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The supply of legal and illegal activity: A choice theoretic analysis

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THE SUPPLY OF LEGAL AND ILLEGAL ACTIVITY:
A CHOICE THEORETIC ANALYSIS

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"Much of the security of person and property in modern nations is the effect of manners and opinion rather than law."

John Stuart Mill
Principles of Political Economy

Recently, a number of economists have begun applying modern choice theory to illegal or criminal activities. Almost without exception, they have emphasized the similarity between the decision to commit an offense and the traditional household choice problem. As Becker [1968, p. 176], in his pioneering article, expresses the proposition: "Some persons become 'criminals' . . . not because their basic motivation differs from that of other persons, but because their benefits and costs differ." Although this point is well-taken, we find that Becker, as well as the more recent contributions of Ehrlich [1972], and Sjoquist [1970], fail to provide an adequate framework for analyzing the costs and benefits of illegal activities. Specifically, Becker, Ehrlich, and Sjoquist attempt to summarize the consequences of illegal activities in terms of a distribution on wealth alone without rigorously considering the underlying multi-attribute choice problem. That is, the commission of an offense results in an expenditure of effort (which may engender feelings of guilt or "wrong doing"), the possibility of an increase in the individual's wealth position, and the possibility of a penalty. Aside from the penalty, the similarity between the offense decision and the traditional labor supply decision is obvious.[1] Moreover, if the penalty is a monetary payment, the analogy is precise. While many criminal choice problems may be viewed within an expended labor choice framework, as we shall show, their interpretation in terms of strictly monetary costs and benefits is not as straightforward.

For the labor allocation problem to be reducible to a monetary cost-benefit analysis, the agent must be able to express *every* effort allocation in terms of a wealth equivalent. While this is conceptually possible in many, but as we shall show not all, effort allocation problems, using such a reduction requires detailed preference information. As an illustration of this point, consider the problem of reducing the traditional household labor supply problem to one that involves only monetary considerations. Graphically, one must locate the optimum labor allocation by finding the wealth intercept, if it exists, of the labor-wealth indifference curve along which the familiar tangency condition holds. Hence, all preference information required in the labor-wealth formulation is also required in the wealth only formulation. The simplicity of the wealth only approach is more illusory than real, since reductions to this form require complete knowledge of the multi-attribute utility function.

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[1]See Block and Heineke [1973] for an analysis of the labor supply decision when returns are stochastic.

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We will show below that failure to fully specify the choice problem and therefore the transformation between what is inherently a multi-attribute decision problem and the wealth only problem has led Becker, Ehrlich, and Sjoquist to conclusions which are valid only in very special cases. In general, we show that plausible preference restrictions are not sufficient to generate unambiguous supply results, a result that should come as no surprise since it is the same situation that confronts the investigator in most household allocation problems.[2] Therefore, policy prescriptions in this area, as in the tax incentive area, do not follow from theory but rather require empirical determination of relative magnitudes.

We proceed as follows: In the first section, the notion of the moral or ethical costs of crime are formalized. Next, the individual's labor-offense supply problem is formulated in terms of the underlying multi-attributed nature of the problem. We then present a means of transforming multi-attributed preferences into a single attribute, wealth, and reformulate the supply problem in these terms. This approach provides a straightforward means of comparing the present model to those adopted elsewhere in the literature.[3] Supply responses to various parameter shifts are then investigated. As would be expected, under "usual" preference restrictions these responses are ambiguous in sign. Since unambiguous results have been reported in the literature, the next section is devoted to determining the conditions under which unequivocal supply effects obtain. Finally, results are summarized and several areas which require further work are noted.

The Ethical Costs of Crime: Trading Ethics

In order to explore the offense decision in some detail, we restrict our analysis to property crimes. This enables us to concentrate on what Stigler [1970] refers to as production offenses. Specifically, we consider an individual who is confronted with two wealth generating activities, legal activity (labor) and illegal activity (theft) and denote the time spent in these activities as L and T, respectively.[4] Hence, the individual's evaluation of his well-being at any point in time will be a function of the time spent generating wealth and the level of his wealth, i.e.

$$(1) \qquad U = U(L,T,W)$$

where U is the agent's utility indicator and W represents wealth. By explicitly including the psychic costs of legal and illegal activity in the individual's utility indicator, we are provided with a straightforward means of analyzing the role of moral and ethical considerations which may constrain the work-theft decision. To the economist, such considerations are specific restrictions on the manner in which preferences are ordered which, along with numerous other factors, determine the "shape" of the individual's utility indicator. We term these restrictions the individual's *trading ethics* and now introduce several descriptively interesting trading ethics.

Absolute Honesty

The trading ethic of "absolute honesty" might be characterized by a preference set in which the rate of substitution of offenses for wealth is zero for all activity levels and wealth configurations, i.e.

$$(2) \qquad \frac{\partial T}{\partial W}\bigg|_U o = 0, \ L,T,W \geqslant 0$$

Agents possessing such preferences would allocate no time to the production of offenses no matter how much labor was expended and no matter how "desperate" the agent's wealth position might be. Indeed, such an individual may be extremely adept in the production of offenses, but an absolute aversion to the activity would prevent him from employing his talents. As will be shown below, this preference restriction implies that a monetary cost equivalent to the psychic cost of crime does not exist.

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[2]In particular, the agent's simple behavior toward risk contains qualitative supply implications only under highly restrictive circumstances.

[3]The primary source is of course Becker [1968]. Ehrlich's [1972] forthcoming paper is an extension of Becker's analysis. In addition, Sjoquist [1970] and Reynolds [1972] have adopted a choice theoretic approach in their efforts. Each of these author's collapses all costs and benefits of criminal activity into simple additions or subtractions from wealth, and hence adopt utility indicators which are a function of the single attribute, wealth.

[4]Legal and illegal activity are measured in the same time units and are both considered to be discommodities.

Relative Honesty

Although individuals displaying absolute honesty are likely to be rare indeed, the same revealed behavior would be observed for the presumably more common phenomena of "relative honesty." Relative honesty arises from preference restrictions that imply a rate of substitution of wealth for theft that is finite but greater than the marginal return to theft for all $L > 0$, $T > 0$ and $W > 0$, i.e.

$$(3) \qquad \text{marginal return to theft} < \left. \frac{\partial W}{\partial T} \right|_U o < \infty, \quad L, T, W, \geqslant 0$$

Unlike absolute honesty, relative honesty is dependent not only upon the agent's preferences but also upon his productivity at transfer. Although both relative and absolute honesty lead to revealed behavior which excludes theft, there is one important difference: Relative honesty does not exclude illegal behavior, or even specialization in illegal activity, if the theft production function shifts. For example, increased skills at theft or a reduction in either private or collective protection efforts might lead to a non-zero level of theft activity.

Absolute and relative honesty are trading ethics that preclude positive allocations to theft. We now turn our attention to a set of restrictions that, while accounting for Mills' "manners and opinion," do not necessarily imply a zero theft allocation.

