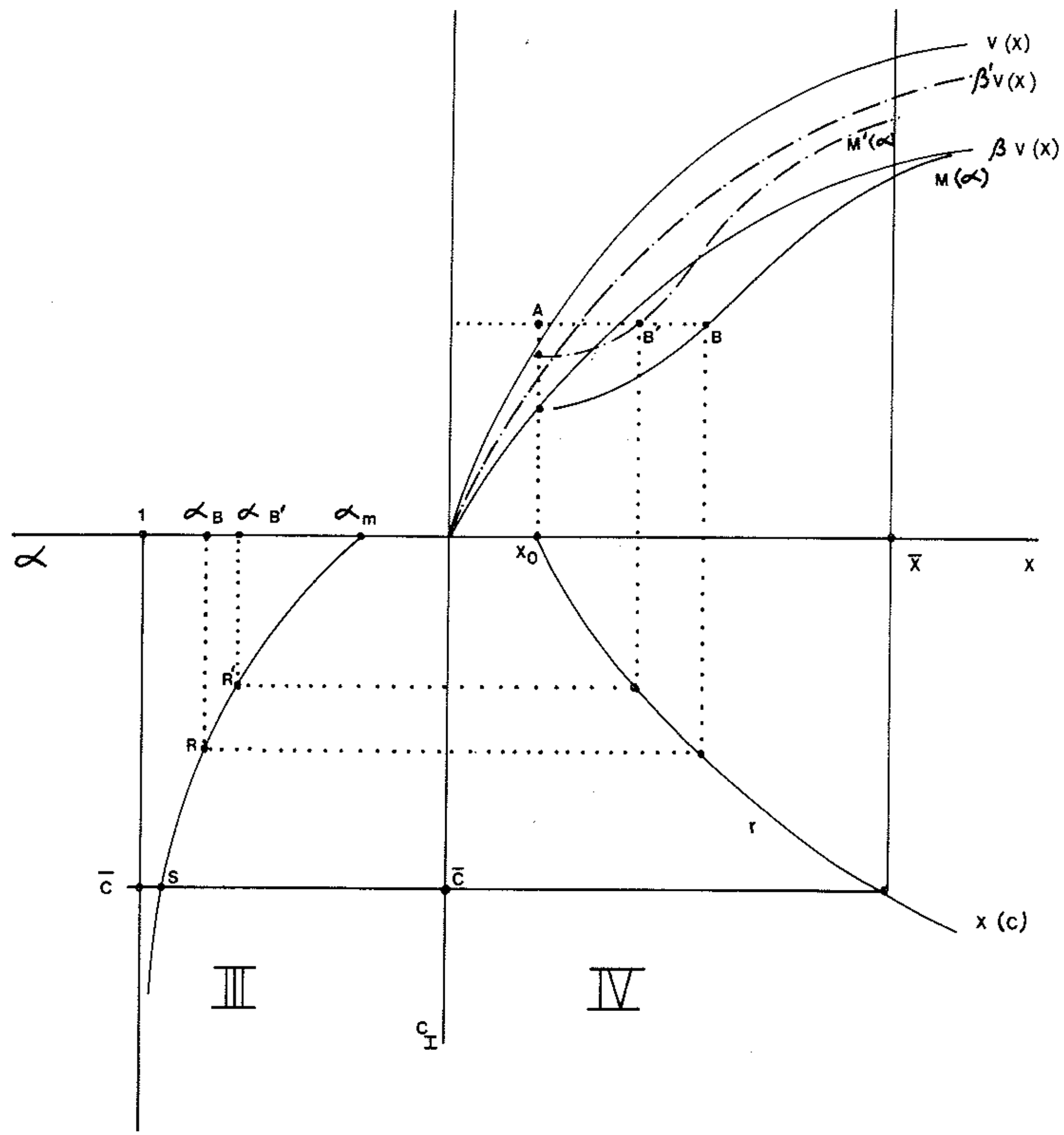

Figure 4

relevant range of $C_I^*(\alpha)$ is now between R' and S. If $\beta = 1$ (no moral constraints) $\alpha_B = \alpha_m$.

A change of X_0

X_0 denotes the individual's income from legitimate activities. The individual's reaction to changes in X_0 has socio-economic implications on whether and to what extent one is willing to participate in crime as he becomes wealthier. There are two aspects to this problem: (1) How is C_I^* affected? and (2) How is the expected income at the optimal level C_I^* affected?

