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ECONOMICS OF CRIMINAL BEHAVIOR

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Abstract

Models of criminal behavior, where a person is assumed to act rationally on the basis of costs and benefits of legal and illegal opportunities, are presented in this chapter. Most of these models are similar to models of portfolio choice and of supply of labor. The empirical studies that are surveyed use various types of regression analyses and employ data from states and police regions down to campuses and individuals. Most studies corroborate the hypothesis that the probability of punishment, and to a lesser degree also the severity of punishment, has a deterrent effect on crime. The effects of various economic factors are less clear, although unemployment seems to increase crime. Methodological problems relating to the assumption of rationality, to statistical identification of equations, to measurement errors, and to operationalization of theoretical variables are discussed.
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1. Introduction

Theories of crime are abundant. Various mental, physical, developmental, economic, social, cultural, and other causes have been launched as explanations of why people offend. Concepts like depravity, insanity, abnormality, deviance and deprivation are used to characterize those who commit crimes. During the last 30 years economists have invaded the field using their all-embracing model of individual rational behavior, where a criminal act is preferred and chosen if the total pay-off, including that of sanctions and other costs, is higher than that of legal alternatives. Offenders are primarily not regarded as deviant individuals with atypical motivations, but rather as simple, normal persons like the rest of us. The theory of deterrence thus obtained is regarded as nothing but a special case of the general theory of rational behavior under uncertainty. Assuming that individual preferences are constant, the model can be used to predict how changes in the probability and severity of sanctions and in various socioeconomic factors may affect the amount of crime. Even if most of those who violate certain laws differ systematically from those who abide by the same

laws, the former, like the latter, do respond to incentives, that is, to sanctions and economic conditions. Empirical tests with increasing statistical rigour and refinement have been carried out on the basis of this theory.

Whereas the general preventive effects of sanctions for a long time have occupied a main position in penal legislation and sentencing policy, such effects were almost totally neglected in criminology and modern sociology until the late 1960s. Criminologists have been more interested in rehabilitation and treatment, and many are still reluctant to accept studies of deterrence in general and models of criminal behavior based on rational choice in particular. However, scholars who are reluctant to accept the assumption of rational choice, still find interest in the rather rigorous empirical studies in the economics of crime literature (Andenaes, 1975), and sociologists have in recent years been inspired to carry out similar research. Below, mainly studies made by economists are included.

2. The Basic Model

Theories of criminal behavior based more or less on the assumption of rational choice were proposed by Beccaria and Bentham. Bentham ([1788] 1843, p. 399) wrote that 'the profit of the crime is the force which urges man to delinquency: the pain of the punishment is the force employed to restrain him from it. If the first of these forces be the greater, the crime will be committed; if the second, the crime will not be committed.' From the beginning of this century interest in their point of view dwindled as a plethora of other theories were developed. The main idea of Bentham was vitalized and modernized in the pathbreaking article on *Crime and Punishment* by Becker (1968), who suggests that 'a useful theory of criminal behavior can dispense with special theories of anomie, psychological inadequacies, or inheritance of special traits and simply extend the economist's usual analysis of choice' (p. 170). He argues that criminals are like anyone else, and assumes that an individual behaves as if he is a rational utility maximizer. As the total outcome of a criminal act is uncertain, Becker employs the usual assumption that people act as if they were maximizing expected utility, and also that utility is a positive function of income. The individual's expected utility $E[U]$ from committing an offense is:

$$E[U] = PU(Y - f) + (1 - P)U(Y), \qquad (1)$$

where $U(\cdot)$ is the individual's von Neumann-Morgenstern utility function, P is the subjective probability of being caught and convicted, Y is the monetary plus psychic income (that is, the monetary equivalent) from an offense, and f is the monetary equivalent of the punishment. The individual will commit the offense if the expected utility is positive, and he will not if it is negative. The common assumption of stable preferences provides a solid foundation for generating

predictions about responses to various changes in parameters and, according to Becker, prevents the analyst from succumbing to the temptation of simply postulating the required shift in preferences in order to 'explain' all apparent contradictions to his predictions. Analysis of comparative statics shows that increases in either the probability or the severity of punishment might change the expected utility from being positive to being negative. For society as a whole Becker introduces a 'supply of offense function', where the two factors have an effect on the total amount of crime.

Whereas Becker considers the income and punishment equivalents of an offense separated from other income, later authors, in accordance with Brown and Reynolds (1973), take the individual's initial income position as a point of reference. Expected utility becomes

$$E[U] = PU(W - f) + (1 - P)U(W+g), \tag{2}$$

where W is present income and g is gains from crime. Here, the crime will be committed if the expected utility is higher than the utility of the initial income W. Furthermore, it is sometimes assumed that the offender in case of conviction might retain some gain from the offense. Becker demonstrated that if the elasticity of the expected utility with respect to the probability of punishment exceeded the elasticity of the expected utility with respect to conviction (both in absolute values), the offenders were risk lovers. Empirical studies by Becker and others corroborated this result. As shown by Brown and Reynolds (1973) equation (2), at variance with equation (1), does not imply such a conclusion.

3. Extensions of the Basic Model

Later, several types of economic models of crime have been developed, all of which draw on the theory of supply and the theory of behavior towards risk. The simplest one is very similar to models of portfolio choice, where a person's wealth is allocated between various risky and non-risky projects. In the economics of crime version of this model the illegal alternatives are considered as risky mainly because of uncertainty about punishment. Allingham and Sandmo (1972), Kolm (1973), and Singh (1973) have constructed such models for tax evasion, where the individual is confronted with the problem of deciding what proportion of income not to report to the tax authorities. At variance with Becker's model where the income of crime is a parameter, here the income of criminal activity is a function of the proportion of the exogenous income not reported.

Both the probability and the severity of punishment are found to deter crime for a risk averse person. For risk lovers, the effect of the severity of punishment is uncertain. An increase in the severity will have similar effects for illegal

activities as a wage decrease in labor supply models will have for legal activities. Two effects obtain: a substitution effect and an income effect. The substitution effect of a more severe punishment will consist in less crime. The sign of the income effect will depend on individual attitude towards risk. For a risk lover the income effect is positive, and the total effect on crime of a change in severity becomes indeterminate. The effects of changes in gains from crime and in exogenous income depend on whether there is decrease or increase in the risk aversion or risk preference. For the common assumption of decreasing absolute risk aversion an individual will allocate a larger proportion of his income to tax cheating the higher his exogenous income and the higher the gains from crime.