Honesty Preference

The individual will be said to display "honesty preference" if the rate of substitution of wealth for offenses is "everywhere" greater than the rate of substitution of wealth for labor. Formally,

$$(4) \qquad \left. \frac{\partial W}{\partial T} \right|_U o - \left. \frac{\partial W}{\partial L} \right|_U o > 0, \quad L, T, W \geqslant 0$$

Honesty preference would lead to zero supply of offenses whenever marginal returns from labor were at least as high as marginal returns from theft. If honesty preference is a general phenomenon, then differences in observed behavior of individuals with respect to participation illegal activity would reflect both ethics and opportunities but would emphasize opportunity sets more than do the ethics of absolute and relative honesty.[5]

Ethical Independence

One additional class of trading ethics is of particular interest — the case of "ethical independence." If K is a constant, then an economic agent will be said to exhibit ethical independence if

$$(5) \qquad \left. \frac{\partial W}{\partial T} \right|_U o - \left. \frac{\partial W}{\partial L} \right|_U o = K, \quad L, T, W \geqslant 0.$$

Individuals whose preference orderings are consistent with (5) have the same relative "taste (distaste) for crime" no matter what their wealth may be and no matter how involved they might be in legal and illegal activities. In other words, the agent's ethical considerations are independent of both his wealth and his participation rates in income generating activities. Ethical independence is of special interest since it provides an intuitively appealing means of interpreting certain aspects of the Becker and Ehrlich models vis a vis the more general approach adopted here. As we shall see below, ethical independence plus a restriction on the manner in which wealth affects "psychic costs" prove to be sufficient for reducing the agent's multi-attribute supply problem into a simple portfolio problem.

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[5] The presumably very common trading ethic of "weak honesty preference" might be depicted as the case where the rate of substitution of wealth for offenses is greater than the rate of substitution of wealth for labor for any W, *whenever T = L*. Of course, weak honesty preference will not generally imply a zero supply of offenses. If marginal returns to work and theft were equal, the agent would allocate more time to work than theft. In fact, a high enough relative return in theft could lead to specialization in these activities. In general, the relative magnitudes of T and L will depend upon the intensity of honesty preference and the individual's comparative advantage in the two activities. Certainly, weak honesty preference combined with a significant comparative advantage at theft is a plausible hypothesis for explaining the behavior of many individuals who specialize in theft. On the other hand, relative returns for some individuals could be sufficient to induce specialization in legal activities.

Several special cases of ethical independence merit brief attention:

First, if K = 0 in definition (5) above, then we will say the individual is "ethically neutral." Ethically neutral individuals find legal and illegal activity equally distasteful and in effect combine them under the heading "work." These individuals probably most adequately represent the caricature of "economic man." Ethically neutral preferences will cause the agent to specialize in the income generating activity yielding the highest marginal return.

If K > 0, then ethical independence becomes a special case of honesty preference, say "strong honesty preference," in which one's "preference for honesty" is invariant to both wealth and activity levels. If K < 0, the symmetric ethic of "strong dishonesty preference" could be defined.

We have discussed several sets of preference restrictions that we termed trading ethics. Clearly, these restrictions are by no means exhaustive, but instead are intended to indicate the scope of the choice theoretic approach in providing a means of interpreting "moral" considerations which may constrain the crime decision.

The Joint Supply of Labor and Offenses

We now turn our attention to a formal analysis of the individual's joint labor-offense supply decision. We proceed by first formulating the agent's supply problem in terms of the underlying attributes of the decision and then reformulate the problem in terms of the wealth argument alone by collapsing psychic costs into their wealth equivalents. Whether consequences of legal and illegal activities are ranked *directly* in terms of their characteristics (L,T,W) or *indirectly* in terms of their wealth equivalents, depends upon the purposes of investigation. As was noted at the outset, the wealth equivalent formulation requires the same preference information as does an analysis in terms of direct rankings. However, if one is interested in contrasting the characteristics of the offense decision when it is modeled as a labor supply problem, to these same characteristics when the decision is modeled as an "output" problem, the wealth equivalent formulation provides the deeper insight; primarily because it provides a means of analyzing the transformation between the attributes of the offense decision and their wealth equivalents. And it is precisely this point, failure to specify the transformation from psychic costs to their monetary equivalents, that is largely responsible for the uncharacteristically unambiguous results which have been reported in the literature.

To our knowledge, psychic costs are transformed into wealth equivalents in all of the existing literature on the criminal choice. For example, Becker [1968, p. 179] writes, costs ". . . can be made comparable by converting them into their monetary equivalent . . ." While Ehrlich [1972, p. 6] defines the individual's wealth so that it includes " . . . assets, earnings within the period and the 'real wealth' equivalent of non-pecuniary returns from legitimate and illegitimate activity . . ." Or, in the words of Sjoquist [1970, p. 12], "The psychic costs are measured by that quantity of money having an equivalent value . . ." Yet, in none of these papers, is the character of this transformation (psychic costs to wealth equivalents) adequately accounted for, either implicitly or explicitly. Some of the consequences of incomplete specification are explored below.

The following definitions will be used in our analysis:

$W^o \equiv$ the agent's initial wealth

$r \equiv$ the rate of return to legal activity

$V \equiv$ the rate of return to illegal activity

$a \equiv$ the failure, capture, or arrest rate. "a" is a non-negative random variable, $0 \leqslant a \leqslant 1$.

$\theta \equiv$ the number of offenses, $\theta = \theta(T)$ and $\theta'(T) > 0$.

$F \equiv$ the fine per offense

$\hat{W} \equiv W^o + rL + (V - aF)\theta(T)$, actual wealth[6]

$N \equiv$ time devoted to non-market activity

$\bar{t} \equiv L + T + N$

Note that the penalty for an offense is specified as a fine. This penalty specification enables us to focus on an issue of central concern in this paper, the role of ethical considerations in the offense decision.[7] In addition, according to Becker [1968, p. 193-98], fines are not only the most common form of punishment, but also the most "efficient."

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[6]We use the term "actual wealth" to denote the wealth that an individual has available to meet his financial obligations. It is his initial wealth (W^o) plus his earnings or losses during the period under consideration. $\hat{W}$ is a particular value of W. In the discussion that follows, it is necessary to formally distinguish between W and $\hat{W}$.

[7]For a discussion of the relationship between fines and prison sentences as alternative punishments, see Block and Lind [1972].

