Economists' Contribution to the Study of Crime and the Criminal Justice System

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ABSTRACT

This essay provides an analytic synthesis of the contribution by economists to the study of crime and the criminal justice system. We begin by summarizing the distinctive features of the economic approach, namely a focus on rational self-seeking behavior and analysis of the consequences of interactions among groups of actors that create equilibria in a system. We then use a taxonomy suggested by Ronald Coase to divide the economists' contributions into three main areas of theory, technique and substantive expertise. With respect to theory, economists' work on perceptual deterrence, with its emphasis on the centrality of time discounting, has already been incorporated into criminological research. There has been a much more mixed record in taking up economic approaches to study of the criminal justice theory; early work on prosecutors has been neglected, while the newer area of outcome analysis, based on maximizing behavior by criminal justice actors, has influenced criminological work on discrimination. With respect to technique, there is also a mixed record. The specialized statistical methods of econometrics, particularly Heckman's approaches to problems of selection, have been influential but often mishandled. Cost-benefit analysis of the criminal justice system, though much sought after by policy makers, has not entered mainstream criminology. We then turn to one substantive area where economists have substantive expertise, namely illegal markets, especially drug markets. Since markets are central to economists' thinking, the little research that has been done on this important criminal phenomenon has been done primarily by economists. They have produced some important findings on the effects of criminal justice interventions on major outcomes such as price and quantity that might be usefully incorporated into criminological research. The final section argues that criminology can benefit from collaboration with economics but need not worry that the economists will dominate the field.

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I. Introduction

I. Introduction

The study of crime has always been a multidisciplinary activity. Apart from criminologists, sociologists are perhaps the dominant group, but psychologists and political scientists have also long been prominent. Economists are among the most recent entrants, with Gary Becker's 1968 "Crime and Punishment: An Economic Approach," serving as the starting point for modern economists' work on crime.[1] After an initial flurry of research, only a few economists notably Phil Cook stayed involved with criminology, with intermittent work by labor economists like Richard Freeman. In the mid to late 1990's, there was renewed flurry of work by young economists like Steven Levitt, Jens Ludwig, Anne Piehl, and Steven Raphael, who developed research agendas largely centered on the study of crime. This has generated a growing flow of articles on crime in major economics' journals. However, this activity has occurred largely outside the view of criminologists, and in our opinion, there has not been a proportional increase in the understanding of or appreciation for economists or economics in criminology and criminal justice. For example, we are aware of no courses on economics and crime in graduate criminology programs and very few trained economists on the faculties of major criminology departments. By the same token, economists rarely talk to, cite or interact with other social scientists who study crime. [2]

[1] Becker's article has 1368 citations in the Social Science Citation Index as of December 2006.

[2] This is not to say that criminologists and sociologists are completely unaware of work by economists or that this awareness is not higher than it was a decade ago. For two concrete examples of the increased awareness and appreciation of economists, see a compelling review essay by sociologist William McCarthy (2002) on the potential contribution of economic theory to sociology and criminology and an important empirical review of econometric techniques for panel data by sociologist Charles Halaby (2004). In addition, there are some excellent examples of

One possible reason for this lack of engagement is the imperialistic attitude of some economists towards other social scientists. Gary Becker, the economist who wrote the seminal paper on the economics of crime, is more than any other figure responsible for the attempts of recent decades to substantially broaden economics beyond the study of economic institutions to the study of human choice under scarcity including fertility, discrimination and suicide (Becker, 2000). Under this definition the study of crime and the criminal justice system falls well within the boundaries of economics.

But economics is not the only social science to study human choice, or to conclude that incentives matter. This study of human choice by economists has a particular ideological slant. Economists have developed price theory, which implies that consumption of any good will decline when the price increases.[3] With admirable conceptual clarity, economists can identify the costs/prices of any given choice, like the decision to commit crime, and identify the expected relationship between punishment and crime. The unique approach of economists means that economists and criminologists have actively butted heads over the topic of deterrence almost since economists began studying the topic.[4] Becker wrote his article, which describes punishment as a cost (or price) of crime, at around same time that labeling theory, which allowed for the possibility that punishment might be criminogenic, had become a major theoretical framework for criminologists and sociologists. These opposing views generated ongoing conflict between the two fields, continuing in the recent popular book, *Freakonomics*, in which

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work by economists that engage heavily with the criminology literature. Two good examples include Cook (1986) on opportunity theory, and Donohue and Siegelman's (1998) cost benefit analysis.

[3] The famous textbook exception of a "Giffen good" (a single inferior good for which there is no good substitute and constitutes such a large share of total expenditures that an increase in its price generates higher consumption) remains just that… a textbook exception. It is possible that for some drug addicts the condition might apply to their preferred drug but that has never been demonstrated.

[4] A skeptic might call desire to find the relevance of price theory in a vast array of contexts to be an example of economic positivism on par with sociological positivism in criminology.

Steve Levitt repeated the inflammatory charge by John DiIulio Jr. that "it takes a Ph.D. in criminology to doubt that keeping dangerous criminals incarcerated cuts crime." (Levitt and Dubner, 2005, p. 123). A recent review on incarceration in this series by Doob and Webster (2003) presents a criminologist's take on the willingness of economists to conclude that increased sentence lengths will cause declines in crime.[5]

The two fields have also clashed heatedly over empirical research on the death penalty in the 1970's, perhaps for the same reason. Despite decades of research from criminologists showing no deterrent effects for death penalty (eg. Sellin 1959), Erhlich's (1975) paper, subsequently largely discredited, showing a strong relationship between the death penalty and murder was cited in the Supreme Court decision reinstating the death penalty. After two decades of silence, some economists have developed new research showing the expected or even preordained negative relationship between the death penalty and crime, only to have other economists demonstrate the fragility of these findings (Donohue and Wolfers 2005). The Donohue and Wolfers critique has much in common with earlier critiques of capital punishment research by criminologist Thorsten Sellin.

Thus we have two fields with ideological stances, one convinced, as a matter of belief, that punishment will reduce crime, and the other regarding this as an empirical issue but with a wealth of arguments as to why the deterrent effect might be negligible or even, in some case, perverse. In this article, the two authors propose a détente in this ideological conflict. We both have economics backgrounds, but have spent the bulk of our careers in and around criminology departments. We agree with criminologist Travis Hirschi (1986) that the economic rational choice perspective is a complement to, rather than a substitute for, many of the leading

[5] See also the recent article by Webster, Doob, and Zimring (2006).

criminological theories and we also see many opportunities for cross fertilization that are unrelated to the ideological conflict.

Perhaps our favorite example of the potential benefits of cross-fertilization are two excellent papers written in 1985 on the relationship between business cycles and crime at the national level using nearly identical data. One paper was written by two economists, Phil Cook and Gary Zarkin (1985) and the other was written by two sociologists, David Cantor and Kenneth Land (1985). The papers ask very similar questions, but used different techniques and ways of measuring the business cycle. Given their simultaneity, it is not surprising they did not cite one another, but it is striking that only 10 of the 138 papers which cite Cantor and Land also cite Cook and Zarkin.[6] Moreover, seven of the 10 citations occurred in 1996 or later, as criminological researchers began to propose alternative ways of measuring cyclical macro-economic change that were more consistent with Cook and Zarkin's approach. This delayed cross-fertilization has lead directly to a richer understanding of the relationship between unemployment and crime at the national level in criminology.

Because of our belief in the benefits in the cross-fertilization between economics and the other social sciences that study crime, we have created a program at the University of Maryland's Population Research Center which has as its primary mission annual workshops that bring together of criminologists, sociologists and economists who are working on related crime topics to talk about their work.[7] It was initially far too easy to find two scholars working on nearly identical topics who were essentially unaware of each other's work. But participants have reacted very positively to the opportunity to interact and learn from one another, and interdisciplinary awareness was noticeably higher in the most recent workshop. This positive

[6] In contrast, 10 out of the 23 articles which cite Cook and Zarkin also cite Cantor and Land.
[7] Conference agendas, abstracts and presentations for the first three workshops can be found at http://www.popcenter.umd.edu/criminologyandeconomics/home.shtml

reaction has pushed us to think more specifically about the relative contributions of the various fields.

It is relatively easy to identify substantive expertise as the main contribution of criminology to economists who study crime. Criminologists study crime and the criminal justice system. They know how the system works, and understand the data issues surrounding the measurement and study of crime. They have also developed a rich theoretical tradition which identifies potential causal mechanisms for the actions of offenders and the criminal justice system. Studying crime and the criminal justice system without the benefit of research and theory by criminologists is at best inefficient and at worst foolish.

It is slightly more difficult to categorize the contribution of economists. Becker's original contribution was theoretical, but much of the recent research has been decidedly empirical and *atheoretic*. We ultimately decided to use the work of Nobel prize winner Ronald Coase to guide our exploration of the potential contribution of economics to the study of crime.[8] Coase offers a framework for the examination of the contribution of economics to other fields in his essay entitled *Economics and Contiguous Disciplines* (1978), which examined competition among disciplines.[9] Coase suggests that any discipline can be defined by three basic characteristics - common theory or approach to a subject, common techniques of analysis, and a common subject matter. The contribution of discipline X to discipline Y, will depend on the extent to which the techniques, approach or subject matter of discipline X are relevant to, and different from those of discipline Y. Moreover, Coase argues that the lasting ability of economics to establish itself in new domains will depend on the extent to which the contribution is based on the subject matter expertise of the discipline. Main stream economists study the

[8] The field of law and economics, which taxonomically includes the study of crime, can be traced back directly to the work of Coase (1960) and Becker (1968).
[9] We thank Michael Tonry for bringing this essay to our attention.

economic system, defined by Stigler as "the operation of economic organizations, and economic organizations are social (and rarely individual) arrangements to deal with the production of economic goods and services." (Stigler 1952) According to Coase's argument, techniques and the theoretical approach of economists that can shed light on the study of crime can be quickly appropriated by criminologists, and become part of criminology. However, contributions that are based on the subject matter expertise of economics are likely to substantiate a subfield of economics and crime.

We propose to follow Coase's threefold classification of approach, technique and subject matter to examine the role of economics in the study of crime. We start by discussing the basic approach of economists. That approach begins with assumptions about the behavior of individual actors that can be expressed in simplified mathematical form, generating falsifiable predictions. Actors, whether offenders or criminal justice officials, are assumed to be rational in the sense that they systematically pursue their self-interests. Actors differ in the nature of those interests, as expressed in their objective functions. Objective functions are formalized expressions of an individual's preferences. Offenders may be characterized by unusual objective functions. The other general insight is that maximization takes place in the context of interactions, so that empirical predictions must take into account the actions of the other affected parties. This focus on individual maximizations and on interactions constitutes a very different approach from that of criminologists.

Section III then considers three major substantive areas of criminology in which economists have made, or have the potential to make, significant contributions. In the study of deterrence, work by economists in the 1970s has been incorporated into the criminological literature on how experiences with the criminal justice system affects individual behavior

through their influence on perceived risks and rewards of crime. In contrast, pioneering work by economists on understanding the decisions of prosecutors has disappeared essentially without trace, even though it potentially had important consequences for criminological research on the performance of the criminal justice system. More recently there has emerged a new economic-based approach to decision making by criminal justice officials, outcome analysis, that has provided potentially useful tests of the existence of discrimination in the system.

In Section IV we turn to the use of economic technique. Econometrics, the area of statistics developed by economists, has produced many new methods of data analysis that are helpful for criminologists, particularly focused on problems of sample selection and endogeneity. Criminologists are increasingly acquiring command of these statistical methods. The other technique, cost-benefit analysis, remains solidly in the hands of economists, who have made what modest progress has occurred in estimating the costs of crime and the returns from specific interventions.

Section V takes up a topic that has largely been neglected by criminologists, though it is of considerable importance to an understanding of crime in contemporary America, namely drug markets. The study of markets is core to economics and the basic tools of supply and demand have been used fruitfully by a few economists to understand the consequences of criminal justice interventions on outcomes of interest, such as price, consumption and related crime. This is an area in which criminologists have much to learn from economists.

We conclude in Section VI with our own judgment of the relevance of the work of economists and economics for criminology. Economists studying crime need to draw more extensively on the research of criminologists if they are to make real progress and not just

reinvent the wheel. We also argue that criminology will be a stronger field if it finds a way of incorporating economic theory, technique and substantive expertise into the field.

II. Thinking Like an Economist

Economists bring a fundamentally different approach to the study of individual and system decision making. In this section we describe two of the principal features of that approach. The first is the emphasis on rationality, defined not as conformity to others' values but simply the realization of one's own self-interests. The second is the focus on interactions among parties with different self-interests, which has effects particularly at the aggregate level.

II.A The Importance of Rational Decision Making

The main insight of Becker was that crime, and the control of crime, were choices that could be modeled in the standard labor economic model of individual decision making about the allocation of time. Crime is simply another choice, like the decision to work or to invest in education.[10] Such choice to an economist has a clear conceptual structure. Individuals face an array of options (goods/activities) that are linked to outcomes. In the simplest model, all choices are known and the probabilities of the associated outcomes are known (perfect information). These assumptions can be, and are, relaxed, but in all cases we have an array of choices linked to outcomes. Individuals weigh these outcomes with the help of an "objective function" which is a statement of goals. This objective function evaluates the various outcomes in terms of how well they help the individual achieve his or her goals. In the simplest consumer choice model, the individual allocates a fixed amount of money between two or more goods; The individual's

[10] Individual can still differ in their willingness to break the law. Becker does not assume that all individuals have the same preferences.

objective function describes what will make him the happiest/most satisfied, given his income constraint.

This framework points to a central concept of economics, "opportunity cost". The cost of choice A is not the money price of that choice, but the cost of not choosing B, the next best option. This conceptualization is crucial to understanding the cost of crime to the potential offender because the true cost of an incarceration sentence is the opportunity cost of spending time in prison (Becker 1968). This may vary among individuals, even though the actual sentence will be the same for all of them.

One hallmark of the economist's approach is their willingness to write the theory down in mathematical form, which includes the mathematical specification of the preference or objective function of individuals. There are many well known utility functions, described in a graduate level micro-economic textbook like that of Hal Varian (2002) that appear to capture at least some known aspects of human behavior. These utility functions include parameters that weigh the tradeoffs betweens returns now and in the future (time discounting), and parameters that describe the value of an additional unit given current levels of consumption. For example, economists assume diminishing marginal returns, i.e., that the benefit of the next unit of a given good is smaller than the benefit of the last unit consumed. Because these objective functions must be written down mathematically, they are necessarily highly simplified descriptions of human behavior. Nonetheless, they include explicit assumptions about human behavior, and more importantly, they can generate clear and testable predictions.

Historically there was controversy in economics about whether the focus on evaluating the value of the model should lie in the accuracy of these assumptions, or the accuracy of the predictions (Friedman 1953). The consensus of economists for the last half century is that the

focus should not be on modeling the exact nature of human decision-making, but rather on creating the simplest possible formal model that generates clear and testable predictions. If these predictions are falsified, then something in the assumptions is incorrect and needs to be changed. A bedrock assumption, not subject to testing, is the fundamental belief that an individual is responding to incentives. If the person is not responding to incentives that are shaped by his objective function, then the basic economic approach fails.

A fundamental misconception of criminologists is that the term rational, when used in reference to the economic model, refers to the character of the objective function of the offender (Clarke and Felson 1993). Becker in his initial model specified a very simple static model which assumed that all individuals had the same objective function in a world of perfect information. Criminologists have, rightly, concluded that this model cannot explain criminal behavior; crime is driven in large part by individual differences, which economists sometimes refer to as population heterogeneity. But some criminologists go one step forward, and also conclude that because a rational person, i.e. the average person with the "typical" objective function, would simply not behave in this manner, the economic model is invalid and should be abandoned (Clarke and Felson 1993).

However economists use the word rational not to refer to the nature of the objective function but to the process by which a person makes choices relative their objective function. There is considerable empirical evidence that prices affect consumption not only of idealized, perfectly rational actors, but also of patients in psychiatric institutions, animals (Kagel et al. 1981), and users of the two licit addictive substances, cigarettes and alcohol (see literature review by Manning et al. 1991). As Phil Cook elegantly argues in his 1980 defense of the economic approach to the study of crime and deterrence, the finding that criminals do not appear

to behave in accord with the simple model developed by Gary Becker did not fundamentally undercut the economic exercise, but rather suggested that the economic model under test needed to be further developed in order to more accurately predict the behavior. In this context, Cook points to the need to allow the objective function (the way people weight outcomes) to vary across the population and to deal with imperfect information (the fact that people do not always know the punishment associated with a particular crime and uncertainty about the punishments in the criminal justice system) as main areas that need to be addressed in further developing the economic model of crime.