Heineke (1978) has presented a somewhat different type of model where the individual allocates his time (and not his wealth or income) between legal and illegal activities. The individual's income is assumed to be equal to the sum of three elements: exogenous income, the monetary and monetized benefits and costs of legal activities, and the monetary and monetized benefits and costs of illegal activities. (Monetization implicitly takes place if an individual, having to choose between actions involving non-monetary gains and losses, acts rationally according to certain axioms.) If convicted, this income is reduced by a factor that represents the monetary and monetized costs of crime. Here, some of the individuals may choose to specialize in either legal or illegal activities, whereas others may choose a mix of the two. A marginal increase in the probability or the severity of sanctions will affect the optimal mix of activities, whereas such an increase may be insufficient to have an effect on individuals who have specialized in one of the two activities. Assuming leisure time not to be fixed, the same comparative statics results as for the portfolio choice model are obtained. The reason for this similarity is the monetization of psychic benefits, and the high degree of independence between the types of activities. In addition, for some attitudes towards risk, it turns out that an increase in returns to legal activity increases time allocated to both types of activities.

Several authors, first and foremost Ehrlich (1973), have studied the latter type of model, but with the additional restriction that time allocated to leisure is fixed (and thus independent of returns and costs for legal and illegal activities). The assumption of a fixed leisure time obviously requires that the time allocated to legal and illegal activity changes in opposite direction (and with equal amounts), but the effects of changes in some of the parameters are also different from the previous model. Whereas the effects on crime of changes in exogenous income and gains to crime are the same as above, the effects of changes in the severity of sanctions become inconclusive without further restrictions on some parameters.

The portfolio model of time allocation with non-fixed leisure time has been somewhat extended by Wolpin (1978) and by Schmidt and Witte (1984), who have introduced four possible criminal justice states, each taking place with a

certain probability. In these models the effects of changes in sanctions, and in gains and losses of crime become more ambiguous than in the previous models. Especially, and somewhat surprisingly, illegal activity will decrease with increasing unemployment under the standard assumption of decreasing absolute risk aversion. The explanation is that unemployment implies a lower income, and therefore a higher risk aversion, and then again a lower expected utility of crime. Under risk neutrality time allocated to illegal activity is not affected by a change in the expected employment rate. Baldry (1974) introduces the assumption that a person has to choose between zero or a given number of hours of legal work per week. Transforming the Ehrlich model into a nonlinear programming model, he obtains unambiguous predictions of the effects on crime of changes in sanctions and economic variables.

If one is not willing to accept the assumption that all psychic factors associated with legal and illegal activities can be monetized, one has to use utility functions where time allocations and their attributes are introduced explicitly. Block and Heineke (1975a) have studied a model where a vector of attributes of the penalty, interpreted as the length of sentence, is included in the utility function. In this model one obtains considerably more ambiguous results than for the previous models. Unless one is willing to make strong assumptions about individual preferences, it is not possible to decide whether criminal activity will decrease or increase as a result of changes in the probability of punishment, of changes in returns to legal and to illegal activity, and of changes in exogenous income.

Block and Heineke (1975a) have shown that changes in legal and illegal remuneration lead to changes in illegal activity that are composed of stochastic counterparts of the substitution and income effects of traditional supply and demand theory. But the similarity is not close. Even if one assumes that illegal activity is inferior (that is, that such activity is decreasing with income), it is not possible to sign the relevant terms. Increasing the penalty, for instance, will not unambiguously deter crime.

Witte (1980, p. 59) and Schmidt and Witte (1984) have studied a simplified version of their several sanctions model where time spent in legal income-generating activity (work), time spent in illegal income-generating activity (theft, and so on), time spent in legal consumption activities, and time spent in illegal consumption activities (drug use, assaultive activities, and so on) are separate arguments in the individual's utility function. Here too, similar inconclusive results are obtained. When benefits and costs of legal activities are risky, even more ambiguous results are obtained.

The standard assumption that people maximize *expected* utility is appealing because it follows from the von Neumann-Morgenstern axioms of individual behavior that many scholars regard as reasonable, or at least as a fruitful hypothesis. However, many laboratory experiments have shown that people do

not always choose in accordance with these axioms, in particular Lattimore, Baker and Witte (1992), who included burglaries in a set of risky prospects to choose between. As a result, various alternative forms of preference functions that are non-linear in the probabilities have been proposed. Eide (1995) has substituted the assumption of rank-dependent expected utility for the ordinary expected utility in various models of criminal behavior. In the latter study it is shown that the qualitative results of comparative statics analyses are the same for both types of assumptions.

Summing up the comparative static results so far, an increase in the probability of clear-up or arrest has, regardless of the sign of the attitude towards risk, a negative effect on the supply of crime. The effect of an increase in the conviction rate, given arrest, is indeterminate without further assumptions, and the same holds true for an increase in the probability of imprisonment given conviction. However, reasonable assumptions will produce the same conclusions as for the unconditional probability of arrest or conviction. These results constitute a certain support for the probability part of the deterrence hypothesis.

For any attitude towards risk in Beckers's model, an increase in the severity of punishment has a negative effect on the supply of crime. For the group of portfolio choice models as a whole the severity part of the deterrence hypothesis hinges upon the question of attitude towards risk. The effect of more severe sanctions is especially uncertain for risk lovers, whereas risk averters in most models offend less when sanctions increase. Furthermore, a positive shift in punishment in the several-sanctions model and in the labor supply model with non-monetized attributes can cause an increase in crime for any attitude towards risk. In the latter model, the restriction necessary to generate this effect is that the income effects must be greater than the substitution effects. The labor supply models with non-monetized attributes give inconclusive effects also for changes in the other parameters that are studied. For the other models the effects of changes in the gains to crime, in exogenous income, and in income from legal activities depend on the individual's attitude towards risk.

As a whole, one may conclude that the effects of changes in the environment depend on the individual's attitude towards risk. If one is willing to stick to the rather common assumption of decreasing absolute risk aversion, and also that psychic effects can be monetized, and that there is just one type of sanctions, the effects are clear: crime is deterred by increases in the probability and in the severity of punishment, and enhanced by increases in exogenous income, and in gains from both legal and illegal activities. The reason why increases in various incomes and gains increases crime is that punishment in the case of decreasing absolute risk aversion produces a smaller reduction in expected (total) income. For risk-neutral people an increase in the probability or severity of punishment and a decrease in the gains to crime will

reduce the supply of crime, whereas changes in exogenous income, and in the remuneration of legal activity have no effect. Here, changes in the latter income components do not change the bite of punishment.

A crucial assumption in the studies mentioned above seems to be the Bernoulli distribution of the probability of punishment. Introducing a more general distribution of risk into the Becker-type model of Block and Lind (1975a), Baldry (1980) concludes that the 'standard' deterrence results cannot be derived.