The Model

According to the expected utility theorem, the individual's labor-theft supply decision is determined by

$$(6) \quad \max_{L, T} \int U[L, T, W^0 + rL + (V - aF)\theta] \, f(a)da$$

subject to the condition that labor and theft levels be non-negative. In (6), $f(a)$ is the agent's subjective probability density on the arrest rate and indicates the agent's beliefs as to the intervals in which the arrest rate is likely to lie. To simplify the exposition, we adopt the specification used in Ehrlich [1972] and in Reynolds [1971] and fix the amount of time allocated to non-market activities.[8] Further, the number of offenses is assumed to be proportional to the time devoted to their production. Under these assumptions the first order condition for a relative maxima requires that

$$(7) \quad E[U_T - U_L + U_W ((V - aF)\theta' - r)] \leqslant 0$$

where $\theta' = d\theta/dT$. As would be expected, when the psychic cost of effort is afforded its traditional labor theoretic role, the agent's simple behavior toward risk (sign U_{WW}) has no unique allocative implications.[9] In general, it is simply not true, as Ehrlich [1972, p. 9] maintains, that preferences toward risk and relative returns alone determine the degree of specialization. Only in the special case where returns include a highly stylized rendering of ethical costs will the assertion be valid.[10] One must know something, not only about the agent's behavior toward risk, but also about the relative "irksomeness" of toil in the alternative occupations. For example, if the individual is risk averse but displays honesty preference, then $(V - E(a)F)\theta' - r > 0$ is a necessary but not sufficient condition for the commission of offenses. While in this case returns to illegal activity must be greater than expected costs (where costs consist of the average penalty plus legal opportunities foregone) before the individual would consider committing an illegal act, for this condition to also be sufficient for $T > 0$, the rate of return must be sufficiently high to outweigh the psychic disadvantage of participation in illegal acts. Nonetheless, increasing the certainty of arrest, increasing penalties, or increasing legal opportunities until "crime does not pay," $(V - E(a)F\theta' - r < 0$, will deter this group of offenders.[11] On the other hand, if the individual displays both a preference for risk and honesty, making "crime not pay" may not deter participation. Also note that if the individual's preferences are characterized by absolute honesty the strict inequality in (7) always holds.

The Model in Wealth Equivalent Form

As we have indicated, previous attempts by economists to model the offense decision have postulated an individual who is able to rank *all* attributes of that decision in terms of wealth alone. And, in most circumstances, this would seem to be a methodologically valid procedure. But unless one is careful in transforming activity levels into their wealth equivalents, one may end up with a model in which all the underlying labor theoretic aspects of the decision have disappeared: In effect, one no longer has a household supply problem, but a firm supply problem, i.e., one may lose the income term in the traditional Slutsky equation. To facilitate contrasting the present model to the existing literature and to explore more fully the link between household supply problems and firm "output" problems, we reformulate the above model in terms of wealth equivalents. To this end we introduce the following

Definition: For an individual possessing wealth stock $\hat{W}$ and allocating L' and T' to legal and illegal activities respectively, $W^* - W'$ is termed the wealth equivalent of $L^* - L'$ units of legal activity and $T^* - T'$ units of illegal activity iff W^*, W', L^* and T^* satisfy $U(L', T' W') = U(L^*, T^*, W^*)$, where $\hat{W}$ is either W' or W^*.[12]

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[8] That is, $N = \bar{N}$, a constant.

[9] See Becker (1971, p. 169-70) for a careful discussion of the role of psychic costs in allocating time among *legal* alternative income generating activities. This treatment is in contrast to his rather casual accounting for psychic costs in the criminal choice problem.

[10] This point is discussed in more detail below.

[11] It is interesting to note that if the individual displays risk aversion but has a preference for illegal activities, $(U_L - U_T) < 0$, making crime not pay in this sense may not deter the individual.

[12] For convenience, the reader might assume that values of L and T are chosen so that $W^* - W' > 0$. Note that $L^* - L' > 0$ or $T^* - T' > 0$ is necessary but not sufficient for $W^* - W' > 0$. Whether, say, $L^* - L' > 0$ and $T^* - T' < 0$ is sufficient for $W^* - W' > 0$ depends not only upon the values L^*, L', T^* and T' but also upon the individual's trading ethics. For example, if $L^* - L' > 0, T^* - T' < 0$ and $|L^* - L'| = |T^* - T'|$, then the ethic of honesty preference would imply $W^* - W' < 0$.

To aid in interpreting the definition, consider the case where $L' = L*$ and $T' = 0$. Then $W* - W'$ is the wealth equivalent of $T*$ hours of illegal activity. If $W' = \hat{W}$, then $W* - \hat{W}$ is the payment (bribe) necessary to induce the individual to supply activity level $T*$. While if $W* = \hat{W}$, then $\hat{W} - W'$ represents the fine or wealth threat necessary to induce the same supply decision.

If wealth equivalents exist for any L', T', and $\hat{W}$, then in particular we know there exists a W' such that

$$(8) \qquad U(L*, T*, \hat{W}) \equiv U(0, 0, W'),[13]$$

i.e., the individual is indifferent between wealth level W' with no effort expended, and wealth level $\hat{W}$ with $L*$ and $T*$ expended. $\hat{W} - W'$ is the wealth equivalent of $L*$ hours of legal activity and $T*$ hours of illegal activity. As is apparent from (8), W' will in general depend upon the level of activity in legal and illegal markets, $L*$ and $T*$, and actual wealth $\hat{W}$. Therefore, the difference between actual wealth, $\hat{W}$, and W', the wealth equivalent, will in general be a function of $L*$, $T*$ and $\hat{W}$. Formally,

$$(9) \qquad \hat{W} - W' = C(L*, T*, \hat{W})$$

Since (9) holds for all $L*$ and $T*$

$$(8') \qquad U(L, T, \hat{W}) \equiv U(0, 0, \hat{W} - C(L, T, \hat{W})).$$

C is the function that maps the various effort allocations and levels of wealth into their monetary equivalent. In other words, C is the "cost" of L and T for any $\hat{W}$.

It is, of course, possible to express the trading ethics discussed above either in terms of the definition of wealth equivalence or in terms of the cost function, C. For example:

(i) Absolute honesty is the case where there exists no $W*(W')$ such that $U(L', 0, W') = U(L', T*, W*)$ for any W' $(W*)$ and $T* > 0$. Intuitively, there exists no increment nor decrement to wealth that would induce the individual to provide a non-zero supply of theft. No wealth equivalent exists.[14] Alternatively, the individual exhibits absolute honesty iff there does not exist $0 < W < \infty$, such that $C_T < \infty$, $L, T, > 0$.

In terms of the cost function, the individual demonstrates:

(ii) Honesty Preference iff $C_T - C_L > 0$, $L, T, W > 0$

(iii) Ethical Independence iff $(C_T - C_L)/(1 - C_W) = $ constant, $L, T, W, > 0$ and

(iv) Ethical Neutrality iff $C_T - C_L = 0$, $L, T, W, > 0$.

The supply analysis that follows is in terms of the utility indicator on the right hand side of $(8')$. As mentioned above, this procedure enables us to interpret the existing literature within the more general labor economic framework.

Supply Behavior and Policy Changes[15]

In this section, we post a number of questions concerning the supply behavior of a single agent. In particular, we investigate the agent's supply response to changes in (i) initial wealth, (ii) the pay-off to illegal activity, (iii) the wage rate, (iv) the arrest rate, and (v) the severity of punishment.

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[13]Choosing W' in this manner transforms the disutility of effort into a simple substraction from wealth and permits expression of the labor supply problem solely in terms of wealth.

[14]More formally, $U(L', 0, \hat{W}) > U(L', T*, W*)$ for arbitrarily large $W*$, and $U(L', 0, 0) > U(L', T*, \hat{W})$, for $T* > 0$. Hence, it is not possible in this case to reduce the multi-attribute decision problem to a decision problem defined on wealth alone.