In order to identify the reaction of C_I^* to a change of X_0, we differentiate both sides of the first order condition (equation 6′), and rearrange it;

$$[P(1-\alpha)V_X - V_{XX}X_C]dX_0 = [-P(1-\alpha) \cdot V_X X_C + V_{XX}X_C^2 + V_X X_{CC}]dC_l^* \quad (9)$$

The expression in the parantheses on the left hand side is obviously positive. The second order condition assures that the expression in the parantheses on the right hand side is negative. Thus, if the first and second order conditions for the maximum are met, $(dC_l^*/dX_0) < 0$. This same change can be seen using the diagram in Figure 1: As a result of an increase in X_0 the Y curve shifts upward, and the Z curve shifts downwards, resulting in a decrease of C_l^*. The above argument implies that the greater the legitimate income, the fewer the number of crimes one is likely to plan to commit.

It has been established that a higher X_0 induces a lower C_l^*, that is, the income generated by illegal activity decreases, while the income generated by legal activity increases. It remains to be seen what happens to the total income $X(C_l^*)$: Since X is a function of C, then:

$$dX(C_l^*) = dX_0 + X_C dC_l^* \quad (10)$$

Substituting (10) into (9) and rearranging yields:

$$[P(1 = \alpha)V_X = V_{XX}X_C]dX(C_l^*) = V_X X_{CC} dC_l^* \quad (11)$$

Again, the expression in the parentheses of the left hand side is positive, hence:

$$\text{Sign}\left(\frac{dX}{dC_l^*}\right) = \text{Sign}\,(X_{CC}).^7$$

and

$$\text{Sign}\left(\frac{dX(C_l^*)}{dX_0}\right) = -\text{Sign}\,(X_{CC}).$$

This implies that if $X_{CC} = 0$, (constant "marginal revenue" from criminal activity), the individual will end up with the same expected income in spite of a possible change in X_0.

A Change of P

A rise of the probability of apprehension P, will decrease the number of planned crimes. This can be easily seen from Figure 1. A rise of P generates an upward shift of curve Y, which lowers C_l^*. In addition a rise in P generates an increase of α_B, the breakdown point. This implies that the higher the probability of apprehension, the lower the social sensitivity required to become involved in criminal activity.

Dynamic Aspects

The analysis up to this point was based on the assumption that the individual has not yet committed any crime. If the individual decides to become a criminal, he plans to commit C_l^* crimes within a planned horizon T. If he is not apprehended, during T, he will reconsider his behavior in the next period. Unless an exogeneous change occurs, he will probably have the same C_l^* in the next period. However, if he is apprehended during period T (not being able to complete C_l^*) then, after being punished, a new planning period starts, with a new set of parameters. P may now be higher since he has a police record. Conversely, P may become lower, if his jail experience improves his criminal expertise. Following the same logic we can anticipate changes of α, β, and the function $X(C)$. If the result of apprehension and punishment is that α decreases (the sensitivity increases) and P increases, *ceteris paribus,* he will commit fewer crimes in the next period, or he may even refrain from that kind of activity in the future. Nevertheless, there is a possibility that being an "ex-convict" reduces legal employment opportunities and social status, which may reduce social sensitivity and lead to a higher rate of crime in the next period.

The approach presented in this paper suggess explicitly that the behavior of a criminal in any period of time depends on his criminal history. This implies that the decision to commit crimes has a cumulative and irreversible effect.

[7]Bear in mind that the second order condition does not prevent X_{CC} from being positive.

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Appendix

We have seen that when an individual decides to commit criminal acts he faces the following expected utility function:

$$W(C_l) = \beta\Big[(1-P)^{C_l}V(X(C_l) + \alpha P \sum_{j=1}^{C_l}(1-P)^{(j-1)}\,V(X(j-1))\Big] \quad (A.1)$$

Since C_l is a discrete variable, W is not differentiable, therefore it obtain maximal value for the largest C_l for which $\Delta W(C_l) > 0$ where:

$$\Delta W(C_l) \equiv W(C_l) - W(C_l - 1)$$

$$\Delta W(C_l) = \beta[(1-P)^{C_l}\mathrm{V}(X(C_l)) - (1-P)^{(C_l-1)}V(X(C_l-1)) + \alpha P(1-P)^{(C_l-1)}V(X(C_l))] \quad (A.2)$$

Define

$$\Delta V(C_l) \equiv V(X(C_l)) - V(X(C_l - 1))$$

and substituting in (A.2) we get:

$$\Delta W(C_l) = \beta(1-P)^{(C_l-1)}\{(1-P)V(X(C_l)) - V(X(C_l) + \Delta V(C_l) + \alpha P\,V(X(C_l))\}$$

$$\Delta W(C_l) = \beta(1-P)^{(C_l-1)}\{\Delta V(C_l) - (1-\alpha)PV(X(C_l))\} \geq 0 \quad (A.3)$$

which is equivalent to the first order condition for the continuous case in equation (6).