A good survey of the main contributions to the development of the economic models of crime is found in Schmidt and Witte (1984).

4. The Benefits and Costs of Crime

Various studies have elaborated on the benefits and costs of crime. The gains and losses included in the economic models of criminal behavior are usually meant to represent all kinds of benefits and costs that have an effect on the people's decisions. People are assumed to allocate time to criminal activity until marginal benefits equal marginal costs. For some people marginal benefits are probably always lower than marginal costs, and we then have a law-abiding person. Others will specialize in crime, whereas most of us possibly commit an offense now and then.

The kinds of gains obtained from a criminal act vary, depending on the type of crime and the individual criminal: some are monetary, obtained from theft, robbery, insurance fraud, and so on. Others are psychic, such as the thrill of danger, peer approval, retribution (bank robbery), sense of accomplishment, or 'pure' satisfaction of wants (rape). For some property crimes the prices obtained on markets of stolen goods are of importance.

Among the costs one may distinguish between material costs (equipment, guns, vehicles), psychic costs (guilt, anxiety, fear, dislike of risk), expected punishment costs and opportunity costs.

The punishment costs include all formal and informal sanctions, as well as pecuniary costs arising from lawsuits (lost income and lawyer's fee). The formal sanctions include fines, various forms of incarceration, and so on. The more severe these sanctions are, the higher the cost. The informal sanctions include any personal inconveniences connected with arrest, suit and conviction. The sanctions related to the social stigma caused by arrest and formal sanctions must be added. The nuisance associated with appearing in court, and the reactions of employer, family and friends, might have a stronger effect than formal sanctions.

The opportunity cost of crime consists of the net benefit (gross benefit minus cost) of the legal activity forgone while planning, performing and

concealing the criminal act. The lower an individual's level of income, the lower is his opportunity cost of engaging in illegal activity.

The amount a person can earn in the legal sector may depend upon age, sex, race, education, training, region, rate of unemployment, IQ, and so on. People able to earn only a rather low wage will have a low opportunity cost of crime, the cost of giving up legal income. We would therefore expect that among criminals there are more young people, men, blacks, low-paid workers, and so on than in the population at large. This is in fact what crime statistics tell us, but more refined empirical studies are necessary to substantiate such relationships.

Many individual characteristics might have an effect on benefits and costs. Individual rates of discount might be important. The gains from crime often occur immediately, whereas punishment is something that might come in the future, and stretched over a long period of time. A high discount rate will therefore tend to increase crime. The probability of punishment will be different for different people. Some are more clever than others at concealing the offense and eluding the police. There are also differences in abilities of defending oneself in court, or in engaging good lawyers. The attitude towards risk will also have an effect.
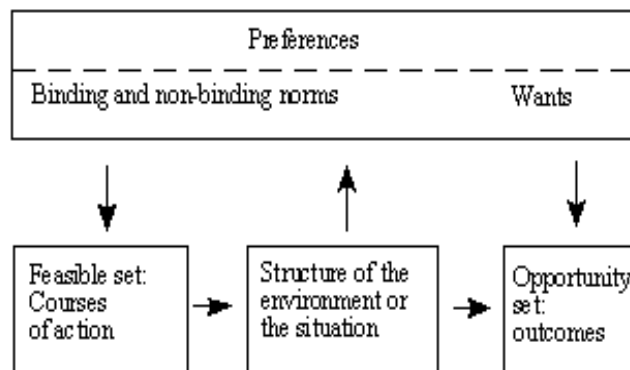
A high rate of recidivism is in accordance with the model of rational choice. If for an offender preferences are stable and the opportunities available remain the same, the degree of criminal activity will not tend to decrease after a conviction. Recidivism is thus not necessarily a result of erratic behavior or lack of self-control, but rather a result of rational choice. Moreover, several factors that count in favor of crime are increased by imprisonment: additional criminal skills are acquired, and opportunities of legal income are reduced. If it was rational to commit a crime in the first place, it is all the more so after having served a prison sentence. If the sentence has increased the criminal's evaluation of how probable or severe sanctions might be, or if he or she has obtained some benefit from prison education schemes, the tendency to recidivism will be counterbalanced.

5. Are Criminals Really Rational?

Exaggerating somewhat the differences between sociologists and economists, one may say that the first consider crime as deviant behavior whereas the latter consider it as rational. Figure 1 illustrates the main elements characterizing an individual's choice situation according to the theory of rational choice. The individual has a feasible set of courses of action, some of which are illegal. The environment, including sanctions and wages, determines the outcomes of the various courses of action. The individual is assumed to choose the course of action that best satisfies its preferences. Preferences include not only wants, but

also norms. The guilt of acting in conflict with norms is part of the costs of crime.

Figure 1 Rational Choice With Norms

In theories of economics of crime, norms are seldom studied, or even mentioned. Preferences as a whole are usually assumed to be constant, and authors do not find it necessary, or do not feel competent to discuss norms. Traditional criminological theories, on the other hand, suggest that the individual's environment has a significant impact on people's preferences, especially on norms, but also on wants. Theories about culture conflict, cultural deviance, anomie and learning relate individual preferences to various characteristics of the society. Other theories suggest that preferences are inherited or dependent on age, gender, race, intelligence and other personal characteristics. In the literature of economics of crime these various theories are often neglected, and the main question studied is how the environment produces incentives to commit, or not to commit, crimes.

In a very broad sense a deterrent is any factor that exerts a preventive force against crime. Sanctions may have an effect on crime either by causing fear or by influencing norms. The combination of these effects is in parts of the literature on crime called 'general prevention' (Andenaes, 1975). In economics of crime one focuses on the effects of law enforcement on the *outcomes* of actions, and thereby on illegal behavior. This is the deterrence mechanism in the narrow sense. The possibility that law enforcement or other aspects of the environment might affect individual norms and wants, for example, by

conditioned aversion as suggested by the behavioral perspective, is given less attention.

An interesting question is whether the model of rational choice is in conflict with, a substitute for, a supplement to, or a general framework for other theories of crime. Carr-Hill and Stern (1979) emphasize that the economic and criminological approaches should be seen as complementary rather than conflicting. They maintain that the economic approach isolates the importance of the probabilities and magnitude of reward and punishment, and shows how they can be treated formally. The criminological approach takes these for granted and indicates how different groups might view and react to these probabilities, rewards, and punishments.

These two approaches are related to the issue of opportunity vs. motivation as explanation of crime. Economists and others who focus on costs and benefits of crime in a rational choice framework, also take into account that crime presupposes potential victims. The better the opportunities of hitting valuable and low-risk targets, the more crime there is. Those who more or less explicitly dismiss the theory of rational choice often focus on the motivation of individuals, assuming that behavior is determined by individual characteristics and by the norms of the groups to which they belong.