The process proposed by Cook is formal theory development, economics style. In economics, the basic model of any problem is written down and then extended and developed over time to more accurately reflect reality in formal theory development. The theory is specified with a precise formula that can be written down in testable form and then built on and tested by anyone provided that they make their assumptions clear. Becker's (1968) paper on criminal behavior and Landes' (1971) paper on the criminal justice system are examples of foundational papers in economics in which a basic formal economic model was written down, and then extended by other researchers.

Of course, the idea that theoretical ideas need to be specified in a formula is not limited to economics. The hard sciences follow this form, and theorists in sociology have also advocated this approach. For example, Gibbs (1972) suggest that empirical tests of theory virtually require formulae. ''[T]he stipulation of formulas and requisite data is a distinct step in theory construction. Neither stipulation is realized by a definition of a concept, and the theorist should not presume that a definition will somehow suggest the same formula and procedure to all investigators'' (p. 133).

Sociologist Robert O'Brien (2001) when commenting on a theoretical debate between Greenberg (2001) and Britt (1997) regarding tests of Greenberg's theory of juvenile delinquency, cites the lack of a referential formula by theorists as a major problem in criminology.

> He (Greenberg) could help by outlining the conditions necessary for an adequate test, including the time period, level of analysis, measures of ''crime'' to be used, and so on. This task is not an easy one or one typically performed by criminologists. Performing this task is especially important in cases where an empirical test does not accompany a theory. Without such an empirical test accompanying a theory, it is more difficult to know how one should test a theory. In my view theorists have the right to criticize those who test their theories in an unreasonable manner, but the range of reasonableness is certainly extended when theorists do not provide clear instructions for appropriate tests. Many theories in the social sciences are discursive. Such discursive theories may be valuable in terms of the thinking of those in and out of a field, but they are difficult to test. Those who formulate their theories in a discursive manner will view a requirement that theorists explain how to test their theories as too strong a requirement. Formal theorists will view a requirement that refers only to ''clear instructions for appropriate tests'' as not strong enough. (p. 373)

Formal theories, which can be written down and then modified when falsified, lead to clearer testing and clearer thinking.

The problem of course, is that as the model becomes more complicated, it becomes harder to test. Theoretical economists have steadily and busily worked on extending the basic model to generate predictions that appear to be more consistent with observed behavior. Theoretical economists have demonstrated time and again that the economic modeling framework is flexible enough to accommodate a wide range of possible complications, such as imperfect information by potential offenders about the probability of apprehension or variation in attitudes towards risk (Garoupa 1997).

But as early as 1978, economist Charles Manski concluded that existing economic theory was "too idealized and abstract from too much of the criminal decision problem to serve as useful bases of empirical work" (Manski 1978, p, 90). Clarke and Cornish had much the same

complaint when they discussed the economic model of decision making for a *Crime and Justice* review article in 1985. Almost thirty years after Manski, Judge (and economist) Richard Posner's review of Shavell's theoretical book, *Foundations of Economic Analysis of Law* makes much the same point. The models, while rich, are abstract, do not deal with specific situations and are therefore too hard to test (Posner 2006).[11]

Another strain or version of economics does not actually require the researcher to test the exact formal theory, but rather to test broad implications of the theory in a manner similar to what criminoligists typically call theory testing. This is the basic approach that motivates the wildly popular book *Freakonomics* by Levitt and Dubner (2005), which is based on a series of studies by Levitt and various co-authors. Levitt examines a series of situations in which individuals have clear incentives, generates predictions of specific outcomes and then analyzes the data to compare actual outcomes with his predictions. The economic model predicts, for example, that real estate agents have lower incentives to wait for a better price than do homeowners, since the agent gets only a small share of the increment from waiting for a better offer. Levitt does not actually estimate his model, but he examines data where a real estate agent sells her own home, and compares their selling behavior when they are an agent versus when they are a seller. If Levitt is right, than one would expect to see that selling realtors-owners would have higher prices, and longer wait periods, than when realtors are selling another person's house. These empirical tests are not structural, which means that Levitt is not trying to estimate the key parameters of the preference function. But, the apparent evidence is at least

[11] This mathematically rigorous kind of theory falls into a kind of parallel universe, often devoted to making economists simply feel better about the scientific rigor of the economic enterprise; we do not pretend to cover this other kind of theorizing in this paper. The Nobel prize is frequently awarded to economists of this kind. For example, Gerard Debreu received the prize in 1983 for showing that it was possible for markets to come to equilbirium even with very weak assumptions about the shape of individual utility functions and production functions (Debreu 1959). It involves use of sophisticated mathematics.

consistent with the claim of mismatched incentives. In nearly every example, Levitt develops predictions based on a simple economic model, and then compares the evidence with that prediction. Colloquially, this process of generating a prediction based on the idea that incentives matter for choices is what some people mean when they say someone is "thinking like an economist." It is analogous to how thinking like a sociologist involves paying particular attention to social context. While neither approach will capture all of the important variation in crime by itself, they are both valid and valuable approaches to the study of behavior. At other times, thinking like an economist simply means thinking carefully or creatively about the impact of a policy change. The idea that abortion can account for part of the crime drop (Donohue and Levitt 2001) is an example of this type of creative thinking often associated with economists that could clearly be done by non-economists.

II.B The Importance of Aggregate or Market Forces

It would be a mistake to focus too much on the individual and the implications of rational behavior in a discussion of the economic approach. Economics is largely the study of supply and demand for goods. As such, there are two sets of actors, producers and consumers, trying to maximize their objective functions (profits for producers, utility or wellbeing for consumers). The key claim of microeconomics is that producers and consumers can interact to reach an equilibrium price and quantity without any explicit intervention. This focus on two competing forces interacting to reach an equilibrium is an explicit part of economists' thinking. In fact, Coase (1978) suggested that this tendency by economists to think about the economic system as a unified interdependent system means they are "more likely to uncover the basic interrelationships within a social system than is someone less accustomed to looking at the

working of a system as a whole (Coase 1978:209)." This system focus was explicit in Becker's original approach to the topic. Becker states that "(t)he amount of crime is determined not only by the rationality and preferences of would be criminals but also by the economic and social environment created by public policies, including expenditures on police, punishments for different crimes and opportunities for employment, schooling and training programs (Becker 1993: 390)."

In Becker's view, the social system that generates crime is not limited to potential offenders on the one hand and the criminal justice system on the other, but on any part of the social and economic environment that changes the incentives to commit crime. This fundamental realization that the total amount of crime is determined as an outcome of the interactions between all members of the system is not uniquely economic, but it certainly is not surprising that economists have focused on this insight from the beginning of their study of crime.

In an economic market, the fact that quantity sold is a function of the interaction between supply and demand is recognized by the specification of two simultaneous equations, one for supply and one for demand. Producers will agree to produce a certain amount of the good conditional on a variety of factors, including price of the good. Consumers will agree to purchase a certain amount of the good, conditional on a number of factors including price. In equilibrium, the quantity produced is equal to the quantity demanded. Price is the mechanism by which the market reaches its equilibrium. For example, suppose that initially producers produced more than was demanded by the market. The only option is for producers to lower the price, at which point more will be sold. As such, price depends on quantity demanded and supplied, and vice versa. In economic language, price is endogenous, determined by the system

of equations. In contrast, other factors are exogenous, meaning they exist outside of the system and do not depend on what happens as the system arrives at an equilibrium. A drought that affects the production of corn is an example of an exogenous shock to the market.

Any attempt to estimate the impact of price on the quantity demanded (or supplied) must somehow break the endogeneity of the system through the introduction of a source of exogenous variation. The most obvious would be some kind of experiment, where people would be randomly assigned different prices, but economists have developed other methods which we will address in the technique section of this paper. The point of this section is that in thinking about systems, economists naturally think about the extent to which any variable is endogenous or dependent on the system. This way of thinking has been essential to the way economists approach the study of crime, and we believe it forms one of the major contributions of the economic approach to the study of crime.

The key variables in the crime system are not quantity and price but crime and the crime prevention measures taken by the criminal justice system as well as potential victims. Crime is dependent on, among other factors, the crime prevention measures taken in the social system. But, these measures are in turn dependent on the amount of crime in the system, among other things. That means that crime prevention is endogenous i.e., crime and crime prevention are simultaneously determined. This fact is perhaps the biggest hurdle to models that attempt to study the deterrent impact of prison and police. Places that have a lot of crime are also likely to have a lot of crime prevention. This induces a positive correlation between crime and crime prevention policies like the number of police, when theoretically we expect that crime prevention should have a negative relationship with crime. This fundamental insight forms a key part of Nagin's 1978 paper on deterrence and is a major hurdle to any empirical estimation of

deterrence. At the close of 1970's, Cook (1980) authored an influential review paper in the second volume in this series, suggesting a new way forward for economic research on deterrence. This new approach largely deemphasized direct tests of the economic model, and instead urged empirical tests of policy interventions with special attention to the problem of endogeneity between actors in what some might consider the market for crime (Cook 1986).[12]

This analogy of a market for crime, which has never become embedded in criminological thought, has value in its identification of interacting parties (most prominently, potential offenders on one hand, and the criminal justice system and potential victims on the other) who simultaneously affect each other's behavior. Estimates of the impact of policies that fail to take into account the endogeneity of these policies and the response of the potential offenders (i.e. displacement) to these policies are fundamentally flawed. But this endogeneity is not just a statistical problem – it is a substantive problem that fundamentally frames the economists' approach to the study of crime since the criminal justice system, potential victims and the offenders are reacting to each other's action. A standard critique from other economists of a analyst's policy recommendation is that the author has failed to take into account the feedback loop between the actions of the system and would be offender. For example, consider the potential tension between reintegration for ex-offenders and deterrence. A policy that encourages reintegration may reduce barriers to reentry but it also simultaneously lowers the punishment cost of an arrest and conviction.

Cook's examination of opportunity theory from an economic point of view is an excellent example of the value added that comes from applying the economic perspective to an area often studied in criminology. Social learning theory (Cloward and Ohlin 1960) focuses on the role of

[12] In this notional market, the "demand for crime" is the inverse of the "demand for safety;" as the price of safety rises, the demand for crime will increase.

opportunity to provide the social context by which individuals can learn delinquent values and sub-culture. Basic criminological theory of victimization tended to focus only on the lifestyle that leads to differential exposure of social context of the environment of the potential victims. Criminal opportunity theory, as developed both by economists and criminologists (see Clarke 1983), builds on this history but adds a particular emphasis on the feedback loop between the threat of crime and the crime prevention steps of potential victims. According to Cook, a "complete theory of the volume and distribution of crime requires a complete characterization of both potential criminals and potential victims (Cook 1986 p.27). Situational crime prevention as a theory suggests that in fact victimization can be affected by steps the potential victim can take to avoid victimization. This affects the targets available to potential offenders who have to access the relative risk and rewards of any particular crime. This interaction then affects the final distribution of crime that we observe.

Cook offers this theory as a way to help explain the apparent mismatch between victimization rates and fear of crime. Women are particular vulnerable to threats of force and present attractive targets to potential robbers, who are primarily male. And women are more frightened of robbery than are men. But, men were 2.7 times more likely to be victims of robbery than women in 2005 (U.S Department of Justice 2006). From criminal opportunity theory perspective, this not because men are inherently more attractive targets than women, but because women, on average, take steps to prevent robbery that men do not take, and as a result of these steps, men are more attractive targets on average. From this perspective, researchers must always remember that one observes is the result of actions taken by both potential criminals and potential victims.

The fact that individuals can take steps to prevent crime over and above that of the criminal justice system also means that researchers are likely to consistently underestimate the impact of any effective crime prevention strategy on the part of the government. Suppose the government institutes a program that reduced the number of burglars by 20% in a business district in the short-run. Businesses perceiving a reduced threat may be more likely to hold cash, and spend less resources on crime prevention. This in turn will increase the returns from theft and may induce additional individuals to offend. Whatever the exact interaction, criminal opportunity theory predicts less than a 20% reduction in crime in the long-run. This is relevant not only from a policy perspective, but for a research strategy. Any research effort to measure the impact of the original treatment must take into account the subsequent responses which might lessen the initial impact.

The nature of this discussion at the system levels means that most research on the endogeneity of crime prevention and crime is done at the aggregate level (for a review of economic studies that look at crime prevention, see Levitt and Miles 2007). But recent work on both incapacitation (Owens 2007, Bhati forthcoming, Nieuwbeerta and Blokland forthcoming, Sweeten and Apel forthcoming) and deterrence (Loeffler 2006, Helland and Tabarrok 2007, Kuziemko 2007) has extended these analyses to the individual level. We will discuss the types of techniques which can deal with this type of endogeneity in the next section.

III. Illustrative Topics in the Economics of Crime

In this section we examine three specific topics that illustrate the ways in which economic analysis has been used to illuminate major issues of interest to criminologists. The first, perceptual deterrence theory, is core to both theoretical and empirical economics. Early

insights from economic papers on time discounting have been incorporated into the mainstream criminological research and have led to stronger empirical research on the connection between the experience of arrest and perceptions of criminal justice risks. In contrast, the second field, the behavior of the criminal justice system, illustrates how the insights of economics can be lost. Early promising empirical research by economists on the behavior of prosecutors produced some findings that have not entered into criminological research. However, the same interest in maximization decisions by criminal justice officials, in this case police, has generated a new approach (outcome analysis), which is influencing study of disparate outcomes and the extent to which they can be interpreted as evidence of discrimination.

III. A Perceptual Deterrence Theory

Coase argues that, to the extent that the theoretical approach of economics was useful for the study in a discipline, members of that discipline could acquire and incorporate these insights into their discipline. The study of individual deterrence by criminologists has in fact incorporated many lessons from economics, and developed an interesting and important literature in criminology. Good reviews of this literature are offered elsewhere (Paternoster 1987, Nagin 1998), but we highlight key papers here to show how insights from economics have been incorporated into criminological research.

One lesson from the initial flurry of research on deterrence by economists was that the connection between punishment and behavior was not as strong as might have been expected (Nagin 1978). One possible explanation was that individuals did not make "good decisions", where good is defined as choices that would lead to better outcomes for the decision maker according to "typical" objective functions. One reason for these poor choices are that severe sentences (i.e. which extended far into the future) were heavily discounted by offender. The

future is usually discounted in decision making framework – a dollar now is always better than a dollar in the future. But, the rate of this discounting is subject to debate and may vary across individuals. An individual with a "normal" discount rate might be willing to trade 90 cents today for one dollar next year. A person with a high discount rate might be willing to trade 50 cents or less today for a dollar next year. Wilson and Herrnstein (1985) identified high time discounting as a potentially valuable explanation of criminal behavior given the time delay of imprisonment. Economists have typically considered the time discount factor when discussion the potential effects of policies which increase sentence severity (Kessler and Levitt 1999).

Research by Nagin and Pogarsky more explicitly builds on work by economists, using scenario data on college students (Nagin and Pogarsky 2001, 2003) and panel data from the National Longitudinal Study of Adolescent Health (Nagin and Pogarsky 2004) to document that individuals who discount the future more heavily are less likely to be deterred by a given punishment. They differentiate the concept of time discounting from impulsivity, which is more similar to the mainstream criminological concept of self-control. Impulsive people do not consider the consequences of their actions, while high time discounters do consider the consequences, but heavily discount future consequences. Cauffman and Steinberg (2000) refer to the ability to consider the larger consequences of a decision as perspective, and the ability to control one's impulses as temperance. Cauffman and Steinberg (2000) refer to a final non traditional feature of choice that might explain poor choices to commit crime as judgment. Judgment is the ability to avoid allowing outside immediate influences like peers and physiological arousal to have an undue influence on behavior. Loewenstein (1996) posits that visceral factors like anger and sexual arousal can narrow the range of consequences considered by decisionmakers. Nagin (2007) used his acceptance speech of the American Society of

Criminology's Edwin H. Sutherland Award to argue for more research into these components of choice (judgment, temperance and perspective) that might explain why individuals, particularly young adults, are not deterred from crime despite the presence of steep penalties.

Another reason that individuals might not be deterred is that they are largely unaware of the true sanction probability and severity. In economic terms, there may be imperfect information or even optimism bias about sanctions. Paternoster (1987) details a large body of work mostly by criminologists trying to link perceptions of risk to behavior. He also points to the need for researchers to consider how these perceptions are developed through individual experience. Stafford and Warr (1993) redefined the criminological idea of specific deterrence as information updating, and identified mechanisms based on own and peer experience by which individuals could update their perceptions of punishment. The idea that the experience of peers might influence the perceptions of punishment was raised initially by Cook (1980).