[15]In the discussion that follows, we assume internal solutions exist to first order conditions.

To begin, we employ identity (8′) and rewrite first order condition (7) as

$$(7') \qquad E[U_W(O,O,\hat{W}\text{-}C) \ [((V\text{-}aF)\theta'\text{-}r) (1\text{-}C_W) + C_L - C_T]] \leqslant 0$$

By (8′) $E[U_T(L,T,\hat{W}) - U_L(L,T,\hat{W})] \equiv EU_W(O,O,\hat{W}\text{-}C) (C_L - C_T)$ and hence $U_W(O,O,\hat{W}\text{-}C)$ is the "utility weight" that transforms changes in "costs," $C_L - C_T$, into the appropriate utility changes. In addition, the term $U_W(O,O,\hat{W}\text{-}C) (1\text{-}C_W) \equiv U_W(L,T,\hat{W})$ by (8′). To interpret $U_W(O,O,\hat{W}\text{-}C) (1\text{-}C_W)$, assume, as is most likely, $C_W > 0$ and note that a one dollar increase in wealth generates an increase in "well being" of less than $U_W(O,O,\hat{W}\text{-}C)$, since increases in wealth increase the payment the individual would be willing to make *not* to supply a given amount of effort. The value of the "net" increase in wealth to the individual is $U_W(O,O,\hat{W}\text{-}C) (1\text{-}C_W)$.

In most of the comparative static derivatives which follow, second derivatives of U appear in product expectations. This points up a well-known characteristic of stochastic models, viz. that a qualitative analysis of parameter shifts in these models often requires third derivative information concerning the agent's utility indicator. The customary method of providing this information is to postulate plausible hypotheses regarding the agent's behavior toward risk as various arguments of the utility indicator change. For example, if $U = U(L,T,W)$ then $R \equiv -U_{WW}(L,T,W)/U_W(L,T,W)$ has been termed the coefficient of absolute risk aversion. And if the agent becomes increasingly willing to accept a wealth gamble of a given size as his wealth increases, he is said to display decreasing absolute risk aversion, i.e. $\partial R/\partial W < 0$. This restriction on the agent's preferences has been widely utilized and has led to many interesting results.[16] An important question concerns the relation between R and the analogous coefficient defined on the wealth equivalent utility formulation, say, $\overline{R} \equiv -U_{WW}(O,O,\hat{W}\text{-}C)/U_W(O,O,\hat{W}\text{-}C)$. Although it would seem entirely reasonable to require $R = \overline{R}$ for all L, T, and W, to our knowledge this topic has not been investigated.[17]

Wealth Effects

A question of considerable interest to both criminologists and economists is the effect on the level of criminal activity of changes in the potential criminal's "initial wealth." For example, would increased welfare payments have incentive or disincentive effects on the supply of offenses. To investigate this question, differentiate (7′) with respect to W^o. In which case

$$(10) \qquad \partial T/\partial W^o = -E[U_W[((V\text{-}aF)\theta'\text{-}r) (\text{-}C_{WW}) + C_{LW} - C_{TW}] +$$
$$[((V\text{-}aF)\theta'\text{-}r) (1\text{-}C_W) + C_L - C_T] (1\text{-}C_W) U_{WW}]/H_{TT}$$

where $H \equiv EU[O,O,\hat{W} - C(L,T,\hat{W})]$.

Neither decreasing absolute risk aversion nor decreasing absolute aversion combined with any of the above trading ethics provide sufficient information to deduce the inferiority of illegal activity. Only *a priori* considerations can sign $\partial T/\partial W^o$ at this level of generality. Undoubtedly, such considerations would lead most economists to argue that effort expended generating income in either legal or illegal markets is an inferior activity. And indeed, any analysis which implied the normality of "work" would be considered highly suspect.

Payoff Effects

To our knowledge, most of the research on illegal activities has focused directly on deterrance and hence payoff effects on the supply of these activities have been largely ignored.[18] This neglect appears even in much of the recent economics of crime literature. For example, although Becker includes "net returns" in his formulation, it is not central to his supply of offenses analysis. Certainly, any analysis of property crimes must include an examination of payoff effects as a matter of

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[16]For example, Sandmo [1970, 1971], Leland [1968, 1971, 1972], Mossin [1968a, 1968b] and Block and Heineke [1972a, 1972b, 1973].

[17]To simplify notation in the work that follows, U_W will be used to represent $U_W(O,O,\hat{W}\text{-}C)$ unless otherwise indicated.

[18]See Schrag [1971, pp. 20-113] for a brief survey of the criminological literature in this area.

central concern.

$$(11) \quad \partial T/\partial V = -EU_W(1-C_W)\theta'/H_{TT} + \theta \; \partial T/\partial W^o.$$

Equation (11) is the stochastic analog of the familiar Slutsky expression composed of a substitution effect and a wealth effect. Since H_{TT} and $1-C_W$ are negative and positive respectively, the substitution term is positive.[19] Hence, the direction of the supply response will depend upon the wealth effect. If theft is an inferior activity, as is most likely, no qualitative conclusions are forthcoming.

Of course, this comes as no surprise. Economists have long known that "price effects" in household decision models are ambiguous in sign. With no further preference information *the* sufficient condition for a positive supply response is the normality of illegal activity. Without this condition, the possibility that theft is a Giffen activity cannot be dismissed.

Wage Effects

The thesis that poverty causes crime[20] and the Skinnerian prescription for extinguishing criminal behavior . . . "by seeing to it that it goes unrewarded and (by) reinforc(ing) some more acceptable form of behavior," might be interpreted as expressions of the hypothesis that increased legal opportunities have a deterent effect on the offense decision.[21] This hypothesis is of more than passing interest. If valid, the major effort in American correctional institutions to retrain and "rehabilitate" the individual offender may be justified. For the important case where illegal behavior is an inferior activity, our model supports this hypothesis. To see this, consider the following derivative:

$$(12) \quad \partial T/\partial r = EU_W(1-C_W)/H_{TT} + L \; \partial T/\partial W^o$$

Since the substitution effect of a change in legal returns is negative, increased legal opportunities will deter offenders if theft is an inferior activity.[22]

Enforcement Effects

In the model being investigated in this paper, uncertainty is introduced through the enforcement variable "a". The payoff and penalty are both assumed to be known but the frequency of penalty imposition (the arrest rate) "a" is taken by the agent to be a random variable. This specification is a generalization of the Becker and Ehrlich Bernoulli formulations.

The relation between the offense decision and changes in the degree of enforcement has been a topic of long-standing speculation. But because the arrest rate is a random variable there is no unique interpretation of an increase in enforcement. However, an intuitive approach is to consider changes in enforcement procedures that increase the expected number of arrests but leave all other moments of f(a) unaltered. That is, we consider a "pure" increase in the arrest rate. This may be accomplished by replacing "a" in $(7')$ with $a+\delta$, where δ is a mean altering, dispersion preserving parameter. Differentiating with respect to δ and evaluating at $\delta = 0$ yields:

$$(13) \quad \partial T/\partial \delta = -F \cdot (\partial T/\partial V)$$

As we have noted, the sufficient condition for unambiguously signing $\partial T/\partial V$ is to assume the normality of illegal activity. Hence, for this class of penalties, we are able to assert unequivocally the deterrent effect of increases in the arrest rate $(\partial T/\partial \delta < 0)$ only by making this rather disturbing assumption. Of course, the reason for sign ambiguity in (13) is that increases in E(a) decrease expected returns, which in turn decrease the individual's expected wealth. Decreases in expected wealth most likely lead to increases in effort expended. That is, an increase in E(a) has an incentive effect in the wealth term of (13) if

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[19]$1-C_W > 0$ by identity $(8')$.