The opportunity approach is an element in the market models of crime, where the number of offenses is determined by the interaction of potential offenders, who are seeking the best targets, and potential victims, who by measures of private protection seek to be less attractive or vulnerable to crime (compare Ehrlich, 1981, 1982, 1996, and Cook, 1986).

Several authors have discussed whether people have sufficient information about the environment and about outcomes of actions to make rational choices. Becker and others maintain that even if choices are based on subjective beliefs that are wrong, the choices are meaningful from a subjective point of view, and behavior can be explained and understood on this basis. One may argue that this is not a satisfactory answer to the claim that people have cognitive limitations, and that they stick to 'satisficing' and not to maximization. The studies of Caroll and Weaver (1986), Tunnell (1992), and Nagin and Paternoster (1993) suggest that Simon's theory of bounded rationality might be a better representation of offenders' behavior than the rational choice theory, a conclusion that is supported by Niggli (1994).

It has also been argued that the simple rational choice theory is inadequate because people's behavior is determined by procedural rationality, in which an individual is portrayed as a follower of rules established by history or social relations, or by expressive rationality, in which an individual, through symbolic acts, demonstrates to himself and others his self-conception and worth. There is disagreement about how serious such criticism is for the use of the rational choice theory in studies of crime. Ehrlich (1973, p. 532) maintains that '[s]ince

those who hate need not respond to incentives any differently than those who love or are indifferent to the well-being of others, the analysis ... would apply ... to crimes against the person as well as to crime involving material gains'.

6. Empirical Studies

In a great number of empirical studies the theoretical models of criminal behavior have been tested, and the effect on crime of the probability and severity of punishment, and of benefits and costs of legal and illegal activities has been estimated. The influence of norms, tastes, and abilities, corresponding to constitutional and acquired individual characteristics, have in some cases been studied indirectly by including variables like age, race, gender, and so on. A variety of equation specifications and estimation techniques have been used, and the studies have been based on data from countries and states down to municipalities, campuses, and individuals.

Analogously to the terms psychometric studies, cliometric studies, and so on it seems appropriate to introduce the term 'criminometric studies' to characterize this field of research. The subject matter is crime, and it gives the field a somewhat distorted and too limited range to call these studies econometric, although this is what is usually done. The studies are rooted in a general theory of rational choice, and not in some rational choice theory presumably limited to economics.

In the framework of norm-guided rational behavior norms may depend on the environment. In most criminometric studies norms, as well as wants, are assumed to be constant, and often also equal among individuals. Becker (1976, p. 5) expresses a rather common attitude by stating that '[s]ince economists generally have little to contribute, especially in recent times, to the understanding of how preferences are formed, preferences are assumed not to be very different between wealthy and poor persons, or even between persons in different societies and cultures'. With this assumption it is relatively easy to test other parts of the theory, such as hypotheses about the effect of sanctions, and of gains and losses of legal and illegal activities. If preferences differ among individuals, estimates of the effects of sanctions will be relevant for an 'average' person. The explicit assumption that individual preferences are constant, distinguish criminometric studies from most other studies in criminology.

There are good reasons to carry out empirical studies of criminal behavior at the individual level instead of an aggregated level. In the first place it is at best controversial to posit that behavior is anything but individual. Second, the theoretical models that are developed are based on individual rational choice. Third, as will be discussed below, studies based on aggregated data require a number of additional assumptions of questionable validity. Fourth, the

statistical identification problem is less serious when individual behavior is studied. Using aggregated data one faces the problem of distinguishing between the effect of the probability of arrest on the amount of crime and the effect of the amount of crime on the probability of arrest. In empirical studies at the individual level it can reasonably be assumed that the probability and severity of punishment is determined without being influenced by the actions of a given individual. Thus, the deterrence variables can be considered to be exogenous to the individual's choices, and the problem of simultaneity inherent in macro studies is absent. Unfortunately, empirical tests of these models by use of information on individuals are few. The application of the theoretical models to empirical studies is intricate (Manski, 1978), and suitable data are scarce. The data we have are mainly self-reports on criminal activity, and records of criminal activity compiled by the criminal justice system. The most serious problem with the latter type of data is that they do not constitute representative samples of the population, but are biased in the sense that only convicted persons are included. It is hardly possible to test a general theory of rational criminal behavior by studying only one subgroup of the offenders. A related problem is that most available data sources include information only about choices made, and not about those available, but not chosen. It is difficult, if not impossible, to test a theory of rational choice if the choice set in this way is limited. Whereas such data are of limited interest for studies of general deterrence, that is, of effects on people in general, they are useful for studies of special deterrence, that is, of effects on the individuals that are punished.

The bulk of criminometric studies consists of cross-section regression analyses based on macro data. Some of them are rather broad, including many types of regional areas, estimation techniques and types of crime, whereas others concentrate on particular types of crime, such as property crimes or hijacking. A few of them address special questions, such as the effect of police 'aggressiveness' in patrolling, or the influence of income differentials. Time series studies are less numerous, and employ mostly data on total crime.

The majority of these empirical studies of crime have been evaluated in various surveys. In an annotated bibliography Beyleveld (1980) reviews a number of investigations of correlations between crime and deterrence variables, in addition to 35 cross-sectional and 31 time-series econometric studies of crime. A thorough review of the empirical evidence of general deterrence is also given by Nagin (1978), who comments on 24 correlation and econometric studies, all but two also covered by Beyleveld. Taylor (1978) concentrates upon six major econometric studies, whereas Pyle (1983) reviews the same studies and about 15 others. A shorter, but somewhat more up to date review is Cameron (1988), and a more recent comprehensive survey is found in Eide (1994). Reviews of certain parts of the literature are found in Passell and Taylor (1977), Fisher and Nagin (1978), Klein, Forst and Filatov (1978), Nagin (1978), Vandaele (1978).