A variety of empirical tests have studied the ways in which perceptions are updated using both real and vignette data (Paternoster and Piquero 1995, Piquero and Paternoster 1998, Piquero and Pogarsky 2002 and Pogarsky, Piquero, and Paternoster 2004). This work has been brought together with the work on how perceptions affect behavior in a recent paper in the *American Sociological Review* by sociologist Ross Matsueda and colleagues (Matsueda, Kreager and Huizinga. 2006) using panel data on high risk youth in Denver, specifically collected to answer these kinds of questions. This paper, like others in this literature, explicitly uses concepts from economics like expected utility to set up its analysis. It also uses formal equations to specify its models. The paper finds fairly strong evidence that the individual experience of arrest leads to updating of the perceived probability of arrest. Moreover, it finds that these individual experiences, rather than the neighborhood environment, drives the formation of these

expectations. Finally, the paper shows that increases in the perceived probability of arrest leads to meaningful declines in offending.

A very similar article was written almost simultaneously by economist Lance Lochner (2007), also looking at the link between personal experience and perceptions, and then perceptions and behavior, using panel data from adolescents. The results of the two papers are eerily similar – both find that a 10 percentage point increase in the probability of arrest will lead to a 3 percent decrease in theft – although the methods used are different, underscoring difference in technique between the two fields.[13] Notwithstanding the differences in technique, the similarity between the two papers underscores Coase's point that other fields can take advantage of key insights from economics, without the necessary involvement of economists.

III.B Economics of Sentencing

Not all areas of criminology and criminal justice search present equally cheering stories about learning from the economic approach. A fair assessment of the impact of economics on the study of the criminal justice system would have to conclude that the economic approach has not greatly informed the current state of the art, in part because economists have not remained committed to research in the area over a long period of time. In this section we review some of the early work by economists and discuss ways in which the results might be relevant for current research. The section concludes with a discussion of outcome analysis, a formal economic

[13] Matsueda, Kreager and Huizinga (2006) use random effect analysis, while Lochner (2007) uses fixed effect methods. Matsueda, Kreager and Huizinga use a tobit model for the perception model and a negative binomial model in the crime equation to model more precisely the non normal distribution of the dependent variables. Lochner used OLS as the primary estimator for both models. Finally, Lochner made an attempt to use an instrumental variable estimator in the crime equation. These differences are emblematic of standard approaches by the two disciplines.

model of the criminal justice system that has inspired a recent flurry of theoretical and empirical work by both criminologists and economists.

Economist William Landes (1971) followed Becker's model of criminal activity with an important, if less well cited, article entitled "An Economic Analysis of the Courts". He provided a mathematical model of the court behavior, which he then tested with empirical data. The criminal justice system is on its face probably more amenable to the economic approach than is crime itself. The actors in the criminal justice system are known, and are more likely to behave rationally, in the economic sense of consistently following their objective function. These objective functions are likely to be "reasonable", in the sense of striving to achieve intuitively appealing goals. Data on the behavior of the court actors is also available for every case, which means that the models are likely to be easier to test.

Landes' model is very simple, and like any good economic modeler, he makes his assumptions very clear. He assumes there are a limited number of defendants, and that prosecutors and defendants each have their own perceived probability of conviction in a case, which is a function of both the prosecutor's and defendant's resources, and all other information, common to both actors, which might contribute to a conviction. He also assumes that the sentence to be awarded after a trial is known to both defendant and prosecutor and that it is independent of resources. Finally, he assumes that there are no monetary or non monetary costs to a trial. The prosecutor's objective function is such that he attempts to maximize the expected number of convictions weighted by the expected sentence given at trial, subject to a budget constraint on his resources. This maximization exercise produces what economists call the first order conditions – the things that must be true if the prosecutor maximized his objective function under these assumptions. These first order conditions create implications or predictions which

can than be tested. For example, his model predicts that pretrial detention (meaning that someone was not released on bail) would lead to higher opportunity costs for the defendant than if he were released on bail. These higher costs would lead to acceptance of longer sentences in plea bargains for those held on bail relative to those who are released on bail. If making bail is a function of wealth, this model suggests that the current bail system will lead to discriminatory sentencing outcomes for those with less wealth. In particular, lower income participants who do not make bail will be more likely to plea guilty and get harsher plea sentences.

Despite the highly simplified assumptions, the empirical results in Landes (1971) largely support the model's predictions particularly for bail (see also Landes 1973, 1974). William Rhodes and Brian Forst followed with models that attempted to make Landes' model more realistic. For example, Forst and Brosi (1977) extended Landes' single period model to multiple periods in an attempt to examine the relative tradeoff between case quality and criminal history as predictors of prosecutor effort. Rhodes (1976) added additional courtroom workgroup actors to the model. However, very little has been done to extend these models since the 1970's. Perhaps this lack of activity by economists accounts for why this body of work is largely unknown in the criminology literature.

Economists were also heavily involved in the writing of the National Academy of Sciences volume on Sentencing in 1983. The articles in these volumes were explicitly intended to evaluate the current literature and lay out effective strategies for additional research on sentencing. Klepper, Nagin and Tierney (1983) examine research that looks at discrimination in sentencing. They make two particularly broad critiques about the literature. First, they note the absence of formal models of processing decisions in the criminal justice system. Without theory, empirical models might be mis-specified, and inference about social class and race at each stage

may be extremely misleading. Garber, Klepper, and Nagin (1983) lay out a structural model that follows from their formal model of the criminal justice system. Klepper, Nagin and Tierney (1983) also strongly advocate against including plea cases and trial cases into the same analysis given that they follow a different process. Second, the existing literature did not pay attention to the sample selection biases resulting from screening and processing decisions. These two concerns are obviously related, because a formal model of the courts could help estimate the selection processes that occur. A related article concerning the problems of selection by Berk (1983) also brought the issue of selection to the attention of sentencing researchers.

Research in the immediate aftermath of the NAS report by criminologists appeared to take these warnings to heart. Zatz and Hagan (1985) demonstrate how controlling for selection can dramatically alter the inference about key predictors of the sentencing process. Smith (1985) applies the logic of Landes's model to the plea bargain decision to show that the trial penalties in his dataset are on average consistent with a model in which pleas are discounted by the probability of conviction.

But, over time, a fair evaluation must conclude that Klepper, Nagin and Tierney (1983) and Landes (1971) have not had a lasting impact on research on the criminal justice system. Plea bargains and trial cases are almost always analyzed together, for example. Bushway, Johnson and Slocum (2007) details the somewhat dismal history of controls for selection in sentencing research. The principal statistical technique advocated by Berk (1983) and Klepper, Nagin and Tierney (1983) is the Heckman two-step technique. This estimator explicitly models selection from a larger sample into a non-random subsample using a probit equation in the first stage and an ordinary least squares model for the subsample in the second stage. The hazard for selection into the second stage, estimated in the first probit equation, is included as a regressor in the

second equation. This approach has been implemented in a mechanistic (and often incorrect) way to deal with the acknowledged selection problems. In general, there has been little attempt to model the selection process.

There has also been little independent progress in the development of criminal justice theory (Hagan 1989, Duffee and Allan 2007). Those theories that do exist, while often quite rich, are discursive and informal. An example is the current dominant theory in sentencing, focal concerns theory (Steffensmeier, Kramer, and Streifel 1993, Steffensmeier, Kramer, and Ulmer 1998). The focal concerns theory states that courtroom actors' sentencing decisions reflect three primary "focal concerns": (1) the blameworthiness or culpability of the offender; (2) the desire to protect the community by incapacitating current offenders or deterring potential offenders; and (3) the resource constraints of the courts. The argument is that because actors do not have enough information to accurately determine an offender's culpability or dangerousness, they develop a short-hand based on stereotypes and attributions that are themselves linked to offender characteristics such as race, sex, and age. "Race, age, and sex will interact to influence sentencing because of images or attributions relating these statuses to membership in social groups thought to be dangerous and crime prone" (Steffensmeier et al., 1998, 768). The theory is not tested directly – key concepts such as perceived dangerousness or culpability are never operationalized - but the theory is used to interpret the finding that age, race and sex are correlated with some sentencing outcomes. Of course, other theories might also predict that age, race and sex will be correlated with sentencing outcomes.

Direct tests of focal concerns are complicated by the lack of a formal model. Some parts of the theory are consistent with Landes – for example, the existence of a budget constraint is common between the two models. But, essentially, focal concerns theory argues that actors such

as prosecutors have a more complex objective function than the one specified by Landes and that actors cannot maximize effectively. While these assertions are clearly possible and even plausible, they are not tested in the current literature.

For example, Ulmer and Bradley (2006) attempt to use focal concerns theory to explain the size of the trial penalty – the difference between the plea bargain and the penalty at trial - with particular attention to the potential for racial discrimination by prosecutors. This is very similar to the problem modeled by Landes (1971). But Ulmer and Bradley do not include measures of the probability of conviction, the existence of pretrial detention, or considerations of attitudes towards risk, three major factors that explain plea bargaining in the Landes model. At the very least, the simple Landes model presents an important alternative explanation or competing theory that could serve as a useful stalking horse or straw man that criminologists could use to show the need for more complicated theories. Moreover, the absence of key variables predicted to be major players by Landes underscores Klepper, Nagin, and Tierney's (1983) concerns about misspecification in the absence of formal models. Ulmer and Bradley conclude that they found mixed support for focal concerns theory, but the direction for future research is unclear given the absence of a precise model by which plea decisions are made.

Economic thinking about plea decisions provides direction for research that may cast doubt on the current consensus in the criminology literature regarding the impact of race on sentencing. The literature shows repeatedly that race appears to be correlated with incarceration risk but not sentence length when studied using conviction data (Spohn 2000). Researchers are generally unwilling to refer to this effect as racial discrimination by judges because of the possibility of omitted variable bias – other unobserved factors such as wealth, family support and demeanor which are correlated with race could drive the race effect — but most researchers are

willing to say that this racial disparity is being created at the sentencing stage. Therefore, policy reforms, such as sentencing guidelines that reduce judicial discretion, are needed at the sentencing stage.

But the economic model raises some doubt about this conclusion. The model predicts that people who do not make bail will both more likely to be convicted and receive harsher sentences. This means that that a conviction sample will have a disproportionate number of people who are both lower class and did not make bail. The finding that race predicts incarceration but not sentence length could feasibly be the result of selection bias at the conviction stage.

Demuth (2003) convincingly shows that blacks and Hispanics are indeed more likely to be detained pre-trial, all else equal. And, several studies have found that being held prior to adjudication is associated with an increased probability of receiving a sentence of incarceration (Rankin 1964, Farrell and Swigert 1978, Nobling, Spohn and Delone 1998). A master's thesis by Hart (2006) using the same data as Demuth showed the race effect of incarceration at conviction was eliminated in an indictment sample once controls for pretrial incarceration were included. While not convincing proof, this evidence is at least suggestive that the warnings of Klepper, Nagin and Tierney (1983) are meaningful. Models that fail to control for the process by which people move through the criminal justice system may misallocate discretion to the wrong stage of the criminal justice system. Modeling the decision making process in the criminal justice system carefully may lead to new empirical findings that challenge conventional wisdom and lead to both new theories and new recommendations for policy reform. In the above example, reform that focuses on pretrial detention and plea processes rather than the sentencing stage might be more productive for reducing racial disparity.

Recent work by a new wave of economists have at least raised the possibility that economists can, after a long absence, once again contribute to this literature particularly when it comes to modeling selection and discretion across the system. Some of these contributions are very similar to criminology papers, although they usually have some modeling twist which marks the author as an economist. For example, Mustard (2001) studied racial disparity in the federal guideline data in a manner very similar to Steffensmeier and Demuth (2000), but he used cell dummy variable to control for the recommendations of the guidelines rather than using the linear scores for criminal history and crime severity used to define the grid. Schanzenbach and Yaeger (2006) use the federal data to first replicate the basic criminological finding of racial disparity in sentences for white collar crimes, before showing that accounting for fines and the payment of fines, which is driven by an omitted variable – income – can reduce these estimates by at least a third. In another example, David Bjerk (2005) studied how prosecutors use their discretion to avoid three strike laws in CA. His work builds on the existing criminology literature on mandatory minimums by showing that failure to take this discretion into account could lead to an overstatement of the impact of three strike laws on sentencing outcomes in conviction data sets.

Helland and Tabarrok (2007) use the prosecutors' discretion to avoid giving someone a second strike to provide a rare economic estimate of individual level deterrence. They compare the post-sentencing criminal activity of criminals who were convicted of a strikeable offense with those who were tried for a strikeable offense but convicted of a non-strikeable offense. They find that the threat of the third strike reduces arrest rates by about 15 percent. Other economists have also started using the discretion of individual actors to identify the causal impact of specific deterrence and incapacitation at the individual level. Kuziemko (2007) looks

at discretion at the parole level to study the specific deterrent (or rehabilitative) impact of longer sentences on imprisoned offenders in Georgia and finds that an additional month in prison reduces the three year recidivism rates by 1.5 percentage points, an estimate that challenges Doob and Webster's (2003) conclusion that additional sentence length has a null impact on recidivism. Owens (2007) uses a change in how sentencing guidelines handle juvenile records in Maryland to generate unique individual level estimates of incapacitation of around 1.6 Index I crimes per year, an estimate that is an order of magnitude smaller than the current consensus in criminology of around 16 to 20 Index I crimes. We expect that more papers along these lines which directly contribute to long established literatures in criminology will be appearing in economic journals with increasing frequency.

Bjerk (forthcoming a, forthcoming b) has also developed formal models of plea bargaining that attempt to make the Landes model more realistic. Although this work is similar to modeling in law and economics, it is among the first to study plea bargains in criminal courts in detail. Economists have also done some work on prosecutors which explicitly looks at the nature of their objective function. One criticism of economic models is that economists have simplistic assumptions about what prosecutors attempt to maximize. But Glaeser, Kessler, and Piehl (2000) suggest that federal prosecutors are maximizing on a number of dimensions, including the public profile of a case, when selecting cases to try in federal courts. Moreover, Glaeser, Kessler, and Piehl argue that this selection mechanism can lead to non-random sampling of cases into federal court, a possibility that is largely ignored in the criminological literature on the federal system. Schanzenbach and Tiller (2007) do not model selection, but they do use the federal sentencing data to write a paper with formal theory and empirical analysis to study the impact of judge characteristics on sentencing outcomes. This paper is similar in spirit to work by

criminologists studying judge effects (e.g. Johnson 2006), although again the methods and models are quite different. Although there is very little cross-fertilization at this point in both literatures, we feel strongly that the work of both the economists and criminologists who are studying sentencing could be improved by collaboration and cross-citation.

III.C Outcome Analysis

Recent developments in the study of racial profiling by police suggest that non economists are also beginning to see the potential usefulness of the economic approach for the study of discrimination in the criminal justice system. Lawsuits accusing police of racial profiling typically involve statistical evidence that search and stop rates per capita vary among different groups in the population. If blacks and whites were otherwise identical, then we could test for the presence of racial discrimination by simply comparing the fraction of blacks searched to the fraction of whites searched. Under the null hypothesis of no discrimination, whites and blacks should be searched at the same rate. However, this approach has a well-known problem: there is no particular reason to believe that all other things are equal. Socioeconomic characteristics vary considerably among blacks and whites, including characteristics (e.g., income, wages, neighborhood residence) thought to be related to crime. Since these characteristics are related both to race and to crime, rational police seeking to maximize hit rates would take them into account in deciding whom to search. For this reason, not all discrimination is equally inappropriate or illegal.

The traditional solution to this problem is to add control variables in a model that tries to predict search on the basis of race. This approach mimics the standard sentencing analysis of discrimination where an outcome such as incarceration is regressed on all legally relevant

variables plus race. The fundamental limitation of this approach is that it is unlikely that researchers observe all the potentially relevant variables that the decisionmaker – here, the state trooper – does. Thus there remains the substantial possibility of omitted variables bias (Engel forthcoming). Several courts hearing selective enforcement claims have ruled that stop and/or search rates are not meaningful or are insufficient for determinations of discriminatory purpose and/or effect.

Economists have proposed a solution to this problem known as an "outcome test". The basic intuition of the outcome test approach dates at least to Becker (1957), in his classic treatise on discrimination, and has also been used by Ayres (2001) in several applications. The model was applied to police profiling by Knowles, Persico, and Todd (2001). The model is a formal mathematical model of police behavior based on the key assumption that police are trying to maximize hits (the number of offenders) when they conduct searches. Knowles, Persico and Todd (2001) then build from this model to show that, under certain assumptions, the stable equilibrium will occur when all observable groups have the same hit rate at the margin. That is, police officers will make use of all available information in observable correlates such as race and behavior, in their attempt to maximize hits. Intuitively, this means that if searches of one group have a lower hit rate than searches of another group, then rational, unbiased police officers would reallocate searches away from the low-hit group and toward the high-hit group; once they did that, the overall hit rate would increase. Thus, if officers actually behaved in this manner, evidence that the marginal success rate differs by race would be strong evidence of discrimination. And evidence that the marginal success rate is equal across races would then be compelling evidence of the absence of taste-based discrimination.