[20]This thesis has long been popular in criminology. See Vold's [1958, p. 169] survey of the literature about which he states, ". . . the conclusion has usually been taken for granted that poverty and unemployment are major factors producing criminality."

[21]The Skinnerian interpretation of the crime prevention problem is discussed in Conrad [1965, p. 303].

[22]The reader will note that fixing the time allocation to non-market activities implies legal and illegal activities are net stochastic substitutes.

criminal activities are inferior, and a disincentive effect in the substitution term.

Penalty Effects

In the past decade we have witnessed a heated polemic concerning the effects of changes in the severity of punishment on the crime rate. Protagonists of the "liberal" position have often claimed that increasing the severity of punishment has little or no deterrent effect on the supply of offenses while more "conservative" individuals have denounced this group as "soft on crime" and recommended increased penalties to combat growing crime rates. Although much of this argument has been couched in ideological considerations, the central question concerning the supply effects of changes in the severity of punishment is a major concern of policy makers. We now consider this question in the context of the present model.

The first order conditions, (7') indicate that three "pieces of information" jointly determine the offense level: the net rate of return to theft, the individual's behavior toward risk and his trading ethics. Hence, by examining (7') one can find several combinations of trading ethics and behavior toward risk which would result in zero offenses for sufficiently severe penalties. For example, if the world were comprised of risk averse individuals who possessed the trading ethic of honesty preference, then the supply of offenses could be driven to zero by making F sufficiently large. However, this may not be possible, and if not, the question of the supply response to a change in the severity of the penalty must be formulated in terms of marginal changes in the penalty.

Since F is deterministic, the interpretation of a change in the penalty is straightforward. In fact, increases in F act as scale changes on the random variable "a," decreasing expected returns and increasing the dispersion of returns. Formally

$$(14) \quad \partial T/\partial F = EU_W(1-C_W)a\theta'/H_{TT} + \theta E[U_{Wa}[((V-aF)\theta'-r)(-C_{WW}) + C_{LW} - C_{TW}] + U_{WWa}[((V-aF)\theta'-r)(1-C_W) + C_L - C_T](1-C_W)]/H_{TT}$$

Inspection of (14) reveals the substitution effect of a change in penalty to be negative and the wealth effect to be unsigned without further preference information. Hence, at least at the present level of generality, arguments alleging the disincentive effects of increases in the severity of punishment are not unambiguously supported by theory.

We have seen that if the multi-attributed nature of the individual's decision problem is properly accounted for, then the "usual" preference restrictions concerning the individual's behavior toward risk will not provide sufficient information to sign the supply effects of increased "payoffs," "enforcement," and "penalties." The core of the problem is of course the fact that wealth effects are unsigned. And, assuming theft to be an inferior activity does not alleviate the ambiguity, since relative magnitude difficulties then arise in each case.

Above we alleged that failure to fully specify the choice problem and therefore the transformation between the multi-attribute decision problem and the wealth only problem had led Becker and Ehrlich to conclusions which are valid only in special cases.[23] An interesting question thus arises. What assumptions concerning this transformation are implicit in the several unambiguous results reported by these authors? Or more generally, given the supply problem as posed in (6), under what conditions do changes in the various components of the return to illegal activity lead to unambiguous supply responses? It is to this question that we now turn.

Ethical Costs and Wealth: The Case of Independence

Up to this point, we have analyzed the offense decision in terms of a fully general wealth equivalent. That is, the "cost" function, C = C(W,L,T), was unrestricted in all arguments; only sign and magnitude restrictions that followed directly from the definition of wealth as a commodity and labor as a discommodity were employed in the analysis. As we have seen, the price of this generality is qualitative ambiguity. In particular, the unambiguous results reported by Becker and Ehrlich are not forthcoming when the offense decision is analyzed as a general multi-attribute decision problem.[24] However, if one is

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[23]We will direct any further remarks to the work of Becker and Ehrlich only. The Sjoquist paper, among other things, utilizes several extremely restrictive assumptions and for this reason is of less interest than the Becker and Ehrlich papers.

[24]The only exception to this statement is the response of offenses due to a change in p (the Bernoulli parameter), a result that is reported in both Becker and Ehrlich. Although the reported result holds after the problem is properly specified, it is rescued only because of the extremely simple density employed in their analyses. The Bernoulli is discussed in more detail below.

willing to place *a priori* restrictions on the form of the transformation between the multi-attribute decision and its wealth equivalent, then traditional assumptions concerning behavior toward risk will often sign supply effects.

In the work that follows, we explore the implications of assuming that the "net returns" to crime are independent of the individual's wealth level. Note that this is precisely the assumption that is implicit in the analysis of criminal activity presented by both Becker and Erhlich.[25] By neglecting to specify the transformation between the underlying multi-attribute decision problem and their "wealth only" problem, they fail to account for the interaction between changes in wealth and changes in the psychic costs of crime. This omission is equivalent to the assumption that C is independent of W, i.e., $C = C$ (L,T). Or, in more traditional terms, under conditions of certainty, the allocations to theft and labor are invariant to changes in wealth. From the perspective of trading ethics, the assumption that $C = C(L,T)$ implies that honesty (dishonesty) preference is constant in wealth.

Wealth Effects ($C_W = 0$)

While the assumption that "ethical costs," C, are independent of wealth would not appear to be widely applicable, one should judge this assumption, as all assumptions, by its implications. To this end we replace C(L,T,W) in $(8')$ with C(L,T). In which case equation (10) becomes

$$(10') \qquad \partial T/\partial W^o = -EU_{WW}[(V - aF)\theta' - r + C_L - C_T]/H_{TT}$$

As is obvious, the agent's simple behavior toward risk (the sign of U_{WW}) provides sufficient information for signing $(10')$ only in the trivial cases of risk neutrality or quadratic utility. Generally, third derivative information will be needed. If the individual is risk averse, the Arrow-Pratt measure provides the needed information. As is well-known, if this measure decreases in wealth ($\partial R/\partial W < 0$), then the numerator of $(10')$ is negative.[26] The crucial requirement, which is absent in the *general* wealth equivalent, is that the nonlinear portion of the wealth constraint be non-random. This is precisely the effect of making C independent of wealth. We now have

$$(15) \qquad \partial T/\partial W^o > 0.[27]$$

Inequality (15) gives the first clear indication that the labor theoretic structure of the basic problem has been abrogated. If the psychic costs of effort are independent of wealth, and if the agent exhibits decreasing absolute risk aversion, then effort expended generating income via illegal activity will increase with wealth. *Theft is a normal activity.*[28] This disturbing implication is a direct result of "independence" which collapses the labor supply problem into an "output" problem; for indeed in this class of problems, decreasing absolute risk aversion implies risky assets are normal goods.[29]

It is of interest to briefly re-examine several of the other supply effects reported above for the case where C and W are independent.