6.1 Empirical Effects of Punishment Variables

In empirical studies the measures used to represent the probability of punishment include the probabilities of arrest, of clearance, of conviction, and of conviction given arrest. The severity of punishment is represented by fines, by the length of sentence, or by time served. Witte (1980) and Schmidt and Witte (1984) have employed individual data on post-release activities of a random sample of 641 men released from prison in North Carolina. The effects on crime of measures of both the probability and the severity of punishment are found to be more or less negative. Myers (1983), using a sample of 2127 individuals released from US Federal prisons, finds that severity of punishment has a statistically significant negative effect on crime, whereas the probability measure (the ratio of previous prison commitments to previous convictions) has a positive effect. Higher wages are found to reduce recidivism. Trumbull (1989) has used data on about 2000 offenders released from prisons in North Carolina to study recidivism and special deterrence. He finds that none of the deterrence variables (probabilities of arrest, conviction and imprisonment, and length of sentence) are statistically significant. Trumbull finds this result natural, since the sample consists only of individuals who, whatever the probability and severity of punishment, have chosen to engage in illegitimate activities. However, an increase in an offender's own previous sentence length has a significant negative effect on crime, a result that corroborates the hypothesis of special deterrence. Higher earnings on the first job after release has a negative effect on crime. Quite unexpectedly, so has unemployment. Viscusi (1986b) uses an approach common in labor economics in the studies of hazardous jobs to estimate the risk/reward trade-off for illegal activities. In labor markets increasing health risks are often rewarded by some amounts of money in addition to non-risk wages. Treating the probability and severity of punishment in the same manner as the probability and severity of injury are treated in analyses of hazardous jobs, Viscusi is able to estimate the effects of changes in these variables. A survey of 2358 inner-city minority youths from Boston, Chicago and Philadelphia constitutes the data employed. Viscusi finds that the premiums obtained for criminal risks are strong and quite robust. In his framework this is interpreted as a corroboration of the general deterrence hypothesis.

Studies of tax cheating based on individual data by Clotfelter (1983), Slemrod (1985), Witte and Woodbury (1985) and Klepper and Nagin (1989a) all conclude that both the probability and the severity of punishment have negative effects upon crime.

Many studies of correlation between crime rates and punishment based on aggregated data appeared in the late 1960s and early 1970s. Using mostly US data on the state or municipal level these studies indicate a negative association between the certainty of arrest and the crime rate for different crime categories. But crime rates are not generally found to vary with the severity of

imprisonment, although in some studies a deterrent effect is obtained for homicide and a couple of other crime categories.

A necessary condition for interpreting the results of these correlation studies, mostly carried out by sociologists, as estimates of deterrence is, of course, that there is a one-way causation from punishment to crime, and none in the opposite direction. The many subsequent cross-section criminometric studies allowed for a two-way causation by various specifications of the general model

$$C = f(P, S, Z_j), \qquad\qquad (3)$$

$$P = g(C, R, Z_k), \qquad\qquad (4)$$

$$R = h(C, Z_l), \qquad\qquad (5)$$

where C = crime rate (number of crimes per population), P = probability of punishment, S = severity of punishment, R = resources per capita of the Criminal Justice System (CJS), and Z_j, Z_k, Z_l = vectors of socioeconomic factors. The crime function (3) assumes that the crime rate is a function of the probability and the severity of punishment; equation (4) assumes that the probability of punishment is a function of the crime rate and the resources allocated to the CJS; and equation (5) assumes that the resources allocated to the CJS is a function of the crime rate. Various socioeconomic factors are included as explanatory variables in all three equations. In some studies police resources is included as an explanatory variable in the crime function.

Among the first simultaneous regression analyses in this field we find Ehrlich (1972), Phillips and Votey (1972) and Orsagh (1973). The first major cross-section study appearing after Becker's theoretical article was Ehrlich (1973). He studies seven types of crimes in the US based on data for all states from 1940, 1950 and 1960. He finds that the probability of imprisonment has a statistically significant negative effect on all types of crime, and, except for murder, not less for crimes against the person than for other crimes. The severity of punishment has a similar effect, but here only about half of the estimates are statistically significant. Crime is also found to be positively related to median family income (presumably more assets to steal) and to income differentials. Ehrlich's study has been thoroughly scrutinized by several authors, some of whom have given harsh evaluations of his work. Revisions, replications and extensions of Ehrlich's studies by Forst (1976), Vandaele (1978), and Nagin (1978) resulted in more moderate deterrent effects of the probability and severity of punishment. Moreover, Forst found that by introducing variables thought to be correlated with the punishment variables, such as population migration and population density, the punishment variables became statistically insignificant. Nagin found that incapacitation could explain

a large part of the apparent deterrent effect. In a fierce attack on Ehrlich's study Brier and Fienberg (1980) conclude an empirical investigation of the Ehrlich type that no deterrence effect of sanctions were found. A response to the criticism from these and other authors is found in Ehrlich and Mark (1977). Despite critical remarks by various authors, there is now a long list of studies similar to the one by Ehrlich.

The great majority of correlation studies and cross-section regression analyses show a clear negative association between punishment variables and the crime rate. Almost without exception the coefficients of the punishment variables (which usually are the elasticities of the crime rates with respect to the punishment variables) are negative, and in most of the cases significantly so. Furthermore, the estimated elasticities have rather high values. Eide (1994) summarizes such estimates of 20 cross-section studies based on a variety of model specifications, types of data and regression techniques (Ehrlich, 1973; Sjoquist, 1973; Swimmer, 1974; Danziger and Wheeler, 1975; Phillips and Votey, 1975, 1981; Chapman, 1976; Forst, 1976; Mathieson and Passell, 1976; Blumstein and Nagin, 1977; Thaler, 1977; Avio and Clark, 1978; Heineke, 1978; Holtman and Yap, 1978; Mathur, 1978; Vandaele, 1978; Wilson and Boland, 1978; Carr-Hill and Stern, 1979; Myers, 1980, 1982; Furlong and Mehay, 1981; Sesnowitz and Hexter, 1982; Willis, 1983; Schuller, 1986; Trumbull, 1989). Eide finds the median value of the 118 estimates of elasticities of crime rates with respect to various measures of the probability of punishment to be about ! 0.7. The median of the somewhat fewer severity elasticities is about ! 0.4. The rates of clearance by arrest are usually considered to be better measures of the certainty of sanction than the rates of conviction (Andenaes, 1975, p. 347). The median of the elasticities of arrest is found to be somewhat smaller than the median of the elasticities of conviction, but the difference is not great.

Almost all criminometric time series studies give additional firm support to the hypothesis that the probability of punishment has a preventive effect on crime. The results concerning the effect of the severity of punishment is somewhat less conclusive. Wahlroos (1981), using Finnish data, finds that the severity of punishment has a statistically significant deterrent effect on larceny, but not on robbery. Cloninger and Sartorius (1979), using data from the city of Houston in the US, obtains a negative, but not statistically significant effect of the mean sentence length. Wolpin (1978), using a time-series for England and Wales in the period 1894-1967, finds that the estimates of the effects of the length of sentences differ among types of crime, and are often not statistically significant. Schuller (1986) on the other hand, using Swedish data, finds a negative effect of the average time in prison. In an international comparison of crime between Japan, England and the US, Wolpin (1980) obtains firm support for the deterrent effect of the severity of punishment. These diverging results are not surprising. The theories surveyed above tell us that if there is a significant proportion of risk lovers in the population, and/or if the income

effect is greater than the substitution effect, and/or the effects of legal activities are risky, and/or household protection expenditures are inversely related to the severity of punishment, an increase in the severity of punishment may well cause crime to increase on the macro level. If, however, in spite of these crime increasing effects, macro studies show that crime is reduced when punishment becomes more severe, there is all the more reason to believe in a deterrent and/or a norm formation effect of punishment.