This test is interesting for several reasons. First, it is based explicitly on a formal economic model[14] of an actor in the criminal justice system and the response by potential offenders to that actor. Second, outcome analysis requires a very simple empirical test with no complicated econometrics. In a very short time, outcome analysis has been used by numerous economists and criminologists, and has even become the standard for legal tests of discrimination in racial profiling lawsuits (Engel forthcoming). Third, the test has spawned a number of worthwhile discussions about the model. Criminologist Robin Engel (forthcoming) argues that the assumptions of the model do not apply to the standard police search. This is an interesting challenge because it is made on substantive grounds, and it involves a detailed investigation of how police make decisions. Other economists have also challenged some of the key assumptions of the model which has led to an interesting dialogue and a number of alternative tests (Anwar and Fang 2006, Dharmapala and Ross 2004).

Perhaps the most interesting challenge from our perspective is the recent book arguing against using race in police decisions by law professor and political scientist Bernard Harcourt (2004, 2007). His challenge is noteworthy because it assumes the model is correct, and poses a theoretical challenge from within the model. He notes that the policy of racial profiling may not lead to the desired effect of increasing hits (and decreasing crime) if blacks and whites are not equally deterred by police pressure. Specifically, the policy of discriminating on the basis of race could lead to increased crime AND decreased fairness if blacks are less responsive to police pressure than are whites. See a related argument by Bjerk (2007) and Persico (2002). This challenge puts the pressure directly on empirical estimates of key parameters from the model. Economist Paul Heaton (2007) made a creative attempt to estimate the elasticity of response to

[14] Economic does not refer to any money value but simply to the notion that the actors attempt to maximize their objective function, in this case perhaps the rewards provided by their employer. This objective function can be anything deemed realistic by the modeler, and does not have to be crime control.

the police by blacks using the change in police behavior in New Jersey after the state police were accused of racial profiling. His point estimates were similar to other estimates for whites (around .8) , but his data and measures were so imprecise as to leave very wide confidence intervals around the point estimate, meaning that he cannot reject the null hypothesis that blacks may in fact have substantially lower elasticities than do whites. Other data may have to be found to answer this question, but we believe the critique of outcome analysis by Harcourt is a demonstration of how outcome analysis can lead to interesting theoretical and empirical discussions.

There may be other criminal justice problems where the logic of outcome analysis can be applied in a constructive way. For example, Ayres and Waldfogel (1994) studied the question of bailsetting using outcome tests and Bushway and Gelbach (2006) write down a formal model of bail decision which tries to incorporate more realistic assumptions about bail setting. This type of formal modeling is a potentially interesting path forward that would require the involvement of both criminologists and economists to make serious headway. Economists are probably required for the formal modeling, while criminologists are required for the institutional knowledge that will allow for realistic model building.

IV. Specialized Economic Techniques

Coase observes that every field develops techniques and methods to address problems that arise in the study of a particular subject. This section considers the application of two core economic techniques to crime and the criminal justice system. Econometrics involves the application of specialized statistical methods and has already influenced the empirical analyses of criminologists. Cost-benefit analysis as a technique is much more rooted in economic

reasoning. And economists are responsible for most of the modest advances in the application of cost-benefits analysis to criminal justice topics.

IV. A. Econometrics

Econometrics is a substantial subfield of economics that deals primarily with the statistical analysis of observational data. Some economists who study crime are essentially applied econometricians, and their main competitive advantage is their use of these statistical tools, rather than the application of the economic model. These tools can be (and have been) learned by criminologists to aid them in the study of crime. The result has been empirical studies that have stronger claims about the identification of causal relationships.

Panel data models are one set of tools developed primarily by economists which have been used most often by economists in the study of crime. Panel data is data for which there are multiple observations over time for individual units of observation. Almost all of the aggregate studies of deterrence, which focus on the impact of the criminal justice system on crime, make use of panel data (see Levitt and Miles 2007 for a review).

Criminology (and sociology) has tended to use random effect models for the estimation of panel data (HLM is a random effect model), while economics has a clear bias in favor of fixed effect models. Both models assume that there is an individual specific component to the error term that is unobserved and constant over time. The difference between the models is driven by the assumptions the models make about this component of the error terms. The random effect models assume that this individual specific component is distributed in a particular parametric form, usual the normal distribution. This means that only the parameters of that distribution need to be estimated, which makes the estimator very efficient. However, the estimator only generates unbiased estimates under fairly strict assumptions about the relationship between the

included variables and the error term. Fixed effect models, in contrast, do not make any assumptions about the distribution of this unobserved part of the error term, but rather estimate it directly, usually with an individual-specific dummy variable. This is much less efficient, but requires fewer assumptions, and will to lead to unbiased coefficient estimates relative to the random effect model. This basic advantage of fixed effect models has not been well understood in sociology (and criminology), although recent work by sociologist Charles Halaby (2004) attempts to correct this problem. In his review, he takes sociologists to task for failing to heed the lessons of the econometric literature.

One substantive area where these panel data methods are particularly relevant is the study of state dependence. The idea that offending can dynamically cause future offending is known to economists as state dependence. Labeling is one example of a state dependent process in criminology theory. Nagin and Paternoster (1991) were the first to apply this concept from economics to criminology. The key to generating good estimates of state dependence is controlling for individual heterogeneity. Bushway, Brame, and Paternoster (1999) and Brame, Bushway and Paternoster (1999) are two criminology papers that apply a variety of techniques from economics to study the question in criminology. Perhaps more importantly, state dependence is now used as a concept in criminology to describe different types of dynamic change (e.g. Laub and Sampson 2003). The initial work on state dependence led directly to work by Nagin and Land (1993) which became the semi-parametric trajectory method for studying offending over the life course. This latter case is an example where a technique initially borrowed from economics has been further developed by non-economists for application to a particular criminological problem (See Nagin 2005 for more details).

Another distinct empirical contribution of economics to study of crime involves the use of explicitly causal models like instrumental variables.[15] Instrumental variables are variables are linked to the dependent variable exclusively through their relationship with the independent variable of interest. Or to put it another way, instrumental variables create exogenous variation in the independent variable, which can then be studied to look at the causal link between the independent and the dependent variable. Experimental random assignment is the classic instrumental variable. Random assignment creates exogenous (meaning outside the system) variation in the independent variable X. This variation is uncorrelated with any omitted variable, and is not influenced by any simultaneous (endogenous) relationship between the independent and dependent variable. As a result of this induced variation, we should be able to generate a better estimate of the true effect of X on Y.

Most of Steve Levitt's original contributions to the study of the crime have been based on the identification of interesting instrumental variables which could potentially solve the endogeneity problem identified by Nagin (1978) and Cook (1980) in their initial reviews of the deterrence literature. For example, Levitt used legally mandated reductions in prison capacity to estimate the impact of incarceration on crime (Levitt 1998). His claim was that the court decisions that reduced incarceration were not caused by crime, but were caused by larger societal forces that had nothing to do with the crime generation process. As a result, this variation is essentially random, and he can use this random variation in incarceration to study the impact of incarceration on crime at the state level.[16] Other interesting (and high profile) papers on crime

[15] A full treatment of instrumental variables is beyond the scope of this article and an interested reader should read assessable treatments of the topic by Angrist and Kreuger (2001) and Angrist (2006). Economists are also responsible for importing other causal techniques for the study of crime such as Granger causality testing (Marvell and Moody 1994,1996).

[16] This is not the same thing as saying that the court decisions are uncorrelated with crime. We have encountered non-economists who assert that the instrumental variable, in this case the court decision, must be uncorrelated with crime. An instrument that is uncorrelated with the dependent variable is a useless instrumental variable, and Levitt

related topics which make use of the instrumental variable technique include a paper by Jacob and Lefgren (2003) which uses using teacher conference days to estimate the impact of mandatory school attendance on the crime distribution in the larger community a paper by Kling (2006) which uses random assignment of cases to judges as instrumental variables to study the impact of sentence length on employment outcomes, a paper by McCrary (2007) which uses court ordered hiring of police officers to study the impact of affirmative action on police hiring and (and crime) and a paper by Evans and Owens (2007) which uses federal spending on COPS spending as an instrument to generate additional estimates of the impact of policing on crime (Evans and Owens 2007). In these papers, the instrumental variable methods lead to estimates that are fundamentally different than from those found with traditional OLS analysis.

While this technique has been used almost exclusively by economists, there is no reason criminologists cannot use the instrumental variable technique. It is a straightforward method that is based largely on substantive expertise to identify mechanisms of exogenous change. Given this focus on substantive expertise, criminologists who can "think like economists" econometrically should have a decided advantage over the economist who knows the technique but does not know the criminal justice system or the literature in criminology. Opportunities for collaboration also clearly exist to generate new estimates in a variety of important criminological domains.

IV:B. Cost Benefit Analysis

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shows clearly that the court decisions are in fact correlated with crime rates. The key assumption of instrumental variables is that the ONLY way the instrumental variable is correlated with the dependent variable is through the independent variable (in this case, incarceration rates). In arguing for the validity of his instrument, Levitt needed to argue that the only reason that the court decisions are correlated with crime is because the court decision affects incarceration rates, which then affect crime.

Cost benefit analysis is a natural extension of the economist's normative framework, focused on maximizing society's welfare. In practice it is a method which can help policymakers rationally choose between policies since it is an application of the rational choice model to the macro level of a policy maker choosing between different crime control strategies. Cost benefit analysis starts with an assessment of whether any given program or treatment works to prevent crime, and then estimates the relative costs and benefits of such a policy.

There is a large and growing demand for such analyses, part of the general movement toward greater accountability in public sector decision making in the western world. In the United Kingdom the Home Office has published a number of specific programmatic cost-benefit evaluations (e.g. Bowles and Pradiptyo, 2004). In the United States state government has been the principal source of such analyses. In particular the Washington state legislature has set up an institute (the Washington State Institute for Public Policy) to evaluate policy options and it has produced a stream of cost-benefit analyses of criminal justice interventions (e.g. Aos et al. 2001; Aos, Miller, and Drake, 2006). These studies are done primarily by economists (in the U.K.) and by business analysts (in Washington state); criminologists are marginal to both enterprises.

In its initial formulations, cost benefit analysis in criminal justice was limited to an assessment of crime prevention, and further limited to a discussion of the costs borne by the victim and the costs saved by the criminal justice system. Various attempts have been made to arrive at valid estimates of the former category, including the creative use of contingent valuation surveys [17] and jury awards for pain and suffering; for a comprehensive review, see Cohen 2005. Indeed, Mark Cohen has often been the lone economist pushing cost benefit analysis forward as a technique for criminal justice, and his estimates of the cost of crime have

[17] A contingent value survey asks respondents to estimate how much they are willing to pay for a specific benefit, such as breathing clean air, or to avoid a specific harm, such as being mugged. They are widely used in environmental policy evaluations (Arrow et al. 1993)

been used often by both economists and criminologists seeking to evaluate the costs and benefits of various polices (e.g. Levitt 1996; Greenwood et al. 1994). It is now almost standard practice for economists estimating the effect of any given policy to conduct at least a rudimentary cost benefit analysis of the policy but even sophisticated economists tend to tack this on in a rather mechanical fashion (see Levitt, 1996).

Criminologists have published a number of cost-benefit analyses; Welsh, Farrington, and Sherman (2000) summarize the state of the art at the beginning of this decade. These analyses use accounting rather than economic costs. In particular they do not consider opportunity costs where resources are not well valued by the market. Nor do they follow one of the basic rules of cost benefit analysis, which is that alternatives have to be considered simultaneously and using a consistent set of criteria (Stokey and Zekchauser, 1978).

Donohue and Siegelman (1998), both economists, show the broader reach of cost benefit analysis by comparing the costs and benefits of social policies versus prison. This analysis takes one step beyond criminological efforts to summarize the crime prevention power of any given policies by not only identifying policies with positive effect sizes (Sherman et al. 1997), but then evaluating the relative costs and benefits of a number of policies. Given the notorious difficulty of estimating costs and benefits, the relative comparison of programs is perhaps a more defensible approach than a one-at a time evaluation of the marginal benefit and costs of any given policy.

In recent years, the economic approach to cost benefit analysis of criminal justice interventions has been extended to consider a broader set of costs and benefits. Instead of focusing only on the victim and offender, this new approach considers the actions and reactions of a broad set of individuals who might be impacted by any given policy. For example,

Cavanaugh and Kleiman (1990) consider both the costs of operating a prison and the costs of welfare payments made to an offender's family while the offender is in prison. More broadly, Cook and Ludwig (2000) reconsider the costs of gun violence to include not just the cost to the victims, but also the costs incurred by the rest of society as they respond, a priori, to the threat of increased violence. For example, not only do victims of crime appear to respond by moving out of neighborhoods (Dugan 1999), it also appears to be the case that non victimized individuals will move from cities in response to increased violence (Cullen and Levitt 1999), housing prices will decline (Tita, Petras, and Greenbaum 2006) and business activity declines after violence surges (Greenbaum and Tita 2004).

These type of macro level impacts suggest that costs associated with suburban sprawl are at least partially attributable to crime. The recent focus on the costs of incarceration on families and communities, often the product of interdisciplinary collaboration between economists, sociologists and criminologists, are also part of this larger awareness about the societal impacts of crime and crime control efforts (eg. Patillo, Weiman, and Western 2004).

This interest in the broader social costs of crime has led economists to search for surrogate markets that might provide measures of the willingness to pay for less crime. In a pioneering paper, Thaler (1978) took advantage in differences in crime rates across areas within a city to estimate the capitalized value of a reduction in crime rates through analysis of housing prices. If reducing the expected number of property crimes experienced by the ave3rage household in the neighborhood by one raises the value of each house by, say, $10,000, then it is possible to infer that at the margin, a property crime is worth $500 (using a 5% rate of return). A more recent study by two economists (Linden and Rockoff, 2006) showed that the

requirement that a convicted sex offender's address be provided to the public had large effects on housing prices; the authors use this to estimate a willingness to pay to avoid crime..

A subtler demonstration of this broader consideration of the unintended consequences of policies involves Ayres and Levitt's (1998) analysis of Lojack, an electronic device developed by a private company designed not to deter crime, but to recover a car after a theft has occur. The device is activated after a theft (it silently transmits a signal to a police station), and police can track the automobile using equipment provided by the company. But Ayres and Levitt noticed that, besides increasing the probability of recovering a stolen car, Lojack has the potential to create a general deterrent effect given that people are not allowed, by contract with the company, to identify their car as having Lojack. Car thieves are uncertain about which car has this new technology, and may decide to avoid stealing any car that has the potential of having Lojack.

A conservative estimate was that each additional one percentage point of Lojack market share leads to a 7% decline in auto theft, which makes Lojack one of the most effective crime prevention programs ever studied. The tragedy of the commons, an economic concept that deals with private underinvestment in public goods, is then applied to the cost benefit analysis to demonstrate that investment in Lojack appears to be sub-optimal. The person who installs LoJack only captures 10% of the social benefit generated by Lojack. This economically derived analysis then predicts that insurance companies, the main beneficiary of recovery and theft prevention, will subsidize Lojack adoption. Indeed, in some parts of South America, insurance companies install LoJack for free. Ayres and Levitt (1998) conclude that this subsidy is still less than the socially optimal level – but neither the car owner or the insurance company will recover

these benefits. Perhaps one role for government would be to encourage higher LoJack adoptions. Indeed, seven states have passed statutes requiring a subsidy for its installation.

The differentiation between public and private costs and benefits is also a major feature of cost-benefits analysis of crime prevention strategies. The economic model clearly suggests that employment and school related activities that are not directly related to crime may affect crime. For example, Lochner and Moretti (2004) suggests that the about 10-15% of the social benefit from increased schooling comes from crime reduction. The possibility that other social policies have crime prevention benefits is a provocative counterpoint to the insight that prison may have negative impacts on individuals and communities, and not just the individual offender.

V. Economics as an Area of Expertise: Markets

The final type of contribution of economics and economists to criminology, according to Coase's three part scheme, comes from cases in which the study of crime intersects with the economic area of expertise. Markets are at the heart of economics. After a brief discussion of labor markets and crime, we turn to an examination of a major criminal phenomenon, namely the markets for illicit drugs. Economists have shown that the basic concepts of demand and supply and some elements of industrial organization theory can illuminate the effects of enforcement on outcomes of interest, such as the price and availability of drugs. Other economic tools have also proven useful; for example, the notion of a "tournament" may help explain the peculiar feature of contemporary drug markets, in which so many participants earn low returns. Given the centrality of drug markets to crime in the United States and the extent to which criminologists have researched the consequences of drug use itself, it is striking that they have contributed so little to the study of the markets themselves.