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[25] Evidence supporting this assertion appears throughout the Becker and Ehrlich papers. For example, see Ehrlich [1972, p. 12] where he states that the sign of wealth effects, produced by equal proportional increases in wealth in every state of the world, is determined by the sign of the coefficient of relative risk aversion. It is easily shown that the coefficient of relative risk aversion will sign wealth effects generated in this manner *only* if C is independent of wealth.

[26] For proof of a formally identical proposition, see Sandmo's (1971, p. 68-69] demonstration of the negative output effects associated with changes in fixed costs.

[27] This result is also forthcoming if $C_{WW} = 0$ and $\overline{R} = R$, where $\overline{R}$ and R represent the coefficient of absolute risk aversion associated with the utility indicators on the left and right hand sides of identity (8) respectively.

[28] This result is reported in Ehrlich [1970, p. 31].

[29] We have used the designations "output" problem and "portfolio" problem. Usually both terms refer to problems in which wealth is the sole argument in the utility indicator, the difference being that output problems include nonlinear definitions of wealth while portfolio problems are characterized by what Arrow has called "constant stochastic returns." As far as wealth effects are concerned, both output and portfolio models yield the result that risky assets are normal goods, as long as nonlinearities are non-random.

Payoff Effects ($C_W = 0$)

For the case at hand, equation (11) above becomes

$$(11') \qquad \partial T/\partial V = - EU_W \theta'/H_{TT} + \theta \partial T/\partial W^0$$

The substitution effect in $(11')$ is obviously positive and as we have seen, under the Arrow-Pratt hypothesis the wealth effect is also positive. Hence, if psychic costs are invariant in wealth and if absolute risk aversion decreases in wealth, then the agent will unambiguously devote more hours to illegal activity as the return to these activities increases.

Enforcement Effects ($C_W = 0$)

Derivative (13) is, of course, still

$$(13') \qquad \partial T/\partial \delta = -F \cdot (\partial T/\partial V),$$

where δ is the mean altering dispersion preserving parameter defined above, which was used as an additive shift on the random variable a. But, as has been noted, unlike the case of the general wealth equivalent, $\partial R/\partial W < 0$ here implies the normality of illegal activity and therefore increases in the arrest rate will produce an unambiguous deterrent effect on the supply of offenses.

Penalty Effects ($C_W = 0$)

This case is a bit messier since shifts in F "scale" the random variable a. When $C_W = 0$ equation (14) becomes

$$(14') \qquad \partial T/\partial F = E(U_W a)\theta'/H_{TT} + E[U_{WW}((V-aF)\theta'-r + C_L - C_T)a]/H_{TT}$$

Since U_W and "a" are each non-negative random variables, the first term in this expression is clearly negative. In addition, it is easy to show that decreasing absolute risk aversion implies the numerator of the second term is positive.[30] Therefore, both terms are negative and we have the result reported by Becker [1968, p. 177] in his paper: Increases in "punishment" unequivocally reduce the incentive to engage in illegal activities. Notice that two assumptions support this result. The first is the independence of psychic costs and wealth which as we have seen is implicit in both the Becker and Ehrlich models. The second is decreasing absolute risk aversion, an assumption which will be needed unless f(a) is restricted to a particularly simple density function. Indeed, if $C_W = 0$ and f(a) is Bernoulli, risk aversion alone is sufficient for $(14')$ to be negative. Before briefly examining the Bernoulli, we consider the effect on the supply of offenses of one additional parameter shift, a shift discussed by both Becker and Ehrlich.

Pure Dispersion Changes:

The relation between the offense decision and the degree of certainty with which the penalty is administered has been debated endlessly by criminologists. Well over a century and a half ago, Sir Samuel Romilly, in a series of debates with William Paley, held that not only did certainty of punishment deter criminal activities, but also that certainty of punishment was more crucial than severity. "So evident is the truth of this maxim that if it were possible that punishment could be reduced to an absolute certainty a very slight penalty would be sufficient to deter almost every species of crime . . ."[31] Modern support for this position has come from the field of experimental psychology. For example, Dr. Azrin holds that if punishment is to be an effective deterrent, it must be delivered immediately and with certainty.[32] We next determine whether the present model contains any implications concerning the deterrent effects of increases in the certainty of punishment.

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[30]To see this, let $Z \equiv (V-aF)\theta'-r+C_L - C_T$ and let $\overline{W}$ be that wealth level such that $Z = 0$. We must show $E(U_{WW}Za) > 0$. If $Z \geqslant 0$, then $aR < \overline{(aR)}$ where $\overline{(aR)}$ signifies that the product aR is evaluated at $\overline{W}$ and hence is non-random. Therefore, $-ZaU_{WW} < \overline{(aR)}U_W Z$. If $Z < 0$ the analogo rgument yields the same result. Hence, $-E(U_{WW}Za) < \overline{(aR)}E(U_W Z)$. But $E(U_W Z)$ is the necessary condition for an internal maximum and n. ist be zero. Therefore, $E(U_{WW}Za) > 0$.

[31]This debate is reported in Michael and Wichsler [1940, p. 250ff.].

[32]The work of Azrin is discussed in Honig [1960, p. 380].

A widely utilized method of studying the effects of changes in the dispersion of a random variable consists of using a combination of a multiplicative and an additive parameter shift on the variable in question. The multiplicative shift "spreads" the density, while the additive shift is used to keep the mean of the variable unchanged.[33] To assess the supply effects of a change in the dispersion of punishment, we apply the additive shift parameter to "a", say Υ, which in turn acts as a multiplicative shift on F. The parameter Υ is restricted to ensure E(aF) is unchanged.[34] It is interesting to note that dispersion changes generated in this manner are formally identical to the changes in the probability of arrest "compensated" by changes in the penalty reported by Becker [1968, p. 178] and Ehrlich [1972, p. 11].