Among the several empirical studies concentrating on just one type of crime, it is worth noticing that Landes (1978) obtained firm support for the deterrence hypothesis for hijacking. In a study of draft evasion in the US, Blumstein and Nagin (1977) avoid four of the main objections against criminometric studies (see discussion of objections below): draft evaders are likely to be well informed about possible sanctions; data are relatively error free; as draft evasion can happen only once, there is no danger of confounding incapacitation effects with deterrence effects; simultaneity problems caused by over-taxing of the Criminal Justice System are unlikely because draft evasion was given priority in the relatively well staffed federal courts. The authors consider that their results provide an important statistical confirmation of the existence of a deterrent effect. They find, however, that the severity of the formal sanction has a modest effect on draft evasion compared to the stigma effect of being arrested and convicted.

The economic model of crime suggests that changes in benefits and costs of committing a particular type of crime might have effects on other types of crime. If, for instance, the probability of being convicted for robbery increases, some robbers might shift to burglary. One crime is substituted for another, just as people buy more apples instead of oranges when the price of oranges goes up. Such substitution effects between crimes have been estimated by Heineke (1978), Holtman and Yap (1978) and Cameron (1987b). A certain number of statistically significant effects are found, indicating that some crimes are substitutes whereas others are alternatives.

As a whole, criminometric studies clearly indicate a negative association between crime and the probability and severity of punishment. The result may be regarded as a rather firm corroboration of the deterrence explanation obtained from the theory of rational behavior: an increase in the probability or severity of punishment will decrease the expected utility of criminal acts, and thereby the level of crime. It should be remembered, however, that in some studies the effect of an increase in the severity of punishment is not statistically different from zero, and a statistically significant positive effect has also occasionally been obtained.

6.2 Empirical Effects of Income, Norm and Taste Variables

In accordance with the theoretical models, most criminometric studies contain income variables representing some of the benefits and costs of legal and/or illegal activities. Looking first at the benefits of legal activities, the great variety of proxies applied is striking: median family income, median income, labor income to manufacturing workers, mean family income, mean income per tax unit, mean income per capita, and so on. No systematic relationship appears between the income measures applied and the estimates obtained. Although the hypothesis that an increase in legal income opportunities decreases crime is not rejected in most of the studies, others would not reject the inverse hypothesis that an increase in legal income opportunities would increase crime. This ambiguity in results might be due to the fact that the income measures used represent benefits not only of legal activities, but also of illegal ones: Higher legal incomes (mostly wages) tend to make work more attractive than crime, but to the extent that higher legal income in a region produces a greater number of more profitable targets for crime, the same empirical income measure may be positively correlated with criminal activity. In addition, high legal incomes also mean high incomes foregone when incarcerated, a cost of crime that will have a negative effect on crime. If these mechanisms are at work simultaneously, and their relative strength not universally constant, it is not surprising that the results of various studies differ. The theory is not necessarily deficient, but the methods applied do not distinguish between the two mechanisms. The main problem is that the incomes of legal and illegal activities are highly correlated, and that it is difficult (or impossible?) to find empirical measures that with enough precision can distinguish between their effects. The impact of income is further obfuscated by the fact that private security measures increase with income, while higher income probably reduces the marginal utility of each piece of property, and therefore also the measures taken to protect property. These problems of correlation are not present in studies where individual data are employed, such as Witte (1980) and Myers (1980).

The estimates of the effects of gains to crime underscore the problem of finding good empirical measures for theoretical variables. Whereas Ehrlich uses median family income as a measure of *gains to crime*, other authors use the same measure to represent *legal income opportunities*. A variety of other measures of gains have been used, with diverse estimated effects on crime.

A large income differential may indicate that crime is a comparatively rewarding activity for the very low income group (that may find a lot to steal from the very rich). Estimates of the effect on crime of income differentials also vary across studies. It is interesting to note, however, that a study which includes variables of both legal and illegal income opportunities in addition to one of income differential (Holtman and Yap, 1978), obtains significant estimates of the expected signs for all three variables. Also Freeman (1995)

finds that wages from legitimate work and measures of inequality have the expected effects on crime.

Unemployment is usually included in criminometric studies as a proxy for (lack of) legal income opportunities. Unemployment will make crime more attractive if the alternative is a life in poverty. The estimates of the effect of unemployment on crime, however, are positive in some studies, and negative in others. A comprehensive survey by Chiricos (1987) demonstrates that unemployment in most studies seems to increase crime. He has reviewed 63 aggregate studies published in major journals of economics, sociology and criminology containing 288 estimates of the relationship between unemployment and crime. He finds that 31 percent of the estimates were positive and statistically significant, whereas only 2 percent were negative and statistically significant. Most of the non-significant estimates were positive. A similar conclusion is obtained in a survey by Freeman (1995). Chiricos finds little support for the hypothesis that unemployment decreases the opportunity for criminal activity because of fewer and better protected criminal targets, an hypothesis that has been launched in order to explain why in some studies a negative relationship is obtained. Another explanation of such a negative association, suggested by Carr-Hill and Stern (1973), is that unemployed fathers stay at home and keep an eye on their delinquent sons. Furthermore, differences in results might be the variability in unemployment insurance schemes. In some places unemployment insurance is only slightly below ordinary legal income, and in addition, some of the formally unemployed receive income from short term jobs. According to economic models of crime, the number of offenses will then not increase when unemployment increases. A decrease may even occur. But if unemployment hits people without such income opportunities, crime will increase.

According to criminal statistics the well-to-do are less likely to commit crimes than the poor. Lott (1990c) provides a survey of various explanations of this fact. In an empirical study of ex-convicts Lott (1992a) finds that the reduction in income from conviction is extremely progressive, a result that corroborates the hypothesis that an increase in the costs of committing crimes has a negative effect on the amount of crime.

6.3 Effects of Norm and Taste Variables

In most studies various sociodemographic variables have been included. Unfortunately, the reasons for including many of these variables are often not thoroughly discussed. For instance, an explanation of how differences in preferences (tastes) for legal and illegal activities may vary between groups of people are often lacking. The various choices of empirical measures probably reflect the availability of data. The estimated coefficients on the proportion of non-whites in the population are usually found to be positive. It is difficult to

decide whether this result reflects differences in norms, in tastes, in abilities, or in income opportunities. The high proportion of non-whites might also be the result of a tendency among the police to concentrate search for offenders to this group.