The most obvious example of the intersection of markets and crime involves the study of the relationship between work on the one hand and crime and the criminal justice system on the other. The two main topics are the tradeoff between illegal work (crime) and legal work, and the impact of criminal history records on employment . Economists have a natural contribution to make in studies of this kind given their substantive expertise, and research in both areas contains a nice mix of research by both economists and non economists.[18] The contributions of both groups to the study of crime and the labor market is detailed in a good recent review article by, fittingly enough, a criminologist and an economist, Jeff Fagan and Richard Freeman (1999). Perhaps not surprisingly, this is the one area in crime research where economists and non economists seem the most aware of the other's work, with increasingly frequent cross citations. Indeed, recent research by criminologists, sociologists and economists often use many of the same techniques and datasets.[19]

V.A Drug Markets

A lesser studied area that has been dominated by economists is the study of illegal markets. In what follows we provide a review of the largest illegal market, that for drugs, which is particularly relevant for the study of crime.

[18] For example, consider two articles on the macro level relationship between the business cycle and crime on the US time series that we already have referred to in the introduction. One is a high profile article by sociologists Cantor and Land (1985) and the other a lesser known article by economists Cook and Zarkin (1985). The main difference between the two articles lies in how they measure the concept of an economic business cycle. Paternoster and Bushway (2001) assert that Cook and Zarkin's (1985) approach is more faithful to the long run description of change implied by the concept of a business cycle and argue that the large body of work inspired by Cantor and Land's article could have been profitably augmented by familiarity with the work of Cook and Zarkin.

[19] See, for example, a recent edited book on the labor market effects of incarceration by Bushway, Stoll and Weiman (2007). It has an interdisciplinary mix of authors but the techniques and datasets are very similar across disciplines. See also Western (2002), a paper by a sociologist using the NLSY79, a classic "economics" database to answer a question about employment and the criminal justice system..

The markets for illegal drugs constitute an important criminal phenomenon, particularly in the United States. Collectively they were estimated to generate $60 billion in retail sales in 2000 (and twice that in 1990) (ONDCP, 2001). They matter both because they generate large criminal earnings and harms as a consequence of their operation (e.g. diverting youth from education, creating disorder and crime around market places) and also because they provide dangerous substances whose use generates violent crime, at least when the drug is a stimulant. According to surveys of arrestees about half of all arrestees have recently used narcotics (National Institute of Justice, 2003). In other historical periods illegal gambling and bootlegging of prohibited alcohol have been large and troubling markets in the United States.

Moreover, governments make a large investment of both money and authority in suppressing drug markets. Drug control is probably a $40 billion annual effort in the United States (Walsh 2004). On any given day in 2005, approximately 500,000 persons were incarcerated in jails and prisons in the United States because of violations of drug prohibitions, mostly drug selling (Caulkins and Chandler 2006). Beyond being important in its own right, this effort competes with more traditional crime fighting efforts for criminal justice resources (Kuziemko and Levitt 2004, Rasmussen and Benson 1994).

The price and conditions under which drugs are sold have important criminal consequences. If heroin were to cost $1 a dose rather than $25, the consequences for society would be very different because there would be many more users and much less crime (MacCoun and Reuter (2001). Not only would the lower prices reduce the needs of dependent users to commit crimes to fund their purchases but it would also reduce the incentives of sellers to compete violently or to resolve conflicts about transactions through violence. The illegal price appears to be many times higher than the price in legal markets (Moore, 1990). This is not

simply a function of illegality; for example, illegal bookmakers charge roughly the same for their services as do their legal counterparts (Strumpf 2003). What factors explain the high prices of cocaine and heroin?

Similarly, it is important to understand the distribution of earnings in the drug trades: Drug markets would generate much smaller problems if the unskilled manager of a heroin distribution gang earned what the manager of a McDonalds earns. Instead, many senior drug dealers earn as much as a successful lawyer, without the necessity of law school; some, mostly in producer and transshipment countries, earn large fortunes. What might explain the very uneven distribution of earnings in the trade?

Finally, it is important to understand how drug markets respond to various kinds of interventions. For example, how will an increased risk of incarceration or more restrictive access to specific inputs (e.g., precursor chemicals for drugs such as methamphetamines) affect prices, the size of the market and the distribution of returns across groups of participants?

Criminologists have done little research on drug markets, though a great deal on related phenomena such as the role of drug use in crime both at the individual and population levels (see the review in MacCoun, Kilmer and Reuter, 2003).. There is a large ethnographic literature on drug markets (e.g. Bourgois 1996; Jacobs 1999, Hoffer 2006) but minimal theorizing about the determinants of prices or of the distribution of profits among the different participants. The ethnographic literature emphasizes the relationship between involvement in the illegal market (particularly selling drugs or prostitution) and other criminal activities. The more conceptually oriented studies (e.g. Haller 1990; Morselli 2005) focus on the nature of the enterprises that populate the markets and how they relate to organized crime. The criminological literature assessing the effects of enforcement, such as the "war on drugs"(e.g. Blumstein 1993, Tonry,

1995) may make references to prices but it offers no specific criminological theory on how enforcement affects the working of the market.

Yet market analysis is essential to understanding the effects of the tough enforcement that has characterized U.S. drug policy for so long. In considering the effects of longer sentences on other crimes, there is no mediating factor to complicate analysis of the effect of making the activity riskier. However the effects of increased incarceration of drug sellers and users is mediated through prices. If a small rise in prices induces many new individuals to enter the market as sellers, then toughness may have little effect.

Thus the territory is ceded to economists and their fellow travelers.[20]. Markets are the very heart of economics, both as a topic and a method; no social science diagram is better known than the classic demand and supply intersection, showing the determinants of price and quantity in a market. Intellectually, drug markets are of interest to economists because they operate not merely without the protections provided by the government but in the face of (more or less) active hostility from the government. The government aims to promote competition and to smooth market operation in legal markets, even while regulating against negative external consequences (e.g. through rules on emissions controls) and perhaps influencing the distribution of revenues within enterprises (e.g. through minimum wage laws). In contrast, the state aims to eliminate, or at least reduce the extent of, illegal markets. This can lead to perverse incentives for governments. For example, in legal markets there is a well established doctrine that monopoly control or any suppression of competition hurts society, so that the anti-trust division of the Department of Justice as well as the Federal Trade Commission, are empowered to detect and sanction any such anti-competitive efforts. However the state may actually find itself allied

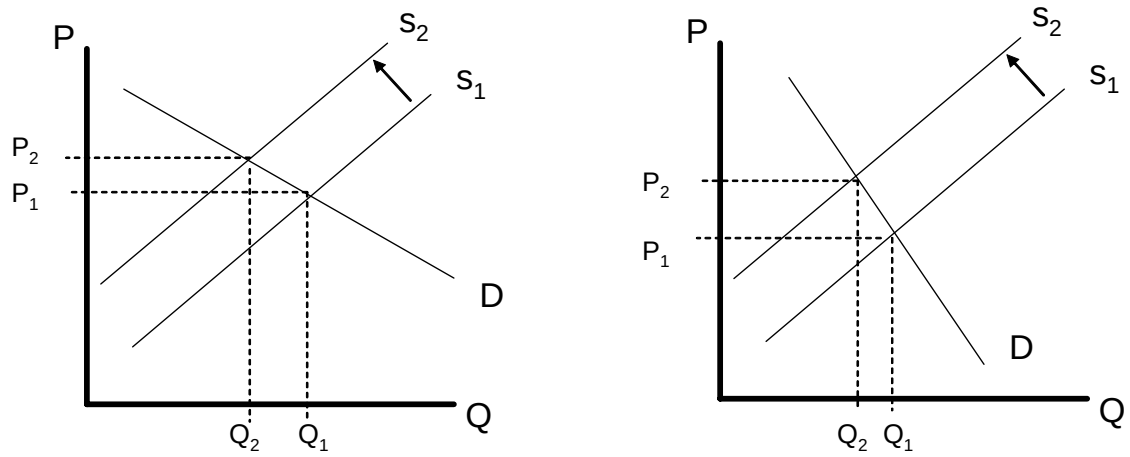
[20] Two frequently cited scholars in this section are Jonathan Caulkins and Mark Kleiman. Neither has an Economics degree; Caulkins' PhD is in Operations Research while Kleiman's is in Public Policy. Both make extensive use of economic reasoning and market models.

with cartel organizers in illegal markets, if that will result in higher prices and thus reduce the production of "bads" (Buchanan 1973; Schelling 1984). Illegal markets may enable economists to learn more about the influence of purely abstract forces of competition by contrasting legal and illegal markets for similar goods.

Demand and Supply

Application of the standard competitive model to markets for illegal drugs is now regularly featured in introductory economics texts (e.g., Frank and Bernanke 2004). The most basic concepts for economists are those of demand and supply. A demand curve maps the relationship between price and the quantity consumers are willing to purchase. The supply curve maps the relationship between price and the quantity that producers (distributors) are willing to produce (provide). The market clears at the price at which the quantity demanded by consumers equals the quantity that distributors are willing to supply. Any intervention will be thought of in terms of how it affects the supply curve or the demand curve and the resulting equilibrium price and quantity.

Figure 1
Illegal Drug Markets



Consider, for instance, the effect of a policy that restricts supply by incarcerating a higher fraction of drug dealers. The standard analysis is that, because drug sellers will now engage in the activity only in return for more money, the supply curve shifts up and to the left (i.e. at any given price less is supplied), increasing the market price and reducing the quantity of drugs sold in the market. See Figure 1, first graph. In the textbook analysis, the magnitude of the reduction in equilibrium quantity is shown to depend on the elasticity of demand, as is the effect on dealers' revenues. The second graph of Figure 1 shows the same change but with a much less elastic demand curve.

Economists have done extensive work on estimating the price elasticity of demand for various drugs, particularly cocaine and marijuana, including the cross-elasticity between illegal

drugs and cigarettes or alcohol (e.g., Cameron and Williams 2001).[21] The topic is of interest because it bears on the importance of shifting the supply curve through enforcement or legal changes and thus determining the change in prevalence and intensity of drug use. If the demand is completely inelastic (i.e. the quantity sought by customers is fixed and unaffected by price) then shifting the supply curve will simply raise the price of the drug and total expenditures. If it is very elastic (i.e even a small increase in price will have large effects on consumption), then enforcement that raises prices a small amount may have large effects on the total consumed.

Estimating the price elasticity of demand for drugs has been facilitated by the availability of prevalence data from population surveys (such as Monitoring the Future and the National Survey on Drug Use and Health) and price data from DEA (STRIDE[22]), permitting the use of sophisticated econometric techniques. Becker's work on rational addiction theory has been a major influence here (Becker and Murphy 1988).

Manski, Pepper and Petrie (2001), in a major National Research Concil Report on drug policy research, report an uncomfortably wide range of estimates of price elasticities. For example, estimates for the price elasticity of the demand for cocaine vary between -0.6 and -2.5. To suggest how much this affects policy analysis consider the effect of a policy that raises the price of cocaine by 25 percent; if the elasticity is -0.6, then consumption will fall by 15%, where as it will fall by over 60% if the elasticity is -2.5.

Manski, Pepper, and Petrie. note that among the many factors leading to differences across estimates, one major problem is that price is so heterogeneous. The models assume that

[21] The price elasticity of demand is the percentage reduction in demand caused by a one percent increase in price; except under exceptional conditions it is negative. There is a similar price elasticity of supply, usually positive. The cross elasticity of marijuana and alcohol is the percentage change in the demand for marijuana caused by a one percent increase in the price of alcohol; the cross elasticity will be positive if the marijuana and alcohol are substitutes and negative if they are complements. Demand is labeled "inelastic" if the absolute value of the elasticity is smaller than one, since it means that a rise in price will lead to a rise in total revenues.

[22] STRIDE is the System to Retrieve Information from Drug Evidence. It consists of price and purity data from all undercover purchases processed in DEA labs and purity for all seizures processed in those labs.

there is a price index which captures variation faced by consumers over time and/or space. The price of milk might differ across communities within a metropolitan area (assuming that is the unit of geographic analysis) but it is meaningful to report the average price for each metropolitan area in a national sample and use that to estimate how much consumption varies as a function of price. . For illegal drugs, it is known that there is substantial variation within and across metropolitan areas (ONDCP 2004) but there are no data on the share of transactions that take place at each price. The simple arithmetic average that is used for construction of prices is merely an uninformed guess as to how the large variation in prices should be averaged. The estimates thus have a very noisy independent variable.[23]

The standard economic model also predicts, slightly less intuitively, that the arrest of users (for example through 'sell and bust' operations) will shift the demand curve downwards (less is demanded at any given price). That is because the risk of arrest and accompanying sanctions is part of the cost of drugs. These interventions will reduce the market price but also the total quantity sold. This will therefore decrease total revenue to the drug sellers, and make it less attractive to sellers. In contrast, shifting the supply curve upwards will in crease the price and, in case of price elasticity less than one in absolute value, increase the total amount of revenue for the sellers. .

Thirty years ago Mark Moore (1973) suggested that a useful way of augmenting the conventional economists' framework was to think of the "effective price" of a drug as being the sum of the money price and the other costs that the buyer incurs, including the inconvenience of finding a seller when the state prevents open advertising and the risks incurred of being sanctioned by the criminal justice system. This insight has considerable potential. For example,

[23] More sophisticated price series have been developed which take account of purity variation unknown to the buyer, the "expected purity" model first developed by Caulkins (1994). However, the adjusted observations are still simply averaged to form the index for the specific city/year.

Moore's model suggests that enforcement against buyers may reduce demand among highly educated groups more than among the less educated because the stigma and potential earnings losses associated with arrest may be higher. Eatherly (1974) provided an early analysis; three studies have incorporated crude measures of user legal risk into demand equation. Only Caulkins has provided a recent quantitative analysis of the effects of search time, suggesting that current levels constitute a fairly minor component of total purchase cost.

Economists have done almost no research on the supply side.[24] There are, for example, no estimates of the price elasticity of supply of cocaine. Instead, economists assume that the supply curve is flat, i.e. that consumers can purchase any quantity they wish at the prevailing price, established by the level of enforcement. For example, Becker, Murphy, and Grossman (2006) explicitly assume that the market for drugs is competitive and subject to constant returns to scale, so that any amount of drugs can be supplied at the minimum production cost, which is determined *inter alia* by the monetary equivalent of criminal justice penalties and seizures of drugs and assets.

Price Determination

The analysis above deals with the effect of marginal changes but not the most basic determinants of equilibrium. Why are cocaine and even marijuana so expensive? These are plant products subject to very modest processing, yet cocaine costs ten times more than gold.

[24] Miron (1999, 2003) is one of the few economists to study the supply side of illegal drug markets. He has attacked the claim that illegality raises price much above the level that would prevail in a legal market. He argues that the ratio of retail price of cocaine to the farm-gate price is not much higher than for other semi-processed goods such as coffee. Thus the price of cocaine would not fall much if it were legally available. Miron's analysis is problematic. For example, he assumes that illegality does not elevate the raw materials price or the importation costs. Opium farmers in Colombia and Mexico face risks from the government in the form of eradication. They are, in fact, much higher cost producers than farmers in either Afghanistan or Burma for precisely that reason, since governments in those countries do not pose significant threats to their opium growers. Yet the U.S. imports of its heroin from these high cost countries because, as a result of dense traffic and commerce generally, Colombia and Mexico are relatively safe from interdiction and thus serve as low cost transportation sources for the United States. That is to say, the mark-up between export and import prices from the Latin American sources is only about 1500 percent, as compared to 2500 percent from Asia. This compares with import-export price differentials typically of approximately 12% in the market for legal goods (Reuter and Greenfield 2001)

Reuter and Kleiman (1986) offered an account of the interaction between enforcement and price in drug markets that attempts to explain this. Material, transportation, and packaging/promotion costs are negligible for illicit drugs such as cocaine and heroin; the costs of producing and refining the drug constitute less than one percent of the final retail price. Other non-labor costs are similarly modest. For example, Caulkins et al. (1999) report that interviews with retail drug dealers show that they spent little money on packaging etc. The dominant cost of supply is labor and the price of labor is principally determined by risks faced by participants in the trade. Risks came from two sources. The government threatens to arrest and incarcerate dealers, as well as seize their assets and drugs. Other participants in the trade pose threat of stealing drugs and inflicting injury. To persuade individuals to incur these risks require compensation, just as risks in other lines of dangerous work (e.g. coal mining) also require compensation in the form of higher wages (Viscusi 1992). In this model it is the combination of illegality and tough enforcement that makes the drugs expensive. That drug dealing organizations do not have to pay taxes, meet regulatory requirements with respect to workplace safety, etc. turns out to have a much smaller cost-reducing impact.