Differentiating $(7')$ with respect to Υ and evaluating the result at $\Upsilon = 0$ we have

$$(16) \qquad \partial T/\partial \Upsilon = -F/E(a)[Cov(U_W,a)\theta' + \theta \, Cov[U_{WW}((V\text{-}aF)\theta' \text{-} r + C_L \text{-} C_T),a]\,]/H_{TT}[35]$$

unlike the other comparative static results reported in this section, decreasing absolute risk aversion will not be sufficient to sign (16). For risk averse agents $Cov(U_W,a)$ is obviously positive, but non-linear trading ethics, $C_L - C_T$, prevent further analysis of the second convariance term. It would seem that this term can be signed only if the function C(L,T) is linear, i.e. if the individual displays ethical independence.[36] In which case it can be shown that $\partial R/\partial W < 0$ implies the second covariance in (16) is positive and therefore

$$(17) \qquad \partial T/\partial \Upsilon > 0.[37]$$

Given the preference restrictions which have been enumerated, the model supports the hypothesis that increases in the certainty of arrest induce disincentive effects. But clearly, this is not the point that deserves amplification. The seemingly very plausible hypothesis that increases in the certainty of arrest will discourage criminal activity, a hypothesis that is often accepted as fact, rests upon a series of preference restrictions, several of which are quite exacting. To wit: (i) the individual is risk averse and (ii) displays decreasing absolute risk aversion; (iii) the "psychic costs" of theft are independent of the individual's wealth and (iv) the individual exhibits ethical independence, $C_L - C_T$ = constant. As we have seen, (iii) reduces what is essentially a labor supply problem to an output problem and with (i) and (ii) implies theft is a normal activity. (iv) goes one step further and reduces the output problem to a problem characterized by "constant stochastic returns," a portfolio problem.[38]

Interpreted in an alternative manner, inequality (17) may be viewed as a more general rendering of Becker's [1968, p. 178] result that compensated increases in the arrest rate reduce the number of offenses less than compensated increases in the penalty if the agent is risk averse and have the same effect if the agent is risk neutral, i.e. $\partial T/\partial \Upsilon = 0$ if $U_{WW}=0$.[39] These results were also reported by Ehrlich. Recall that the result reported in (17) rests on the four preference restrictions listed in the previous paragraph. Since Becker and Ehrlich report the same result using only (i), we next briefly consider their models.[40]

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[33]For example, see Sandmo [1970,1971], Leland [1972] and Block and Heineke [1973].

[34]Formally, $dE(a + \Upsilon)F/d\Upsilon = 0$ and hence $dF/d\Upsilon = -F/E(a)$ when $\Upsilon = 0$.

[35]Of course, $C_W = 0$ in this derivative. If not, there is no possibility of extracting qualitative information.

[36]Note that if $C_W = 0$ then ethical independence implies $C_L - C_T = K$.

[37]Define $Z \equiv (V - aF)\theta' - r + C_L - C_T$. We are to show $Cov(U_{WW}Z,a) \equiv E[U_{WW}Z(a - \mu_a)] > 0$. Note that $Z - \mu_Z \equiv (a - \mu_a)(-F\theta')$ and hence $E(U_{WW}Z(a-\mu_a)] \equiv -F\theta'E[U_{WW}Z(Z-\mu_Z)] \equiv -F\theta'[EU_{WW}Z^2 - \mu_Z EU_{WW}Z]$. For risk averse individuals $EU_{WW}Z^2 < 0$ and if $\partial R/\partial W < 0$ then $EU_{WW}Z > 0$ by $(10')$ and (15) above. The only remaining unsigned item is μ_Z. If the individual exhibits ethical independence, the necessary condition for a non-zero supply of offenses is $\mu_Z > 0$. Therefore, the term in brackets is negative and $Cov(U_{WW}Z,a) > 0$.

[38]See f.n. 29 above.

[39]To interpret $\partial T/\partial \Upsilon$ in terms of the Becker result, note that "a" is increased and F is decreased such that E(aF) is constant. Since $\partial T/\partial \Upsilon > 0$, the decrease in F has the greater effect on T.

[40]Since Ehrlich's model generalized Becker's work we restrict our subsequent analysis to Ehrlich's model. The conclusions drawn hold *a fortiori* for the Becker model.

A Specific Subjective Density: The Bernoulli

In the analysis above we have assumed only the existence of a subjective probability distribution f(a). This is a much more general approach than has been adopted in previous work. Becker's pioneering work in the area and Ehrlich's extension both assume "a" is either one or zero with f(1) = p and f(0) = 1-p. i.e., f(a) is Bernoulli. In other words, in the Becker and Ehrlich formulations the individual is assumed to make decisions as if the only possible outcomes are total failure (he is caught for all offenses) or complete success (he is not caught for any offense). This is in contrast to the present formulation in which the "arrest rate" or "failure rate" may take on any value between 0 and 1. In other words, in the model employed up to this point, the individual is free to consider all failure possibilities. While both Ehrlich and Becker suggest that their results are forthcoming for more general densities, as the results above indicate, this is not the case.[41] However, because the Bernoulli density significantly simplifies comparative static derivatives, it does enable us to focus on the precise nature of the preference assumptions underlying the Ehrlich and Becker analysis.

To see the implications of this density, let f(a) be Bernoulli in the wealth equivalent version of equation (6). In this case expected utility is

$$(18) \qquad pU[W^o + rL + (V-F)\theta - C(L,T,W')] + (1-p)U[W^o + rL + V\theta - C(L,T,W'')]$$

For convenience, we define $W' \equiv W^o + rL + (V-F)\theta$ and $W'' \equiv W^o + rL + V\theta$. Note that equation (18) is the Ehrlich model if C (L,T,W) is not subsumed into V.[42] It is, of course, this subsuming of "psychic elements" into the net monetary benefits and costs of crime as well as the use of a Bernoulli distribution that restricts the Ehrlich and Becker formulations. While both authors claim to include both monetary and psychic benefits and costs in revenue and cost functions, as we have seen, their implicit assumptions concerning psychic costs and benefits are quite severe.

To examine the essential elements of these preference restrictions, it is sufficient to consider the effect on illegal activity of a "compensated" increase in the arrest rate. A compensated increase in the arrest rate consists of an increase in the arrest rate compensated by a decrease in the penalty, so that the effect of both changes is to leave the expected punishment (pF) unchanged. While Becker and Ehrlich employ equal and opposite percentage changes in p and F to accomplish this compensated change, it may also be performed by simply setting

$$d(pF)/dp = F + p(dF/dp) = 0$$

and hence dF/dp is equal to -F/p. This latter approach has the advantage of emphasizing the relationship between compensated changes in p and the more general dispersion changes discussed above. Within the Bernoulli framework, the Becker-Ehrlich compensated change is a change in the dispersion of returns to illegal activity.

To proceed, note that $\qquad (19) \qquad \partial T/\partial \Upsilon = \partial T/\partial p - (\partial T/\partial F)(F/p),$

where $\partial T/\partial \Upsilon$ is the effect on illegal activity of a mean preserving (or compensated) change in p, and $\partial T/\partial p$ and $\partial T/\partial F$ are the effects on T of changes in p and F respectively. Since the individual's optimal level of illegal activity is obtained by maximizing (18), if we define $\overline{W} \equiv W' - C(L,T,W')$ and $\underline{W} \equiv W'' - C(L,T,W'')$, (19) may be written as

$$(19') \qquad \partial T/\partial \Upsilon = \{ -U_W(\overline{W}) [(V\theta'-r)(1-C_W(L,T,W'))+C_L(L,T,W')-C_T(L,T,W')]$$

$$+U_W(\underline{W})[V\theta'-r)(1-C_W(L,T,W''))+C_L(L,T,W'')-C_T(L,T,W'')]$$

$$-F\theta U_W(\overline{W})[C_{LW}(L,T,W')-C_{TW}(L,T,W')-C_{WW}(L,T,W')((V-F)\theta'-r)]$$

$$-F\theta U_{WW}(\overline{W})(1-C_W(L,T,W'))[((V-F)\theta'-r)(1-C_W(L,T,W'))$$

$$+C_L(L,T,W')-C_T(L,T,W')]\}/G_{TT}^{43}$$

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[41] For example, Ehrlich [1972, p. 9] states, "Although our model has been illustrated for two states of the world, the analysis equally well applies to n states . . ."