The predominance of young people among those arrested and convicted suggest that age would be a very important factor in explaining crime. In many studies such an effect is not found. One reason might be that there is not enough variability in the proportion of youth between statistical units to produce precise estimates. Also possible is that crime among young people is not a consequence of their preferences (lack of socialization, and so on), but of their meager legal income opportunities that possibly is adequately represented by other variables. Young people are perhaps not different, just poorer.

Population density is in most cases found to be a statistically significant explanatory variable. Population density may reflect various phenomena, such as differences in social control, psychic diseases, and so on. The studies reviewed are hardly suitable for a discussion of which of these mechanisms may be at work.

Some studies use police expenditures or the number of police officers as possible deterrent variables instead of measures of probability and/or severity of punishment. Many of these studies show that police activity has a negligible, and sometimes positive, effect on crime. On the other hand, Buck et al. (1983), including both police presence and arrest rates as explanatory variables, find that the former rather than the latter has a deterrent effect. The studies concluding that police activities have a minor effect have tempted some authors to dismiss deterrence as an efficient means against crime. It must be kept in mind, however, that in the theoretical models the deterrence variables are the probability and the severity of punishment, and not the police. There are at least two interpretations of the minor effect on crime of expenditures on the police. Either these expenditures do not have a noticeable effect on the probability of punishment, or such expenditures result in a higher proportion recorded of crimes, a fact that decreases the probability of punishment registered in the data used.

In some studies routine activity and situational opportunity are included as main explanations of crime (compare Cohen, Felson and Land, 1980). Chapman (1976), for instance, finds that the female participation rate in the labor market, a proxy for the proportion of unguarded homes, has a significant positive effect.

It has been argued that the rational choice framework might be relevant for certain property crimes, but not for violent crimes that are considered to be 'expressive' and not 'instrumental'. Undoubtedly, the degree of 'expressiveness' differs among crimes. Many empirical studies may be interpreted as support for the view that threat of punishment also has a preventive effect on expressive crime. At least substantial elements of

rationality are revealed in a study of mugging by Lejeune (1977), in a study of rape and homicide by Athens (1980), and in a study of spouse abuse by Dobash and Dobash (1984). Although the effect of punishment may differ among types of crime, evidence so far indicates that the rational choice framework is relevant for all types of crime, and that analyses rejecting a priori that some particular types of crime are deterrable are inadequate.

7. Methodological Problems and Criticism

Objections to economic studies of criminal behavior have been many and occasionally fierce, see for example, Blumstein, Cohen and Nagin (1978), Orsagh (1979), Brier and Fienberg (1980), Prisching (1982), and Cameron (1988). In particular, studies based on aggregated data have been criticized. In addition to attacks on the assumption of rational behavior, the main criticism relates to interpretations of empirical results, to statistical identification of equations and unobserved heterogeneity, to measurement errors, and to operationalization of theoretical variables.

7.1 Interpretation of Empirical Results

It has been argued that many studies do not take into consideration that more certain or more severe punishment may prevent crime by two different mechanisms: either directly as a cost, or indirectly through norm formation. A type of crime that is cleared up more and more seldom, or sanctioned more and more leniently, will easily be considered as not very serious by the population. Individual norms may adjust accordingly, people's crime aversion decrease, and consequently the level of crime increases. It seems true that in most empirical studies no effort is made to distinguish between this mechanism and the more direct deterrence effect of an increase in punishment. Results are often interpreted as a deterrent effect, and not as a general prevention effect where also the indirect norm formation mechanism is included.

Can criminometric studies possibly distinguish between the two mechanisms? In cross-section studies one can imagine that people living in regions where the clear-up probability is low tend to consider crime as less serious than do people in other regions. If such differences in norm formation exist, they are probably more predominant the longer the distance between the regions that are compared, for instance in international comparisons, or in studies of states in the US. It is not probable that norm formation differ among the districts within a rather small region, especially if news about punishment can be assumed to be more or less the same, and mobility of people is high. The effect on crime of variation in the severity of punishment found in studies using data from rather small areas within a region can therefore hardly be explained

by a norm formation mechanism. Where one obtains a negative relationship between the crime rate and the clear-up probability when data representing counties of only one state (Chapman, 1976; Avio and Clark, 1978; Trumbull, 1989), or of police districts in a metropolitan area (Mathieson and Passell, 1976; Thaler, 1977; Furlong and Mehay, 1981), one will have reason to believe that the norm formation mechanism must be of minor importance. The same holds true for some studies of substitution of crime which show that an increase in punishment of one type of property crime will have a statistically significant effect on the number of other property crimes. It is not probable that a higher probability of being punished for burglary has any effect on the norms regarding robbery. It is more reasonable to think that robbery is substituted for burglary because of a change in relative costs.

Even if the importance of each mechanism is regarded as uncertain, the estimates obtained in various studies are still of interest. Not only from a political point of view, but also from a scholarly one, it may be useful to know that the probability of punishment has a certain negative effect on crime, notwithstanding the mechanism(s) involved.

Another possible uncertainty concerning the evaluation of results is that there might exist an underlying phenomenon, unknown and/or not studied, a phenomenon that at the same time produces a low crime rate and a high probability of punishment. Individual norms may create such a relationship. If people in one region appreciate each others' welfare more than on average, they will both have a relatively strong aversion against criminal infringements against others, and a high interest in clearing up crimes in order to decrease crime in general. If such differences in norms exist, they must be rooted in cultural differences of some kind. Possibly, such differences can develop if regions are situated far from each other, or if distance in time is substantial. For the smaller regions, such differences seem less realistic.

Theories of criminal behavior show that a whole series of 'causes' may be involved, and that recorded differences in crime between regions, gender, races, drug abuse, and so on might be related to more fundamental explanations of crime, involving norms, wants, opportunities and circumstances. The intricacy of relationships shows the difficulty in interpreting the estimates of the effects on crime of such variables.

7.2 Identification and Unobserved Heterogeneity

If, in an empirical study, one finds that crime rates and probabilities of punishment are negatively correlated, one cannot easily distinguish between the hypothesis that higher probabilities of punishment cause lower crime rates (equation (3)), or the hypothesis that higher crime rates cause lower probabilities of punishment (because of police overloading, equation (4)). If such a simultaeneity exists it is not acceptable to use the method of ordinary

least squares (OLS) to estimate each equation. Using the Hausman test Layson (1985) and Trumbull (1989) have for homicide found that simultaneity was not a problem in their data, and OLS could be applied. If simultaneity is present, the standard procedure to identify the first relation, the crime function, consists of introducing exogenous variables that have an effect on the probability of punishment, but not on the crime rate. In an excellent discussion of the (im)possibility of identifying the crime function in macro studies, Fisher and Nagin (1978, p. 379) declare that they know of no such variables. The consequence of this view is that all attempts of identification in empirical macro studies are illusory. The equations may be technically identified, but by false assumptions. Using panel data for police districts, Aasness, Eide and Skjerpen (1994) claim to have solved this problem. In studies based on individual data, the question of identification is much less serious, see above.