This model of price formation has been used in numerous simulation studies (e.g. Reuter, Crawford, and Cave1988, Rydell and Everningham 1994) but has not been tested in any empirical studies. Reuter, MacCoun, and Murphy (1990) found that retail drug prices in Washington, DC in 1988 could be accounted for by risk compensation and labor time but the available measures are crude enough that this constitutes a weak test.[25]

[25] For example, Reuter, MacCoun, and Murphy. assumed that a value of a lost life for the affected population was $500,000. This number is an important component of the cost calculation since the estimated annual probability of being killed in the trade at that time in Washington was about one in 70. Though $500,000 is a plausible number, given the observable characteristics of arrested drug dealers and other studies of the value of a statistical life (e.g. Viscusi and Aldy 2003), it is highly speculative.

Drug markets have some distinctive features distinguishing them from both legal markets and other illegal markets that are important for policy purposes. For example, a substantial fraction of sellers are heavy consumers[26] and account for a large share of total consumption. Coffee retailers may like coffee a great deal more than the average purchaser but they do not consume a noticeable fraction of the total coffee sold. However those who sell heroin may be responsible for a third of total heroin consumed, since many sellers are opportunistic participants in that activity. Separating demand and supply effects becomes more complicated as a consequence. Treatment, a demand side intervention, may have large supply side effects because many of those in treatment are also sellers. Similarly, incarcerating drug sellers, the classic supply side intervention, has the effect of locking up a substantial share of demand.[27]

Earnings and Profits

Apart from Reuter, MacCoun, and Murphy. (1990) there is only one empirical study that has taken an economic approach to earnings in drug markets. Levitt and Venkatesh (2000) analyzed data from the accounts of a drug selling gang[28] to show that most of those selling crack in this mid-1990s Chicago gang were earning roughly the legal minimum wages.[29] Only the leaders made large incomes. The conceptual innovation of the study was to introduce the notion of drug dealing as a "tournament" (e.g. Lazear and Rosen 1981). Most participants in such an activity might have low earnings but each believes that he has an opportunity to win the "prize,"

[26] This reflects the fact that selling is a part-time and opportunistic activity.
[27] This has been modeled in Caulkins et al. (1997).
[28] Venkatesh, a sociologist with an ethnographic bent, was provided these accounts by subjects of his long-term study of life in Chicago housing projects.
[29] Some aspects of the Levitt and Venkatesh data set are anomalous when compared to other data on drug selling. For example they estimate a four year cumulative death risk for gang members of over 25%, far higher than found for example by Reuter, MacCoun and Murphy (1990) or are consistent with other measures of drug-related mortality and the scale of cocaine markets. Similarly the total sales volumes per participant are far lower than reported in a variety of other studies. We use the study for its analytic insights rather than specific quantitative findings.

namely the large incomes associated with one of the top positions in a hierarchy. The commitment of so many college students to the rigors of playing competitive football, given the low probability of a well paid professional career, may be partly explained that way. Levitt and Venkatesh hypothesize that it is the high earnings of a few leaders that induce many young males to continue to sell drugs even when their current returns are low.

They also assessed the strategies of the gang and its rivals in economic terms. For example, the value of expanding the geographic domain of the gang is increased by the limited mobility of its many customers without cars. They suggest that some sales during gang warfare periods were below the marginal cost of such sales but represented strategic decisions to building market share during a period of expansion in the demand for an addictive drug. They also suggested that the levels of violence may have been higher than optimal for the gang as a drug selling organization because members had an incentive to use violence to establish personal reputation for toughness and thus move up in the organization.

Economic analysis can also help with important claims about "monopoly control" in illegal markets. For example, it used to be asserted that the Medellin cartel had monopoly control in the U.S. cocaine market However, that claim could be challenged by simple analysis of the price of cocaine at different stages of the distribution system and consideration of the elasticity of demand. Monopoly power is defined by the ability to limit production, whether through a cartel arrangement, use of force, or other means. A monopolist will never choose to price so as to face inelastic demand i.e. where an increase of 1 percent in price will reduce consumption by less than 1 percent. In that circumstance, the monopolist can always increase his profit by reducing output and thus raising prices; that will raise total revenues and lower total

costs (since he produces less). Since the demand for cocaine was believed by all observers to be inelastic, monopoly was unlikely to characterize the market.[30]

Relevant here is a small literature by economists on organized crime. Schelling (1984) conceptualized the Mafia's role in illegal markets as that of a collector for centralized corrupt police agencies. Schelling offered the example of the Miami bookmaking market, at a time when neither state nor federal agencies were actively involved in gambling enforcement. The Miami Police Department (offered merely as an example, but one that had then been in the news for its corruption) maximized its own potential returns by maximizing the profits of the industry which it could tax. The Mafia was then the cartel organizer; it extorted money from operators on behalf of the police, while retaining money for itself for providing that service. Behind the Mafia's threat of force was the implicit power of the police to act against those who were not willing to collaborate with the collector.

As mentioned earlier, both Schelling (1984) and Buchanan (1973) suggested that the government has incentives to encourage monopolies in illegal markets, so as to reduce the production of undesired goods. However that is a very incomplete analysis of the consequences of criminal monopoly. Such monopoly provides the resources for criminals to challenge the power of the state, as revealed in the systemic and high level urban corruption long associated with the Mafia throughout much of the twentieth century. Similarly, if monopoly power increases the earnings of the most highly paid offenders, it may increase the incentive to enter these activities, as in the Levitt and Venkatesh (2000) model. Nonetheless, this market approach provides insights into the effects of policies such as the creation of overlapping police jurisdictions. If local police agencies no longer have the ability to fully protect illegal operators,

[30] More sophisticated models of price formation by monopoly suppliers under special circumstances can generate more complex findings. However, the special circumstances required for those models do not seem to apply to the wholesale cocaine market.

as the result of extending the jurisdiction of state and federal agencies, the local police cannot safely license privileged offender groups, since one way in which a drug dealer can get a reduction in the severe federal prison sentences is to provide information about corrupt police officers. This may be an important factor in explaining the relative lack of systemic corruption in contemporary U.S. drug markets.

The Path Forward

It is hard to imagine that the study of drug markets, and illegal markets generally without the inclusion of economists and economic insight. However it is also true that, as discussed above, there are unusual features to illegal markets that present major challenges to conventional market models; these include extreme price dispersion, the use of physical coercion, selection into the occupation by risk taking of a particular kind, ties to other kinds of crime) for which criminologists bring specific expertise. A recent collaboration among two economists, an ethnographer and a criminologist (Cook et al. 2005) examining the market for illicit guns in Chicago is indicative of the path forward. Cook et al. show that the very thin nature of the market (in which transactions occur at a rate two or three orders of magnitude less frequently than in drug markets) makes it very inefficient. Information is scarce and transaction costs are high. The result is that guns are expensive and time consuming to acquire for many prohibited purchasers such as gang members. The concepts of market analysis have been combined well with the understanding of criminality of a criminologist and the data collection skills of an ethnographer.

VI. Conclusion

In this article, we have borrowed a conceptual framework from economist Ronald Coase's discourse on the nature of invasions by economics into contiguous social sciences.

These invasions have been motivated in part by a redefinition of economics as the study of human choice under scarcity, a definition that opens a wide array of social phenomena to study by economists. Coase was more pessimistic about the staying power of these invasions than were most economists at the time the article was written. He based his skepticism on a tripartite view of the contributions that economics brings to the study of new subjects: approach/theory, techniques and substantive expertise. He predicted that true subfields, such as the economics of crime or law and economics , would only sustain themselves to the extent to which they intersected in meaningful ways with the study of the economic system, the main area of economic expertise.

Nearly 30 years after Coase wrote, he appears remarkably prophetic. Consider the field of law and economics, which focuses mostly on civil and regulatory law. These laws regulate the economic system, and the laws are mediated through financial means (fines and lawsuits), as in markets. Because of this obvious intersection with the economic system, the field of law and economics has grown into a mature discipline. It has its own journals and professional association and there are numerous faculty positions for economists in major law schools; for example, there are eight Ph.D. trained economists on the faculty of Boalt Hall Law School at Berkeley. There is even a newly created Ph.D. program in law and economics at Vanderbilt University.

In contrast, the field of economics and crime is barely recognizable as a subfield.[31] There is no annual conference on economics and crime for economists, and most economists who study crime as their main pursuit do so in public policy schools, usually as the sole scholar interested in the topic. Many economists who have studied crime tend to exploit a particular technique such

[31] Only in 2007 did the National Bureau of Economic Research (NBER), a central institution in the development of economics for the last quarter century, held its first one day Work Group on the Economics of Crime. Official recognition by NBER is important for the viability of a subfield, particularly for young economists.

as instrumental variables models or illustrate a particular insight from public finance, and then move onto other more mainstream topics in economics. Those mainstream economists who have studied crime over a long period, like Richard Freeman, Jeff Grogger and Harry Holzer have been involved with the study of the labor market and crime, a natural point of intersection between the two fields. Another group, led by Gary Becker, Steven Levitt and their students focuses on deterrence as an outgrowth of price theory, but there are still few examples of economists in mainstream economics departments with a primary interest in the study of deterrence. The growing interest in reentry and the impact of mass incarceration on other domains of life, such as education and employment, forms a potential new point of overlap which could sustain a field of crime and economics. And there are institutional movements, perhaps spurred on by the prominence of the work of Steven Levitt, which could lead to the final emergence of a crime and economics as a subfield.

The existence or absence of a subfield of crime and economics is perhaps of only marginal importance for criminologists. To the extent to which the question is interesting, we can apply Coase's argument in the opposite direction equally well. Suppose one examines economics of crime as an independent subfield of economics. According to Coase, criminology can contribute to this field to the extent to which the techniques, approaches, and subject matter expertise are relevant to this new field. Techniques, such as measuring self reported crime, or approaches that focus on the lifecourse and social context can be adopted and adapted by economists willing to take the time to learn these techniques and approaches from criminologists. But, criminology can and should make a large impact on this new field of economics of crime simply because of its subject matter expertise falls squarely within the confines of this new field. The field of economics of crime will do little more than reinvent the wheel if it does not

explicitly recognize and exploit the subject matter expertise of criminology and criminologists. Economists intent on establishing the study of economics of crime as a separate sub-field of economics would do well to concentrate on both understanding and explaining why their work improves and builds on what is known in criminology.

One potential model of this evolution would be that economists could develop a relationship to criminology very similar to that of sociologists who study crime. Such sociologists often work in sociology departments and maintain their professional identity as sociologists, with the American Sociological Association as their principal affiliation. Yet, while their work appears in sociology journals, they also publish regularly in mainstream criminology journals, and they regularly attend and are recognized at the American Society of Criminology meetings. Regardless of where they appear, the articles by sociologists are cited in the mainstream criminology literature. While there are some obvious language and professional barriers for economists, we see no reason why economists who study crime while working outside of criminology departments cannot become an integral part of the interdisciplinary field of criminology.

Of course, whether this outcome is desirable to criminologists depends in part on what almost 40 years of research by economists on crime have to offer criminology. We have not attempted to provide a comprehensive survey of all the crime related topics that economists have tackled. Long termed the "dismal science," economics has become quite playful. Economics journals are full of articles (many by Steve Levitt and a growing cast of collaborators) which are justified by their clever ways of finding insights into human behavior rather than advancing understanding of economic phenomena. For example, Duggan and Levitt (2002) analyzed cheating by sumo wrestlers, showing that one could use data on patterns of past results to predict

when one participant was likely to have incentives to throw the contest to his rival. Donohue and Levitt (1998) developed an interesting theoretical model of the circumstances under which the availability of guns would decrease the use of criminal violence, focusing on the increased uncertainty about the outcome of conflict that they induce. Edward Glaeser, an urban economist, has produced an array of interesting models to explain, for example, the concentration of crime within cities (Glaeser, Sacerdotes, and Scheinkman 1996, Glaeser and Sacerdote 1999). The study of corruption has produced a large and rich literature, particularly in the context of its effects on economic development (Rose-Ackerman 1999). Crime of all sorts is an attractive topic for such insightful exercises and economics journals now bristle with articles potentially of some interest to criminologists. We think criminologists who work at the intersection of crime, the criminal justice system, and the economic system are already fairly aware of and make use of the work of economists. Another very productive example of this type of work exists in the work of rational choice theorists in criminology, particularly those who have been studying perceptual deterrence. These scholars have done an excellent job of building on and developing economic insight in a particularly criminological way. We find the similarity of the recent articles by Matsueda, Kreager, and Huizinga (2006) and Lochner (2007) to be a testimony of the ability of criminologists and sociologists to learn from and then build on the work of economists. Matsueda, Kreager, and Huizinga's article is unique in that they also looked at the impact of perceptions of punishment and perceptions of other potential rewards (and costs) of crime besides arrest and incarceration. Thus they take the rational choice model out of a narrow focus on deterrence and make an argument for rational choice as viable theoretical framework for the study of crime more broadly. This type of extension can be done best by criminologists who are familiar with the larger theoretical landscape about the sources of crime.

A related area that might benefit from some more cross fertilization between economists and criminologists involves the growing area of studies that looks at the interaction between dynamic factors and self control or impulsivity. Ousey and Wilcox (2007) review this literature (see also Hay and Forrest 2006), and suggest that there is some theoretical and empirical confusion in the development of the literature. They list a number of theoretical models that predict an interaction between dynamic variables like employment and marriage and time stable propensity to offend. They include the criminology version of rational choice model, via Nagin and Paternoster (1994). But they suggest that individual preferences should moderate the impact of social bonds, rather than interact with time varying characteristics. The economic model though is very clear that the preference function will condition the impact of the time varying covariates that affect the decision to commit crime. If a person heavily discounts the future, large increases in the severity of future punishment will have a minimal change on the costs of crime, and therefore will not affect the decision to commit crime. This point is made formally and empirically in a recent working paper by economists Lee and McCrary (2006) on the effect of punishment on adolescent offending. Lee and McCrary have not distinguished between impulsivity and time discounting, but both groups are arriving at the same basic conclusion, at about the same time. We predict that progress in this topic will be both faster and more productive if useful insights and techniques from economics are at least considered in the discussion.

Other areas in criminology that might profit from a great willingness to engage with the work of economists include the study of illegal markets, especially drug markets. Courses in criminology programs on the Drugs and Crime or illegal markets that do not at least discuss the economic study of markets are hard to justify. And while we understand why Gary Becker's

work is not standard reading in criminology, we have a harder time understand the lack of familiarity of criminology students with the work of economists like Phil Cook, who has written several accessible articles in criminology outlets integrating economic and criminological thought.

Perhaps the most promising area for interaction with economists involves application of formal economic theory to the study of the criminal justice system, attempted by Landes (1971) and more recently by Knowles, Persico, and Todd (2001). On the one hand, criminal justice theory is much less developed than criminological theory. On the other hand, the actors in the criminal justice system seem to better targets for the formal, but rather simple, models of economics. Predictions from the simple models can be compared with reality, and then developed into richer models that can be used to both predict and explain behavior in the criminal justice system.

One final observation: Economics does not appear posed to take over criminology any time soon. But, economics is a large and rich field, and some of its approaches and techniques could profitably used by criminologists to better understand the study of crime. We have attempted to identify some of the most appropriate techniques and approaches, and we have also tried to identify important areas of criminological work that might benefit from more formal engagement with economics and economists. We therefore predict that in twenty years economics and economists will be much more important to the study of crime than they are currently.

References

Aos, Steven, Marna Miller, and Elizabeth Drake. 2006. *Evidence-Based Public Policy Options to Reduce Future Prison Construction, Criminal Justice Costs, and Crime Rates.* Olympia, WA.: Washington State Institute for Public Policy.

Aos, Steve, Polly Phipps, Robert Barnoski, and Roxanne Lieb. 2001. *The Comparative Costs and Benefits of Programs to Reduce Crime Version 4.0.* Olympia, WA: Washington State Institute for Public Policy.

Angrist, Joshua, and Alan Krueger. 2001. "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives* 15:1:69-85.

Angrist, Joshua. 2006. "Instrumental Variables Methods in Experimental Criminological Research: What, Why and How." *Journal of Experimental Criminology* 2:1:23-44.

Anwar, Shamena and Hanming Fang. 2006. "An Alternative Test of Racial Profiling in Motor Vehicle Searches: Theory and Evidence." *American Economic Review* 96:1:127-151.

Arrow, Kenneth, Robert Solow, Paul Portney, Edward Leamer, Roy Radner, and Howard Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation" *Federal Register* 56:.4601-4614.

Ayres, Ian. 2001. *Pervasive Prejudice?: Non-Traditional Evidence of Race and Gender Discrimination*. Chicago, IL.: University of Chicago Press.

Ayres, Ian, and Steven Levitt. 1998. "Measuring Positive Externalities from Unobservable Victim Precaution: An Empirical Analysis of Lojack." *Quarterly Journal of Economics* 113:1: 43-77.

Ayres, Ian, and Joel Waldfogel. 1994. "A Market Test for Race Discrimination in Bail Setting." *Stanford Law Review* 46:5: 987-1047.