[42] There does remain one minor difference between the model specified in (18) and the Ehrlich formulation. Specifically, Ehrlich allows for variable punishment by considering a punishment function F(θ).

[43] Recall that time allocated to non-market activities is fixed.

where $G \equiv pU(\overline{W}) + (1-p)U(\underline{W})$. It is important to note that, in general and contrary to the assertions made by both Becker and Ehrlich, simple behavior towards risk (sign U_{WW}) is not sufficient to establish the qualitative effect of a compensated change in p. That is, the sign of (19′) is not uniquely determined by the individual's simple behavior toward risk. To sign (19′) one must have information not only on the individual's behavior toward risk but also on the properties of the cost function C. We now show that it is an implicit assumption about ethical costs that allow these authors to infer the effect of a compensated change in p from the sign of U_{WW} alone.

To see this, consider the special case in which ethical costs are independent of the individual's wealth position. Under this condition (19′) is greatly simplified and may be rewritten as follows:

$$(19'') \qquad \partial T/\partial \Upsilon = \Big\{ -U_W(\overline{W}) \left[(V\theta'-r)+C_L(L,T)-C_T(L,T) \right.$$

$$+U_W(\underline{W}) \left[(V\theta'-r)+C_L(L,T)-C_T(L,T)\right]$$

$$-F\theta U_{WW}(\overline{W}) \left[((V-F)\theta'-r)+C_L(L,T)-C_T(L,T)\right] \Big\}/G_{TT}$$

Equation (19″) is the result obtained by Ehrlich and is, in fact, identical to his expression for a compensated change in p except for the fact that in (19″) ethical costs are not aggregated into "net" returns and the penalty is fixed.[44] Ehrlich, and Becker in a less rigorous fashion, implicitly assume that ethical costs are independent of wealth. This assumption carries a number of disquieting implications. For example, if the individual, say displays honesty preference, then these "tastes" for honesty are invariant to changes in the individual's wealth level. Individuals who differ greatly in their wealth positions, but only in wealth positions, will display equal intensity of honesty preference. Equation (19″) describes such an individual's reaction to a compensated change in p.

It is straightforward to show that the sign of (19″) is uniquely determined by the individual's simple behavior toward risk, i.e. the sign of U_{WW}.[45] For example, if the individual is risk averse (19″) will be positive and a compensated increase in the arrest rate (p) will increase the individual's allocation to illegal activities. In other words, under the condition that ethical costs are independent of wealth, a decrease in the dispersion of returns to illegal activities, when the density is Bernoulli, will unambiguously lead a risk averse individual to increase his supply of such activities. Crucial in this result is the specific density and the independence of ethical costs and wealth. As we have shown above, if the density is not Bernoulli and/or ethical costs are not independent of wealth, simple behavior toward risk is not sufficient to establish the effect of mean preserving dispersion changes.

Since the crucial assumption underlying Becker's and Ehrlich's analyses is the independence of ethical costs and wealth, it is well to recall one of the implications of this assumption. For any density, including the Bernoulli, this assumption implies that illegal activity is a *normal* activity for all those individuals whose absolute aversion to risk is non-increasing in wealth. In other words, if we make the common and as yet empirically unrefuted assumption that an individual's coefficient of absolute risk aversion (R) decreases in wealth, the independence of ethical costs and wealth implies that illegal activity will be an increasing function of wealth.[46] Surely this is, at best, an uncomfortable implication of the independence assumption.

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[44]See Ehrlich [1972, f.n. 14, p. 55].

[45]To see this, note that $((V-F)\theta'-r+C_L(L,T)-C_T(L,T)) < 0$ and $(V\theta'-r+C_L(L,T)-C_T(L,T)) > 0$ by the first order condition and $G_{TT} < 0$ by the second order condition. Therefore, the sign of the first two terms on the right hand side of (19″) will be determined by the sign of U_{WW}. Since the sign of these terms will be opposite that of U_{WW}, the sign of U_{WW} uniquely determines the sign of (19″). In fact, with $C_W = 0$, $\partial T/\partial \Upsilon \gtrless 0$ iff $U_{WW} \lesseqgtr 0$.

[46]See equation (10′).

Summary

We have examined in some detail the individual's choice among two income generating alternatives, one legal and one illegal. Unlike the literature in this area, the problem was formulated in terms of the underlying multi-attributed structure of preferences which is inherent to household decision problems. This approach permitted us to focus attention on the role of moral and ethical considerations which may constrain the decision maker — considerations we have termed "trading ethics" and which heretofore have not been accorded explicit attention.

Although authors of previous work in this area have assumed that individuals order their preferences in terms of the wealth attribute alone, they purport to fully account for "trading ethics." We have shown that this is not the case. Clearly, collapsing preferences into orderings on wealth alone can provide only illusory simplification, since the same preference information that is explicit in multi-attribute orderings must be implicit in "wealth only" orderings. Indeed, "simplifications" which may appear to be forthcoming are the result of a failure to carefully specify the transformation between the multi-attribute model and its single attribute equivalent.

To provide a vehicle for contrasting our model to previous work, we formalized the notion of the wealth equivalent of an action. This concept, when appropriately defined, insures that the original and transformed decision problems are identical.

We next explored the supply response of variations in several policy instruments, and found, as would be expected, that no supply implications were forthcoming under "usual" preference restrictions, although "substitution effects" were signed. The problem was of course that wealth effects were indeterminate in sign. To deal with this problem and to provide a link to the literature, we introduced the assumption that "ethical costs" are independent of wealth, an assumption implicit in the work of Becker and Ehrlich; in which case the pervasive qualitative ambiguity disappeared. But it was at this point that we got the first clear indication that the intrinsic labor theoretic structure of the problem had been violated: Independence of wealth and ethical costs and decreasing absolute risk aversion implied theft is a normal activity. Formally, $C_W = 0$ reduced the household supply problem to a firm output problem. But even decreasing absolute risk aversion and the independence of ethical costs and wealth did not provide sufficient information to assess the effects of increases in the arrest rate that are compensated by an equal percentage reduction in the penalty. Analytically, such changes are pure dispersion changes in the net return, and appear to be signable only for the case of "constant stochastic returns"; that is, only if the "output" problem is further reduced to a "portfolio" problem. Finally, we briefly reconsidered the effect of such dispersion changes within the context of a further simplification — the case where the individual's density over outcomes is Bernoulli.

Although the present paper generalizes previous work, a great deal of work remains to be done. Among the most important immediate extensions of our analysis is the need to more adequately account for penalties, especially imprisonment, which is a unique pricing device due to the direct physical restraints on the individual's choices. In addition, the decision makers choice set should be expanded to include substitution, not only among alternative income-generating activities, but also between income-generating activities and leisure. Both problems are under investigation by the present authors and are rife with perplexing problems.

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