It is interesting to note that in the cross-section studies reviewed by Eide (1994) the method of ordinary least squares tend to give smaller estimates of the elasticities of crime with respect to the probability and severity of sanctions than do the methods of 2 stages least squares, full information maximum likelihood, and other more advanced methods. This is what might be expected if a simultaneous equation bias is present. The difference in estimates is, however, not great.

Cornwell and Trumbull (1994) point to the fact that aggregate cross-section econometric techniques do not control for unobserved heterogeneity. Addressing this problem by use of a panel dataset of North Carolina counties, they obtain more modest deterrent effects of the arrest and conviction rates than those obtained from cross-section estimation.

7.3 Measurement Errors

Since a substantial part of all crimes is not registered by the police, one may have serious doubts about the results of empirical studies based on official statistics. However, the problem of underreporting is not damaging to empirical research if the rate at which actual crimes are reported is constant across regions (in cross-section studies) or over the years (in time-series studies). This seems to be an implicit assumption in most studies. Blumstein, Cohen and Nagin (1978) explain how differences in 'dark numbers' between observational units create a spurious negative association between the recorded crime rate and the probability of clearance. Aasness, Eide and Skjerpen (1994) introduce, in addition to the recorded crime rate, a latent variable for the real crime rate, and relates the latter to the former by a linear function and a stochastic term. By this procedure measurement errors are given an explicit stochastic treatment, that allows for a distribution of 'dark numbers' among police districts.

The existence of a substantial dark number of crime, has fostered a certain interest in using victimization studies to obtain more reliable data. These

studies give more or less similar results as those based on recorded crimes. A prominent example is Goldberg and Nold (1980) who find that the reporting rate, and thus the probability of clearance, has a great impact on the amount of burglaries. Another comprehensive study is Myers (1982) who obtains almost the same estimates of the effects of sanction variables by correcting crime rates by victimization data.

7.4 Wrong Beliefs

If people have wrong beliefs, one may also question the validity of estimates of the effects of punishment variables and various socio-economic factors. Presumably, the true risk of sanction is not known to the individual. Empirical studies suggest that people tend to overestimate the average risk, while at the same time believing that the risk they themselves run is lower than average. Offenders, however, seem to be better informed. Wilson and Herrnstein (1985, p. 392) refer to a study where over two thousand inmates of jails and prisons in California, Michigan and Texas were interviewed about their criminal careers. The study revealed a close correspondence between the actual and perceived risk of imprisonment in Michigan and Texas, whereas a somewhat weaker correspondence was found in California. The study further corroborated the theoretical result that an increase in the probability of imprisonment will decrease crime.

Even if beliefs to some extent are wrong, macro studies might still be of some value. It may well be that some persons do not observe a given change, and also that they have been mistaken in their beliefs. But the gradual change from very lenient to very harsh punishment will certainly be registered by at least a part of the population, and behavior will change, more or less, as already explained.

7.5 Various Operationalizations

Many studies give weak arguments for the choice of theoretical variables (for example, of variables of punishment, benefits and costs), and of their empirical measures. Orsagh (1979) argues that the great diversity of variables in empirical criminology shows that no good theory exists, and that macro studies of the usual kind have little interest. The objection is certainly relevant, but the consequence is not necessarily that such analyses should be avoided. Problems of operationalization do not make a theory irrelevant. Better than to drop such studies is to continue the theoretical discussion about determinants of crime, and produce more empirical studies, in order to improve the foundation for choosing acceptable measures of theoretical constructs. If various operationalizations produce similar results, there is reason to believe that the theory is robust to such differences. Then, one might even conclude that the theory is quite good, despite the fact that each and every formal test of significance is of limited value.

The studies reviewed above reveal quite consistent results as far as the sign of effects of the punishment variables is concerned. The insensitivity of these results to various operationalizations is comforting. The effects of income variables are less consistent, a result that might either imply that economic factors do not have a uniform effect on crime or that some, or all, of the operationalizations tried so far are unacceptable.

Several measures of punishment variables have been employed. When only one type of sanctions is included, one would expect that the effect assigned to this variable really includes effects of punishment variables correlated with the one included. A better alternative is to use several sanctions simultaneously, as proposed and employed by Witte (1980) and others.

8. Future Research

The reasons why people are more or less law-abiding are manifold. The norm-guided rational choice framework seems to provide a suitable framework for discussing various theories of crime, including characteristics of individuals and circumstances (Cornish and Clarke, 1986, p. 10). The framework allows for a simultaneous consideration of many possible determinants of crime. The abstract model is a means of gaining insight into the elements of rational behavior, and it permits filling bits of information into a broader context. In criminometric studies it might be useful to distinguish between norm variables (representing desires for various courses of action), want (or taste) variables (representing preferences for various outcomes), ability variables (representing intellectual, psychic and physical characteristics), punishment variables (representing the probability and severity of punishment), individual economic variables (representing legal and illegal income opportunities) and environmental variables (other than punishment and economic variables). A survey of variables used in various empirical studies of crime organized according to this typology is given in Eide (1994). Variations in crime among individuals are traditionally related to gender, age, race, and so on. A deeper understanding must be sought in variations in norms and wants, in abilities, and in the opportunities, rewards and costs determined by the environment. Variations in crime among individuals may be caused by differences in all these elements of the rational choice framework. Certain individuals may have more crime-prone (or less crime-averse) norms than others. The special norm structure may be a result of genetic, biological or psychological characteristics, an effect of lack of socialization, or a consequence of cultural conflict, cultural deviance, or anomie. Inherited or acquired abilities may restrict legal activities more than illegal ones. In an empirical study of college students Nagin and Paternoster (1993) found that both individual differences (poor self-control) and

the costs and benefits of crime were significantly related to crime. The formidable task for the future may be found in a proposition for social science research by the Nobel Prize Winner Niko Tinbergen (who should not be confused with J. Tinbergen who has won the Nobel Memorial Prize in economics) that four levels of analysis should be put together: the biological (genetical), the developmental (how an individual is socialized), the situational (how the environment influences behavior), and the adaptive (how a person responds to the benefits and costs of alternative courses of action).

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