Becker, Gary. 1993. "Nobel Lecture: The Economic Way of Looking at Behavior." *The Journal of Political Economy* 101:3:385-409.

Becker, Gary. 2000. *A Treatise on the Family*. Cambridge, MA: Harvard University Press (expanded edition).

Becker, Gary. 1968. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76:2: 169-217.

Becker, Gary. 1957. *The Economics of Discrimination.* Chicago, IL: University of Chicago Press.

Becker Gary and Kevin Murphy. 1988. “A Theory of Rational Addiction.” *Journal of Political Economy* 96:675-700.

Becker, Gary, Kevin Murphy, and Michael Grossman. 2006. “The Market for Illegal Goods: The Case of Drugs.” *Journal of Political Economy* 114: 1: 38-60.

Berk, Richard. 1983. “An Introduction to Sample Selection Bias in Sociological Data.” *American Sociological Review* 48:386-398.

Bhati, Avinash. Forthcoming. “Estimating the Number of Crimes Averted by Incapacitation: An Information Theoretic Approach.” *Journal of Quantitative Criminology*.

Bjerk, David. 2005. “Making the Crime Fit the Penalty: The Role of Prosecutorial Discretion Under Mandatory Minimum Sentencing.” *Journal of Law and Economics* 48:2: 591-627.

Bjerk, David. 2007. “Racial Profiling, Statistical Discrimination, and the Effect of a Colorblind Policy on the Crime Rate.” *Journal of Public Economic Theory* 9:3: 543-567.

Bjerk, David. Forthcoming a. “Guilt Shall Not Escape or Innocence Suffer: The Limits of Plea Bargaining When Defendant Guilt is Uncertain.” *American Law and Economics Review*.

Bjerk, David. Forthcoming b. “On the Role of Plea Bargaining and the Distribution of Sentences in the Absence of Judicial System Frictions.” *International Review of Law and Economics*.

Blumstein, Alfred. 1993. "Racial Disproportionality of U.S. Prisons Populations Revisited." *University of Colorado Law Review 64:* 743-760.

Bourgois, Phillippe. 1996. *In Search of Respect: Selling Crack in El Barrio.* NY, NY:Cambridge University Press.

Bowles, Roger and Rimawan Pradiptyo. 2004. *Reducing Burglary Initiative: An Analysis of Costs, Benefits and Cost Effectiveness.* Home Office Research Study. London:H.M. Stationery Office..

Brame, Robert Shawn Bushway, and Raymond Paternoster. 1999. “On the Use of Panel Research Designs and Random Effects Models to Investigate Static and Dynamic Theories of Criminal Offending.” *Criminology* 37:599-641.

Britt, Chester. 1997. “Reconsidering the Unemployment and Crime Relationship: Variations by Age Group and Historical Period. *Journal of Quantitative Criminology*. 13:405–417.

Buchanan, James. 1973. “A Defense of Organized Crime?” In *The Economics of Crime and Punishment,* edited by Simon Rottenberg. Washington; American Enterprise Institute.

Bushway, Shawn, Brian Johnson, and Lee Ann Slocum. 2007. "Is the Magic Still There? The Relevance of the Heckman Two-Step Correction for Selection Bias in Criminology." *Journal of Quantitative Criminology*. 23:151-178.

Bushway, Shawn, Robert Brame, and Raymond Paternoster. 1999. "Assessing Stability and Change in Criminal Offending: A Comparison of Random Effects, Semi-parametric, and Fixed Effect Modeling Strategies." *Journal of Quantitative Criminology* 15:23-61.

Bushway, Shawn, and Jonah Gelbach. 2006. "Are Bail Amounts Racially Discriminatory? Evidence Using Outcome Analysis." University of Maryland Working Paper.

Bushway, Shawn, Michael Stoll, and David Weiman, eds. 2007. *Barriers to Reentry?: The Labor Market for Released Prisoners in Post-Industrial America*. NY:Russell Sage Foundation.

Cameron, Lisa, and Jenny Williams. 2001. "Cannabis, Alcohol and Cigarettes: Substitutes or Complements?" *Economic Record* 77:236:19-34.

Cantor, David, and Kenneth Land. 1985. "Unemployment and Crime Rates in the Post-World War II United States: A Theoretical and Empirical Analysis.**"***American Sociological Review* 50:317-332.

Cauffman, Elizabeth, and Laurence Steinberg. 2000. "Researching Adolescents' Judgement and Culpability." In *Youth on Trial: A Developmental Perspective on Juvenile Justice*, edited by. Thomas Grisso, and Robert G. Schwartz. Chicago, IL: University of Chicago Press.

Caulkins, Jonathan P. 1994. *Developing Price Series for Cocaine* MR-317-DPRC, Santa Monica, CA: RAND.

Caulkins, Jonathan P., C. Peter Rydell, William Schwabe, and James Chiesa. 1997. *Mandatory Minimum Drug Sentences: Throwing Away the Key or the Taxpayers' Money?* MR-827-DPRC, Santa Monica, CA: RAND.

Caulkins, Jonathan, Bruce Johnson, Angela Taylor, and Lowell Taylor. 1999. "What Drug Dealers Tell Us About Their Costs of Doing Business." *Journal of Drug Issues* 29:2:323-340.

Caulkins, Jonathan P. and Sara Chandler. 2006. "Long-Run Trends in Incarceration of Drug Offenders in the US." *Crime and Delinquency* 52:4:619-641.

Caulkins, Jonathan and Peter Reuter. 1998.. "What Price Data Tell Us About Drug Markets," *Journal of Drug Issues,* 28:3:593-612.

Cavanagh, David, and Mark Kleiman.1990. *Cost Benefit Analysis of Prison Cell Construction and Alternative Sanctions*. NCJ 204751. Washington, DC: U.S. Government Printing Office.

Clarke, Ronald. 1983. “Situational Crime Prevention: Its Theoretical Basis and Practical Scope.” In Vol. 4 of *Crime and Justice: A Review of Research*, edited by Michael Tonry and Norval Morris. Chicago: University of Chicago Press.

Clarke, Ronald, and Marcus Felson. 1993. "Introduction: Criminology, Routine Activity and Rational Choice." In *Routine Activity and Rational Choice, Advances in Criminological Theory (Vol.5),* edited by Ronald V. Clarke and Marcus Felson. New Brunswick, NJ: Transaction Press.

Clarke, Ronald, and Derek Cornish. 1985. “Modeling Offenders' Decisions: A Framework for Research and Policy.” In Vol 6 *Crime and Justice* edited by Michael Tonry and Norval Morris.Chicago: University of Chicago Press.

Cloward, Richard, and Ohlin, Lloyd. 1960. *Delinquency and Opportunity*. NY: Free Press.

Coase, Ronald 1960. “The Problem of Social Cost.” *Journal of Law and Economics* 3:1–44.

Coase, Ronald. 1978. “Economics and Contiguous Disciplines.” *Journal of Legal Studies* 7:201-211.

Cohen, Mark. 2005. *The Costs of Crime and Justice*. New York, NY: Routledge.

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

Cook, Philip 1986. “The Demand and Supply of Criminal Opportunities” In Vol. 7 *Crime and Justice: A Review of Research*, edited by Norval Morris and Michael Tonry. Chicago:University of Chicago.

Cook, Philip, and Jens Ludwig. 2000. *Gun Violence: The Real Costs*. NY: Oxford University

Cook, Philip, and Gary Zarkin. 1985. “Crime and the Business Cycle.” *The Journal of Legal Studies* 14:115-128.

Cook, Philip, Jens Ludwig, Sudhir Venkatesh, and Anthony Braga. 2005. “Underground Gun Markets.” NBER Working Paper 11737.

Cullen, Julie, and Steven Levitt. 1999. “Crime, Urban Flight, and the Consequences for Cities." *Review of Economics and Statistics* 81:2:159-69.

Debreu, Gerard. 1959. *Theory of Value: An Axiomatic Analysis of Economic Equilibrium.* New Haven and London: Yale University Press.

Demuth, Stephen. 2003. “Racial and Ethnic Differences in Pretrial Release Decisions and Outcomes: A Comparison of Hispanic, Black, and White Felony Arrestees.” *Criminology* 41:873-908.

Dharmapala, Dhammika, and Stephen Ross, 2004. "Racial Bias in Motor Vehicle Searches: Additional Theory and Evidence." *Contributions to Economic Analysis & Policy*. Berkeley Electronic Press 3:1:Article 12.

Donohue, John, and Justin Wolfers. 2005. "Uses and Abuses of Statistical Evidence in the Death Penalty Debate." *Stanford Law Review 58*: 791-846.

Donohue, John, and Steven Levitt. 2001. "The Impact of Legalized Abortion on Crime." *Quarterly Journal of Economics* 116:2:379-420.

Donohue, John, and Steve Levitt. 1998. "Guns, Violence and the Efficiency of Illegal Markets." *American Economic Review*. 88:2:463-67.

Donohue, John, and Peter Siegelman. 1998. "Allocating Resources Among Prisons and Social Programs In the Battle Against Crime." *Journal of Legal Studies* 27:1:1-43.

Doob, Anthony, and Cheryl Webster. 2003. "Sentence Severity and Crime: Accepting the Null Hypothesis." In Vol. 30. *Crime and Justice: A Review of Research,* edited by Michael Tonry. Chicago: University of Chicago Press.

Duffee, David, and Edward Allan. 2007. "Criminal Justice, Criminology, and Criminal Justice Theory." In *Criminal Justice Theory: Explaining the Nature and Behavior of Criminal Justice*, edited by David Duffee and Edward Maquire. NY: Routledge.

Dugan, Laura.1999. "The Effect of Criminal Victimization on a Household's Moving Decision." *Criminology* 37:4: 901-929.

Duggan, Mark, and Steven Levitt. 2002. "Winning Isn't Everything: Corruption in Sumo Wrestling." *American Economic Review 92*:5:1594-1605.

Eatherly, Billy. 1974. "Drug Law Enforcement: Should We Arrest Pushers or Users?" *Journal of Political Economy* 28:210-214.

Ehrlich, Isaac. 1975. "The Deterrent Effect of Capital Punishment: A Question of Life and Death." *American Economic Review* 65:397-417.

Engel, Robin. Forthcoming. **"**A Critique of the Outcome Test in Racial Profiling Research." *Justice Quarterly.*

Evans, William, and Emily Owens. 2007. "COPS and Crime." *Journal of Public Economics* 91:Issue 1-2: 181-201.

Fagan, Jeffrey, and Richard Freeman.1999. **"**Crime and Work" In Vol. 25 *Crime and Justice: A Review of Research,* edited by Michael Tonry.. Chicago:University of Chicago Press.

Farrell, Ronald, and Victoria Swigert. 1978. “Prior Offense Record as a Self-fulfilling Prophecy.” *Law and Society Review 12*:3:437-453.

Forst, Brian, and Kathleen Brosi. 1977. “A Theoretical and Empirical Analysis of the Prosecutor.” *The Journal of Legal Studies* 6:1:177-191.

Frank, Robert, and Ben Bernanke (2004). *Principles of Microeconomics*, 2nd edition. New York: McGraw-Hill.

Friedman, Milton.1953. “The Methodology of Positive Economics.” In *Essays in Positive Economics*, edited by Milton Friedman. Chicago: University of Chicago Press.

Garber, Steven, Steven Klepper, and Daniel Nagin. 1983. "The Role of Extralegal Factors in Determining Criminal Case Disposition." In Vol. II *Research on Sentencing: The Search for Reform*, edited by Alfred Blumstein. Washington, DC : National Academy Press.

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

Gibbs, Jack. 1972. *Sociological Theory Construction*. Hinsdale, IL:Dryden Press.

Glaeser, Edward, Daniel Kessler, and Anne Piehl. 2000. “What Do Prosecutors Maximize? An Analysis of the Federalization of Drug Crimes.” *American Law and Economics Review* 2:2:259-290.

Glaeser, Edward, Bruce Sacerdote, and Jose Scheinkman. 1996. "Crime and Social Interactions." *The Quarterly Journal of Economics* 111:2: 507-548,

Glaeser, Edward, and Bruce Sacerdote. 1999. "Why Is There More Crime in Cities?" *Journal of Political Economy* 107:S6: S225-29.

Greenbaum, Robert, and George Tita. 2004. “The Impact of Violence Surges on Neighborhood Business Activity.” *Urban Studies* 41:13: 2495-2514.

Greenberg, David. 2001. “Time Series Analyses of Crime Rates.” *Journal of Quantitative Criminology* 17: 291–327.

Greenwood, Peter, C. Peter Rydell, Allan Abrahamse, Jonathan Caulkins, James Chiesa, Karyn Model, and Stephen Klein. 1994. *Three Strikes and You’re out: Estimated Benefits and Costs of California’s New Mandatory-sentencing Law.* Santa Monica, CA; RAND.

Hagan, John. 1989. “Why is There So Little Criminal Justice Theory? Neglected Macro- and Micro-Level Links Between Organization and Power.” *Journal of Research in Crime and Delinquency* 26:2:116-135.

Halaby, Charles. 2004. “Panel Models in Sociological Research: Theory into Practice." *Annual Review of Sociology* 30: 507-544.

Haller, Mark. 1990. “Illegal Enterprise: A Theoretical and Historical Interpretation.” *Criminology* 28**:** 207-235.

Harcourt, Bernard. 2004. "Rethinking Racial Profiling: A Critique of the Economics, Civil Liberties, and Constitutional Literature, and of Criminal Profiling More Generally." *The University of Chicago Law Review* 71:1275-1381.

Harcourt, Bernard. 2007. *Against Prediction: Profiling, Policing, and Punishing in an Actuarial Age*. Chicago, IL:University of Chicago Press.

Hart, Michelle. 2006. *Race, Sentencing, and the Pretrial Process.* University of Maryland Master’s Thesis.

Hay, Carter, and Walter Forrest. 2006. “Self-Control and Social Context: Toward a More Conditional View of the Relationship between Self-Control and Crime.” Presented at the 2006 meetings of the American Society of Criminology.

Heaton, Paul. 2007. “Understanding the Effects of Anti-Profiling Policies.” University of Chicago Working Paper.

Helland, Eric, and Alex Tabarrok. 2007. “Does Three Strikes Deter: A Non-Parametric Investigation.” *Journal of Human Resources* 42:2:309-330.

Hirschi, Travis. 1986. "On the Compatibility of Rational Choice and Social Control Theories of Crime." In *The Reasoning Criminal: Rational Choice Perspectives on Offending*, edited by Derek Cornish, and Ronald Clarke. NY:Springer-Verlag.

Hoffer, Lee. 2006. *Junkie Business: The Evolution and Operation of a Heroin Dealing Network* Belmont CA:Wadsworth Press.

Jacobs, Bruce. 1999. *Dealing Crack: The Social World of Street Corner Selling*. Boston: Northeastern University Press.

Jacob, Brian, and Lefgren, Lars. 2003. “Are Idle Hands the Devil’s Workshop? Incapacitation, Concentration and Juvenile Crime.” *American Economic Review*. 93:5:1560-1577.

Johnson, Brian. 2006. “The Multilevel Context of Criminal Sentencing: Integrating Judge and County Level Influences in the Study of Courtroom Decision Making.” *Criminology* 44:2: 259-298.

Kagel, John, Raymond Battalio, Howard Rachlin, and Leonard Green. 1981. “Demand Curves for Animal Consumers.” *Quarterly Journal of Economics* 96:1-15.

Kessler, Daniel and Steven Levitt. 1999. “Using Sentence Enhancements to Distinguish Between Deterrence and Incapacitation." *Journal of Law and Economics*. 42: 343-63.

Klepper, Steven and Nagin, Daniel and Tierney, Luke-John.(1983) “Discrimination in the Criminal Justice System: A Critical Appraisal of the Literature.” In Vol. 2 *Research on Sentencing: The Search for Reform*. Edited by Alfred Blumstein. Washington, DC : National Academy Press.

Kling, Jeffrey. 2006. “Incarceration Length, Employment, and Earnings.” *American Economic Review* 93:863-876.

Knowles, John, Nicola Persico, and Petra Todd. 2001. “Racial Bias in Motor-Vehicle Searches: Theory and Evidence." *Journal of Political Economy* 109:1:203-29.

Kuziemko, Ilyana. 2007. “Going off Parole: How the Elimination of Discretionary Prison Release Affects the Social Cost of Crime.” Harvard University Working Paper.

Kuziemko, Ilyana, and Steven Levitt. 2004. “An Empirical Analysis of Imprisoning Drug Offenders.” *Journal of Public Economics* 88:Issue 9-10:2043-2066.

Landes, William. 1971. "An Economic Analysis of the Courts." *Journal of Labor Economics* 14:1: 61-107.

Landes, William. 1973. “The Bail System: An Economic Approach.” *Journal of Legal Studies* 2: 79-105.

Landes, William. 1974. **“**Legality and Reality: Some Evidence on Criminal Procedure.**”** *The Journal of Legal Studies* 3: 287-337.

Laub, John, and Robert Sampson. 2003. *Shared Beginnings, Divergent Lives: Delinquent Boys to age 70*. Cambridge: Harvard University Press.

Lazear, Edward, and Sherwin Rosen. 1981. ‘‘Rank Order Tournaments as Optimum Labor Contracts.“ *Journal of Political Economy 79:* 841–864.

Lee, David, and Justin McCrary. 2006. “Crime, Punishment and Myopia.” NBER Working Paper No. 11491.

Levitt, Steven, and Stephen Dubner. 2005. *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything*. NY:William Morrow and Co.

Levitt, Steven. 1998. “Juvenile Crime and Punishment." *Journal of Political Economy* 106:1156-1185.

Levitt, Steven. 1996. "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation." *Quarterly Journal of Economics* 111:2: 319-51.

Levitt, Steven, and Thomas Miles. 2007. "Empirical Study of Criminal Punishment" in *The Handbook of Law and Economics*, edited by A. Mitchell Polinsky, and Steven Shavell.

Levitt, Steve, and Venkatesh Sudhir. 2000. "An Economic Analysis of a Drug-Selling Gang's Finances." *Quarterly Journal of Economics* 115:3:755-789.

Linden, Leigh, and Jonah Rockoff. 2006. "There Goes the Neighborhood? Estimates of Crime Risk on Property Values From Megan's Law." NBER Working Paper No. 12253.

Lochner, Lance. 2007. "Individual Perceptions of the Criminal Justice System." *American Economic Review* 97:1:444-460.

Lochner, Lance, and Enrico Moretti. 2004. "The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports." *American Economic Review* 94:1:155-189.

Loeffler, Charles. 2006. "Using Inter-Judge Sentencing Disparity to Estimate the Effect of Imprisonment on Criminal Recidivism." Harvard Working Paper.

Loewenstein, George. 1996. "Out of Control: Visceral Influences on Behavior." *Organizational Behavior and Human Decision Processes* 65:272-92.

MacCoun, Robert, Beau Kilmer and Peter Reuter. 2003. "Research on Crime-Drugs Linkage: The Next Generation of Research." In *Toward a Drugs and Crime Research Agenda for the 21st Century*, edited by Henry Brounstein and Christine Crossland. Washington, DC:National Institute of Justice.

MacCoun, Robert, and Peter Reuter. 2001. *Drug War Heresies: Learning from other Vices, Times and Places.* Cambridge:Cambridge University Press.

Manning, Willard, Emmett Keeler, Joseph Newhouse, Elizabeth Sloss, and Jeffrey Wassermann. 1991. *The Costs of Poor Health Habits*. Cambridge, Mass.: Harvard University Press.

Manski, Charles. 1978. "Prospects for Inference on Criminal Behavior."In *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanctions on Crime Rates*, edited by Alfred Blumstein, Jacqueline Cohen, and Daniel Nagin. Washington, DC: National Academy Press.

Manski, Charles , John Pepper, and Carol Petrie. 2001. *Informing America's Policy on Illegal Drugs: What We Don't Know Keeps Hurting Us.* Washington, DC: National Academy Press.

Marvell, Thomas, and Carl Moody. 1994. "Prison Population Growth and Crime Reduction." *Journal of Quantitative Criminology* 10:109-140.

Marvell, Thomas, and Carl Moody. 1996. "Police Levels, Crime Rates, and Specification Problems." *Criminology* 24:606-646.

Matsueda, Ross, Derek Kreager, and David Huizinga. 2006. “Deterring Delinquents: A Rational Choice Model of Theft and Violence.” *American Sociological Review* 71:1:95-122.

McCarthy, William. 2002. “New Economics of Sociological Criminology.” *Annual Review of Sociology* 28:417-42.

McCrary, Justin. 2007. “The Effect of Court-Ordered Hiring Quotas on the Composition and Quality of Police.” *American Economic Review*. 97: 318-353.

Miron, Jeffrey. 1999. “Violence and the U.S. Prohibitions of Drugs and Alcohol.” *American Law and Economics Review* 1:78-114.

Miron, Jeffrey. 2003. “Do Prohibitions Raise Prices: Evidence from the Markets for Cocaine and Heroin.” *Review of Economics and Statistics 85:3:522-530.*

Moore, Mark.1973. “Achieving Effective Discrimination in the Price of Heroin.” *American Economic Review* 63:2: 270-277.

Moore, Mark.1990. “Supply Control and Drug Law Enforcement.” In *Drugs and Crime,* edited by Michael Tonry, and James Q. Wilson. Chicago: University of Chicago Press.

Morselli, Carlo. 2005. *Contacts, Opportunities and Criminal Enterprise*. Toronto: University of Toronto Press.

Mustard, David. 2001. "Racial, Ethnic, and Gender Disparities in Sentencing: Evidence from the US Federal Courts." *Journal of Law and Economics 44*:635-358.

Nagin, Daniel. 1978. “General Deterrence: A Review of the Empirical Evidence”. In *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanctions on Crime Rates*, edited by Alfred Blumstein, Jacqueline Cohen, and Daniel Nagin. Washington, DC: National Academy Press.

Nagin, Daniel. 1998. "Criminal Deterrence Research: A Review of the Evidence and a Research Agenda for the Outset of the 21st Century." In *Crime and Justice: An Annual Review of Research,* edited by Michael Tonry. Chicago: University of Chicago Press.

Nagin, Daniel. 2005. *Group-Based Modeling of Development over the Life Course*. Cambridge, MA: Harvard University Press.

Nagin, Daniel. 2007. “Moving Choice to Center Stage in Criminological Research and Theory: The American Society of Criminology 2006 Sutherland Address.” *Criminology* 45: 259-272.

Nagin, Daniel, and Greg Pogarsky. 2001. "Integrating Celerity, Impulsivity, and Extralegal Sanction Threats into a Model of General Deterrence: Theory and Evidence. *Criminology* 39:404-430.

Nagin, Daniel, and Greg Pogarsky. 2003 "An Experimental Investigation of Deterrence: Cheating, Self-serving Bias, and Impulsivity." *Criminology* 41:501-527.

Nagin, Daniel, and Greg Pogarsky. 2004 "Time and Punishment: Delayed Consequences and Criminal Behavior." *Journal of Quantitative Criminology* 20:295-317.

Nagin, Daniel, and Raymond Paternoster. 1991. "On the Relationship Between Past and Future Criminality." *Criminology* 29:163-189.

Nagin, Daniel, and Paternoster, Raymond. 1994. "Personal Capital and Social Control: The Deterrence Implications of a Theory of Individual Differences in Offending." *Criminology* 32: 581-606.

Nagin, Daniel, and Kenneth C. Land. 1993. "Age, Criminal Careers, and Population Heterogeneity: Specific Estimation of a Nonparametric, Mixed Poisson Model." *Criminology* 31:327-62.

National Institute of Justice (2003) *2000 Arrest Drug Abuse Monitoring: Annual Report* Washington, D.C: U.S. Printing Office.

Nieuwbeerta, Paul, and Arjan Blokland. Forthcoming. "Selectively Incapacitating Frequent Offenders: Costs and Benefits of Various Penal Scenarios." *Journal of Quantitative Criminology*.

Nobling, Tracy, Cassia Spohn, and Miriam DeLone. 1998. "A Tale of Two Counties: Unemployment and Sentence Severity." *Justice Quarterly* 15: 3: 459-485.

O'Brien, Robert. 2001. "Theory, Operationalization, Identification, and the Interpretation of Different Differences in Time Series Models." *Journal of Quantitative Criminology* 17:359-375.

Office of National Drug Control Policy (2001) *What America's Users Spend on Illicit Drugs, 1988-2000* Washington, DC.

Office of National Drug Control Policy (2004) *The Price and Purity of Illicit Drugs; 1981 Through the Second Quarter of 2003* Washington, DC.

Ousey, Graham, and Pamela Wilcox. 2007. "The Interaction of Antisocial Propensity and Lifecourse Varying Predictors of Delinquent Behavior: Differences by Method of Estimation and Implications for Theory." *Criminology* 45: 313-354.

Owens, Emily. 2007. "More Time, Less Crime? The Incapacitative Effect of Sentence Enhancements." University of Maryland Working Paper.

Paternoster, Raymond. 1987. “The Deterrent Effect of the Perceived Certainty and Severity of Punishment: A Review of the Evidence and Issues.” *Justice Quarterly* 4:173-218.

Paternoster, Raymond, and Alex Piquero. 1995. “Reconceptualizing Deterrence: An Empirical Test of Personal and Vicarious Experiences.” *Journal of Research in Crime and Delinquency* 32:251-286.

Paternoster, Raymond, and Shawn Bushway. 2001. “Theoretical and Empirical Work on the Relationship Between Unemployment and Crime.” *Journal of Quantitative Criminology* 17: 391-408.

Patillo, Mary, David Weiman, and Bruce Western. 2004. *Imprisoning America: The Social Effects of Mass Incarceration*. NY: Russell Sage Foundation.

Persico, Nicola. 2002. “Racial Profiling, Fairness, and Effectiveness of Policing." *American Economic Review* 92: 1472-97.

Piquero, Alex, and Raymond Paternoster. 1998. “An Application of Stafford and Warr′s Reconceptualization of Deterrence to Drinking and Driving.” *Journal of Research in Crime and Delinquency* 35:5-41.

Piquero, Alex, and Greg Pogarsky. 2002. “Beyond Stafford and Warr's Reconceptualization of Deterrence: Personal and Vicarious Experiences, Impulsivity, and Offending Behavior. *Journal of Research in Crime and Delinquency* 39:153-186.

Pogarsky, Greg, Alex Piquero, and Raymond Paternoster. 2004. “Modeling Change in Perceptions About Sanction Threats: The Neglected Linkage in Deterrence Theory.” *Journal of Quantitative Criminology* 20:343-369.

Posner, Richard. 2006. “A Review of Steven Shavell's *Foundations of Economic Analysis of Law.” Journal of Economic Literature 33:405-414.*

Rankin, Anne. 1964. “The Effect of Pretrial Detention.” *New York University Law Review 39*:641-656.

Rasmussen, David, and Bruce Benson. 1994. *The Economic Anatomy of a Drug War: Criminal Justice in the Commons.* Lanham, MD., Rowman and Littlefield.

Reuter, Peter, and Peter Greenfield. 2001. “Measuring Global Drug Markets; How Good are the Numbers and Why Should We Care About Them.” *World Economics* 2: 4:155-173.

Reuter, Peter, and Mark Kleiman. 1986. "Risks and Prices: An Economic Analysis of Drug Enforcement". In Vol 9 *Crime and Justice: An Annual Review of Research* edited by Norval Morris, and Michael Tonry. Chicago: University of Chicago Press.

Reuter, Peter, Gordon Crawford, and Jonathan Cave. 1988. *Sealing the Borders: Effects of Increased Military Efforts in Drug Interdiction*. Santa Monica, CA: RAND.

Reuter, Peter, Robert MacCoun, and Peter Murphy. 1990. *Money from Crime: A Study of the Economics of Drug Dealing in Washington, D.C.* Santa Monica, CA: RAND.

Rhodes, William. 1976. "The Economics of Criminal Courts: A Theoretical and Empirical Investigation**."** *The Journal of Legal Studies* 5: 311-340.

Rose-Ackerman, Susan. 1999. *Corruption and Government: Causes, Consequences and Reform. NY:*Cambridge University Press.

Rydell, C. Peter, and Susan Everingham. 1994. *Controlling Cocaine: Supply Versus Demand Programs.* Santa Monica, CA: RAND.

Sellin, Thorsten. 1959. *The Death Penalty.* Beverly Hills: Sage.

Schanzenbach, Max, and Michael Yaeger. 2006. "Prison Time and Fines: Explaining Racial Disparities in Sentencing for White-Collar Criminals." *Journal of Criminal Law & Criminology* 56:757-793.

Schanzenbach, Max, and Emerson Tiller. *2007.* "Strategic Judging under the United States Sentencing Guidelines: Positive Political Theory and Evidence." *Journal of Law, Economics, & Organization 23:24-56*.

Schelling, Thomas. 1984. *Choice and Consequence*. Cambridge, MA: Harvard University Press.

Shavell, Steven. 2004. *Foundations of Economic Analysis of Law*. Cambridge: Harvard University Press.

Sherman, Lawrence , Denise Gottfredson, Doris MacKenzie, John Eck, Peter Reuter and Shawn Bushway.1997. Preventing Crime: What Works, What Doesn't, What's Promising. A Report to U.S. Congress.

Smith, Douglas A. 1985. "The Plea Bargaining Controversy." *Journal of Criminal Law and Criminology* 77: 949-968.

Spohn, Cassia. 2000. "Thirty Years of Sentencing Reform: The Quest for a Racially Neutral Sentencing Process." *National Institute of Justice: Criminal Justice 2000*. Washington, DC: National Institute of Justice.

Stafford, Mark, and E. Mark Warr. 1993. "A Reconceptualization of General and Specific Deterrence." *Journal of Research in Crime and Delinquency* 30:123-35.

Steffensmeier, Darrell, John Kramer, and Cathy Streifel. 1993. "Gender and Imprisonment Decisions" *Criminology* 31: 411-446.

Steffensmeier, Darrell, John Kramer and Jeffrey Ulmer. 1998. "The Interaction of Race, Gender, and Age in Criminal Sentencing: The Punishment Cost of Being Young, Black, and Male." *Criminology* 36:4:763-798.

Steffensmeier, Darrell, and Stephen Demuth. 2000. "Ethnicity and Sentencing Outcomes in U.S. Federal Courts: Who is Punished More Harshly?" *American Sociological Review* 65:705-729.

Stigler, George. 1952. *The Theory of Price*: *Revised Edition*. New York: The MacMillan Co.

Stokey, Nancy and Richard Zeckhauser. 1978. *A Primer for Policy Analysis* New York, Norton Press.

Strumpf, Koleman. (2003) *Illegal Sport Bookmakers*. University of North Carolina working paper.

Sweeten, Gary, and Robert Apel. Forthcoming. "Incapacitation: Revisiting an Old Question with a New Method and New Data." *Journal of Quantitative Criminology*.

Thaler, Richard . 1977. "An Econometric Analysis of Property Crime: Interaction Between Police and Criminals." *Journal of Public Economics* 8:1:37-51.

Thaler, Richard. 1978. "A Note on the Value of Crime Control: Evidence from the Property Market." *Journal of Urban Economics* 5:1:137-145.

Tita, George, Tricia Petras, and Robert Greenbaum. 2006. "Crime and Residential Choice: A Neighborhood Level Analysis of the Impact of Crime on Housing Prices," *Journal of Quantitative Criminology* 22:4: 299-317.

Tonry, Michael. 1995. *Malign Neglect: Race, Crime and Punishment in America* New York, Oxford University Press.

Ulmer, Jeffrey, and Mindy Bradley. 2006. "Variation in Trial Penalties Among Serious Violent Offenses" *Criminology* 44:631-670.

United States Department of Justice, Bureau of Justice Statistics. 2006. *A National Crime Victimization Survey 2005: Statistical Tables.* NCJ 215244.

Varian, Hal. 2002. *Intermediate Microeconomics (*6th edition), Berkeley, University of California Press.

Viscusi,W. Kip. 1992. *Fatal Tradeoffs: Public and Private Responsibilities for Risk*. Oxford: Oxford University Press.

Viscusi, W. Kip and Joseph Aldy. 2003. "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World." *Journal of Risk and Uncertainty* 27:1:5-76.

Walsh, John. 2004. “Fuzzy Math: Why the White House Drug Control Budget Doesn’t Add Up.” *Drug Policy Analysis Bulletin (online) 10.*

Webster, Cheryl, Anthony Doob, and Franklin Zimring. 2006. “Proposition 8 and Crime Rates in California: The Case of the Disappearing Deterrent,” *Criminology and Public Policy* 5:3: 417-448.

Welsh, Brandon, David Farrington and Lawrence Sherman, eds. 2000. *Costs and Benefits of Preventing Crime.* Boulder: Westview.

Western, Bruce. 2002. “The Impact of Incarceration on Wage Mobility and Inequality.” *American Sociological Review* 67: 4:526-546.

Wilson, James Q., and Richard Herrnstein. 1985. *Crime and Human Nature: The Definitive Study of the Causes of Crime*. New York: Simon and Schuster.

Zatz, Marjorie, and John Hagan. 1985. “Crime, Time, and Punishment: An Exploration of Selection Bias in Sentencing Research.” *Journal of Quantitative Criminology* 1:103–126.